Technical Report G

Contamination and acid sulfate soils impact assessment

Part 1

Viva Energy Gas Terminal Project

Prepared for
Viva Energy Gas Australia Pty Ltd
ABN: N/A

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

ABN: N/A

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Abbreviations

Abbreviation/Term	Definition
AAASS	Atlas of Australian Acid Sulfate Soils
AHD	Australian Height Datum
APGA	Australian Pipelines and Gas Association
ASRIS	Australian Soil Resource Information System
ASS	Acid sulfate soil
CRS	Chromium Reducible Sulfur
CUN	Clean Up Notice
CASS	Coastal acid sulfate soils
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CEMP	Construction Environmental Management Plan
COPC	Contaminants of Potential Concern
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
CCMA	Corangamite Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DMG	Dredged Material Ground
EIL	Ecological Investigation Level
ESL	Ecological Screening Level
ESV	Energy Safe Victoria
EES	Environment Effects Statement
EPA	Environment Protection Authority
ERS	Environment Reference Standards
EMF	Environmental Management Framework
FSRU	Floating Storage and Regasification Unit
FO	Floodway Overlay
FF	Fyansford Formation
GED	General Environment Duty
GIS	Geographic Information System
GW	Groundwater
GDE	Groundwater Dependent Ecosystem
GMA	Groundwater Management Areas
GMU	Groundwater Management Units
GQRUZ	Groundwater Quality Restricted Use Zones
HSL	Health Screening Level
HDD	Horizontal Directional Drilling

Abbreviation/Term	Definition
IWMP	Industrial Waste Management Policy
IWRG	Industrial Waste Resource Guidelines
LSIO	Land Subject to Inundation Overlay
LNAPL	Light Non Aqueous Phase Liquid
LOR	Limit of Reporting
LNG	Liquefied Natural Gas
MHF	Major Hazard Facility
MLA	Marine Loading Arms
mbgs	Metres below ground surface
MVF	Moorabool Viaduct Formation
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measures
NEMP	National Environmental Management Plan
OEMP	Operational Environmental Management Plan
PFAS	Per-and polyfluoroalkyl substances
PFOS	Perfluorooctane sulfonate
PAN	Pollution Abatement Notice
QA/QC	Quality assurance/Quality control
QA	Quaternary Alluvium
ROW	Right of way
SDS	Safety Data Sheets
SWI	Seawater Intake
SIC	Service Identification and Clearance
SB	Soil Bore
SWP	South West Pipeline
SBO	Special Building Overlay
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulfate
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbon
TRH	Total Recoverable Hydrocarbons
uPVC	Unplasticised Polyvinyl Chloride
UTAM	Upper Tertiary Aquifer (Marine)
UTB	Upper Tertiary/Quaternary Basalt
VLR	Victorian Landfill Register
VTS	Victorian Transmission System
WMIS	Water Measurement Information System
WSPA	Water Supply Protection Area

Glossary of Terms

Abbreviation/Term	Definition
Acid Sulfate Soil	Acid sulfate soils are naturally occurring soils, sediments or organic substrates that are formed under waterlogged conditions. These soils contain iron sulphide minerals or their oxidation products. When exposed, these soils oxidise and they can generate acidic water (if in contact with rainfall or other water source).
Contaminated land (Potentially)	Land is contaminated if waste, a chemical substance or a prescribed substance is present on or under the surface of the land, and the waste, chemical substance or prescribed substance— (a) is present in a concentration above the background level; and (b) creates a risk of harm to human health or the environment. As defined in the *Environment Protection Act 2017* (EP Act 2017).
Contaminated soil	Soil is considered to be contaminated when concentrations of compounds can be detected above naturally occurring (where applicable) background concentrations.
EES	Environment Effects Statement. An Environment Effects Statement provides a comprehensive framework for the assessment of the potential environmental impacts or effects of a proposed development under the *Environment Effects Act 1978*.
Environmental Value	A use, an attribute or a function of the environment, as defined in the *Environment Protection Act 2017* (EP Act 2017), which is conducive to public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from the effects of waste discharges, emissions or deposits, or of the emission of noise; or is declared in the Victorian Environment Reference Standard (2021) to be an environmental standard.
Potential acid sulfate soils	Soils that contain appreciable amounts of reduced inorganic sulfur that have not oxidised but will acidify to a pH of less than 4.0 after oxidation. The soils are also known as hypersulfidic soil materials. The field pH of these soils in their undisturbed state is pH 4 or more and may be neutral or slightly alkaline. Potential acid sulfate soils pose an environmental hazard if disturbed, as they can generate considerable acidity if mismanaged.

Executive Summary

This technical report provides a contamination and acid sulfate soil impact assessment conducted to support the Environment Effects Statement (EES) for the onshore components of 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 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 ships (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.

Existing conditions

Following a desktop assessment, the study area was divided into two zones: Zone 1 beneath the Viva Energy Geelong Refinery and Zone 2 north of the refinery. It was concluded that Zone 1 has a high potential for contamination based on historic land use, storage and processing of bulk fuels and Zone 2 has a low potential for contamination based on agricultural and open space land uses.

Soil contamination was encountered during field investigations at depths of 1.5m and greater within Zone 1, which is associated with impacted groundwater plumes on the refinery site. The concentration of hydrocarbon compounds such as benzene and Total Recoverable Hydrocarbons (TRH) in Zone 1 exceeded both human health and ecological screening criteria within the boundary of the refinery and this means that this soil would require management in accordance with existing procedures at the refinery. While trace concentrations of per-and polyfluoroalkyl substances (PFAS) were also encountered, they were reported below sensitive human health and ecological exposure investigation levels on site. The presence of elevated hydrocarbon soil impacts is consistent with expectations within the boundary of the refinery. In Zone 2 to the north of the refinery, the sampled soil within the proposed underground pipeline alignment is generally not contaminated. This is consistent with historic land use and the low potential for contamination identified during the desktop assessment.

Exceedances of the Environment Protection Authority (EPA) Publication 1669.4: Interim position statement on PFAS reuse guidelines were reported in shallow soils collected at several locations (SB02, SB04 SB07, TP04, TP11, TP12 and TP13) within Zone 1 (refinery site) and one location (SB23) within Zone 2 (northern end of pipeline alignment). Therefore, management of spoil excavated as part of this project, which cannot be reused in the location that it was originally removed from, would need to

be discussed with EPA, regardless of whether the re-use criteria in EPA Publication 1669.4 is exceeded or not. Based on the sample results, the soils within Zone 1 and Zone 2 are generally suitable for reuse in the location the soil was originally removed from on site (e.g., for backfilling of development excavations), however, if reused at a different location of the site (e.g., longitudinally displaced along the trench) or off-site disposal is required then further sampling and analysis would be required to determine the acceptability for establishing a lawful place for disposal.

The field investigation concluded that groundwater contamination is limited largely to Zone 1. Contamination in groundwater beneath the refinery consisted of Light Non Aqueous Phase Liquid (LNAPL) i.e., petroleum product floating on top of groundwater, TRH and benzene. In the event of the project requiring excavations beyond 3m depth in Zone 1 and below 5m depth in Zone 2, groundwater may be intersected and would require appropriate management and disposal based on the expected groundwater conditions in the relevant area.

In Zone 2, groundwater is generally not contaminated although phosphorous and nitrate were detected, potentially representing regional fertiliser use. Phosphorous exceeded long term irrigation investigation levels only and not short term use investigation levels. The concentration of nitrate is not likely to preclude use or irrigation of encountered groundwater, however, if groundwater is intersected it should not be discharged to waterways. PFAS was encountered in groundwater from one well (GW05) at concentrations orders of magnitude above Groundwater Dependent Ecosystems (GDE) investigation levels and would require offsite treatment should it be abstracted during pipeline construction. Given that the location of the PFAS contamination is over 3km to the north of the refinery, it is not considered that the contamination is related to the Viva Energy operation and the source is unknown.

It should be noted that likely areas of contamination were assessed as part of this investigation, however, additional localised soil and groundwater contamination may be encountered during construction of the project, in both Zone 1 and Zone 2. For spoil excavated from Zone 1 existing refinery human health and environmental management protocols would be appropriate to adequately manage encountered contaminated soils. For spoil excavated from Zone 2 the projects construction mitigation measures would be in place to adequately manage encountered contaminated soils.

A broadly spaced and targeted intrusive investigation was conducted across the study area. Localised Potential Acid Sulfate Soil (PASS) was identified in one near surface sample within Zone 1 (SB07_0.2). A geomorphological investigation of the Zone 1 and Zone 2 showed Zone 1 has potential geological indicators of acid sulfate soils. The geology of Zone 2 showed low indicators of acid sulfate soils, with potential indicators in the unnamed water way near the tie-in point, however, a targeted investigation for acid sulfate soils in this area did not find any evidence of PASS or actual acid sulfate soils.

Impact assessment

Based on the existing conditions of the project area and the proposed construction, operation and decommissioning activities, it is considered that the project has limited potential to result in impacts to human health (via direct and secondary contact) and/or the environment, following the application of standard mitigation measures. This is predominantly due to the limited extent of existing contamination identified outside the boundaries of the Geelong Refinery, which has established contaminant management procedures in place. Due to the observation of PASS at a central area in Zone 1 along the refinery pipe trench parallel with Shell Parade (SB07_0.2m), the area within Zone 1 where the aboveground pipeline would be constructed would need to be managed during construction. The proposed construction methodologies would maximise the reuse of spoil to reduce the volume of spoil that would need to be disposed offsite. In addition, the proposed construction methodologies would confine potential impacts to within the project area and would be unlikely to have any adverse effect on the surrounding area.

The potential impacts on the environment and/or human health via direct and secondary contact with soils, groundwater and surface water were assessed as minor, and could be mitigated with the recommended mitigation measures outlined in Section 9.0.

It was concluded that the project could meet the EES evaluation objective with respect to potential impacts on the environment or health from contamination, acid sulfate soils, waste materials generated by the project works, and spills or other incidents during project construction and operation, with application of industry standard mitigation measures that are commonly applied and have proven effective in major construction projects.

Summary of required mitigation measures

The identified mitigation measures recommended to avoid, minimise and manage potential adverse effects on human health and the environment are listed below:

- **Contaminated soils (MM-CO01):** contaminated soils should be managed in accordance with the *Environment Protection Act (Vic)* ('EP Act 2017'), Environment Protection Regulations (EP Regulations) 2021, the Environment Reference Standards 2021 (ERS), and the Per-and poly-fluoroalkyl substances (PFAS) National Environmental Management Plan 2.0 2020 (NEMP). Stockpiled soils should be classified under EPA Publication 1828.2 *Waste Disposal Categories - Characteristics and Thresholds* and managed in accordance with *APGA Code of Environmental Practice – Onshore Pipelines*. All material transported off and on site as part of the construction should be managed in accordance with the EP Act 2017 waste framework. Based on the site history and assessment work, Zone 1 should be assumed to be contaminated particularly below 1.5m depth.
- **Contaminated groundwater (MM-CO02):** contaminated groundwater should be managed in accordance with the EP Act 2017, EP Regulations 2021, the ERS, and the PFAS NEMP 2.0. The development should be carried out so as to minimise the disturbance of saturated soils and groundwater within identified hydrocarbon and PFAS contaminated areas. Disturbance should be minimised by designing infrastructure to not extend into the water table or to bypass groundwater by using Horizontal Directional Drilling (HDD) or trenchless construction techniques. Water from areas that have been identified as contaminated should not be discharged to the environment (land, waterways, sewer). Where a wet-trench installation approach is not undertaken contaminated water should be sampled and either treated onsite, depending on contaminant encountered (this may require approval from the EPA Victoria) or disposed offsite to an EPA Victoria licensed facility.
- **Contaminant migration (MM-CO03):** Trench dewatering of groundwater or perched water should be avoided. In the unlikely event that dewatering of groundwater or perched water inflow is unavoidable, the trench should be dewatered prior to lowering the pipes. Abstracted water should be managed as per MM-CO02).
- **Unexpected finds (MM-CO04):** Incorporate management strategies within the CEMP to manage potential unexpected finds. If unknown contamination (including asbestos containing material) is encountered during construction works and ground disturbance should cease in that area and within the immediate vicinity. Further works should be carried out to assess the site contamination in accordance with the National Environment Protection (Assessment of Site Contamination) Measure (2013) and identify appropriate remedial action. The remedial action must manage contamination to prevent impact to human health and the environment in accordance with the Duty to Manage. Such material may be identified by visual or olfactory observations, the presence of asbestos and/or other anthropogenic material.
- **Acid Sulfate Soils (MM-CO05):** Incorporate management strategies within the CEMP to manage potential ASS risks for a 'Medium' ASS hazard in accordance with Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999, EPA Victoria Publication IWRG655.1: Acid Sulfate Soil and Rock, Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010), National Acid Sulfate Soils Guidance (series of documents) 2018. Construction works should not occur during wet months without appropriate mitigation measures implemented for runoff or surface water interaction. Training to be provided to relevant site-based personnel on the requirements of the ASS management procedure. Minimise the duration of stockpiling, if longer duration stockpiling is unavoidable additional management procedures are to be put in place. If required, include management procedure for trench dewatering that will limit PASS activation in accordance with the Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010) and the National ASS Guidance '*Guidance for the dewatering of aid sulfate soils in shallow groundwater environments*', in the project CEMP.
- **Drilling mud disposal (MM-CO06):** Drilling mud could be generated from activities such as horizontal direct drilling. Drilling muds should be disposed of in accordance with the EP Regulations 2021 and Schedule 5 of the Regulations should be used to classify drilling mud for

disposal. Drilling mud should also be disposed of in accordance with the Australian Pipelines and Gas Association (APGA) Code of Environmental Practice – Onshore Pipelines. Requirements for disposal of drilling mud should be confirmed at the time of construction.

- **Hydrotest water (MM-CO07):** test water should be managed in accordance with EPA ERS 2021 (Water) and the APGA Code of Environmental Practice – Onshore Pipelines. Where possible water should be reused, and a storage facility should be constructed (as needed) to enable appropriate test water management (testing regime prior to disposal).
- **Fuel and chemical leaks and spills (MM-CO08):** Fuels and hazardous materials should be stored and used in accordance with the relevant Australian standards (AS1940-2017 and AS1692-2006) and the *Occupational Health and Safety Act 2004 (Vic)* ('OHS Act'), *Occupational Health and Safety Regulations 2007* (OHS Regulations), and *Dangerous Goods (Storage and Handling) Regulations 2012*. Maintenance schedules should be put in place and spill recover equipment should be available in the storage areas, with Safety Data Sheets (SDS) maintained in a site register.

Performance monitoring

The identified mitigation measures should be incorporated into the Construction Environmental Management Plan (CEMP) during construction and the Operational Environmental Management Plan (OEMP) once the project is operational. The CEMP and OEMP should be developed in accordance with industry standards, regulatory guidelines and conditions imposed by regulatory authorities.

Compliance with the CEMP and OEMP and the relevant mitigation measures should be monitored. The monitoring requirements should be clearly specified in the CEMP and OEMP. Monitoring may include periodic inspections and audits of work areas during construction and the operation of project component once constructed to verify and confirm the effectiveness of mitigation measures implemented.

1.0 Introduction

This technical report provides a contamination and acid sulfate soil impact assessment conducted to support the Environment Effects Statement (EES) for the onshore components of 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) located at Lara.

The project is proposed to 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 contamination and acid sulfate soils impact assessment identifies, assesses and characterises potential environmental impacts associated with the construction, operation and decommissioning of the project to inform the preparation of the EES required for the project.

The report identifies potential impacts 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.

The evaluation and characterisation of potential environmental impacts on groundwater environmental values and groundwater users due to changes in groundwater levels and groundwater flow are addressed in Technical Report F*: Groundwater impact assessment*. While the potential environmental impacts on surface water are addressed in Technical Report E*: Surface water impact assessment*.

1.2 Why Understanding Contamination and Acid Sulfate Soils is Important

The new *Environment Protection Act 2017 (Vic)* ('EP Act 2017') came into effect as of 1 July 2021. The EP Act 2017 introduces a new regime for contaminated land, including a stand-alone definition of "contaminated land" and new duties to manage contaminated land and notify the Victorian Environment Protection Authority (EPA) of "notifiable contamination". Central to the EP Act 2017 is the General

Environmental Duty (GED). The GED requires Victorians to understand and minimise their risks of harm to human health and the environment from pollution and waste as far as reasonably practicable.

Section 35(1) of the EP Act 2017 specifies that land is contaminated "if waste, a chemical substance or a prescribed substance is present on or under the surface of the land, and the waste, chemical substance or prescribed substance is present in a concentration above the background level; and creates a risk of harm to human health or the environment".

Should contaminated land become industrial waste, including waste spoil (excess soil that cannot be reused in the location from which it was removed), as part of this project, the waste would be required to be managed under regulations and duties of the EP Act 2017, Environment Protection Regulations 2021 (EP Regulations 2021) and waste framework.

The project has the potential to intersect and disturb contaminated soil and groundwater that is present due to the heavily industrialised nature of much of the project area, as well as historic land use in the area. This includes contamination from releases from a variety of sources, and also the potential placement of uncontrolled wastes as part of land reclamation and historical fill placement. In addition to potentially contaminated areas, the underground pipeline also passes through a coastal area which is mapped as land that has the potential to contain acid sulfate soils. Acid sulfate soils are soils that contain significant amounts of iron sulphides and disturbance of acid sulfate soils has the potential to cause serious or long-term impacts to receiving environments or sensitive receptors.

The construction of the project has the potential to disturb contaminated soils, groundwater and/or acid sulfate soils which could result in mobilisation of contaminants. It is important to assess whether these activities could adversely impact the environmental values of soil, groundwater and/or groundwater users and result in a risk of harm to human health and the environment. Groundwater users include people who pump water from existing groundwater bores, and groundwater dependent ecosystems (GDEs). GDEs are those ecosystems that require access to groundwater to meet all or some of their water requirements to maintain the terrestrial and aquatic communities and ecological processes they support, and ecosystem services they provide[1]. These can include streams or lakes that groundwater flows into, vegetation with roots that access groundwater or biota living in groundwater systems.

The impacts of mobilised contaminants and acid sulfate soils can be costly to manage or remediate if they arise and appropriate mitigation measures are not in place. Understanding the condition of existing land and the environmental values that require protection, enables construction methods to be developed to minimise or prevent impacts on offsite and onsite receptors.

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 7km 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 the Victorian Regional Channels Authority (VRCA)) 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.

[1] Definition from *Ministerial Guidelines for Groundwater Licensing and the Protection of High Value Groundwater Dependent Ecosystems*, dated 13 April 2015.

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 manufacture.

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.

