Prepared for
Star of the South Wind Farm Pty Ltd as trustee for Star of the South Trust
ABN: 68239717297

AECOM

Technical Report H: Groundwater

Star of the South Offshore Wind Farm

20-Mar-2026

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ABN: 68239717297

Prepared by

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Executive Summary

Overview

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

A delegate of the Commonwealth Minister for the Environment decided that the project is a controlled action (as set out in notice dated 2 June 2020) and is required to be assessed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) through preparation of an Environmental Impact Statement (EIS) and the Victorian Minister for Planning determined that an Environment Effects Statement (EES) is required (as set out in notice dated 11 May 2020) under the *Environment Effects Act 1978* (EE Act).

The scope of work for this report is derived from the Ministerial scoping requirements (Environment Effects Act 1978) – the following evaluation objective is relevant to the groundwater assessment:

- To minimise adverse effects on water (including groundwater, waterway, wetland, estuarine, intertidal and marine) quality and movement.

Groundwater (that is, water found underground in spaces between soil and rock) is an important resource in the region and all reasonably practicable steps must be taken to minimise potential impacts to groundwater from the project.

Existing environment

The groundwater study area encompasses the project onshore footprint as well as a 200-metre wide buffer area and 10 metre depth (35 metre depth at shore crossing). This study area is considered sufficient to include the zone where groundwater levels, flows, or quality could be impacted by the project.

The existing groundwater environment was described using publicly available datasets and literature along with results of site-specific geotechnical and acid sulfate soil field investigations.

The water table relevant to the project is within the Quaternary Aquifer (QA) and includes various Quaternary aged coastal dune, swamp and lake, alluvial, and aeolian dune deposits. The permeability of the QA varies from high in some of the clean sand deposits to low in the clay dominant sediments. The variability reflects the varying depositional environments.

The water table is mapped as shallow (less than two metres below ground surface) near the coast and in the vicinity of present-day streams. Geotechnical and acid sulfate soil investigations and two groundwater monitoring wells (GA20-BH01 and P003) installed near the coast confirm that groundwater is shallow in these locations (0.3 – 2.1 metres below ground surface). Geotechnical and acid sulfate soil investigations further inland suggest that groundwater is usually at depths greater than three metres below ground surface. In groundwater observation well P003 the shallowest water table was observed in November and July, whereas in groundwater observation well P008 the shallowest water table was observed in November. Combined with the water table depth from the State Observation Wells, the water table is observed to fluctuate seasonably.

The salinity of the groundwater in the QA based on reported total dissolved solids concentration in the study area varies from Segment B (1,201-3,100 mg/L) to Segment C (3,101-5,400 mg/L). Segment B has been conservatively adopted for the study area and therefore there are several environmental values that need to be maintained. These include water dependent ecosystems and species, potable mineral water supply, agriculture and irrigation, industrial and commercial water use, water-based recreation, Traditional Owner cultural values, buildings and structures and geothermal properties. Potable mineral water supply and geothermal properties are not considered relevant as the water table groundwater has not been reported to naturally effervesce or have temperatures above 30^{o}C.

There are seven registered groundwater wells in the study area based on a WMIS search conducted in March 2025, including domestic and/or stock water supply (four wells) and unknown uses (three wells). None of the registered wells are located in the project easement or construction corridor. It is possible that wells with incorrect coordinates and/or unregistered wells may exist within the study area.

There are four watercourses listed as potential GDEs may receive groundwater discharge and could therefore be classed as 'gaining' streams. There are no Ramsar sites, nationally important wetlands, or springs mapped in the study area. There are eight vegetation classes in the study area that are classified as potential terrestrial GDEs. A regional baseline survey of stygofauna in the Gippsland Basin suggests that the abundance of stygofauna taxa is low, possibly due to the fine-grained nature of the water table aquifer at the locations assessed in the regional baseline survey.

A preliminary acid sulfate soil (ASS) hazard assessment has been undertaken and is reported in *Technical report J: Soil and waste*. The assessment concluded that potential acid sulfate soils (PASS) exist within the study area.

Assessment findings

An assessment was undertaken to evaluate potential impacts associated with the project, considering the existing environment within the study area and associated construction, operational and decommissioning activities.