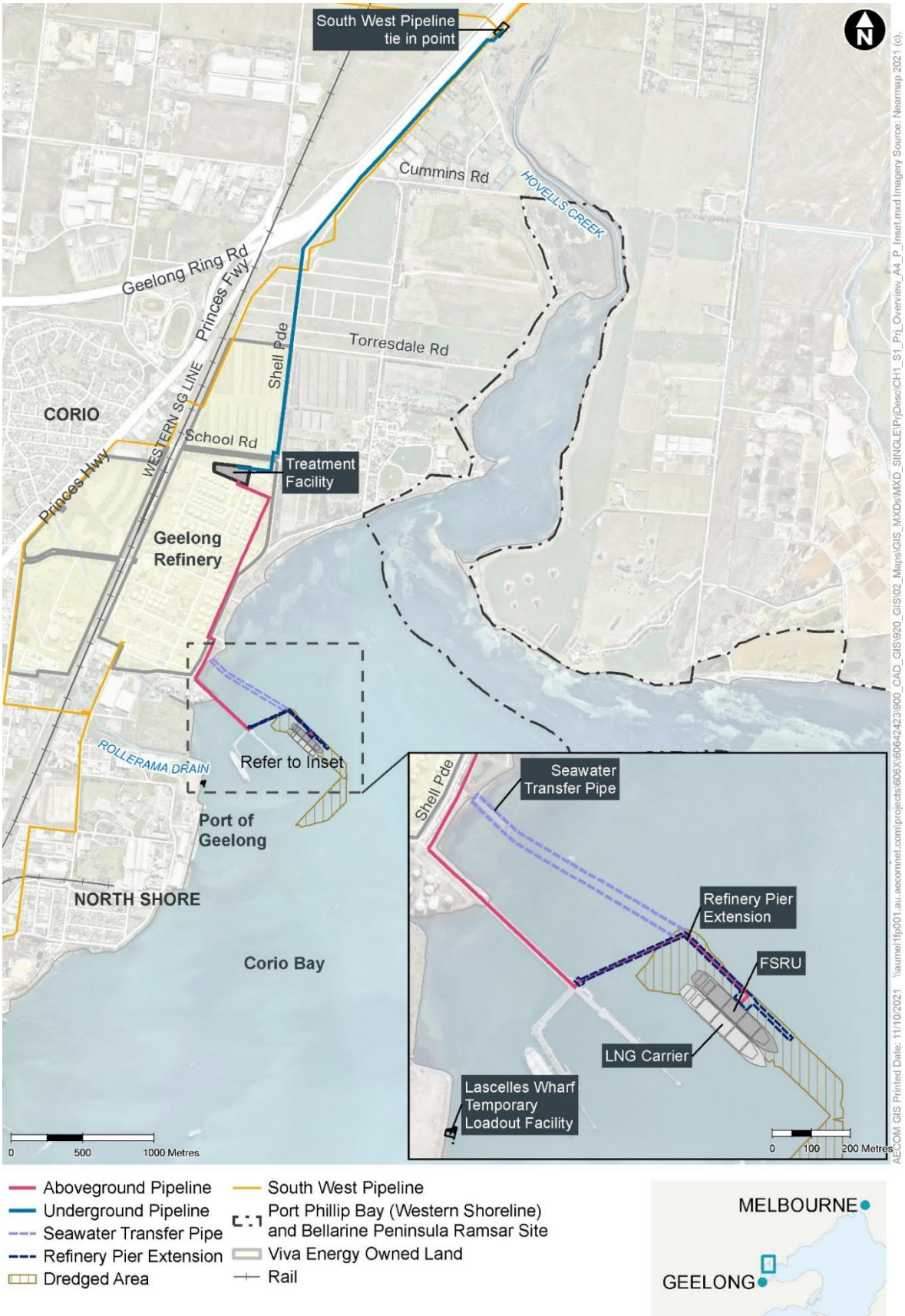

Figure 1-1 Project overview

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 300m in length and 50m 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 on board 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 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. 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 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 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 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 and cover an area of approximately 80m x 20m. Construction of the treatment facility would take up to 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 a 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 segment locations along the proposed 4 km underground pipeline route is 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.

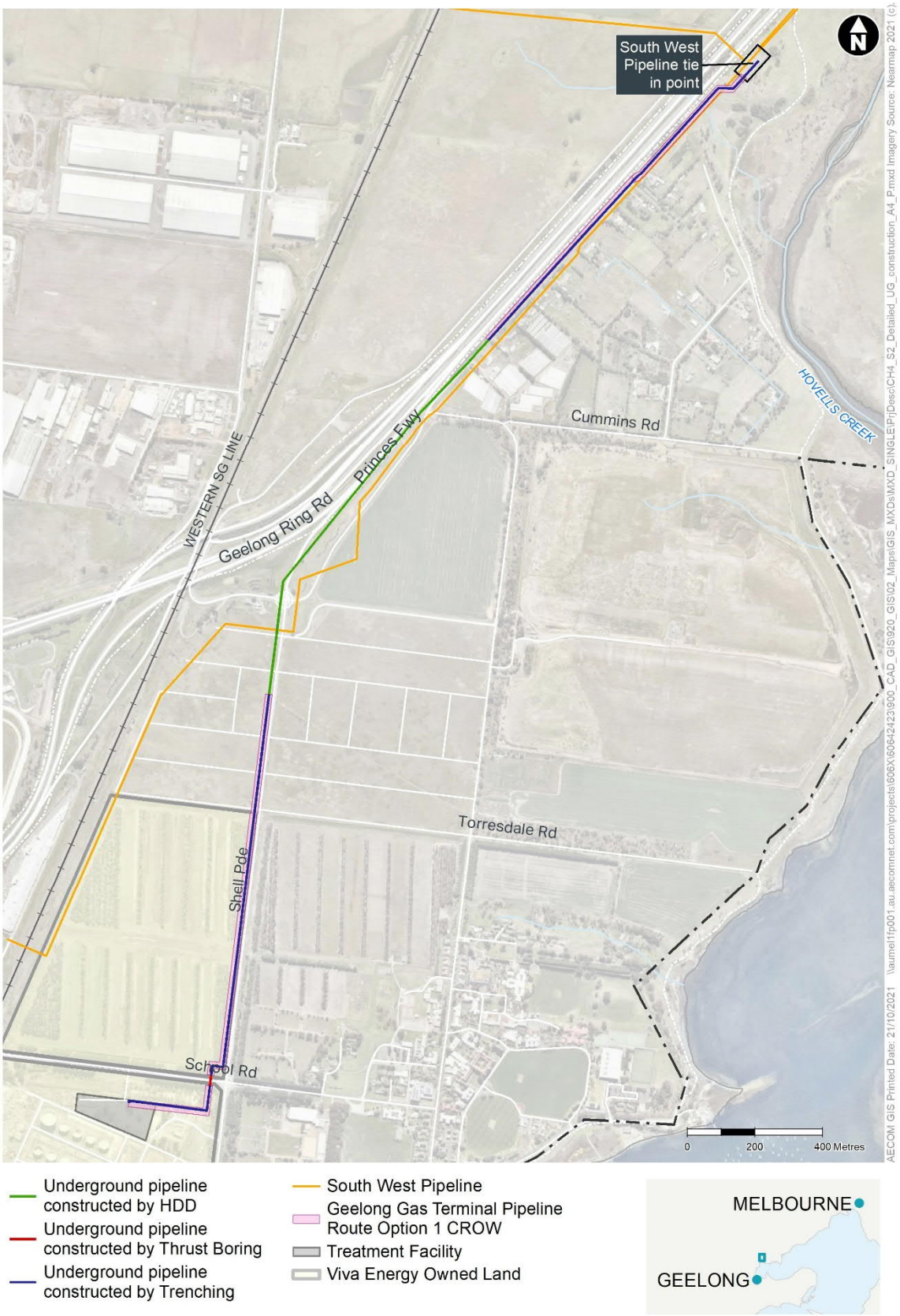

Figure 1-2 Proposed location of trenching construction techniques for the underground pipeline including open trenching, HDD and thrust boring

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 Project Activities Relevant to the Assessment

The contamination and acid sulfate soils impact assessment addresses potential effects on human health and the environment from the onshore components of the project. No impact pathways were considered for offshore activities and infrastructure. A separate investigation into contamination of marine sediments is being undertaken as part of the dredging and spoil disposal options assessment for the EES (Technical Report B: *Dredged sediment disposal options assessment*).

The report focused on those activities that have the potential to intersect and interact with onshore contamination (soil and groundwater) and acid sulfate soils, such as:

- Installation of foundations or piles beneath structures within the treatment facility to be located on an existing laydown area at the northern boundary of the refinery site
- Installation of the aboveground pipeline through a culvert beneath Shell Parade – via trenching or via thrust boring
- Installation of the underground pipeline – via trenching, HDD and thrust boring as per Figure 1-2.

A summary of the buried pipeline construction methods is provided below, with more detail provided in Chapter 4: *Project description*.

1.4.4.1 Trenching

Pipeline construction would comply with all relevant codes and standards including ASNZS2885.1-2018: Pipelines – Gas and liquid petroleum (design and construction) and the Australian Pipelines and Gas Association Code of Environmental Practice and EP Act 2017. The construction would also be in accordance with the environmental requirements to be specified in a Construction Environmental Management Plan (CEMP) prepared in compliance with the Victorian *Pipelines Act 2005 (Vic)* and Pipelines Regulations 2017, EP Act 2017 and approved by the relevant Minister before construction.

Figure 1-3 shows a typical layout for a construction ROW, which would typically be 15-20m wide for the project.

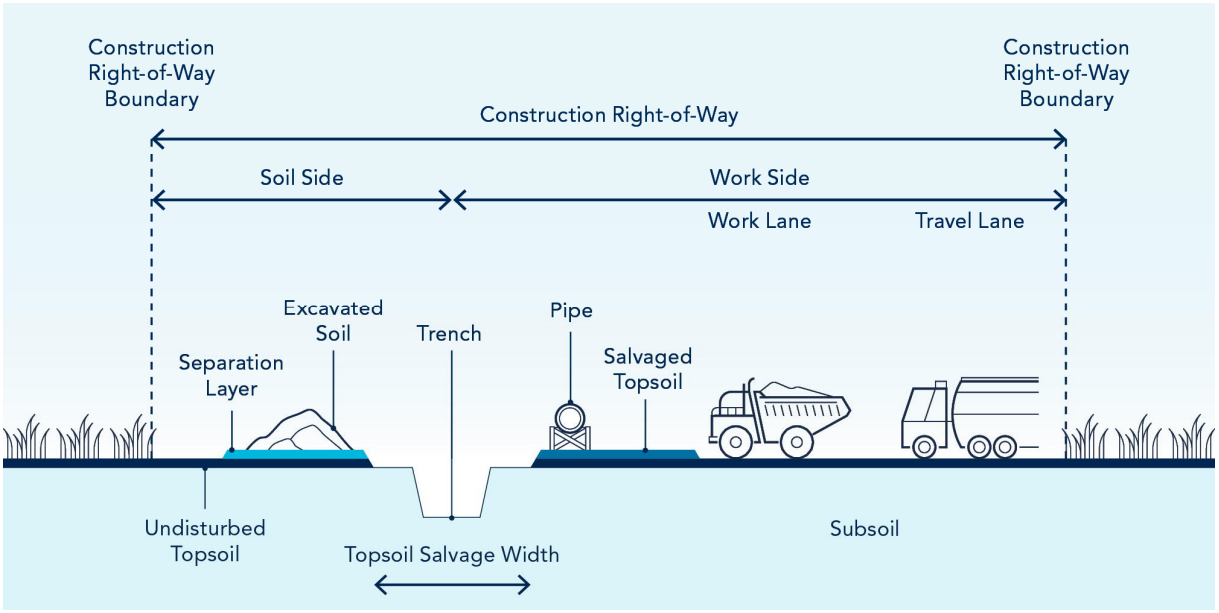

Figure 1-3 Typical construction ROW layout for a pipeline

Excavators would be used to dig the pipeline trench to a depth of typically 2 m to achieve a depth of cover to natural ground level of approximately 1.2 m.

Water that has collected in the trench (such as groundwater, incidental rainwater or a combination of both) would be removed immediately prior to the pipe being installed. The duration of dewatering is minimised to reduce the volumes of water to be managed and to avoid slumping of the trench. It is anticipated that pumping from the trench and installation of the pipe would be completed on the same day. Removed water from the trench would be disposed of in accordance with the EP Act 2017.

Fine grained bedding and padding material may be placed around the pipe to protect the pipe coating from damage due to materials in the excavated spoil. The preference would be to use bedding and padding material produced by sieving the excavated material on site or imported materials would be used if excavated materials were unsuitable.

The trench would then be backfilled using the excavated spoil and excess excavated material may be used to re-establish surface contours or collected and transported for disposal at appropriately licensed facilities in accordance with the requirements under the EP Act 2017 waste framework.

1.4.4.2 Horizontal Directional Drilling

Trenchless construction may be used to install the underground pipeline in some areas where open trenching techniques are not suitable, such as beneath sealed road or crossing of third-party assets (such as water, gas and oil pipelines, and power lines, etc.).

The installation of a pipeline by HDD involves drilling a pilot hole at a shallow angle beneath the surface from an entry point on one side of the crossing to an exit point on the other side of the crossing, as shown in Figure 1-4. The entry and exit pits are typically about 3m wide, 5m long and 2m deep. The hole is enlarged by reaming to allow for the welded pipe string to be pulled back through the drill hole from the exit point to the entry point without damaging the coating.

HDD construction involves the use of bentonite-based muds (bentonite slurry) during drilling that create a ‘filter cake’ along the walls of the borehole to create a barrier between the borehole and formation (as well lubricating the drill head and return drill cuttings to the entry pit) (ASTT, 2010). The filter cake limits the amount of fluid loss into the formation and, together with the positive head pressure maintained by the flooded hole and weighted mud (relative to groundwater head outside the borehole), prevents any ingress of groundwater into the bore during drilling.

Post drilling, the gas pipe is pulled back through the drilled open hole with the filter cake still in place, and with the hole only marginally larger than pipe diameter, essentially resulting in little or no annulus space. Once the pipe is in place the formation and residual filter cake seal any remaining space in the

bore annulus. This provides an effective seal between aquifers and prevents the creation of a preferential pathway between or within aquifers.

Drilling mud generated as part of HDD activities would need to be managed and disposed of in accordance with the relevant regulatory requirements. Groundwater extraction/dewatering is not required as part of the HDD process.

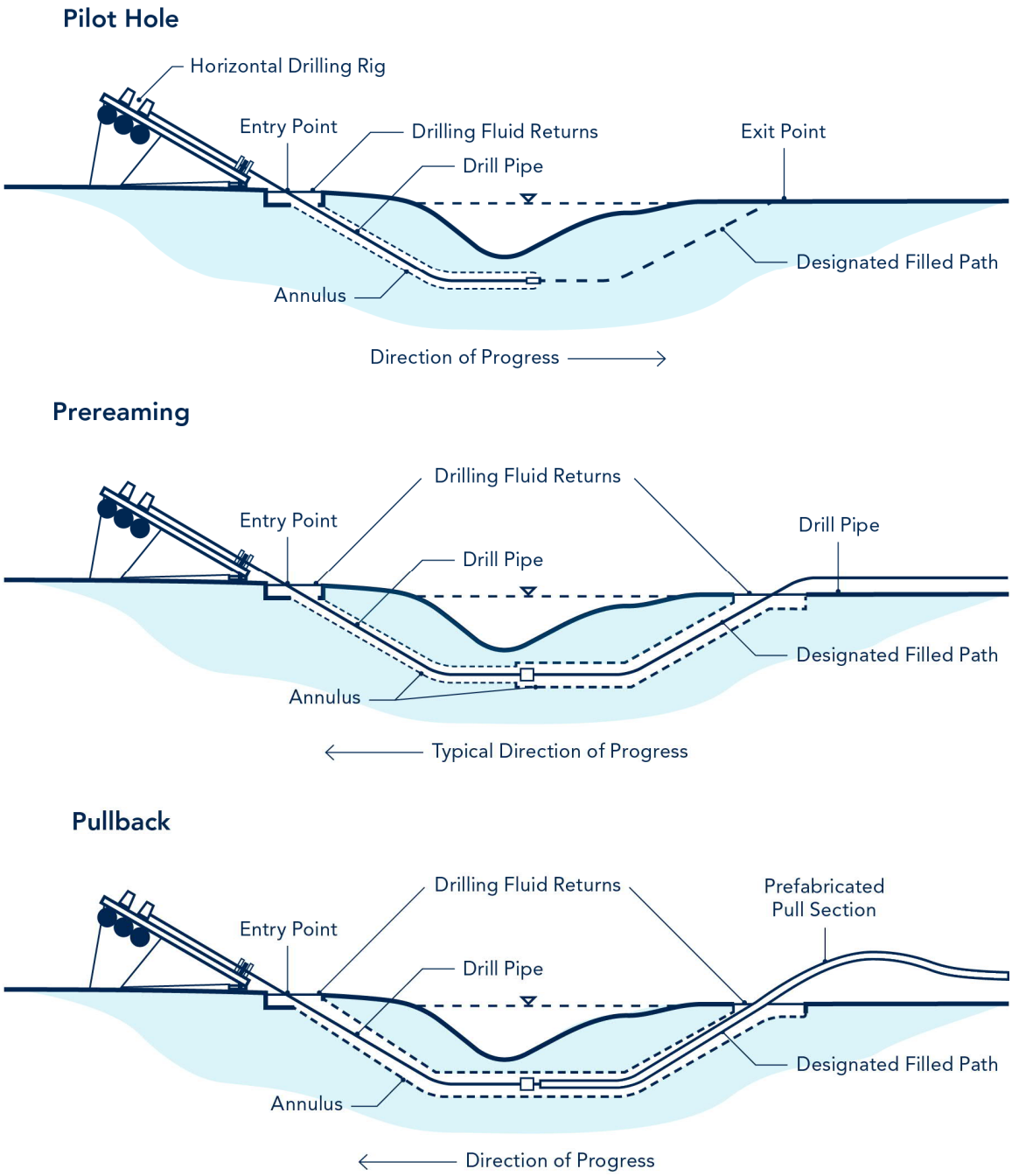

Figure 1-4 Typical HDD process

1.4.4.3 Thrust boring

Shallow horizontal boring (referred to as thrust boring or micro-tunnelling) involves construction of a horizontal bore hole to allow pipeline installation beneath sensitive surface features, roads and underground services.

Bell holes are excavated on both sides of the feature. The entry bell hole is enlarged to allow a boring machine to operate within it and tunnel under the relevant constraint. Entry bell holes would be approximately 10 metres long, four metres wide and typically four metres deep. The exit bell hole would typically be seven metres long, four metres wide and up to four metres deep. The bell holes are maintained dry during construction and therefore temporary dewatering and/or other controls could be required to limit groundwater ingress into the excavation.

The boring machine is located within the entry pit, which uses a hydraulic ram to jack the pipe section, behind a cutting head, in a straight line through the ground to the receiving pit.

It is proposed to construct one segment of thrust boring beneath School Road, and it is anticipated that it could take up to two weeks to complete. Thrust boring could also occur on Shell Parade where the new culvert for the aboveground pipeline is proposed to be constructed adjacent to the existing culvert.

A typical thrust bore set up is shown in Figure 1-5.

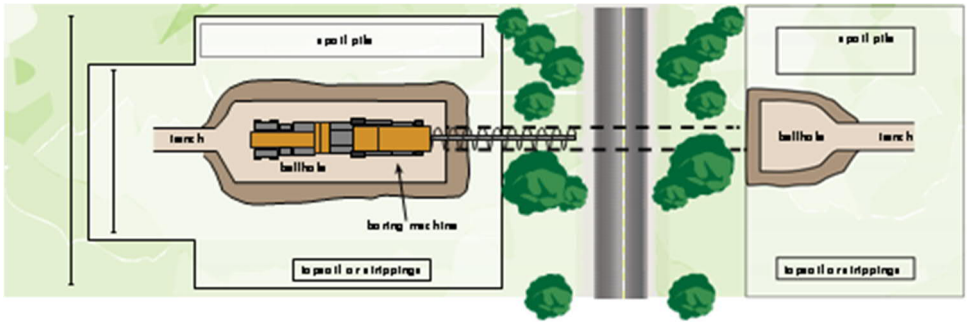

Figure 1-5 Typical thrust bore set up

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 contamination and acid sulfate soil impact assessment:

- **Water and catchment values** – To minimise adverse effects on water (in particular wetland, estuarine, intertidal and marine) quality and movement, and to the ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site.
- **Waste management** - To minimise generation of wastes by or resulting from the project during construction and operation, including dredging and accounting for direct and indirect greenhouse gas emissions.