The assessment found the following key impacts and risks:

- Dewatering reduces groundwater levels at water supply wells.
- Dewatering near the coast causes saline intrusion that affects groundwater quality.
- Poor quality overland flow recharges groundwater via excavations.
- Existing wells are damaged or destroyed during onshore construction activities.
- Excavation and dewatering of acid sulfate soils affects groundwater quality.
- Subsurface infrastructure impedes groundwater flow.
- Onshore trench backfill creates preferential groundwater flow paths.

Five potential impacts and risks were identified for the construction phase of the project. With the implementation of mitigation measures, residual impacts during construction are assessed as being negligible to minor and residual risks are assessed as being very low to low.

Two potential impacts were identified for the operation phase of the project. Based on hydrogeological conditions and project design, both operational phase residual impacts are assessed as being negligible.

No additional impacts were identified for the decommissioning phase of the project.

Mitigation measures

Potential impacts and risks to groundwater due to the project would be avoided, minimised or managed to required standards through the recommended mitigation measures provided in Table 1.

This assessment has identified risks and proportional mitigation measures to address the general environmental duty as required under the *Environment Protection Act 2017*. An assessment of the practicability of control measures not adopted for the project is included in Appendix B.

Table 1 Mitigation measures

Measure ID	Mitigation Measures	Stage
GWM-M001	**Assessment and make good arrangements to manage temporary water level drawdown at water supply well(s)** Following detailed design and prior to construction, the potential for temporary water level drawdown at existing water supply well(s) due to dewatering will be managed as follows: **1. Confirm existing wells** The location, construction details, and intended uses of wells on land adjacent to the easement will be confirmed through liaison with appropriate landowners. This will include wells that may be present in the study area but are not in the registered well database.	Construction

Measure ID	Mitigation Measures	Stage
	2. **Drawdown assessment** An assessment of the potential for adverse dewatering impacts on water supply wells will be completed based on the well's distance from dewatering activities with consideration to drawdown estimates contained herein, well construction and available drawdown (difference between standing water level and pump depth). 3. **Make good arrangements** If the potential for an impact is identified, then make good arrangements between the proponent and landholder/well owner will be agreed and implemented during temporary dewatering activities (if required).	
GWM-M002	**Replacement of lost or damaged well(s)** Following detailed design and prior to construction, the potential for existing wells to be lost or damaged will be managed as follows: 1. **Confirm existing wells** The location, construction details, and intended uses of wells within the construction corridor will be confirmed through liaison with appropriate landowners. 2. **Make good arrangements** In instances where a well is deemed to be impacted by the project, make good arrangements between the proponent and landholder/well owner will be agreed and implemented (subject to any approvals required).	Construction
GWM-M003	**Preventing impacts to groundwater quality from excavation and dewatering of acid sulfate soils** An Acid Sulfate Soil Management Plan will be prepared and implemented for the project (refer to SOL-M005 and SUM-M006). For the purposes of groundwater impacts, the Acid Sulfate Soil Management Plan will be prepared and implemented in accordance with the *National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (Shand et al., 2018). The Acid Sulfate Soil Management Plan will include, but not be limited to, the following actions in areas confirmed to contain potential acid sulfate soil: • Staging of disturbance and dewatering to limit the groundwater cone of depression to less than 100 metres from the edge of excavations; • Installation of groundwater monitoring bores upgradient and downgradient of dewatering and monitoring of groundwater quality pre-dewatering (that is, baseline monitoring), during dewatering, and post-dewatering; • Monitoring of drawdown levels and dewatering discharge quality during construction dewatering; • Contingency measures that include immediate cessation of dewatering if the groundwater quality results indicate that environmental impact has occurred as a result of project works.	Construction

Measure ID	Mitigation Measures	Stage
	The Victorian Environment Protection Authority will be consulted on the Acid Sulfate Soil Management Plan prior to construction commencement.	

The monitoring and contingency measures that are proposed to assess groundwater impacts associated with the project are summarised in Table 2.

Table 2 Monitoring and contingency measures

Measure ID	Monitoring or contingency measure	Phase	Impact/Risk ID
GWM-M004	**Acid Sulfate Soil Management Plan Implementation** Monitoring and contingency measures documented in the Acid Sulfate Soil Management Plan (refer to GWM-M003) will be implemented.	Construction	GWM-R005
GWM-M005	**Onshore trench route inspection** The Onshore Operation Environmental Management Plan will include the following monitoring measure: • In the event that thermal sand is used to backfill the onshore trench, the onshore trench route will be inspected following the first winter post-construction in order to check for areas of waterlogging that could be a result of groundwater discharge along preferential pathways. • A suitably qualified person will determine whether any waterlogging identified is likely to be caused by trench (taking into account landscape location and pre-construction conditions), and if so, recommend contingency measures to address the impact.	Operation	GWM-I007

Abbreviations

Abbreviation	Full term
AC	Alternating current
AECOM	AECOM Australia Pty Ltd
AASS	Actual acid sulfate soil
ASS	Acid sulfate soil
ASSMP	Acid Sulfate Soil Management Plan
BPMG	Best Practice Management Guidelines
CASS	Coastal Acid Sulfate Soils
CEMP	Construction Environmental Management Plan
DEECA	Department of Energy, Environment and Climate Action
DEMP	Decommissioning Environmental Management Plan
EE Act	*Environment Effects Act 1978*
EES	Environment Effects Statement
EIS	Environmental Impact Statement
EMF	Environmental Management Framework
EP Act	*Environment Protection Act 2017*
EPA	Victorian Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERS	Environment Reference Standard
EVC	Ecological vegetation class
GDE	Groundwater dependent ecosystem
GED	General Environmental Duty
GMA	Groundwater Management Area
HDD	Horizontal directional drilling
HDPE	High-density polyethylene
m	Metres
mAHD	metres Australian Height Datum
masl	metres above sea level
mbgs	metres below ground surface
MDS	Maximum design scenario
MNES	Matters of National Environmental Significance
NEM	National electricity market
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OEMP	Operation Environmental Management Plan
PASS	Potential acid sulfate soil

Abbreviation	Full term
PDE	Project design envelope
QA	Quaternary Aquifer
SOTS	Star of the South
SRW	Southern Rural Water
TDS	Total dissolved solids
TSB	Thermally stable backfill
VWAD	Victorian Water Asset Database
Water Act	*Water Act 1989*
WGCMA	West Gippsland Catchment Management Authority
WMIS	Water Measurement Information System
WSPA	Water Supply Protection Area
WTG	Wind turbine generator

Glossary

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 conditions and acidic water (if in contact with rainfall or other water source).
Actual acid sulfate soil	Soils containing highly acidic soil horizons resulting from the oxidation of soil materials are rich in reduced inorganic sulfur, primarily pyrite. When this oxidation of reduced inorganic sulfur produces acidity in excess of the soil material's capacity to neutralise this acidity, the soil material will often acidify to a pH 4 or less, forming an Actual Acid Sulfate Soil (AASS). The recognition of AASS materials can be confirmed by the presence of jarosite in these materials, or the location of other AASS or Potential ASS (PASS) materials within or in the nearby vicinity to the sampling location.
Annulus	The space between the wellhole and an inner casing where fluid can flow.
Aquifer	A geological structure or formation or artificial land fill permeated or capable of being permeated permanently or intermittently with water.
Aquitard	A water-bearing geological formation that inhibits groundwater flow to wells or springs, but may serve as a groundwater storage unit.
Transmission easement	A legal right to use land for the operation, and maintenance of transmission lines. The easement is registered on the property title, but the landowner retains ownership of the land.
Construction corridor	A broadly used term to describe the onshore 'easement' and the temporary construction areas adjacent to it. It also includes the offshore subsea export cables infrastructure route.
Depositional environment	The combination of physical, chemical, and biological processes associated with the deposition of a particular type of sediment and, therefore, the rock types that will be formed.
Environmental value	A use, an attribute or a function of the environment, as set out in the *EP Act* and the Environment Reference Standard.
Gaining stream	A stream that receives groundwater, which adds to its overall flow.
Groundwater dependent ecosystem	A terrestrial, aquatic, or subterranean ecosystem that requires access to groundwater to meet all or some of its requirements.
Groundwater users	Groundwater dependent ecosystems and users of existing wells that are registered for extractive uses.
Hydraulic conductivity	The ease with which a fluid (usually water) can move through pore spaces or fractures.