The scoping requirements of relevance to this contamination and acid sulfate soil impact assessment and where they are addressed in the report are shown in Table 2-1.

Table 2-1 Scoping requirements relevant to contamination and acid sulfate soil

Aspect	Scoping requirement	Section addressed
Key issues	Potential for adverse environmental or health effects from waste materials/streams generated from project works including dredging and disposal of material in dredge spoil management grounds.	Section 6.0 (Construction impacts) Section 7.0 (Operation impacts) Technical Report A: *Marine ecology and water quality impact assessment* Technical Report B: *Dredged sediment disposal options assessment*
	Potential for unplanned spills of product or other pollutants including bilge or ballast water that could contain exotic organisms.	
	Potential for disturbance of contaminated soil or acid sulphate soil particularly during dredging.	
	The potential for adverse impacts on water quality and environmental values due to dredging and sediment mobilisation, spills or other incidents during construction or operation.	
Existing environment	Identify the potential occurrence of contaminated groundwater, contaminated soil/sediment, or potential acid sulfate soils within the area where project works may occur.	Section 5.0 (Existing conditions) Technical Report F: *Groundwater impact assessment*
Likely effects	Identify potential environmental effects resulting from the generation, storage, treatment, transport and disposal of solid waste, including contaminated or potential acid sulphate soil and contaminated sediment from project construction and operation.	Section 6.0 (Construction impacts) Section 7.0 (Operation impacts) Technical Report E: *Surface water impact assessment* Technical Report F: *Groundwater impact assessment*
	Identify and evaluate effects of the project on groundwater, surface water, waterways and wetlands near the project works, including the likely extent, magnitude and duration (short and long term) of changes to water quality, water level,	

Aspect	Scoping requirement	Section addressed
	temperature or flow paths during construction and operation, considering appropriate climate change scenarios and possible cumulative effects resulting in combination with other existing or proposed projects of actions.	
Mitigation measures	Describe available options for treatment or disposal of solid and liquid wastes generated by the project.	Section 9.0 (Recommended mitigation measures) Technical Report A: *Marine ecology and water quality impact assessment* Technical Report E: *Surface water impact assessment* Technical Report F: *Groundwater impact assessment*
	Describe how the waste hierarchy will be applied to control and manage waste.	
	Identify suitable off-site disposal options for waste materials.	
	Describe measures to minimise the risk of spills including of water from vessels which might contain contaminants or exotic organisms.	
	Describe further potential and proposed design options and measures that could avoid or minimise significant effects on environmental values of surface water, groundwater and downstream water environments during the project's construction and operation, including response measures for environmental incidents.	
Performance objectives	Describe proposed management approach for solid waste.	Section 9.0 (Recommended mitigation measures)
	Describe measures for emergency and spill response.	
	Describe contingency measures for responding to unexpected impacts resulting from waste management or discharges.	

3.0 Legislation, Policy and Guidelines

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

Additional guidelines and technical criteria relevant to contamination and acid sulfate soils are described in Section 3.1.

Table 3-1: Primary environmental legislation and associated information

Legislation/policy	Description	Implications for the project	Approval required
Commonwealth			
Legislation			
Environment Protection and Biodiversity Conservation Act 1999 (Cth) ('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.	On 21 January 2021, the delegate for the Commonwealth Minister for the Environment determined the project to be a controlled action due to potential significant impact on the Port Phillip Bay (Western Shoreline) and Bellarine Peninsular Ramsar site, listed threatened species and ecological communities and listed migratory species. The EES process is accredited to assess impacts on MNES under the EPBC Act through the Bilateral Assessment Agreement between the Commonwealth and the State of Victoria. Therefore, the project would be assessed under the bilateral agreement.	Approval of controlled action required
State			
Legislation			
Environment Protection Act 2017 (Vic) ('EP Act 2017')	The EP Act 2017 aims to protect Victoria's air, water and land by adopting a 'General Environmental Duty' (GED) which imposes a broad obligation on entities and individuals to take proactive steps to minimise risks of harm to human health and the environment from pollution or waste. The Victorian Environment Protection Authority (EPA) administers the EP Act 2017 and subordinate legislation.	The EP Act 2017 regulates discharges to land, surface water or groundwater by a system of Development and Operating Licences. Any discharge into a waterway or groundwater during the construction or operation of the project must be in accordance with the requirements of the EP Act 2017. The GED requires all reasonably practicable steps be taken to minimise impacts	The FSRU component of the project would require a Development and Operating Licence. The Geelong Refinery would require a Development Licence or exemption.

Legislation/policy	Description	Implications for the project	Approval required
		from the construction and operation of the project.	
Water Act 1989 (Vic) ('Water Act')	The Water Act provides the legal framework for the integrated management of Victoria's water resources. The main purpose of the Water Act is to promote the efficient and equitable use of water resources and ensure water resources are conserved and appropriately managed for sustainable use. The Water Act provides a formal means of protecting and enhancing waterway flow, water quality and catchment conditions.	Under the Water Act, Southern Rural Water was formed as a Water Corporation in July 1995, and is responsible for managing irrigation districts, the regulation of surface water and groundwater licensing, and storage dams across the southern third of Victoria.	Bore construction licences for installation of groundwater monitoring wells
Pipelines Act 2005 (Vic) ('Pipelines Act')	This is the primary act governing the construction and operation of pipelines in Victoria. The Pipelines Act covers 'high transmission' pipelines for the conveyance of gas, oil and other substances. The Department of Environment, Land, Water and Planning (DELWP) and Energy Safe Victoria (ESV) are responsible for administering the Pipelines Act and the Pipelines Regulations 2017.	The project requires a Pipeline Licence(s) under the Pipelines Act for the construction and operation of the pipeline. The CEMP, required prior to construction of the pipeline, would include measures to minimise contamination and acid sulfate soil impacts during construction.	Pipeline Licence(s) required
Planning and Environment Act (Vic) 1987 ('P&E Act')	The P&E Act establishes a framework for planning the use, development and protection of land in Victoria. The P&E Act provides for the preparation of planning schemes in each municipality consistent with the Victoria Planning Provisions and procedures by which planning schemes may be amended and planning permits obtained to govern land use and development. Under the P&E Act, a permit is required to carry out any works in an area intersecting Floodway Overlay (FO), Land Subject to Inundation	For works not covered under *the Pipelines Act 2005 (Vic)* such as the pier extension and ancillary pier infrastructure, FSRU and treatment facility planning approval would be required.	Planning Scheme Amendment to the Greater Geelong Planning Scheme

Legislation/policy	Description	Implications for the project	Approval required
	Overlay (LSIO) or Special Building Overlay (SBO) layers.		
Policy			
Environment Reference Standard	This Environment Reference Standard (ERS) is made under section 93 of the *Environment Protection Act 2017 (Vic)*. It sets out the environmental values of the ambient air, ambient sound, land and water environments that are sought to be achieved or maintained in Victoria and standards to support those values. Environmental values are the uses, attributes and functions of the environment that Victorians value. Standards for the environmental values are comprised of objectives for supporting different uses of the environment and indicators that can be measured to determine whether those objectives are being met.	The project would seek to minimise the potential for impacts to land and water (including marine/surface water and groundwater) to ensure that existing environmental values are protected, with priority given to maintaining environmental values of areas of high conservation value (Ramsar sites).	No approvals required but ERS used to inform EPA's decision making under the EP Act 2017.

3.1 Legislation

3.1.1 Commonwealth Legislation

National Environment Protection Council Act 1994 (Cth)

The National Environment Protection Council Act 1994 and complementary State and Territory legislation allow the National Environment Protection Council (NEPC) to make National Environment Protection Measures (NEPMs).

The *National Environment Protection (Assessment of Site Contamination) Measure, 1999* (the ASC NEPM), as amended in 2013, provides a nationally consistent approach to the assessment of potentially contaminated sites, to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, landowners, developers and industry.

In Victoria, the ASC NEPM is mainly implemented through the State policies such as the Environmental Reference Standard and guidelines, as described it Section 3.2.

3.1.2 State Legislation

The *Environment Protection Act 2017 (Vic)* ('EP Act 2017') came into effect on 1 July 2021. The EP Act 2017 provides a legal framework to protect the environment in Victoria, including the protection of air, land and water from pollution. The EP Act 2017 also makes provisions with respect to the powers, duties, and functions of the EPA Victoria.

Central to the EP Act 2017 is the GED. The GED is an ongoing duty to prevent the risk of harm to human health and the environment. According to Section 25(1) of the EP Act 2017, the GED requires that a person or entity who is engaging in an activity that may give rise to risks of harm to human health or the environment, to minimise those risks, so far as reasonably practicable. When determining what is reasonably practicable, Section 6(2) of the EP Act 2017 gives regard to the following:

- The likelihood of those risks eventuating
- The degree of harm that would result if those risks eventuated
- What a person concerned knows, or ought reasonably to know
- The availability and sustainability of ways to eliminate or reduce risks
- The cost of eliminating or reducing risks.

In addition to the GED, the EP Act 2017 imposes the following duties relevant to this EES:

- The duty to respond to harm after a pollution incident (Section 31)
- The duty to notify of certain pollution incidents (Section 32)
- The duty to manage contaminated land and groundwater (Section 39)
- The duty to notify of contaminated land (Section 40)
- Duties relating to industrial, priority and reportable priority waste (Section 133 to Section 143).

The EP Act 2017 includes further amendments to the environment protection framework, including the introduction of a new permissions scheme. This includes development licences, operating licences, permits and registrations. Regarding contaminated land, a permission may be required for the management of excavated construction spoil. Further information on waste management is provided in Section 3.2.2.

3.2 State Policy

3.2.1 Environment Reference Standard

Under the EP Act 2017, the Environment Reference Standard (ERS, 2021) provides the indicators and objectives needed to support environmental values. The ERS is a reference tool and does not set compliance limits or specific obligations that must be followed.

The ERS is a tool that can be used to assess the impacts on human health and the environment that may result from a proposal or activity, or from existing environmental conditions on a site. This application of the ERS must be seen within the context of preventing harm from pollution and waste as part of the broader environment protection framework under the EP Act 2017. Because it is preventative in nature, this framework seeks to minimise risks of harm to human health and the environment rather than setting and authorising acceptable levels of pollution and waste. The focus on prevention allows for continual improvement in managing these risks as knowledge expands and more effective risk- reduction techniques and technologies emerge.

The ERS incorporates many ‘reference standards’ that cover four aspects of Victoria’s environment, the two relevant aspects to this contamination and acid sulfate soil (ASS) impact assessment are:

- Part 4 - Land; and
- Part 5 - Water (surface water and groundwater).

Each of the aspects in the ERS include the following components:

- Environmental values: environmental values are a statement about a desired outcome for human health and the environment:
- Indicators: indicators are the parameters or markers used to assess whether environmental values are being achieved or maintained, or if they are threatened:

- Objectives: the character, level, load, concentration or amount of an indicator used to assess whether an environmental value (or several environmental values) is being achieved, maintained or threatened. Most objectives are scientifically derived quantitative assessment levels or a prescribed scientific basis for assessment; and
- Areas of application: the ERS defines the area or areas to which the environmental values, or specific indicators and objectives apply.

3.2.2 Waste Management

Management of industrial waste, including waste spoil, needs to comply with the EP Act 2017, EP Regulations 2021 and supporting legislation and would need to consider the GED. The EP Regulations 2021 enable elements of the EP Act 2017 to function. Regarding waste management, the EP Regulations 2021 provide detail on how waste should be classified (Schedule 5) and categorised (Schedule 6) where required. Once categorised, waste can only be sent to a place authorise to receive that waste.

EPA Publication 1828 *Waste Disposal Categories – Characteristics and Thresholds* provides the criteria used to categorise waste spoil. The following categories apply to waste spoil:

- Fill Material: waste soil with contaminant concentrations not exceeding the upper limits for fill material contaminant concentrations according to EPA Publication 1828
- Soil Containing Asbestos only: waste soil containing asbestos and which does not contain any contaminant concentration exceeding the upper limits for fill material contaminant concentrations according to EPA Publication 1828
- Category D: waste soil with any contaminant concentration greater than the upper limits for fill material contaminant concentrations, but not exceeding the upper limits for Category D waste contaminant concentrations according to EPA Publication 1828
- Category C: waste with any contaminant concentration greater than the upper limits for Category D waste contaminant concentrations, but not exceeding the upper limits for Category C waste contaminant concentrations according to EPA Publication 1828
- Category B: waste with any contaminant concentration greater than the upper limits for Category C waste contaminant concentrations, but not exceeding the upper limits for Category B waste contaminant concentrations according to EPA Publication 1828
- Category A: waste with any contaminant concentration greater than the upper limits for Category B waste contaminant concentrations according to EPA Publication 1828.

Specific duties relating to the reuse, treatment, transport and disposal of waste spoil apply to each category. Where waste soil contains levels of naturally occurring elements, such as background metals, that exceed the upper limit for fill material, EPA can issue a designation under regulation 86 of the EP Regulations 2021 to categorise the material as fill. Fill material must be managed in accordance with EPA Determination *Specifications Acceptable to the Authority Receiving Fill Material.*

It is noted that EPA Publication 1828 does not contain PFAS contaminant concentrations. EPA Publication 1669.4 *Interim Position Statement on PFAS* provides interim criteria for the reuse of PFAS-impacted soil, however it is noted that where there are any detections of PFAS in soil, the requirements for management of this soil should be clarified with EPA, regardless of whether or not the re-use criteria is exceeded.

Acid sulfate soils must be managed in accordance with the requirements of the EPA Industrial Waste Management Policy (Waste Acid Sulfate Soils) and EPA Publication 655.1 *Acid Sulfate Soil and Rock.* Further guidance on managing acid sulfate soils is provided in the EP Regulations 2021.

3.3 Guidelines

3.3.1 Commonwealth Guidelines

Commonwealth guidelines relevant to contamination and ASS impact assessment include:

- National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM), as amended in 2013
- National Water Quality Management Strategy – Australia and New Zealand Guidelines for Fresh and Marine Water Quality
- Australian Standard (AS) 4482.1 – 2005: Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds
- AS 4482.2 – 1999: Guide to the sampling and investigation of potentially contaminated soil Part 2: Volatile substances
- National Acid Sulfate Soil Sampling and Identification methods manual, 2018
- National Acid Sulfate Soil identification and laboratory methods manual, 2018
- Per-and poly-fluoroalkyl substances (PFAS) National Environmental Management Plan 2.0 2020

3.3.2 State Guidelines

The assessment and management of contaminated land in Victoria is directed by EPA Victoria and guidelines issued by that authority. Guidelines relevant to contamination and acid sulfate soils impact assessment include:

- Industrial Waste Resource Guidelines (IWRG) 702: Soil Sampling (June 2009);
- Publication 1915: Contaminated Land Policy
- Publication 1940: Contaminated Land: Understanding Section 35 of the EP Act 2017
- Publication 2008: Notifiable Contamination Guideline: Duty to Notify of Contaminated Land
- Publication 655.1 (2009): Acid Sulfate Soil and Rock:
- Publication 1669.4 (2020): Interim Position Statement on PFAS:
- Publication 1968: Guide to Classifying Industrial Waste
- Publication 1827.2 (2021): Waste Classification Assessment Protocol:
- Publication 1828.2 (2021): Waste Disposal Categories – Characteristics and Thresholds
- Publication 1977 (2021): Assessing and Controlling Contaminated Land Risks: A Guide to meeting the Duty to Manage for those in Management or Control of Land
- Publication 668 (2006): Hydrogeological Assessment (Groundwater Quality) Guidelines
- Publication 669 (2000): *Groundwater Sampling Guidelines*.

It is noted that while this report is being prepared, new publications and guidance documents are being continuously released by EPA in support of the EP Act 2017.

3.4 Contamination and Acid Sulfate Soils Criteria

The criteria adopted in assessing the existing conditions and potential impacts of the project, based on the identified environmental values (discussed in Section 5.4), are presented in Section 3.0 of the attached contamination and acid sulfate soils field investigation report (Appendix A).

4.0 Methodology

4.1 Overview of Method

This section describes how the contamination and acid sulfate soils assessment was conducted in order to understand the existing environment and potential impacts of the project due to the contamination and acid sulfate soils conditions within the development area.

The following sections outline the study methodology.

4.2 Study Area

This contamination and acid sulfate soils impact assessment considers intrusive works and infrastructure in the project area that may intersect contaminated soil and groundwater, including acid sulfate soils material for the onshore components of the project. The assessment also includes the surrounding areas where disturbed contaminants could impact human health or the environment.

The contamination and acid sulfate soils study area is defined as the following three project components together with a 200-metre buffer zone around them:

- aboveground pipeline (onshore) within the Refinery Pier foreshore pipeline compound and Geelong Refinery, from east of Shell Parade to the treatment facility
    - the preferred option is to utilise the existing pipe track and culverts, with installation of additional concrete supports and shallow trenching or thrust boring utilised beneath roads, as required.
- treatment facility
    - foundations or pilings may be required beneath the nitrogen storage tanks which have the potential to intersect groundwater
- underground pipeline between the treatment facility and the tie-in point to the SWP at Lara
    - trenching is the preferred option; however, thrust boring / HDD is being considered beneath road crossings and the area between GW03 and GW05.

The study area conservatively extends up to 200 metres from project components to capture the potential for contamination and acid sulfate soils that may be encountered as part of the project works.

The depth of assessment for most of the study area was limited to the upper five to ten metres of the subsurface only, due to the shallow nature of proposed pipeline trenching and thrust boring / HDD activities.

The contamination and acid sulfate soils study area is shown in Figure 4-1 below, and Figure F1 (Appendix A, Attachment A).

Figure 4-1 Contamination and acid sulfate soils study area

For the purposes of the contamination and acid sulfate soils assessment, the study area has been split into two zones. The two zones have different current and historic land uses and different potential for contamination to be present. The two zones are as follows:

- Zone 1 - the portion of the project area within the Geelong Refinery boundary and including the Refinery Pier foreshore pipeline compound east of Shell Parade, area shown below in figure 4-2; and

- Zone 2 - the portion of the project area north of the Geelong Refinery boundary along the proposed underground pipeline alignment.

The Zone 1 and 2 areas are presented below in Figure 4-2 and Figure 4-3 and Figures F2 and F3 (Appendix A, Attachment A).