Term	Definition
Hydrograph	A graph showing groundwater level versus time at a specific measurement point (usually a groundwater monitoring well).
Losing stream	A stream with water that recharges the surrounding groundwater.
Permeability	A measure of the ability of a porous material to allow fluids to pass through it. It is represented by the symbol ‘k’ and the SI unit is m^2. Also known as ‘intrinsic permeability’. Unlike saturated hydraulic conductivity, intrinsic permeability is independent of the fluid properties.
Permissible consumptive volume	The maximum volume of water that can be extracted from a Water Supply Protection Area or Groundwater Management Area.
Potential acid sulfate soil	Soils that contain appreciable amounts of reduced inorganic sulfur that have not oxidised but will acidify to a pH of less than 3.0 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. PASS pose an environmental hazard if disturbed, as they can generate considerable acidity if mismanaged.
Preferential flowpath	The uneven and often rapid movement of water and solutes through porous media.
Quaternary Aquifer	The uppermost aquifer in the Victorian Aquifer Framework. In the study area this includes coastal dune deposits, swamp and lake deposits, alluvium, and dune deposits. The aquifer code is QA and the aquifer number is 100.
Saline intrusion	The movement of saline water into a freshwater aquifer.
Segment	A geographic area or feature of the water environment that has common environmental conditions and natural characteristics (in this case, the levels of total dissolved solids for groundwater).
Semi-confined	An aquifer that is partially overlain by a low permeability geologic formation through which water can pass slowly to recharge the aquifer.
Specific storage	The volume of water removed from a unit volume of a confined aquifer for a unit drop in hydraulic head.
Specific yield	The volume of water removed from a unit volume of an unconfined aquifer for a unit drop in water level. It is the volume of water that will drain by gravity from a saturated unit volume of an aquifer and is equivalent to the effective porosity.
Storativity	The volume of water removed from a unit area of an aquifer for a unit drop in hydraulic head. In confined aquifers, it is equal to the specific storage times and the aquifer thickness. In unconfined aquifers, it is approximately equal to the specific yield.
Stygofauna	Fauna that permanently inhabit below ground ecosystems that rely entirely on groundwater.

Term	Definition
Taxon	A taxonomic group of any rank, such as a species, family, or class.
Unconfined	An aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.
Waterbody	Any body of surface water, such as a watercourse, wetland, or dam.
Watercourse	A river, creek, or other stream.
Water table	The surface where the water pressure head is equal to the atmospheric pressure.

1.0 Introduction

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

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

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

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

The purpose of this report is to assess the potential impacts to groundwater associated with the onshore transmission system and shore crossing to inform the preparation of the EIS and EES required for the project.

2.0 Project description

Section 2.0 provides a high-level overview of the project in its entirety. Detailed descriptions of project components and construction processes are provided in Chapter 4 – Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction, and in Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction. Specific project parameters that have informed the groundwater study are detailed in Section 9.1 and Section 10.1 of this report.

Project overview

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

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

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

This technical report focusses on groundwater impacts associated with the construction, operation and decommissioning of the onshore transmission system and shore crossing, within the onshore project area shown in Figure 2-1.

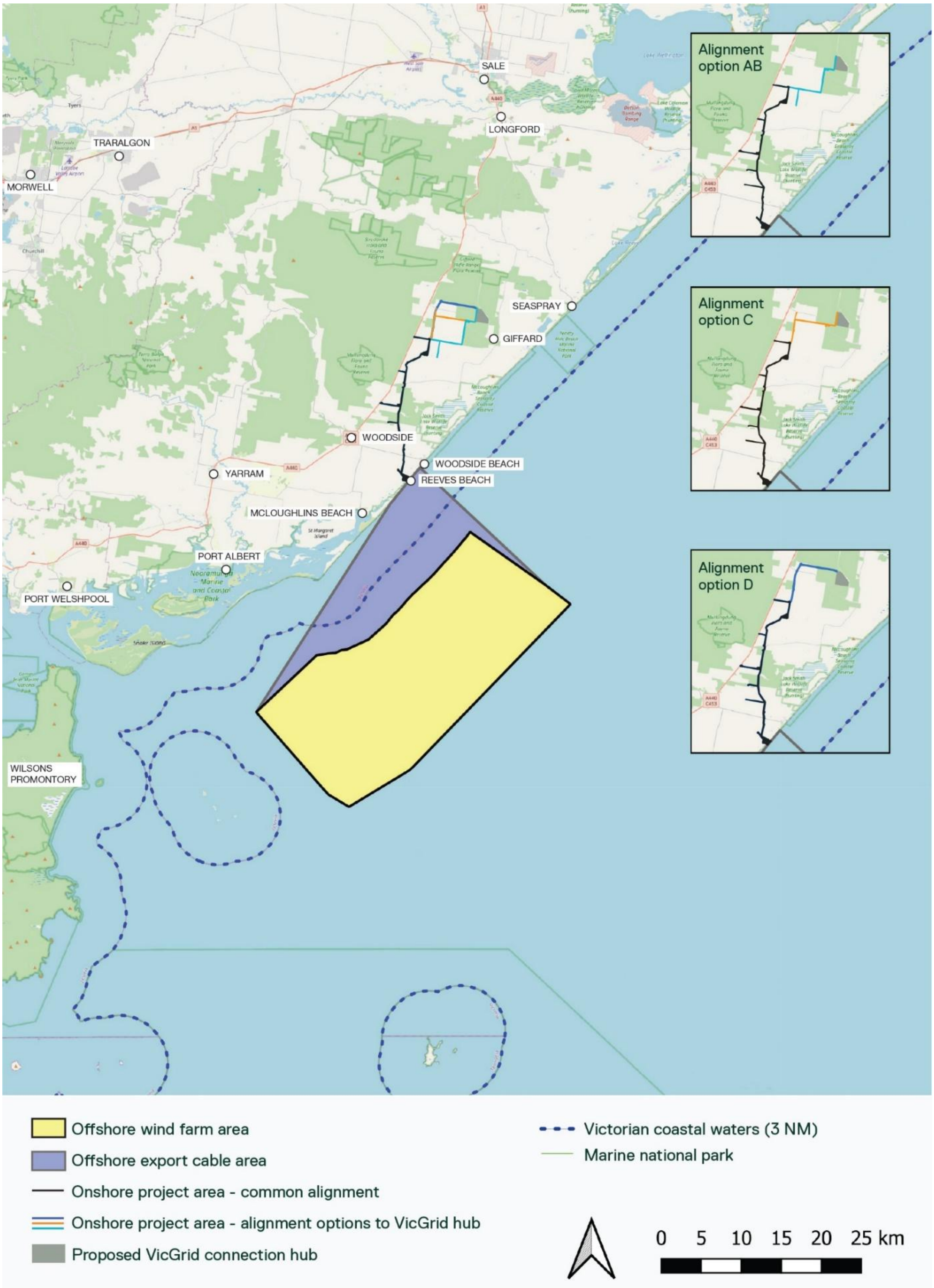

Figure 2-1 Project location

2.1 Project development

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

This approach addresses the general environmental duty (GED) as required under the *Environment Protection Act 2017* (EP Act), as it involves minimising risk of harm to human health and the environment from pollution and waste by adopting controls that are proportionate to identified risks.

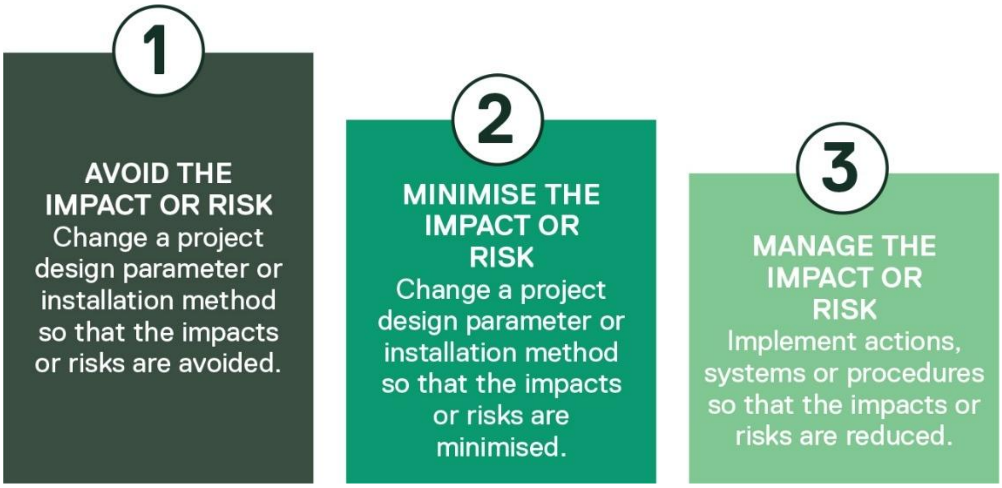

Figure 2-2 Mitigation hierarchy

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

This was considered in the preparation of a project description which is found in Chapter 4 – Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction and Chapter 4 – Victorian works project description of the EES for the Victorian jurisdiction. A description of how avoidance of impact has informed the design in relation to this groundwater assessment can be found in Section 6.6.

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

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

2.2 Project area

The project area is shown in Figure 4-1 has been broken down into three main sections - offshore, shore crossing, and onshore areas.