Figure 4-2 Contamination and acid sulfate soils Zone 1

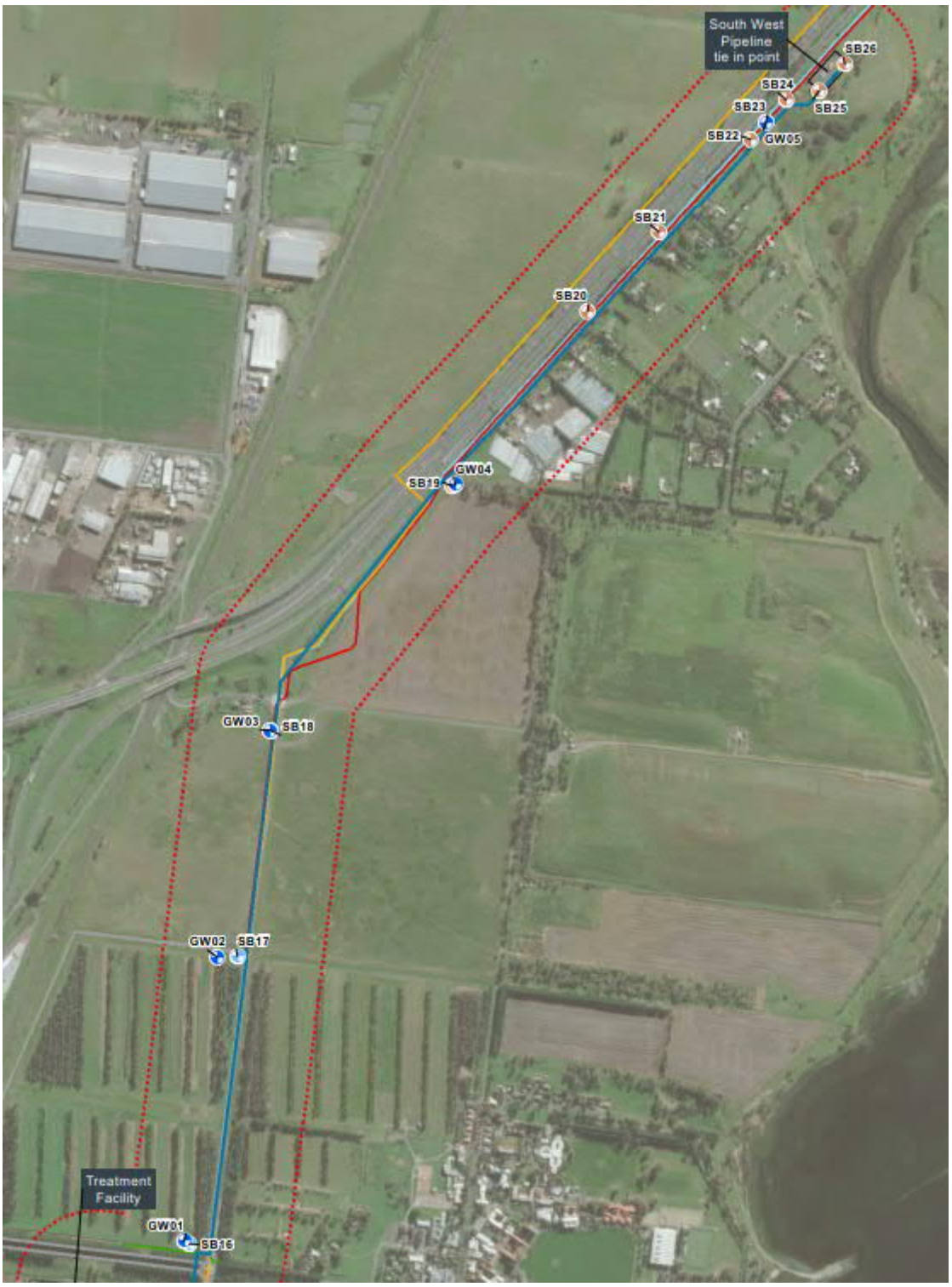

Figure 4-3 Contamination and acid sulfate soils Zone 2

This report does not assess potential impacts on the marine environment in Corio Bay from offshore construction works such as dredging, and operational activities such as operation of the FSRU. Potential impacts to the marine environment are assessed in Technical Report A: *Marine ecology and water quality impact assessment* and Technical Report B*: Dredged sediment disposal options assessment*.

4.3 Existing Conditions

4.3.1 Contamination Assessment

4.3.1.1 Desktop Review

Key elements of the desktop review included:

- Review of current and historic land uses, utilising literature that is publicly available, to identify potentially contaminating land uses and areas of interest. This includes review of:
  - Historical and current aerial photographs and maps of the study area to identify land likely to have been used for industrial and commercial activities, landfills, quarries, or other areas suspected to have the potential for contamination.
  - EPA Victoria Victorian Landfill Register (VLR) to identify the potential for current/historic landfills and quarries within the study area.
- Review of the EPA Victoria Priority Sites Register.
- Review of the EPA Victoria list of issued Certificates and Statements of Environmental Audit.
- Review of Groundwater Quality Restricted Use Zones (GQRUZ) located within the study area, as declared by EPA Victoria.
- Review of available historic site contamination assessment reports as made available by Viva Energy.

4.3.1.2 Field Investigations

Key elements of field investigations included:

- Pre intrusive work clearance – obtaining Dial Before You Dig plans, completing AECOM Service Identification and Clearance (SIC) process, and engaging an independent service locator to scan the proposed drill locations not within the refinery boundary. For sample locations within the refinery boundary clearance was completed by Viva Energy personnel and contractors prior to AECOM drilling commencing.
- Soil Investigation – A total of 22 environmental soil bores and 13 environmental test pits were advanced along the length of the investigation area, to a maximum depth of 4.0 m. 11 soil bores and 13 test pits were completed in Zone 1 and 11 in Zone 2. Soil samples were collected nominally at surface, 0.5m, and every 0.5 m to target depth or refusal on bedrock.
- Groundwater well installation – five of the Zone 2 soil bores were extended to groundwater and a 50mm unplasticised polyvinyl chloride (uPVC) casing groundwater well was installed. Each groundwater well was developed after drilling to prepare the well for sampling, which occurred at least 7 days after development. New groundwater wells were not installed within the Geelong Refinery operational boundary based on the existing groundwater monitoring network and the presence of known contamination within the facility. The current and historical data from this existing groundwater well network was utilised as part of the groundwater data review.
- Analytical laboratory analysis of selected soil and groundwater samples for the identified contaminants of potential concern (COPC) as outlined in *Appendix A, Table 2-1*, namely hydrocarbons, metals. PFAS and acid sulfate soils, and a wide suite of analysis to assist waste classification assessment.

The contamination and acid sulfate soils field investigation scope and methodology are presented in Section 1.0 and 2.0 of the attached contamination and acid sulfate soils field investigation report (Appendix A).

4.3.2 Acid Sulfate Soils Assessment

The acid sulfate soils assessment was undertaken in accordance with the Industrial Waste Management Policy (IWMP) (Waste Acid Sulfate Soils) including EPA Victoria Publication IWRG655.1: *Acid Sulfate Soil and Rock* and the *Victorian Best Practice Guidelines for Assessing and Managing*

Coastal Acid Sulfate Soil (CASS BPMG, 2010). The series of National Acid Sulfate Soils Guidance documents, prepared by Water Quality Australia, has also been utilised in undertaking the ASS assessment.

The following four stages, as recommended by CASS BPMG (2010), was adopted in the acid sulfate soils risk identification and assessment process:

- Stage A – Preliminary coastal acid sulfate soils (CASS) hazard assessment
- Stage B – Detailed site soil sampling program and assessment
- Stage C – Surface/ groundwater sampling program and assessment
- Stage D – CASS hazard assessment.

Key elements completed for each stage are described in the following subsections.

4.3.2.1 Stage A – Preliminary CASS Hazard Assessment

Stage A of the CASS risk identification process involves undertaking a desktop assessment of available information about the site to determine whether a high-risk activity, such as excavation of greater than 1,000 cubic metres of soil or sediment, is proposed in a CASS risk area (areas with a high probability of occurrence of acid sulfate soils). The assessment may also involve a field inspection.

The following are key elements completed for Stage A – preliminary CASS hazard assessment:

- Review of the Victorian CASS Mapping (Maps 2 and 3 of the West Coast and Central Coast of Victoria, respectively) and Atlas of Australian Acid Sulfate Soils (AAASS) to assess the potential for acid sulfate soils conditions. The AAASS tool is available on the Australian Soil Resource Information System (ASRIS), which provides information about the distribution and properties of coastal and inland acid sulfate soils across Australia.
- Review of site topography and height above sea level (Australian Height Datum (AHD)).
- Review of regional geology and indicative soil types and their origins.
- Review of the proposed construction methods of the project to assess whether to the project is classified as High-risk activities under the CASS BPMG (2010).
- A site walkover along the study area, was undertaken on 16 April 2021. The aim of the walkover was to view the condition of the study area, to relate desktop observations to site conditions, to identify any indicators for the presence of CASS and to assess proposed groundwater and soil bore locations.

4.3.2.2 Stage B – Detailed Site Soil Sampling Program and Assessment

Stage B of the CASS risk identification process involves undertaking soil sampling and laboratory analysis to assess the presence of CASS, measure the potential acid production rate of that soil (if present) and investigate the potential impacts if CASS is disturbed. The results of the field investigation provide baseline data for future monitoring programs.

The following are key elements completed for Stage B – Detailed site soil sampling program and assessment, which was undertaken in conjunction with the soil sampling program for the soil contamination investigation (refer to Section 4.3.1):

- Samples for acid sulfate soils assessment within the study area were collected at selected locations in conjunction with soil samples collected for the purpose of assessing potential contamination. Sample were collected along the proposed pipeline at approximately 1km spacing. In addition to the grid-based sample locations, four targeted locations within the area where the pipeline alignment intersects an area of higher potential acid sulfate soils occurrence (as defined in the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Australian Soil Resource Information System (ASRIS)), close to Hovells Creek. The targeted locations were installed at approximately one location per 100 metres, along the northern limit of the investigation area, in accordance with recommendations made in the EPA Victoria Publication 655.1.

- Samples were collected nominally from surface and every 0.5m to 2m or to bore refusal depth, whichever was shallower. This was based on the expected disturbance depth of the development being less than 2m below ground level along the proposed pipe alignment.
- Laboratory analysis comprising:
    - all samples for field pH (pH_F) and field pH peroxide (pH_{FOX}) to guide the selection of the samples for more detailed laboratory analysis.
    - selected samples for the Chromium reducible sulfur (CRS) suite.
    - Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) suite for Quality assurance/Quality control (QA/QC) purposes (10 per cent of the samples analysed for CRS suite), in accordance with Vic EPA IWRG655.1: *Acid Sulfate Soil and Rock*.

Detailed descriptions of the adopted criteria and methodologies used to undertake the field investigations are provided in Section 3.5 of the attached contamination and acid sulfate soils field investigation report (Appendix A).

Stage C – Groundwater Sampling Program and Assessment

Stage C of the CASS risk identification process involves the development of a surface water and/or groundwater sampling program and assessment at locations where Stage B soil assessment finds CASS and the potential acid production rates of the soil exceeded the action criteria level.

A groundwater sampling program was completed for Stage C. The program included installation of five groundwater monitoring wells. One of the groundwater monitoring wells (GW05) was installed in the higher CASS risk area identified in Stage A of the CASS risk identification process at the northern end of the proposed underground pipeline alignment. Groundwater gauging and sampling was completed at GW05 and at a further three groundwater monitoring wells installed as part of the project.

The laboratory analysis suite and the adopted criteria to assess risk to protected environmental values for groundwater are presented in in Section 3.0 of the attached contamination and acid sulfate soils field investigation report (Appendix A).

It is noted that surface water sampling was not undertaken as part of this assessment: surface water assessment is addressed in Technical Report E: *Surface water impact assessment*. The groundwater assessment is detailed in Technical Report F: *Groundwater impact assessment*.

Stage D – CASS Hazard Assessment

Stage D of the CASS risk identification process identifies the level of hazard, associated with the CASS disturbance, using hazard ratings presented in Table 3 of the CASS BPMG (2010). The CASS hazard table presents the CASS hazard ratings (low, medium, high). The CASS hazard rating was assessed based on the laboratory results from the Stage B and Stage C assessment and the tonnes of CASS to be disturbed.

The hazard rating guides the planning and the level of management strategies required to reduce risks to the environment, infrastructure and human health due to the CASS disturbance.

4.4 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.

4.4.1 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
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 4.4.2 below.

4.4.2 Risk Screening results

Table 4-1 provides the key contamination and acid sulfate soils issues identified as part of the risk screening process for the project and presents the screening value for each issue.

Table 4-3 Issue screening results for contamination and acid sulfate soils

Aspect	Issue	Community & stakeholder perceived impacts	Significance of assets, values & uses	Potential impact (spatial, temporal & severity)	Screening Score	Screening Value
Construction						
Onshore contamination	Potential impacts on the environment and human health from exposure to contaminated material. Treatment or disposal of contaminated material and/or acid sulfate soils	2	1	1	4	Medium
Operation						
Onshore contamination	Leaks or spills during operation from machinery/plant, fuel and chemical storage result in contaminated soil and/or groundwater.	2	1	1	3	Medium

4.5 Impact Assessment Method

Potential impacts on surface water condition and groundwater levels and flow from the project are addressed in Technical Report E*: Surface water impact assessment* and Technical Report F*: Groundwater impact assessment*, respectively.

4.5.1 Construction

The construction phase impact assessment focuses on the potential impacts on human health, with respect to nearby residents and the general public, and the environment associated with contamination, specifically exposure of excavated contaminated soils and groundwater and/or acid sulfate soils and potential contamination from project activities such as fuel or chemical leaks/spills and waste management. The impact assessment methodology included:

- Identification of relevant project components such as infrastructure and construction methods that have the potential to encounter, expose and/or excavate contaminated material and/or acid sulfate soils materials
- A summary of existing conditions in the study area based on desktop assessment and site-specific field investigations
- Identification of potential impacts on environmental values of land, groundwater and land and groundwater users from construction activities
- Identification of mitigation measures (where required).

4.5.2 Operation

The operational phase impact assessment focuses on the potential impacts on human health, with respect to nearby residents and general public, and the environment associated with contamination, specifically potential contamination from project activities. such as planned maintenance and testing, fuel or chemical leaks/spills and waste management. The impact assessment included:

- Identification of relevant project infrastructure and operational activities that have the potential to generate waste, leak or spill.
- Summary of study area existing conditions based on desktop assessment and site-specific field investigations
- Identification of potential operational impacts on environmental values of soil and groundwater and groundwater users
- Identification of mitigation measures (where required).

4.5.3 Decommissioning

The impact assessment for the decommissioning phase of the project included:

- Identification of relevant decommissioning activities with the potential to affect the surrounding environment or human health
- Summary of existing conditions in the study area based on desktop assessment and site-specific field investigations
- Identification of potential decommissioning impacts on environmental values of soil and groundwater and groundwater users
- Identification of mitigation measures (where required).

Decommissioning of the project would involve the same, or similar, issues as those associated with the construction of the project, however, the overall level of impact would be lower due to the nature of decommissioning activities.

4.6 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.

Engagement with landholders was undertaken to obtain access and approval to undertake investigations and install soil bores or groundwater wells as part of this study.

In accordance with normal practice for an EES in Victoria, 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. Chapter 6: *Stakeholder and community engagement* provides a summary of the project's key engagement activities.

4.7 Assumptions and Limitations

Assumptions and limitations relating to this impact assessment are as follows:

- The assessment focuses on activities with the potential to intersect contaminated soil and groundwater, as well as ASS material and for that impact to have a negative effect on the surrounding environment and off-site users.
- The desktop assessment was limited to publicly and readily available information; and is based on conditions that existed at the time the assessment was completed. Its findings and conclusions may be affected by the passage of time, by man-made events (e.g., construction on or adjacent to the project area boundary and by new releases of hazardous substances into the environment).
- Historic land use information presented herein is limited to information obtained from a series of aerial photographs taken between 1946 and 2021 (generally one aerial photograph for each decade) and maps, sourced from a service provider. Based on the restricted land use, this approach is considered satisfactory, however it is possible that minor short term contamination events may not have been identified as part of this assessment.
- The compiled data does not necessarily include all landfill sites. As acknowledged by EPA Victoria, there is a lack of consolidated data on the past life cycles of Victorian landfills. It is noted

that landfill sites in and around Melbourne are predominantly former quarry sites (i.e., clay pits, sand pits, and other large voids), and have tended to ultimately be converted to parks or reserves (Taylor E., 2013). In the project area, it is possible that minor landfilling occurred on an 'as needs' basis by farmers, for which there are unlikely to be any official records.

- As noted by CSIRO, the classification of ASS via AAASS map is provisional for areas where analytical data was not available when the map was prepared. As such, further assessment of ASS conditions may be required.
- The Priority Sites Register (based on EPA Victoria data dated 19 July 2021) does not list all known contaminated sites in Victoria. Therefore, a site should not be presumed to be free of contamination if it does not appear on this Register.
- The assessment of existing commercial/industrial operational activities was limited to the results of a brief internet search and a site walkover along the study area, undertaken on 16 April 2021.
- Properties that appeared to be used for residential purposes were generally assumed to have a low potential for contamination of soil and groundwater.
- Detailed investigations should be carried out as part of the detailed design and construction phases to supplement the information contained in this report, as required.
- Interpretation of subsurface conditions and the nature and extent of contamination is based on field observations and laboratory analytical data from a limited number of widely spaced sample locations (both grid and targeted). It is possible that contamination of soil and/or groundwater may be present but has not been detected as part of this assessment.
- Soil sampling density for the field investigation does not comply with EPA Victoria Publication IWRG702: *Soil Sampling* as this site investigation was intended to provide an indication of the potential for soil contamination within the study area only, and not for the purpose of off-site soil reuse, treatment or disposal. If soils are to be moved off-site for reuse, treatment or disposal, soil sampling must be undertaken in accordance with the relevant EPA guidance, including (but not limited to) EPA Publication 1828.2 and IWRG702: *Soil Sampling* to ensure the appropriate hazard categorisation is applied.
- No specific community engagement was undertaken to assist the contamination and acid sulfate soils impact assessment.
- Potential impacts on surface water condition and groundwater level are not covered in this report and are addressed in EES Technical Report E: *Surface water impact assessment* and EES Technical Report F: *Groundwater impact assessment*, respectively.
- Various Commonwealth and State Standards and Guidelines may be updated as the project progresses.

This study should be read in the context of limitations and assumptions mentioned above and the purpose for which it was intended.

4.7.1 Linkages to Other EES Technical Studies

The groundwater impact assessment should be read in conjunction with other relevant technical reports forming part of the EES. Other potential impacts relating to surface water, biodiversity and contamination have been considered in detail in other technical reports:

- Technical Report A: *Marine ecology and water quality impact assessment*
- Technical Report B: *Dredged sediment disposal options assessment*.
- Technical Report D: *Terrestrial ecology impact assessment*
- Technical Report E: *Surface water impact assessment*
- Technical Report F: *Groundwater impact assessment*
- Technical Report H: *Air quality impact assessment.*

5.0 Existing Conditions

The existing conditions of the assets, values and uses being considered throughout this assessment are described in the following sections.

5.1 Project location and Surrounding Environment

5.2 Topography and Surface Water

The general topography of the area slopes from west to the east, with elevations west of Princes Highway in the order of 30 mAHD and falling away east and southeast to Corio Bay.

The project site is located within the Moorabool River basin and Hovells Creek sub-catchment of the Corangamite catchment region and is managed by the Corangamite Catchment Management Authority (CCMA).

The Moorabool River is approximately 6.5 km to the south-east of the project area and Hovells Creek is approximately 300 m to the east of the proposed tie-in point to the SWP at Lara.

There is one unnamed minor watercourse located within the study area which the proposed underground pipeline would cross. The watercourse is several metres wide and is a shallow constructed rock-lined channel with low hierarchy (contains low or minor importance features). The watercourse flows from the north-west beneath Rennie Street and the Princes Highway before draining into a constructed dam built in the low point of the landscape. The dam fills after heavy rainfall events and only overflows to Hovells Creek following significant rainfall events.

Hovells Creek is a small creek that rises in the southern foothills of the You Yangs and flows into Corio Bay via Limeburners Lagoon. The creek is a high value and priority waterway within the landscape zone due to its environmental condition and social amenity value and is the main river of the Hovells landscape zone which includes several wetlands, including Limeburners Lagoon State Nature Reserve.

These wetlands are part of the internationally significant Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The Ramsar site comprises six distinct areas, including Point Wilson/Limeburners Bay which is located along the northern shoreline of Corio Bay approximately one kilometre to the north-east of the project site (refer to Figure 5-1).

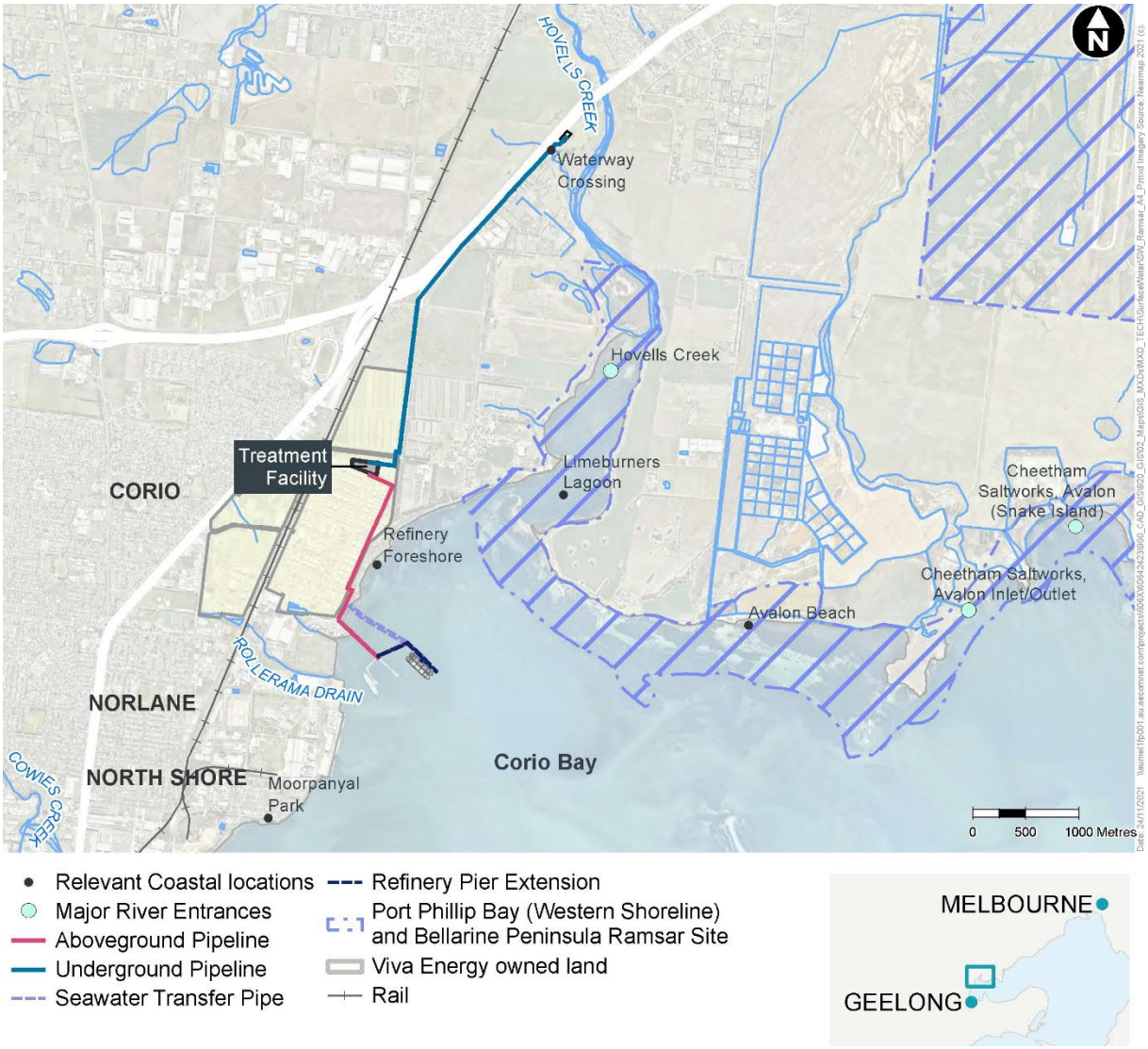

Figure 5-1 Point Wilson/Limeburners Bay Ramsar site boundary and the project

5.3 Regional Geology and Hydrogeology

5.3.1 Geological Setting

The geology encountered was consistent with the *Geological Survey of Victoria Geelong SJ 55-11* 1:63,360 map (1963) and Victorian Seamless Geology Project (DELWP, 2018). The Cainozoic geological history of the area (including the Refinery site) was dominated by both marine and terrestrial sedimentation associated with marine transgression/regression sequences, together with occasional extrusive volcanic events.

Significant geological formations present beneath the site include (from youngest to oldest):

- Recent Sediments
- Newer Volcanics
- Moorabool Viaduct Formation (MVF)
- Fyansford Formation (FF)
- Batesford Limestone

The Tertiary age Black Rock Sandstone (now known as the Sandringham Sandstone) is shown as outcropping at surface at the proposed Shell Parade culvert and to the south of the proposed treatment facility. The Sandringham Sandstone (and predecessor unit names) has variously been described as ranging from quartzose calcareous sandy clay to coarse grained quartz sandstone, and sandy silt, fine sandstone, sandy conglomerate to pebbly sandstone, clayey sand, clayey gravel, and carbonaceous bands including plant fossils[2].

Further north the Sandringham Sandstone is shown to be overlain by the Upper Tertiary/Quaternary age Newer Volcanic Group basalt flows, scoria and pyroclastics.

At the northern extent of the study area, beneath the South West Pipeline tie-in point, Newer Volcanic Group is mapped as being overlain by Quaternary age Darley Gravel comprising gravels, sands and silts. Immediately east and north east of the study area, Quaternary age coastal lagoon deposits are mapped as being present around the low-lying areas of Hovells Creek.

Based on the drilling works completed as part of this assessment, the generalised local geology within the study area is consistent with the regional geology expectations. A generalised description of the local geology encountered is provided in the following Table 5-1.

Table 5-1 Generalised Local Geology

Area	Material Description	Depth Range (m)
Zone 1 (Southern Area)	Fill material (reworked), comprising of clayey gravels and sands, fine to medium grained sands, low to medium plasticity	0 – 1.0
	Natural sandy clays and clayey sands, medium to high plasticity, fine to medium grained sands, with gravels. It is noted one soil bore, SB02, encountered limestone at approximately 1.5m.	1.0 -3.0
Zone 2 (Northern Area)	Natural sandy clays and clays, some reworked material near surface, medium to high plasticity, fine to medium grained sands, with gravels.	0 – 2.0
	Basalt, moderately or less weathered, high strength	2.0 +

Bore logs are provided in Attachment C of the attached contamination and acid sulfate soils field investigation report (Appendix A). Overall, the geology encountered is generally consistent with regional mapping that shows Sandringham Sandstone sediments outcropping beneath the refinery, which are overlain by the Newer Volcanic basalts in the northern portion of the study area.

5.3.2 Hydrogeological Setting

The study area is in the West Port Phillip Bay Groundwater Catchment, which includes four designated groundwater management units (GMUs). The GMUs are the Cut Paw Paw, Lancefield and Merrimu three Groundwater Management Areas (GMAs), and the Deutgam Water Supply Protection Area (WSPA). GMAs are discrete areas where groundwater quality suitable for irrigation, commercial or stock and domestic use is available or expected to be available. The WSPA is an area declared under the *Water Act 1989 (Vic)* to protect groundwater through development of a groundwater management plan to ensure equitable management and long-term sustainability (SRW, 2016). The study area is outside the designated GMUs and is managed through a local management plan. No cap has been placed on the volume of groundwater that can be extracted from these areas outside of the GMUs. The local management plan applies no restrictions on taking groundwater, although extraction is authorised under a groundwater licence; other than for domestic and stock use (SRW, 2016).

The surface geology in the study area is shown in Figure F3 (Appendix A) sourced from published 1:250,000 Seamless geology (DELWP, 2018).

[2] https://asud.ga.gov.au/search-stratigraphic-units/results/80411

The Tertiary age Black Rock Sandstone (now known as the Sandringham Sandstone) is shown as outcropping at surface at the proposed Shell Parade culvert and to the south of the proposed treatment facility. The Sandringham Sandstone (and predecessor unit names) has variously been described as ranging from quartzose calcareous sandy clay to coarse grained quartz sandstone, and sandy silt, fine sandstone, sandy conglomerate to pebbly sandstone, clayey sand, clayey gravel, and carbonaceous bands including plant fossils[3].

Further north the Sandringham Sandstone is shown to be overlain by the Upper Tertiary/Quaternary age Newer Volcanic Group basalt flows, scoria and pyroclastics.

At the northern extent of the study area, beneath the South West Pipeline tie-in point, Newer Volcanic Group is mapped as being overlain by Quaternary age Darley Gravel comprising gravels, sands and silts. Immediately east and north east of the study area, Quaternary age coastal lagoon deposits are mapped as being present around the low-lying areas of Hovells Creek.

The study area lies at the onshore edge of the groundwater basin known as the Port Phillip Basin. The northern margin is bounded by outcropping pre-Tertiary basement bedrock (which form the Southern Uplands), the Rowsley Fault marks the western margin and the Selwyn Fault the eastern margin of the basin (GHD, 2010).

The shallow aquifers of the basin relevant to the groundwater report are summarised in Table 5-2 (based on Victorian Aquifer Framework layers within https://www.vvg.org.au/).

Table 5-2 Hydrostratigraphy of the study area

Aquifer	HGU[1]	Depth (mbgs)	Thickness (m)	Study area zone
Quaternary Alluvium [QA]	Various fluvial/lacustrine/alluvial/ colluvial sediments	0	up to 5	Shell Parade culvert and northern extent of underground pipeline
Upper Tertiary/ Quaternary Basalt [UTB]	Newer Volcanics basalt flows, scoria and pyroclastics	0 to 5	0 to 30	treatment facility and underground pipeline
Upper Tertiary Aquifer (Marine) [UTAM]	Sandringham Sandstone	0 - 30	0 - 20	All (except northern portion of underground pipeline)

NOTES: mbgs – metres below ground surface; 1 - Hydrogeological Groundwater Unit

The UTAM is the water table aquifer in the southern portion of the project area where it outcrops. Further north, the UTAM becomes confined and is overlain by the unconfined UTB aquifer. At the northern extent of the study area, the QA would locally form the water table aquifer.

Depths to groundwater are shown as being between 5 to 10 metres below ground surface (mbgs) within the study area and locally increasing to 15 to 20 mbgs beneath higher topography in the east based on regional scale mapping and interpretation.

The groundwater table is often observed to be a subdued version of the ground surface, and as such, shallower groundwater would be present beneath the south of the study area (in lower lying areas close to the coast) and increasing in depth to the north. Regional groundwater flow would be towards the east and southeast beneath the study area as groundwater flows from higher ground towards the discharge areas of Corio Bay, and potentially localised groundwater discharge to Hovells Creek.

5.4 Environmental values

The Environment Reference Standard (ERS) is promulgated under Section 93 of the EP Act 2017. It sets out the environmental values of the ambient air, ambient sound, land and water environments that are sought to be achieved or maintained in Victoria and standards to support those values.

[3] https://asud.ga.gov.au/search-stratigraphic-units/results/80411

The ERS identifies environmental values that need to be achieved and maintained and provides a method to assess those environmental values in locations across the Victoria.

5.4.1 Land

Table 4.2 of the ERS (reproduced below as Table 5-3) outlines the environmental values to be protected by land use.

Table 5-3 Protected Environmental Values of Land (ERS, 2021)

Environmental Value		Land Use						
		Parks & Reserves	Agricultural	Sensitive Use		Recreation/ Open Space	Commercial	Industrial
				High Density	Other			
Land dependent Ecosystems and Species	*Natural Ecosystems*	✔						
	Modified Ecosystems	✔	✔		✔	✔		
	Highly Modified Ecosystems		✔	✔	✔	✔	✔	✔
Human Health		✔	✔	✔	✔	✔	✔	✔
Buildings and Structures		✔	✔	✔	✔	✔	✔	✔
Aesthetics		✔		✔	✔	✔	✔	
Production of food, flora and fibre		✔	✔		✔			

The existing land uses within the study area, include all those listed in Table 4.2 of the EPA Victoria ERS (2021), except for sensitive use of high density residential. Therefore, all environmental values for land uses listed above in Table 5-3 were considered in assessing the potential impacts from the project construction, operation and decommissioning activities. The key receptors of interest for the study area includes:

- People residing, working, and utilising the land within the study area, reserves, and recreational areas, including schools
- Construction workers undertaking ground intrusive works
- Ecosystems that exist along the study area, including Port Phillip Bay, Hovells Creek Reserve, and transient Groundwater Dependent Ecosystems (GDEs)
- Soil indicators and objectives for the environmental values of land are outlined in Table 4.1 of the ERS (2021).

The adopted investigation levels (ILs) for comparison of the soil analytical results with those identified as potential environmental values relevant for the project, are discussed and summarised in Appendix A (Table B5 to B8 of Attachment B).

5.4.2 Groundwater

Table 5.3 of the ERS (reproduced below as Table 5-4) outlines the environmental values to be protected by groundwater segments. It is noted that the ERS standards for groundwater are based on the former SEPP (Waters), which includes standards for both surface waters and groundwater, indicators and objectives.

Table 5-4 Protected Environmental Values for Groundwater (ERS, 2021)

Environmental Values	Segment (TDS mg/L)						
	A1 (1-600)	A2 (601-1,200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,001)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Cultural spiritual values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties.	✓	✓	✓	✓	✓	✓	✓

Based on the field calculated Total Dissolved Solids (TDS) values collected as part of the 2021 groundwater sampling and available previous sampling of existing groundwater wells in the vicinity of the proposed development area, Segment B has been adopted as the groundwater segment for the study. Further detail in the groundwater TDS is presented in the separate specialist area report Technical Report F: *Groundwater impact assessment* (AECOM, 2021)

Groundwater quality indicators and objectives for the environmental values of groundwater are outlined in Part 5 of the ERS. The environmental values of groundwater to be protected for the Project and the adopted ILs are summarised in Appendix A (Table B12 and B13 of Attachment B).

5.5 Groundwater Users

A search of the Water Measurement Information System (WMIS) registered groundwater bore database returned a total of six registered groundwater bores in the study area. Additionally, a total of 39 groundwater bores were identified from the Geelong Refinery database located within the study area. This number does not include the two monitoring bores installed at the time of writing as part of ongoing EES investigations.

Licensed uses, bore details and Geelong Refinery bores are summarised in Table 5-5 and presented on Figure F4 (Appendix A).

Table 5-5 Licensed uses for registered bores within the study area

Licensed use category	Licensed uses	Number of bores	Bore depth range (m)	Distance from pipeline route (m)
WMIS Database				
Consumptive	Domestic	1	35	126
Monitoring/ Observation	Groundwater investigation, observation	3	5.2 – 7.8^	70 – 325*
Unknown	Not known use	2	25 and unknown	9 – 113
Geelong Refinery				
Geelong Refinery groundwater bores	Groundwater investigation	39	4.4 – 15.5#	0 – 335*

^ - groundwater bores may be counted twice in Geelong Refinery database
* - distance from start of pipeline not from proposed treatment facility
# - no bore depth was reported for a total of 21 bores within the Geelong Refinery database

A summary of the consumptive use (and potentially consumptive use) bores is provided below:

- Consumptive use bore 115471 is registered as being located 126 m from the proposed pipeline alignment and for domestic use. It is recorded as being screened from 27 to 35 mbgs in a sand lithology and is well below the proposed depth of project construction activities and infrastructure
- 104976 is registered as being located approximately 113 metres from the proposed pipeline alignment, with the construction details and bore use listed as unknown
- WRK982178 is registered as being located approximately 9 metres from the proposed pipeline alignment. The bore use and screened interval are not listed; however, the total depth is recorded as 25 metres.

5.6 Groundwater Dependent Ecosystems

The Groundwater Dependent Ecosystems Atlas (the Atlas) was developed as a national dataset of Australian GDEs (http://www.bom.gov.au/water/groundwater/gde/map.shtml).

The Atlas contains information about aquatic ecosystems that rely on the groundwater that discharges to the surface (including rivers, springs and wetlands), terrestrial ecosystems that rely on the subsurface presence of groundwater (including vegetation) and subterranean ecosystems that live in caves and aquifers[4].

The mapping is from national scale assessment based on available geographic information system (GIS) data and a set of rules that describe the potential for groundwater and ecosystems to interact, and: more detailed regional assessment by state and/or regional agencies using field work, satellite imagery or application of conceptual models.

The identification of potential GDEs in the Atlas does not confirm that a particular ecosystem is groundwater dependent.

There are no potential aquatic GDEs mapped as being within the study area, and no terrestrial GDEs within and around the underground pipeline corridor and treatment facility area based on national and regional studies.

There are high potential (from national assessment) terrestrial GDEs mapped within the Shell Parade culvert sub-area. These are described as coastal saltmarsh/mangrove shrubland mosaic and are

[4] The GDE Atlas does not contain information regarding subterranean GDESs for Victoria but is not considered relevant to this study based on the geological formations intersected by the Project's shallow construction activities.

located on the area of foreshore reserve between Shell Parade and Corio Bay (refer to Figure F6, Appendix A).

5.6.1 Groundwater and Surface Water Interaction

The study area is intersected by an unnamed minor watercourse located approximately 120 metres southwest of the South West Pipeline tie-in point. This is a constructed shallow rock lined channel several metres wide that drains into a dam built in the low point of the landscape. Neither feature is mapped as being a potential GDE (refer to Figure F6, Appendix A) and are thought to be fed by surface water.

Although Hovells Creek is mapped as being a high potential GDE (from national assessment), it is located beyond the study area, approximately 300 metres southeast of the proposed underground pipeline corridor.

There is limited potential for groundwater – surface water (GW-SW) interaction within the study area and no nationally classified GW-SW interactions are reported for streams within the study area.

5.7 Contamination

5.7.1 Existing Land Use

Review of publicly available information and aerial photographs indicated that existing land uses within the study area include:

- Viva Energy Geelong Refinery
- Geelong Grammar School
- Commercial / Industrial facilities
- Residential
- Vacant Land
- Agricultural Land
- Road and road reserve areas

With the exception of the Viva Energy Geelong Refinery, the predominant existing land uses are considered to have a relatively low potential for soil and groundwater contamination.

5.7.2 Historic Land Use

Representative aerial photographs for each decade between 1946 and 2021, historical Melway and topographical maps (from 1928 - 2009) covering the entire study area were obtained and reviewed to identify historic land uses. Copies of the aerial photographs and maps are provided in Appendix B (Lotsearch report) and findings are summarised in Table 5-6.

It is noted that image resolution of aerial photographs can vary significantly and as a result, there are uncertainties in interpretation.

Table 5-6 Areas of significant changes to historical land uses

Zone	Change in historical land uses
1 – Geelong Refinery	1954: Geelong Refinery was officially opened (earliest aerial image 1962). Facility appears to cover the same extent as current site, with similar major infrastructure. The area proposed for the project treatment facility is vacant. 1963: A number of dwellings have been developed in the north east area of the refinery within the area now known as Nerita Gardens. 1975: Land to the south of the refinery has been developed with additional above ground bulk storage tanks. 1978: Some additional development on site in the central western area of the site, surrounding area remains unchanged 1990: The dwellings in the north east area of the refinery within the area now known as Nerita Gardens have been removed. 2002: Site to the north east of the refinery has been developed for what appears to be ongoing agricultural purposes. Potentially the land has been subdivided. The former vacant land to the north has been planted with trees. 2009: Further development of commercial properties can be seen to the south of the refinery. Trees have grown on the formerly vacant land to the north of the refinery 2013: The area in the northeast area of the refinery known as Nerita Gardens is further cleared and utilised as a laydown area and waste transfer facility.
2 – Underground Pipeline Alignment	1946: Southern area of Zone 2 is vacant land likely used for agricultural purposes or buffer land from the refinery. Minor structures, likely to be farmhouses and related buildings are located in the central area of Zone 2. 1963: Land use generally unchanged, however, freeway/road networks had been upgraded to the west of the study area. 1978: Land use generally unchanged, however, Geelong Harness and Greyhound Racetrack has been developed to the west of the study area, on northern side of the Princes Freeway. 1990: Land division and rural residential dwellings can be seen in the northern extent of Zone 2. 2002: Land use generally unchanged, however, road network has expanded with a roundabout installed in the central area of Zone 2. Land in the south east corner of Zone 2 has been subdivided. The South West Pipeline Lara City Gate facility is in place, as is the nearby constructed dam (located to the southwest of the Lara City Gate facility). The area on the southern side of the freeway has undergone further development with hobby farms on the south side of the freeway.