1. Offshore project area, comprising:
   - Offshore wind farm area: A 586 square kilometre area extending approximately 10 to 40 kilometres offshore from the shore crossing. Includes offshore wind turbines installed on foundations, offshore substations and offshore transmission cables. This area is in Commonwealth waters.

   - Offshore export cable area: A 232 square kilometre area extending from the offshore wind farm area to the shore crossing. Includes offshore export cables to connect the wind farm to land. This area traverses Commonwealth waters and Victorian coastal waters.
2. Shore crossing: Located at Reeves Beach, this is where the offshore export cables will transition to land and connect to the underground cable system onshore.
3. Onshore project area: An approximately 30 kilometre corridor extending from the shore crossing to the proposed VicGrid connection hub. Includes an underground cable system within a (common) alignment to Giffard West, at which point there are three alignment options (AB, C and D) to reach the proposed VicGrid hub in Giffard.

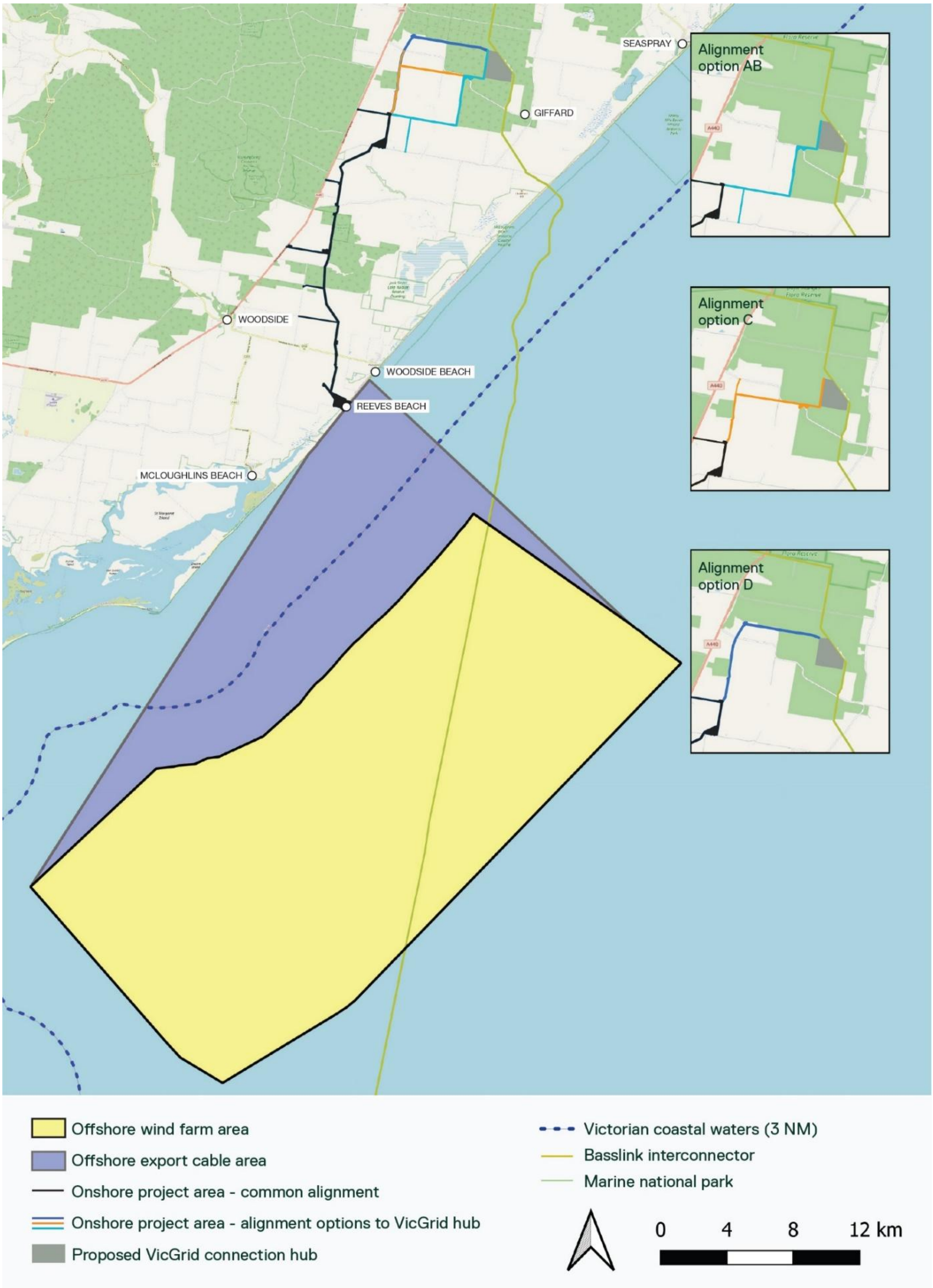

Figure 2-3 Project overview

2.3 Key project components