5.7.3 Contaminated Sites

Publicly available information held by EPA Victoria were reviewed to identify areas with potential for contamination. Information reviewed includes:

- Priority Site Register
- Statutory environmental audit reports
- Groundwater quality restricted use zones (GQRUZ)
- Licence register
- EPA Victoria licence register.

5.7.3.1 Priority Site Register

The EPA Victoria Priority Sites Register lists sites that have been issued with a formal Clean Up Notice (CUN) or Pollution Abatement Notice (PAN). At these sites, EPA Victoria considers that the condition of the site is not compatible with the current approved use without active management to reduce risks to human health and the environment.

EPA Victoria issues CUNs and PANs for a broad range of sites, not only focusing on industrial and commercial sites, but also existing and former landfills and sites where EPA Victoria suspects that contamination has occurred. Sites are removed from the Priority Sites Register once all conditions of a Notice have been complied with and the site has been cleaned up to EPA Victoria's satisfaction.

A search of the EPA Priority Sites Register indicates that, as of 19 July 2021, there are three current priority sites located within of the study area, one of which is the Viva Energy Geelong Refinery. Information obtained through Lotsearch with respect to the priority sites is provided in Appendix B. The other two sites relate to a former landfill, located to the east of the proposed underground pipe alignment, and an accidental release on the Princes Highway, in Lara, parallel to the proposed underground pipeline alignment.

Table 5-7 lists sites located within the study area that are currently listed on the Priority Site Register, additional sites that have previously been on the register are detailed in Appendix B.

Table 5-7 Current Priority Sites located within the study area

Location	Issue	Proximity to the Project Area
Address: 90 Refinery Road, Corio	**Current Notice No**.: 90001012 **Previous Notice No**.: 90002361, NO9549, 9007692, 90008542 Current petroleum storage site, requires ongoing management.	Part of the study area.
Address: 1500 - 1580 Biddlecombe Avenue, Corio	**Current Notice No**.: 90004271 **Previous Notice No**.: 90002361, NO9549, 9007692, 90008542 Former landfill, requires ongoing management.	The priority site is located approximately 200m to the east of the study area.
Address: Princes Highway, Lara	**Current Notice No**.: 90001012 **Previous Notice No**.: NO4904, NO4554 Accidental spill/leak (non-industrial site). Requires assessment and/or clean up.	The site runs parallel to the northern section of the proposed underground pipeline alignment, following the freeway.

5.7.3.2 Statutory Environmental Audits

Prior to the EP Act 2017, EPA Victoria Statutory Environmental Audits were conducted in accordance with the *Environment Protection Act 1970 (Vic)*, typically at the request of local councils, landowners or planning authorities. The Audits were undertaken by an EPA appointed independent Environmental Auditor who assess the suitability of a site for the proposed use and provide a certificate or statement of audit. Sites where Environmental Audit had been undertaken is not an indicator of contamination, although it is likely to be an indicator of historic industrial and commercial land use with potential for contamination.

Under Section 53 of the *Environment Protection Act 1970 (Vic)*, there were two types of environmental audits: 53X and 53V audits.

A 53X ('condition of a segment of the environment') is most frequently used by the planning authorities to assess that specified parcels of potentially contaminated land are suitable for a specific use (industrial, commercial, residential or no land uses). From the 53X Audit, the Auditor issues either a certificate (indicates that the land is suitable for any use with no restrictions on the use of the site due to its environmental condition) or statement (indicates the site is not suitable for any use or suitable for a nominated use, subject to conditions and/or limitations in its use) of environmental audit.

A 53V ('risk of harm') audit is commonly used by EPA Victoria to measure an industrial activity's risk to the environment. It can also verify if the land or groundwater is contaminated and needs to be cleaned up. The outcome of a 53V audit is an audit report identifying risks to the environment, potentially with recommendations for ongoing management of the land.

A search of the EPA Victoria Interaction Portal, indicates that, as of 19 July 2021, there are six properties located within a 1km radius of the study area that had been audited under Section 53 of the *Environment Protection Act 1970 (Vic)*. It is noted that that the refinery site and the former Corio landfill have undergone several Audits. The details of each audit are presented in the attached Lotsearch report (Appendix B).

Of the environmental audits completed, none appear to be located up hydraulic gradient of the study area, with the exception of the refinery with the site conditions managed under current site health and safety protocols which would be relevant to the study area. The remaining audit sites identified are not considered likely to have impact on land or groundwater within the study area.

5.7.3.3 Groundwater Quality Restricted Use Zones (GQRUZ)

Groundwater Quality Restricted Use Zones (GQRUZ) are areas where groundwater pollution is present, as a result of previous industrial or other activities, and the site has been assessed as part of a Section 53X Environmental Audit in accordance with the *Environment Protection Act 1970 (Vic)*. These zones have been subject to clean-up, in line with the relevant environmental standards, but not all environmental values of groundwater have been restored. As such, restrictions remain on what the groundwater can be used for, if it is abstracted or discharges to a surface water body. The presence of contaminated groundwater in the study area may present constraints during excavation activities.

A search of the EPA Victoria GQRUZ map indicates, that as of 9 August 2021, there is one GQRUZ located within the study area. It is associated with a former petroleum service station located at 391 - 395 Princess Highway, Corio. The restrictions on use for the site and the areas to the east and south are for drinking water, livestock, and water use for recreational and/or industrial purposes. The site is located approximately 800m to the east and is considered unlikely to have any impact on land or groundwater quality within the study area.

5.7.3.4 EPA Victoria Licence Register

The *EP Act 2017 (s45)* require prescribed activities to apply for an EPA licence, unless the permission exemption has been granted under the EP Act 2017. The licence covers the actual operation of the site, and sets operating conditions, waste discharge limits and waste acceptance conditions, as appropriate.

A search of the EPA Victoria Interaction Portal, for properties issued with an EPA licence, indicates that as of 19 July 2021, there are four scheduled premises located within the study area, including the Viva Energy Geelong Refinery. The desktop review identified the following premises as having higher potential for contamination due to historical or current activities:

- Viva Energy Geelong Refinery
- Terminals Pty Ltd

Former licensed activities within 1km of the study area have included the former Corio Landfill to the north-east and the Ford manufacturing plant to the south-west.

With the exception of the refinery, it is considered unlikely that the former or currently licensed premises would have any impact on land or groundwater quality within the study area. The licensed activities within the refinery are considered adequately managed by current site management processes that would apply, as relevant, to the study area development works.

5.7.4 Previous Investigation

Extensive environmental assessments have been carried out by many parties on the Geelong Refinery site on behalf of Viva Energy (and former operator Shell). For the purposes of this contamination and acid sulfate soils impact assessment, the compliance groundwater assessment summary reports from 2018 – 2021 were used for obtaining groundwater data for the existing refinery wells located in the vicinity of the proposed development area, namely:

- Shell Parade Culvert (Zone 1) – MW046, MW238, and MW239
- Treatment Facility (Zone 1) – MW138, MW293, MW294, and MW348
- Underground Pipeline Alignment (Zone 2) – MW121 and MW145.

The groundwater summary reports are presented in Attachment G of the field investigation report (Appendix A).

The results of the previous assessments indicate that the soil and groundwater in the study area is impacted with petroleum hydrocarbons, with LNAPL noted in wells within Zone 1 of the study area (the refinery)

AECOM is not aware of any previous contamination and acid sulfate soils assessment reports that apply to the Zone 2 area (proposed underground pipeline alignment).

5.7.5 Chemicals of potential concern (COPC) identification

An evaluation of the information reviewed in Sections 5.7.1, 5.7.2, 5.7.3 & 5.7.4 identified the following COPC in vicinity of the site:

- Soil
    - Total petroleum hydrocarbon (TPH) C6-C40 fraction,
    - Benzene, toluene, ethylbenzene and xylene (BTEX),
    - Polycyclic aromatic hydrocarbons (PAHs),
    - Metals (Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc);
    - Organochlorine (OC) and organophosphorus (OP) pesticides;
    - Presence of asbestos containing materials; and
    - PFAS suite (28 analytes)

In addition to the COPC's identified above, at least one soil sample for each location was screened using a reduced EPA Publication 1828.2 Table 2 (in line with the previous IWRG621, that was current during the scoping and initial fieldworks for this assessment)

- Groundwater Zone 1
    - Total petroleum hydrocarbon (TPH) C6-C40 fraction;
    - Benzene, toluene, ethylbenzene and xylene (BTEX);
    - Volatile organic compound (VOC)

Groundwater within Zone 1 is not anticipated to be encountered during the construction or operation phases of the project. Groundwater was sampled to screen for the potential risks associated with vapour intrusion into slab on grade enclosed structures during the operation phase of the project.

- Groundwater Zone 2
    - Total petroleum hydrocarbon (TPH) C6-C40 fraction;
    - Benzene, toluene, ethylbenzene, xylene and Naphthalene (BTEXN);
    - Volatile organic compound (VOC)/semi-VOC (SVOC);
    - Metals (Arsenic (As), Cadmium (Cd), Chromium (Cr), Trivalent Chromium (Cr(III)), Hexavalent Chromium (Cr(VI)), Copper (Cu), Lead (Pb), Mercury (dissolved) (Hg), Nickel (Ni) and Zinc(Zn));

- Organochlorine (OC) and organophosphorus (OP) pesticides;
- PFAS Super ultra-trace suite (29 analytes);
- Nutrients (Nitrate, ammonia and total phosphorous);
- Major Ions; and
- Total Dissolved Solids (TDS).

5.7.6 2021 Field Investigations

Details of the intrusive soil and groundwater investigations undertaken for this study are presented in the contamination and acid sulfate soils field investigation report (Appendix A). Based on the review of existing available site assessment data, and the completed field works as part of the 2021 contamination and acid sulfate soils assessment, the following conclusions have been made. It should be noted that the information presented in the following sections forms the basis of the impact assessment outlined later in this report.

5.7.6.1 Soil Conditions

Zone 1

Based on a combination of broadly spaced and targeted intrusive investigations, the investigation concluded that soil contamination, with the exception of PFAS (see Section 5.7.6.1 PFAS below), is expected to be encountered in soils from approximately 1.5m bgl of the existing pipe track surface level within Zone 1, on the refinery site. The affected soils from 1.5m bgl are likely to be associated with the refinery groundwater contamination plumes and groundwater level fluctuations in the study area creating a 'smear zone' above and below the typical groundwater level of approximately 3m bgl. Soil contamination above the screening levels was not identified for locations in the vicinity of proposed culvert installation below existing roads.

The concentrations of TRH and benzene in one or more samples, exceeded NEPM Health Screening Levels (HSLs) and Ecological Screening Levels (ESLs) for industrial / commercial land use and Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) HSLs for intrusive workers in shallow trenches. It is considered that contamination is likely to be relatively widespread at depth across the Zone 1 area. The following samples reported concentrations in excess of the adopted investigation levels:

- NEPM 2013 HSL D (Commercial/Industrial)
  - Benzene - SB09_1.5, 12.6 mg/kg (Criteria 3 mg/kg)
- NEPM 2013 ESLs for Commercial/Industrial
  - TRH C6-C10 fraction (F1) – SB11_1.5-1.6, 232 mg/kg (Criteria 215 mg/kg)
  - TRH >C10-16 fraction – SB09_1.5, 600 mg/kg (Criteria 170 mg/kg)
- NEPM 2013 Table 1B(5) Generic Ecological Investigation Levels (EILs) for Urban Residential
  - Arsenic – SB04_1.75, 122 mg/kg (Criteria 100 mg/kg)

The concentration of arsenic above the EILs was encountered at depth in natural soil and not in the overlying shallow sample. The arsenic may reflect natural variability with the geology at the site and is not considered to represent a risk to human health or the environment as part of the project. It is noted that the arsenic from this sample location was not readily leachable (below limit of reporting (LOR)).

Zone 2

In Zone 2, to the north of the refinery, the sampled soil within the proposed underground pipeline alignment is generally not contaminated (excluding PFAS discussed further below) consistent with the historically rural land use and the low potential for contamination identified.

PFAS

Detectable PFAS compounds were reported along the entire length of the investigation area, with 27 of the 35 soil bores and test pits reporting detectable concentrations. However, no results were reported above the PFAS NEMP 2020 guidelines level for human health or ecological levels.

Exceedances of the EPA Publication 1669.4 Interim statement on PFAS reuse guidelines were reported in shallow soils collected at SB02, SB04, SB07, TP04, TP11, TP12 and TP13 within Zone 1 (refinery site) and SB23 within Zone 2 (northern end of pipeline alignment). As such, if spoil cannot be placed back into the proposed pipeline trench where it was excavated from, it would need to be assessed to confirm whether it can be reused at the refinery (if from originally removed from within Zone 1) or elsewhere on the project site. If there are any detections of PFAS in soil to be reused at the refinery (if from originally removed from within Zone 1) or elsewhere on the project site, the requirements for management of this soil would need to be discussed with EPA, regardless of whether or not the re-use criteria in EPA Publication 1669.4 are exceeded. Additionally, where the material remains on site (i.e., put back in the same trench at the location where it was excavated from), no permission is required, but the duty holder must comply with the General Environmental Duty (GED) and Duty to Manage contaminated land. It is noted that, if soils containing PFAS are required to be disposed off-site, then an EPA designation is required (unless the soils are being sent offsite to a treatment facility for destruction).

Given that the location of the PFAS contamination at SB23 within Zone 2 (northern end of pipeline alignment), is over 3km to the north of the refinery it is not considered that the contamination is related to the Viva Energy operation and the source of PFAS in Zone 2 is unknown. Due to their widespread use and persistence in the environment, PFAS can be found in soils, surface water and groundwater in low concentrations in many areas. The PFAS detected at SB23 could potentially be from surface water flows through this area from the unnamed, artificial watercourse which flows during rain events from the north in a culvert beneath the Princes Freeway.

Offsite Disposal Requirements

It is noted that sampling density does not comply with EPA Victoria Publication IWRG702: *Soil Sampling* and is based on the assessed potential for contamination over the study area. Localised contamination may be present at other locations and may be encountered during project construction works. Encountered localised contamination or unexpected contamination should be managed in accordance with section 6.1 and section 6.4 respectively.

One sample per location was analysed for an extended suite of analytes and one additional sample per location was analysed for a suite of COPC to enable comparison with EPA Victoria Publication 1828.2 (2021). The laboratory results indicated presence of hydrocarbon compound benzene in excess of the Category C criteria on total concentrations in sample SB09_1.5 (Zone 1, refinery site). This sample also reported total petroleum hydrocarbon concentrations in excess of the Category D criteria. While the soil results only exceed the lower toxicity waste category criteria, the exceedances mean that excavated material may be required to be landfilled in line with the EP Act 2017 waste framework.

Metal compounds arsenic, nickel and zinc, as well as fluoride, were reported in excess of the Fill Material criteria in samples from one or more bores located across the study area. However, the concentrations of these compounds were not high, are considered likely to represent natural variability and are unlikely to affect disposal requirements. The leachability of arsenic was reported either below the laboratory LORs or the allowed Category D leachable limit and is likely to represent natural variability within the geology beneath the project area. It is noted that further sampling and analysis would be required to meet sampling density requirements and to fully classify and allow off-site soil disposal. An application would be required to be submitted to EPA Victoria where soils are excavated from identified PFAS impacted areas and planned to be disposed offsite (unless being sent to a treatment facility for destruction).

It is noted under the EP Act 2017 waste framework, even if material is classified as "Fill" based on publication 1828.2, uncontrolled use at a different location is not permitted. If reuse is required at a different location the specifications in the Fill Material determination (http://www.gazette.vic.gov.au/gazette/Gazettes2021/GG2021S301.pdf) must be met, or an alternative method of establishing lawful place (e.g., designation).

5.7.6.2 Groundwater Conditions

Groundwater is noted to be intersected between approximately 2m to 4m below ground level within Zone 1 (dependent on raised roadways and bunds and lower infrastructure levels of the existing pipe tracks), increasing to greater than 5m in Zone 2. It is noted that, in the central portion of Zone 2 (along the proposed underground pipeline alignment), basalt was encountered, and groundwater was not intersected within 9m bgl, while groundwater less than 3m bgl was encountered at the northern extent of the study area (GW05).

The field investigation concluded that groundwater contamination is limited largely to Zone 1. Contamination in groundwater beneath the refinery consisted of Light Non Aqueous Phase Liquid (LNAPL), TRH and benzene. In the event of the development requiring excavations and dewatering beyond 3m depth in Zone 1, and below 5m depth in Zone 2, groundwater may be intersected and would require appropriate management and disposal based on the expected groundwater conditions in the relevant area.

In Zone 2, groundwater is generally not contaminated although nitrogen and phosphorous was detected in samples where it was analysed for, potentially representing regional fertiliser use. PFAS was encountered in groundwater from GW05 at concentrations orders of magnitude above GDE investigation levels and would require offsite treatment should it be abstracted during pipeline construction. Given that the location of the PFAS contamination is over 3km to the north of the refinery it is not considered that the contamination is related to the Viva Energy operation and the source of PFAS in Zone 2 is unknown. Due to their widespread use and persistence in the environment, PFAS can be found in soils, surface water and groundwater in low concentrations in many areas. Groundwater within Zone 1 was not analysed for PFAS, however PFAS could be present given its presence in soil in Zone 1 in the Refinery.

It is noted that localised contamination may be present at other locations and may be encountered during project construction works.

5.7.6.3 Acid Sulfate Soils Conditions

Based on data collected as part of a combination of broadly spaced and targeted intrusive investigations, it has been concluded that net acidity concentrations in soil are generally below the adopted action criteria for ASS Management across the study area. Localised presence of Potential Acid sulfate soils (PASS) was reported at shallow depths with lithology classified as clayey sands, exceeding the action criteria at one location in the central area of Zone 1 along the refinery pipe trench parallel with Shell Parade (SB07_0.2m). The area within Zone 1 where the aboveground pipeline would be constructed would need to be managed during construction.

It is noted that sampling density for the majority of the study area does not comply with EPA Victoria Publication 655.1 and is based on preliminary evaluation for presence or absence of ASS within the study area. Localised ASS could be present at other locations and could be encountered during project construction works.

6.0 Construction Impacts

This section provides an overview of the potential impacts resulting from contaminated land and groundwater and acid sulfate soils associated with construction of the project. Mitigation measures have been recommended to manage potential impacts where appropriate.

6.1 Contaminated Soils

Due to current and historical land uses within the project area, there is a potential for contaminated soil to be encountered during construction of the onshore works. However, the field investigation concluded that, based on broadly spaced and targeted intrusive investigations, soil contamination is limited in extent to the Zone 1 area within the Geelong Refinery. The assessment of soil on the refinery site did identify some exceedances of the investigation levels adopted to be protective of human health, however, these soils are within restricted access areas. The assessment of soil in Zone 2, along the proposed underground pipeline alignment, did not identify any contamination exceeding investigation levels adopted to be protective of human health. Due to the presence of impacted material being restricted to the controlled refinery site, and the absence of a source of contamination in the publicly accessible areas, the potential impact to human health is considered low.