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

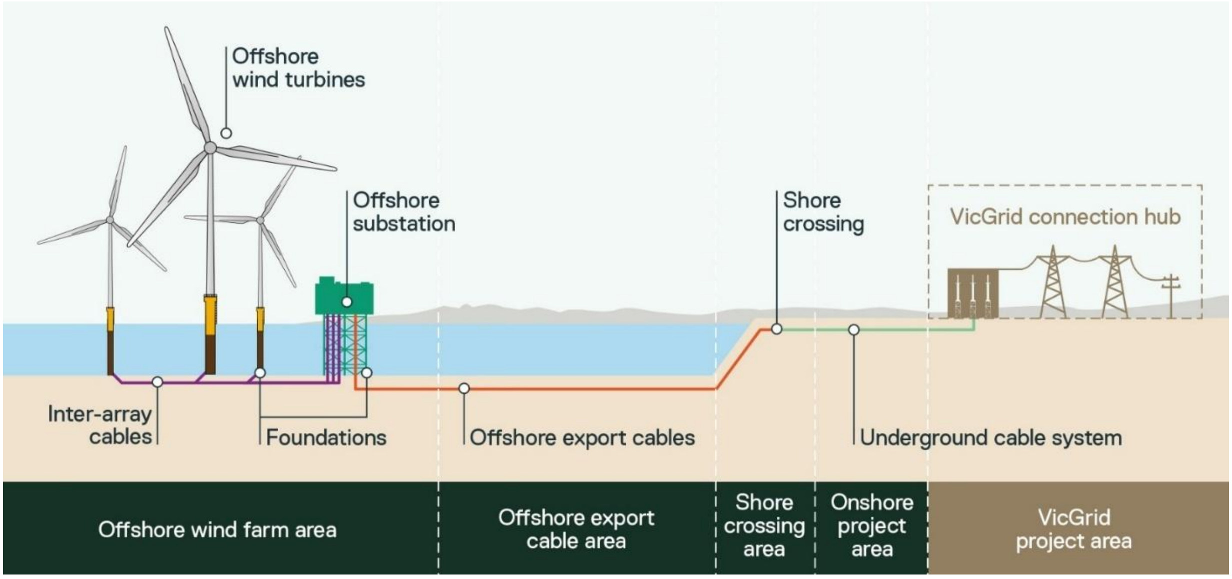

Figure 2-4 Project components

Key components are shown in Figure 2-4 and include:

- Offshore wind farm and transmission infrastructure:
  - Up to 147 offshore wind turbines installed on foundations with connecting inter-array cables
  - Up to five offshore substations and three interlink cables
  - Up to eight offshore export cables.
- Shore crossing infrastructure:
  - Up to eight trenchless crossings containing the offshore export cables.
- Onshore transmission infrastructure, which consists of:
  - An underground cable system connecting to the proposed VicGrid connection hub.

2.4 Construction approach

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

- Drilling and duct installation
- Cable pulling

The construction of the shore crossing and onshore transmission system would involve the following key activities:

- Site establishment
- Cable system construction (including trenching, installation and jointing)
- Pre-commissioning and commissioning of the cable system
- Demobilisation and rehabilitation of areas disturbed by construction.