The concentration of petroleum hydrocarbons in Zone 1 exceeded ecological screening levels and may adversely impact the ecology of the area during excavation. All excavated soils in Zone 1 would have to be carefully managed to avoid spreading contamination and discharge to stormwater systems and Corio Bay. In accordance with EPA Publication 1828.2 (2021) and with consideration to the GED, where possible, soils may be returned to the excavation after laying the pipe support infrastructure in a similar order to excavation (i.e. deepest soil is placed back at the greatest depth). Further information on waste management is presented in Section 3.2.2. While contamination was not encountered in Zone 2, similar practices should be adopted during construction to avoid sedimentation of surrounding stormwater systems and waterways.

Soil categorisation in accordance with the EPA Victoria Publication 1828.2 (2021) indicated presence of benzene in excess of the Category C criteria (total concentration) in sample SB09_1.5, located within Zone 1. This sample also reported total petroleum hydrocarbon (TPH) concentrations in excess of the Category D criteria. The leachability of benzene was below the LOR in the soil sample with the highest total concentration of benzene was encountered. Metal compounds arsenic, nickel and zinc, as well as fluoride were reported in excess of the Fill Material criteria in samples from one or more bores located across the study area. However, the concentrations of these compounds were not high and are considered likely to represent natural variability and are unlikely to affect disposal requirements. The leachability of arsenic was reported either below the laboratory LORs or the allowance Category D leachable limit and is likely to represent natural variability within the geology beneath the site. The proposed onshore works comprise:

- Constructing a culvert beneath Shell Parade between the foreshore pipeline compound and the refinery, and installation of additional concrete supports and culverts as required within the existing refinery pipe trench for the aboveground pipeline (Zone 1)
- Construction of the treatment facility (Zone 1)
- Excavating a trench or use of thrust boring / HDD along the proposed 4 km underground pipeline alignment (Zone 2),

The proposed construction methods for the treatment facility and underground pipeline alignment are detailed in Chapter 4: *Project description*. The following provides a basic sequence for the proposed construction works:

- Underground Pipeline
    - clearing and grading the construction ROW, with topsoil and seedstock windrowed along the edge of ROW. Vegetation and spoil would be stockpiled at set locations along the ROW, including outside of riparian areas of watercourses where profiling is required:
    - stringing (laying the pipe sections end to end) and bending of the pipe:

  - welding and field joint coating of the pipe:
  - digging the pipeline trench and trench spoil placement (with sufficient separation from topsoil):
  - lowering the pipe into the trench:
  - backfilling the trench with spoil: and
  - rehabilitating the ROW and additional workspaces by contouring the surface to the surrounding profiles and then re-spreading the stockpiled topsoil and seedstock across the disturbed areas (along with soil treatment and re-seeding where required – not required in Zone 1 for example).
- Treatment Facility
  - constructing temporary access roads in and out of the construction site, temporary fencing, and site offices with associated facilities, equipment/material lay-down and pre-staging areas, clearing of vegetation, and relocating existing services if required:
  - existing ground levels would be excavated/built up and levelled to the required design levels. The topsoil may be required to be replaced with engineered fill. The proposed works are to be focused on reuse of excavated materials within the development area to build up sections as required and minimise off-site soil management needs. Soils not able to be reused for the development would be stockpiled for future assessment for appropriate end use:
  - excavation for and installation of steel reinforced concrete foundations and footings would be installed. The proposed permanent buildings, equipment and supports would be fixed on to these.:
  - excavation of required shallow trenches, removal of soil material, installation of service conduits and backfill with imported clean fill and with excavation spoil: and
  - surface areas prepared for installation of aboveground infrastructure associated with the treatment facility.

It is noted that as sampling density does not meet EPA Victoria Publication IWRG702: *Soil Sampling requirements* and is based on the potential for contamination over the study area. There is the potential that localised contamination could be present at other locations and could be encountered during project construction works. However, if contaminated soils were encountered in Zone 1, existing refinery human health and environmental management protocols would be appropriate to adequately manage potential impacts. These protocols include:

- Stockpiling of excess soil removed during the construction phase, in a designated soil management area within Zone 1
  - Stockpiles should be identifiably segregated by project due to the nature of the operational facility with multiple concurrent projects and operational works at any given time.
- Sampling of soil stockpiles in accordance with EPA Victoria Publication IWRG702: Soil Sampling requirements and analysis and characterisation in accordance with EPA Victoria Publication 1828.2: Waste disposal categories – characteristics and thresholds.
- Following the characterisation of the soil stockpiles:
  - If applicable the soil may be retained in the refinery for future reuse; or
  - Disposed offsite at an appropriate waste management facility in accordance with the requirements of the GED and contaminated land (and other duties) under the EP Act 2017.

Reuse of excavated soil (topsoil, trench spoil, and excavated material not able to be reused on site) to backfill the proposed pipeline trench or excavations related to the treatment facility would need to be managed in accordance with EP Regulations, the ERS, EPA Victoria Publication 1669.4: *Interim position statement on PFAS* and would need to consider the GED. Surface water runoff from the stockpiles should be managed in accordance with the mitigation measures described in the Technical Report E*: Surface water impact assessment*.

If soils are to be disposed offsite or uncontrolled use at a different location is proposed, a lawful place would need to be established in accordance with the *Environment Protection Act 2017 (Vic)*, EPA Victoria Publication 1828.2: *Waste disposal categories – characteristics and thresholds*, and a designation application would need to be submitted to EPA Victoria for approval prior to disposal of any PFAS-impacted soils.

Any material imported onto the project area for use as backfill would be required to comply with the EPA Victoria Publication 1828.2: *Waste disposal categories – characteristics and thresholds*, for Fill Material (Table 3), meet the requirements of the Fill Material Determination (Gazette No. S 301, 18 June 2021) and should be accompanied by relevant documentation confirming its compliance to the Fill Material criteria.

The combined desktop and field investigation results indicate that contaminated soils are expected to be encountered during construction of the project within the boundaries of the Geelong Refinery (Zone 1) but unlikely along the proposed underground pipeline alignment (Zone 2). Based on the data collected, and the controlled nature of the refinery in respect of public access, the disturbance of contaminated soils during the project would have low impacts on human health and the environment subject to the recommended industry standard management measures being implemented.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO01) be included in the project CEMP.

6.2 Contaminated Groundwater

Due to current and historical land uses within the study area, contaminated groundwater may be present beneath the construction area of the onshore works, especially in Zone 1 (Geelong Refinery area) due to the large scale oil refining operations. Inappropriate management and disposal of contaminated/acidic/brackish groundwater has the potential to impact soil and/or surface water resulting in changes to soil and surface water chemistry which could preclude protected environmental values.

The two-metre deep trenched sections of the underground pipeline are not expected to intersect groundwater, with groundwater levels typically at least three metres deep in monitoring wells closest to proposed trenching activities. The groundwater is contaminated with hydrocarbons in Zone 1 and with PFAS at the northern end of the proposed underground pipeline alignment, where the groundwater is noted to be the shallowest at 2.65m bgl (GW05), in the low-lying area close to the unnamed water course. The concentration of PFAS compound perfluorooctane sulfonate (PFOS) in GW05 indicates there is potential for impacts to sensitive aquatic ecosystems if groundwater is not properly managed and if contact with the contaminated groundwater occurs over an extended time frame. Due to the shallow groundwater depth, trenching in the area around GW05 has the greatest potential to intersect groundwater although it is still not anticipated. Should trenching be used to cross this unnamed watercourse, groundwater intersection (if any) would be along a limited portion of the trench and the duration of any dewatering would typically occur immediately prior to laying of the pipe (i.e., on the same day). Further, the clay and sandy clay encountered at GW05 would have a low hydraulic conductivity in the order of less than one metre per day (Fetter, 1994) so volumes of groundwater would be expected to be low.

Where HDD is used to install sections of pipework (to depths of up to 25 metres) in the northern portion of the study area (Zone 2) it is possible that groundwater could be intersected however groundwater extraction/dewatering is not required for this construction method. At the Shell Parade (Zone 1) and School Road (Zone 2) crossings should excavation (e.g,, for thrust bore bell holes) deeper than 3 and 5 metres respectively be required groundwater could be intersected.

While the need for dewatering to facilitate pipeline installation is not anticipated, if groundwater dewatering is required (e.g., perched water inflow), trench dewatering should only be undertaken prior to lowering the pipes, and the dewatered water should be analysed to confirm contaminant status and only be discharged to land in accordance with requirements under the EP Act 2017, subordinate legislation and guidelines and with consideration to the GED. Discharge to land would be subject to approval from the relevant regulators. Reuse of PFAS-contaminated groundwater may require specific approval as prescribed in the PFAS NEMP (2020). Any dewatered water disposed in this way would

not be expected to enter the surface water system, rather, the water would seep through the ground and re-enter the groundwater system. Any potentially contaminated groundwater, (including PFAS-impacted trench water), should be disposed of appropriately in accordance with requirements under the EP Act 2017, subordinate legislation and guidelines. The dewatered water should be contained in appropriate holding containers and disposed to an appropriately licensed facility. Where HDD or trenchless construction is used to install the pipeline, the intersected groundwater should be managed as part of the drilling mud handling, as defined in Section 6.7.

In Zone 1, several COPC's have not historically been assessed, including PFAS. If groundwater is intersected within Zone 1, all analytes described in Section 5.7.5 including PFAS shall be included for assessment. If contaminated groundwater is encountered in Zone 1, existing refinery human health and environmental management protocols are considered appropriate and adequate to manage potential impacts. These protocols include:

- Collection and disposal through existing trade waste systems, agreements and licences;
- Where identified contaminants are not listed in the trade waste licence, (e.g. PFAS contaminated water) the abstracted water should be treated and/or disposed of appropriately, in accordance with EPA guidelines. The dewatered water should be contained in appropriate holding containers until treated or disposed of at an appropriately licensed facility.

Based on the proposed construction requirements and the low probability of encountering groundwater, the potential impact to human health via direct and secondary contact, and/or the environment, due to inappropriate handling, storage and disposal of contaminated groundwater during construction of the pipeline is generally considered to be minor. The absence of groundwater within the expected trench excavation depth and the dewatering procedures outlined above are considered sufficient to restrict the movement of contaminated groundwater into surface water in the vicinity of the project area. As such, the pathway between the source (discreet plumes of groundwater contamination) and receptors, including human health and the environment would not be realised.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO02) be included in the project CEMP.

6.3 Contaminant Migration

When an excavation intersects groundwater and dewatering is required, a temporary and localised, 'cone of depression' (i.e., area of reduced groundwater levels) would be created away from the edge of the excavation. This has the potential to affect groundwater levels and groundwater flow to nearby receptors such as consumptive use bores and potential GDEs.

As discussed in Technical Report F: *Groundwater impact assessment.*, trenching for the proposed underground pipeline is not expected to intersect groundwater based on groundwater level data from the existing refinery monitoring well network and newly installed monitoring wells GW01 to GW05. The need for dewatering to facilitate pipeline installation is therefore not anticipated.

Any unexpected intersection of groundwater would be along limited portions of the trench, result in limited depths of intersection, and would not require significant dewatering. The duration of any such dewatering would also be very limited - typically occurring immediately prior to laying of the pipe (i.e., same day), providing only a short period of time over which groundwater drawdown would extend away from the trench (known as the cone of depression).

Overall, potential effects on groundwater levels from the unlikely occurrence of trench dewatering activities would be limited in magnitude, extent and duration immediately adjacent to the trench; with potential impacts to groundwater uses and users being negligible.

On the basis of the above discussion, the potential impacts on environmental values from increased contamination migration as a result of the trench dewatering, is generally considered to be minor.

It is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO03) be included in the project CEMP.

6.4 Unexpected finds

Encountering unknown contamination (including asbestos) during any construction project is possible. Unknown contamination may be identified by visual or olfactory observations (such as staining or odours), the presence of asbestos and/or other anthropogenic material. However, based on the site history and field investigation results, it is considered unlikely that the project construction would encounter unknown contamination that will result in long-term and irreversible impacts to human health and the environment. Based on the historical land use and the results of the field investigation, contamination is conservatively assumed to be present throughout Zone 1 and therefore all exposed soils and encountered groundwater in that area will be managed on that basis using existing site management protocols.

In the event that unknown contamination is uncovered during project construction in Zone 2, the following measures would need to be undertaken:

- Cessation of ground disturbance at the unknown contamination location and within the immediate vicinity.
- Assessment of the site contamination and determination of appropriate remedial action (if required).
- Undertaking appropriate remedial action.

On this basis, potential impacts to human health and the environment from unknown contaminants are generally considered to be minor as pathways to receptors, including surface water bodies can be readily managed.

It is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO04) be included in the project CEMP.

6.5 Acid Sulfate Soils

Presence of acid sulfate soils in sufficient amounts can have a lasting effect on soil characteristics, causing deoxygenation or release of contaminants when iron sulfide minerals are exposed to oxygen (Fitzpatrick, R. and Shand, P., 2008). Acid sulfate soils may become a potential constraint to construction activities, requiring implementation of controls to manage the spoil during excavation, trenching and drilling activities. Based on the preliminary data, PASS has been noted in shallow clayey sands at a single location, in Zone 1. The PASS was only encountered in the surface sample and not within underlying clays and there were no other indicators of acid sulfate soils or PASS at any other sampled location. While the presence of acid sulfate soils is limited, the data is not sufficient to completely rule-out the presence of acid sulfate soils at other locations within Zone 1 (excluding the treatment facility area). Note that no indicators or detection of acid sulfate soils was identified in Zone 2.

The proposed construction methodology within Zone 1 would need to be cognisant of acid sulfate soils requirements to minimise the potential for oxidation of PASS and generation of acidic leachate. A management strategy would need to be developed and implemented within the CEMP to manage potential ASS risks for a ‘Medium’ ASS hazard in Zone 1 (excluding the treatment facility area) in accordance with Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999, EPA Victoria Publication IWRG655.1: Acid Sulfate Soil and Rock, Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010), National Acid Sulfate Soils Guidance (series of documents) 2018.

The EPA Victoria Publication IWRG655.1: *Acid Sulfate Soil and Rock* recommends the following acid sulfate soils management strategies described in the CASS BPMG (2010), numbered in order of priority:

- Avoid disturbance of CASS at all sites.
- Minimise disturbance.
- Prevent oxidation.
- Treat to reduce or neutralise acidity.

- Offsite reuse or disposal.

The requirement for management of acid sulfate soils for the project, including management of surface water and groundwater, would need to be detailed in the CEMP. The CEMP would be developed with consideration of the following legislation and guidelines:

- *Environment Protection Act 2017 (Vic)*
- Environment Protection Regulations 2021
- Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999
- EPA Victoria Publication IWRG655.1: Acid Sulfate Soil and Rock (July 2009)
- Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soil (CASS BPMG, 2010).
- National Acid Sulfate Soil Sampling and Identification methods manual, 2018
- National acid Sulfate soil identification and laboratory methods manual, 2018
- Australian Standards 4969.

As described above, localised presence of PASS exceeding the action criteria was reported at shallow depth with lithology classified as clayey sands in Zone 1 at one location and as such to facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO05) be included in a management strategy which should be incorporated into the CEMP.

6.6 PASS Activation from Dewatering Activities

Generation of acid leachate through oxidation of previously submerged soils (dewatering from trenches) leads to generation of acidic waters that can affect human health via direct and secondary contact, surface water and/or groundwater quality. The management of PASS during any dewatering will be incorporated into the CEMP (as specified in Section 6.5). It is recommended that any dewatering (if any) be minimised to reduce the potential for oxidation of ASS and generation of low pH leachate / groundwater. While it is not expected that dewatering will be required as part of this project based on the groundwater impact assessment report, if required it should be undertaken in accordance with the National ASS Dewatering Guideline

In the event that dewatering is required in Zone 1, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO05) be included in a management strategy which should be incorporated into the CEMP.

6.7 Drilling mud disposal

The proposed underground pipeline from the treatment facility on the refinery site to the connection point with the VTS located approximately 4km to the north may be installed by either trenching or horizontal directional drilling (HDD)/thrust boring. Drilling mud, consisting predominantly of natural bentonite clay, is used to act as a coolant, to wash in-situ material (cuttings) from the drilled hole and to seal and line the hole to facilitate insertion of the pipe. Cuttings would be screened, removed at the HDD rig and the drilling mud recycled. Screened cuttings are diverted to skip bins prior to disposal off-site.

The drilling mud should be managed using industry best practice per the Australian Pipelines and Gas Association (APGA) Code of Environmental Practice – Onshore Pipelines. Disposal of drill cuttings and drilling mud should be undertaken in accordance with the EP Regulations 2021 and Schedule 5 of the Regulations to classify drilling mud for appropriate disposal. Depending on the depth of drilling, HDD may encounter groundwater and mixing may occur. Therefore, all drilling muds should be tested to confirm the suitability for disposal, given the presence of PFAS, particularly at the northern extent of Zone 2 (GW05).

On the basis that industry standard practices are adopted for the management of drilling mud disposal, the likelihood of any impacts to human health and/or the environment would be minor.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO06) be included in the project CEMP.

6.8 Hydrotest water

Prior to commissioning, the pipeline would be subjected to a strength and leak test in accordance with AS2885.5: *Pipelines – Gas and liquid petroleum field pressure testing*. This testing is referred as hydrostatic pressure testing (also known as hydrotest).

The hydrotest involves filling a section of the pipeline with water and monitoring its pressure to detect for leaks. The testing procedure would be developed by the hydrotest contractor based on the pipeline design.

Approximately 2 megalitres (ML) of water in total would be required for the pipeline hydrotest(s). The project intends to use potable water directly from the refinery freshwater supply. Oxygen scavenger and biocide may be added to the hydrotest water as required to minimise the risk of corrosion and bacterial growth.

After completion of the testing, if test water is not able to be reused or recycled within the refinery, the used water should be disposed of by an appropriately licensed waste contractor in accordance with EPA requirements. As per AS2885.5: *Pipelines – Gas and liquid petroleum field pressure testing* (Section 4.4) the approved test plan should include the procedures and precautions for the disposal of the test water.

On the basis that industry standard measures would be used for management of the hydrotest water, the likelihood of inappropriate handling, storage and disposal of the water is considered unlikely and the impacts to human health and/or the environment would be minor, as the pathways to receptors, including surface water bodies can be readily managed.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO07) be included in the project CEMP.

6.9 Fuel and Chemical Leaks and Spills

During project construction, bulk fuel/chemicals would be stored, and vehicles, plant and machinery would be operating throughout the project area.

There is a possibility that leaks, or spills may occur during construction from machinery/plant, fuel and chemical storage with the potential to impact human health and the environment. However, potential impacts would be minor with the application of industry standard mitigation measures. Furthermore, a potential spill would likely be localised and contained at the active work site rather than being widespread.

Bulk fuel (if required) should be stored in self-bunded tanks in accordance with relevant Australian standards (AS1940-2017 and AS1692-2006); and refuelling of mobile equipment should occur in designated areas at least 20 metres away from any watercourses. Hazardous materials should be stored in ventilated, self-bunded and secured containers in accordance with the *Occupational Health and Safety Act 2004 (Vic)* ('OHS Act') and *Occupational Health and Safety Regulations 2007* (OHS Regulations); and dangerous goods should be stored in accordance with the *Dangerous Goods (Storage and Handling) Regulations 2012* and the code of practice for the storage and handling of dangerous goods. A dangerous goods and hazardous materials register and current safety data sheets (SDSs) should be maintained. Spill kits and firefighting equipment should be kept with the chemicals required by legislation.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO08) be included in the project CEMP.

6.10 Waste Streams

The project would generate a range of wastes during construction. Wastes other than soil, hydrotest water and/or drilling muds that would be generated during construction include:

- wastes from transportation and storage of construction materials (i.e., packaging)
- wastes from clearing the pipeline alignment
- pipeline coating or lubricant containers
- welding/grinding waste (e.g., spent welding rods)
- machinery waste
- other solid inert, liquid, organic, packaging and food scraps.

If these wastes are not appropriately managed, they could be released to the environment resulting in impacts to human health, aesthetics and/or the environment. The project would be required to manage construction waste in accordance with the EP Act (2017) and the APGA Code of Environmental Practice – Onshore Pipelines. All waste generated during construction should be minimised through recycling with wastes that cannot be recycled disposed to a licensed waste management facility.

Inappropriate management and disposal of these waste streams could result in minor impacts to human health, the environment and/or aesthetics. Potential impacts should be mitigated by suitable storage, reusing and recycling (where practicable) and disposal at appropriately licensed facilities in accordance with the applicable regulations and guidelines.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO09) be included in the project CEMP.

7.0 Operation Impacts

This section provides an overview of the potential impacts from contaminated land and groundwater, and acid sulfate soils associated with operation of the project. Mitigation measures have been recommended to manage potential impacts where appropriate.

The pipeline would be operated in accordance with the Australian Standard for Pipelines – Gas and Liquid Petroleum (AS2885), approved Operational Environmental Management Plan(s) (OEMPs). The treatment facility would be operated in accordance with the approved facility OEMP.

Planned maintenance activities for the project include:

- Equipment maintenance at the pipeline and treatment facilities.
- Pipeline corridor inspections to address issues such as land stability (e.g., subsidence, erosion), revegetation, weed invasion, cover at watercourse crossings and third-party (such as asset owners) and landowner activities.
- Pipeline pigging
- Regular rounds of inspection at key inspection points within the treatment facility. The frequency of maintenance would be as per manufacturer or vendor specifications for the treatment facility equipment.

The on-going operation of the project has the potential to cause leaks or spillages from machinery / plant, fuel and chemicals storage and usage and mismanagement of waste streams (solid inert, liquid, organic, packaging etc.). Such spills have the potential to affect human health, aesthetics and/or the environment. The potential impacts are discussed in the following subsections.

7.1 Leaks and Spills

The treatment facility would include the bulk storage and distribution of hazardous materials such as liquid nitrogen and odorant. Up to 1200m^3 liquid nitrogen would be stored in vacuum insulated vessels. Liquid nitrogen would be stored below -150 ºC and odorant would be stored and distributed as gas. Any potential release of these materials would not be expected to contaminate soil or groundwater.

Other miscellaneous hazardous materials and chemicals relating to the project (i.e., for routine maintenance) may be stored within the Geelong Refinery site. These materials should be managed in accordance with the relevant SDSs and Australian Standards and should be stored on site in appropriately sized bunded dangerous goods containers. A dangerous goods and hazardous materials register and current SDSs should be maintained. Spill kits and firefighting equipment should be kept with the chemicals as required by legislation. Plant and machinery should also be maintained in accordance with manufacturer specification. As such the potential for impacts to soil, groundwater and surface water associated with loss of sources including fuel, oils or other maintenance related chemicals would be minor with the application of industry standard procedures and the implementation of project's OEMPs, and therefore the pathway from sources to receptors is unlikely to be completed.

To minimise risk of leaks and spills and facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO08) be included in the OEMP.

7.2 Waste Streams

The project is not likely to generate a large amount of waste as a result of operation or maintenance. Wastes that could be generated include:

- Oils and grease from pipeline maintenance activities.
- Dust and millscale (steel flakes) from infrequent maintenance or pigging activities (e.g., every five years).
- Mixed solid waste such as food scraps, paper, glass, packaging and recyclables.

If these wastes are not appropriately managed, they could be released to the environment resulting in impacts to human health, aesthetics and the environment.

The project should manage waste in accordance with the EP Regulations (2021) and the APGA Code of Environmental Practice – Onshore Pipelines. Waste generation should be minimised through recycling with all waste that cannot be recycled disposed to a licensed waste management facility. On this basis, the potential for impacts to human health, land and surface or groundwater and aesthetics associated with loss from operational waste streams would be minor and any loss of products can be easily managed and maintained in a small lateral extent. As such, the pathway from sources to receptors is unlikely to be completed.

To facilitate compliance with applicable regulatory requirements and guidelines, it is recommended that the mitigation measures described in Section 9.0 (refer to MM-CO09) be included in the OEMP.

8.0 Decommissioning Impacts

It has been assumed that decommissioning of the pipeline(s) would require regulatory approval at that time. Currently AS2285 refers to APGA's Code of Environmental Practice - Onshore Pipelines which includes the need for a decommissioning strategy to be developed and approved. The activities that would likely take place at decommissioning comprise the following:

- Disconnecting pipeline
- Pipeline depressurisation
- Capping and injection of corrosion-inhibiting water
- Removal of above ground facilities and rehabilitating of the areas
- Removal of signage
- Obtaining landowner releases and relinquishing easements.

Wastes generated during the decommissioning primarily would be associated with the removal of the aboveground infrastructure such as concrete, metals and wastewater. The potential impacts to human health, the environment and aesthetics from inappropriate management and disposal of these wastes would require management and disposal would need to be undertaken in accordance with legislative requirements that will be applicable at that time.

Due to uncertainty on the legislation requirements that would be applicable during the decommissioning phase, management measures are not included in this report but will be addressed at the time of decommissioning.

9.0 Recommended mitigation measures

Mitigation measures recommended to avoid, minimise and mitigate potential adverse effects on human health and the environment from the disturbance of contaminated soil, contaminated groundwater and/or acid sulfate soils are listed in Table 9-1.

Table 9-1 Recommended mitigation measures

Mitigation measure ID	Recommended mitigation measures	Stage
MM-CO01	**Contaminated soils** 1. Manage contaminated soil (as identified within Zone 1 – the refinery) in accordance with: a. EP Act 2017 b. EP Regulations 2021 c. ERS 2021 and in consideration of EPA Publication 1834 d. PFAS National Environmental Management Plan 2.0 (2020), or subsequent publication e. EPA Victoria Publication: 1669.4: Interim Position Statement on PFAS, or subsequent publication 2. Stockpiles of trench spoil should be managed in accordance with *APGA Code of Environmental Practice – Onshore Pipelines.* 3. Sample and classify excess soils and HDD screened cuttings for off-site disposal in accordance with: a. EPA Victoria Publication IWRG702: Soil Sampling, or subsequent publication b. EPA Victoria Publication 1828.2: Waste Disposal Categories - Characteristics and Thresholds, or subsequent publication 4. Manage and transport contaminated spoil for off-site treatment/disposal in accordance with: a. EP Act 2017 and EP Regulations 2021. 5. Any material imported for use as backfill should comply with the EPA Victoria Publication *1828.2 Waste Disposal Categories - Characteristics and Thresholds* for 'Fill Material' and meet the requirements of the Fill Material Determination (Gazette No. S 301, 18 June 2021). The backfill should be accompanied by relevant documentation confirming its compliance to the 'Fill Material' criteria.	Construction
MM-CO02	**Contaminated groundwater** 1. Manage contaminated groundwater in accordance with: a. EP Act 2017 b. EP Regulations 2021 c. ERS 2021 d. PFAS National Environmental Management Plan 2.0 (2020) , or subsequent publication 2. Minimise disturbance of saturated soil and groundwater within the PFAS affected areas (refinery and in vicinity of GW05) and prevent migration of PFAS into the surrounding soil or surface water. Disturbance may be minimised by design of the infrastructure not to extend into the water table or to be bypassed by using HDD techniques. 3. Water from areas that have been identified as contaminated should not be discharged to the environment (land, waterways, sewer).	Construction

Mitigation measure ID	Recommended mitigation measures	Stage
	4. Where a wet-trench installation approach is not undertaken contaminated water should be sampled and either treated onsite, depending on contaminant encountered (this may require approval from the EPA Victoria) or disposed offsite to an EPA Victoria licensed facility.	
MM-CO03	**Contaminant migration** Trench dewatering of groundwater or perched water should be avoided. In the unlikely event that dewatering of groundwater or perched water inflow is unavoidable, the trench should be dewatered prior to lowering the pipes	Construction
MM-CO04	**Unexpected finds** Incorporate management strategies within the CEMP to manage potential unexpected finds. 1. In the event that unknown contamination (including asbestos containing material) is encountered during construction: a. Cease ground disturbance at the unknown contamination location and within the immediate vicinity. b. Assess site contamination in accordance with the National Environment Protection (Assessment of Site Contamination) Measure (2013) and identify appropriate remedial action. The remedial action must manage contamination to prevent impact to human health and the environment in accordance with the Duty to Manage. c. Undertake required remediation. d. Such material may be identified by visual or olfactory observations, the presence of asbestos and/or other anthropogenic material.	Construction
MM-CO05	**Acid sulfate soils** 1. Incorporate management strategies within the CEMP to manage potential ASS risks for a 'Medium' ASS hazard (CASS BPMG, 2010) in accordance with: a. *Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999*, or subsequent publication b. EPA Victoria Publication IWRG655.1: *Acid Sulfate Soil and Rock*, or subsequent publication c. Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010), or subsequent publication d. National Acid Sulfate Soils Guidance (series of documents) 2018, or subsequent publication 2. The CEMP must be approved by the Pipeline regulator in consultation with EPA Victoria. 3. Construction works should not occur during wet months unless conditions are such that land degradation and surface water management problems can be avoided, or appropriate mitigation measures implemented. 4. Provide training to relevant site-based personnel on the requirements of the ASS management procedure including the recommended time period over which soils may be temporarily stockpiled before treatment commences as recommended by the CASS BPMG (2010).	Construction

Mitigation measure ID	Recommended mitigation measures	Stage
	5. Minimise the duration of stockpiling in accordance with the CASS BPMG (2010). 6. Include a procedure for managing unexpected discovery of ASS/PASS in the CEMP. 7. If ASSs are to be stockpiled for an extended time period (exceeding the CASS BPMG (2010) recommended short-term stockpiling durations), the potential generation of acidic leachate should be managed by treating the stockpile and or spreading a guard layer before stockpiling and/or covering the stockpile. The CEMP should include details for when or if the requirements for containment with bund and a leachate collection system is necessary. 8. Capture and manage run-off that has the potential to be impacted by stockpile material in accordance with the CASS BPMG (2010). 9. Develop and implement a monitoring program as part of the CEMP in accordance with the CASS BPMG (2010) to measure the effectiveness of the management strategy and to provide an early warning of any environmental degradation or impact to surface water, groundwater and soils. 10. Include management procedure for trench dewatering that will limit PASS activation in accordance with the Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (CASS BPMG, 2010) and the National ASS Guidance 'Guidance for the dewatering of aid sulfate soils in shallow groundwater environments', in the project CEMP	
MM-CO06	**Drilling mud disposal** Dispose drilling muds in accordance with: 1. The EP Act 2017 and t EP Regulations 2021. Schedule 5 of the Regulations will be used to classify drilling mud for appropriate disposal. 2. APGA Code of Environmental Practice – Onshore Pipelines. Requirements for disposal of drilling mud should be confirmed at the time of construction.	Construction
MM-CO07	**Hydrotest water** 1. Manage hydrostatic test water in accordance with ERS 2021 (Water) and APGA Code of Environmental Practice – Onshore Pipelines. 2. Reuse water where practicable to conserve water and minimise the volume of water to be disposed of. 3. If water is unable to be reused or recycled dispose of in accordance with EP Regulations 2021.	Construction
MM-CO08	**Fuel and chemical leaks and spills** 1. Store bulk fuel (if required) in self-bunded tanks in accordance with relevant Australian standards (AS1940-2017 and AS1692-2006). 2. Refuelling or maintenance of equipment, machinery and vehicles should be conducted at least 20 metres or as far away	Construction and operation

Mitigation measure ID	Recommended mitigation measures	Stage
	as is reasonably practical from any waterway with appropriate measures to contain spills. For sensitive sites (i.e. wetlands), refuelling or maintenance of equipment should be conducted no closer than 50 metres. 3. Store hazardous materials in ventilated, self-bunded and secured containers in accordance with the *Occupational Health and Safety Act 2004 (Vic)* ('OHS Act') and *Occupational Health and Safety Regulations 2007* (OHS Regulations). 4. Store dangerous goods in accordance with the *Dangerous Goods (Storage and Handling) Regulations 2012* and the code of practice for the storage and handling of dangerous goods. 5. Undertake routine and scheduled maintenance of vehicles and plant/machinery/equipment to minimise the potential for leaks/spills to occur. 6. Supply spill kits and firefighting equipment with the chemicals required by legislation. 7. Maintain dangerous goods and hazardous materials register and current SDSs. If a chemical leak or spill has occurred, the duty to respond to harm as per, Section 31 of the EP Act 2017, may be required.	
MM-CO09	**Waste management** 1. Manage waste in accordance with Environment Protection Regulations 2021 and the APGA Code of Environmental Practice – Onshore Pipelines, including establishment of appropriate and secured waste storage locations on-site, as required. 2. Develop and implement waste management procedures. 3. Reuse or recycle waste materials where practicable. 4. Collect and transport wastes by licensed contractors for disposal at appropriately licensed facilities. 5. Provide waste containers for different types of waste generated onsite. 6. Refuse containers should be lidded to mitigate fauna access.	Construction and operation

9.1 Summary of residual impacts

Residual impacts are those that remain once mitigation and management measures have been implemented. This section describes potential residual impacts during the construction and operation phase of the project once mitigation and management measures have been considered and applied.

The recommended mitigation measures are standard practice and are consistent with the current regulatory requirements. These mitigation measures would be applied through the CEMP or OEMP or other statutory approval conditions. Following application of the proposed mitigation measures it is considered that there will not be residual impacts likely to result in a risk of harm to human health or the environment. No additional mitigation measures are required in addition to the standard mitigation measures that have been recommended.

9.2 Performance monitoring

Recommended mitigation measures outlined above in Table 9-1 should be incorporated into the CEMP and OEMP. The CEMP and OEMP should include best practice measures to monitor, manage and avoid surface water impacts in line with relevant Victorian legislation and policies. Indicators and objectives, as outlined in the Environment Reference Standard (2021), adopted as part of this assessment are detailed in Section 3.2.1 and 3.2.2 of the Field Investigation Report (Appendix A).

The project CEMP should be developed to determine how the requirements of the GED and contaminated land (and other duties) under the EP Act 2017 will be met. and in accordance with the Civil construction, building and demolition guide (EPA Publication 1834) and EPA Victoria (1991) Construction Techniques for Sediment Pollution Control (EPA Publication 275. Methods to implement the CEMP can be also informed by the International Erosion Control Association (IECA) Best Practice Erosion and Sediment Control Appendix P (2008).

Compliance with the CEMP and OEMP and the relevant mitigation measures should be monitored. The monitoring requirements should be clearly specified in the CEMP and OEMP. Monitoring may include periodic inspections and audits of work areas during construction and the operation of project component once constructed to verify and confirm the effectiveness of mitigation measures implemented.

10.0 Conclusion

The purpose of this report is to provide a contamination and acid sulfate soils impact assessment to inform the preparation of the EES required for the project. A summary of the key findings is provided below.

10.1 Existing Conditions

The construction and operation of the project has the potential to preclude protected environmental values of land and groundwater as prescribed in the EPA Victoria ERS.

The field investigation found that, soil contamination is present within Zone 1 at depths of 1.5m and greater on the Geelong Refinery site, associated with the impacted groundwater plumes known to exist beneath the refinery. To the north of the refinery in Zone 2, along the proposed underground pipeline alignment, it was concluded that the presence of contamination is limited.

In Zone 2 to the north of the Refinery, the sampled soil within the proposed underground pipeline alignment is generally not contaminated. This is consistent with historic land use and the low potential for contamination identified during the desktop assessment. Based on the sample results, the soils within Zone 1 and Zone 2 are generally suitable for reuse on site (e.g., for backfilling of soil in the same location it was removed from), however, if off-site disposal is required or if reuse in a different location is required then further sampling and analysis and discussions with EPA would be required to determine the acceptability for off-site disposal or reuse at a different location.

It is noted that as sampling density does not meet EPA Victoria Publication IWRG702: *Soil Sampling requirements* and is based on the potential for contamination over the study area, there is the potential that localised impacts could be present at other locations and could be encountered during project construction works. However, if contamination soil is encountered in Zone 1, existing refinery human health and environmental management protocols would be adequate to manage potential impacts.

The field investigation concluded that groundwater contamination is also limited largely to Zone 1. Contamination in groundwater beneath the refinery consisted of Light Non Aqueous Phase Liquid (LNAPL) i.e., petroleum product floating on top of groundwater, TRH and benzene. In the event of the project requiring excavations beyond 3m depth in Zone 1 and below 5m depth in Zone 2, groundwater may be intersected and would require appropriate management and disposal based on the expected groundwater conditions in the relevant area.

In Zone 2, groundwater is generally not contaminated although phosphorous and nitrate were detected, potentially representing regional fertiliser use. Phosphorous exceeded long term irrigation investigation levels only and not short term use investigation levels. The concentration of nitrate is not likely to preclude use or irrigation of encountered groundwater, however, if groundwater is intersected it should not be discharged to waterways. PFAS was encountered in groundwater from one well (GW05) at concentrations orders of magnitude above Water Dependent Ecosystems investigation levels and would require offsite treatment should it be abstracted during pipeline construction. Given that the location of the PFAS contamination is over 3km to the north of the refinery, it is not considered that the impact is related to the Viva Energy operation and the source is unknown. If groundwater is intersected within Zone 1, consideration to all analytes described in Section 5.7.5 including PFAS should be considered for analysis. If contamination groundwater is encountered in Zone 1, existing refinery human health and environmental management protocols would be adequate to manage potential impacts. While likely areas of concern were assessed as part of this investigation, additional localised soil and/or groundwater contamination could be encountered during construction of the project.

Acid sulfate soil data was collected from a combination of broadly spaced and targeted intrusive investigations. Localised presence of PASS was reported in one near surface sample at a central area of the aboveground pipe track area (SB07_0.2) in Zone 1. However there have been no indicators or detection of PASS or acid sulfate soils in the treatment facility or in Zone 2. The proposed construction methodology within Zone 1 would need to be cognisant of acid sulfate soils requirements to minimise any potential effects to the environment and human health. To manage the potential for acid sulfate soils it is recommended that management strategies are incorporated into the CEMP as per MM-CO06 for Zone 1 (excluding the treatment facility area).

10.2 Impact Assessment

Overall, construction, operation and decommissioning of the project is considered to present limited potential to adversely impact soil, groundwater and receiving surface water due to the limited extent of existing contamination outside of the Geelong Refinery site, which has existing contaminant management procedures. Potential environmental impacts associated with potential acid sulfate soils, are limited to Zone 1 and exclude the treatment facility area. The proposed construction methodologies would confine potential impacts within the project area and thus have very limited effect upon the surrounding area.

The potential impacts on human health via direct and secondary contact with soils, groundwater and surface water were assessed as minor, and can be mitigated with the recommended mitigation measures as outlined in Section 9.0.

It was concluded that the project could meet the EES evaluation objective with respect to potential impacts on the environment or health from contamination, acid sulfate soils, waste materials generated by the project works, and spills or other incidents during project construction and operation, with application of industry standard mitigation measures that are commonly applied and have proven effective in major construction projects.

The identified mitigation measures should be incorporated into the CEMP during construction and the OEMP once the project is operational. The CEMP and OEMP should be developed in accordance with industry standards, regulatory guidelines and conditions imposed by regulatory authorities.

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