2.5 Project timeline

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

Figure 2-5 Project timeline

2.6 Construction schedule

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

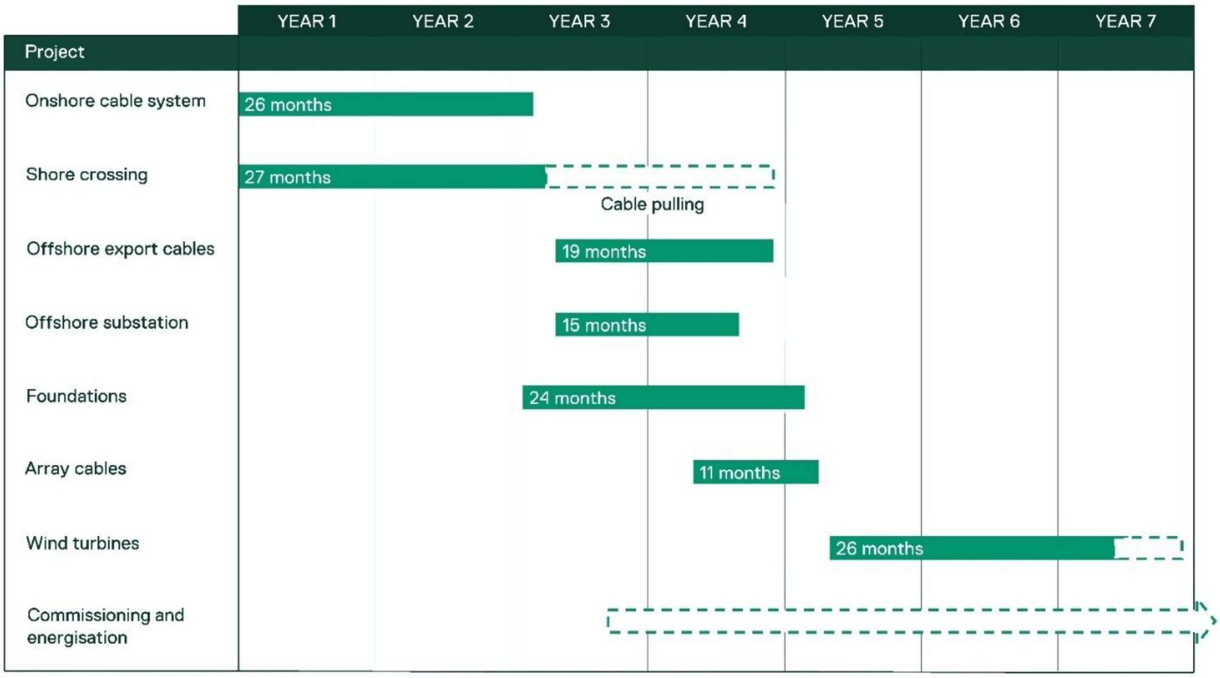

Figure 2-6 Indicative project construction schedule

2.7 Operational requirements

The underground cable system will be remotely monitored through control and condition monitoring systems. Routine access will be minimal, with testing required once or twice a year at the link pits located at each joint bay.

A small workforce will undertake periodic inspections and routine maintenance of the cable system using light service vehicles, including cable easement inspections to monitor and control vegetation and confirm compliance with easement terms.

2.8 Decommissioning

Decommissioning of onshore components will be planned and carried out in accordance with regulatory and landholder requirements current at the time. The decommissioning approach is expected to be agreed with regulators before project operations cease. The assessment of the project assumes current industry practices will be adopted.

To minimise disturbance, most below-ground infrastructure is expected to be left in place, with cable ends cut, sealed and securely buried. Surface infrastructure such as signage, markers, link and fibre pits may be removed if required by landholders or if environmental impacts arise.

3.0 Scoping

3.1 Study objective

The objective of this study is to:

- To assess, avoid and minimise adverse effects on groundwater functions and values, such as quality, flows and environmental values, during construction, operation and decommissioning of the project.

This objective guides the approach to assessments and the avoidance and minimisation of potential impacts.

3.2 EIS guidelines

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

There are no aspects of the guidelines that are relevant to the groundwater assessment. GDEs that may be impacted by the project, and which may fall under the EPBC Act, are addressed in *Technical report G: Onshore ecology.*

3.3 EES evaluation objectives and scoping requirements

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

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

The following evaluation objective is relevant to groundwater:

- To minimise adverse effects on water (including groundwater, waterway, wetland, estuarine, intertidal and marine) quality and movement

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

Table 3 Scoping requirements relevant to groundwater

Aspect	Scoping requirement	Section addressed
Key issues	The potential for adverse effects on the functions, values and beneficial uses of groundwater due to the project's shore crossing construction.	Section 9.0 (construction impact assessment)
Priorities for characterising the existing environment	Characterise the local groundwater quality and behaviour, including the protected beneficial uses and values and identifying any GDEs that might be affected by the project during construction.	Section 7.0 (existing environment)
Design and mitigation measures	Identify and evaluate aspects of project works and operations, and proposed design refinement options or measures, that could	Section 9.0 to Section 13.0 (construction impact assessment to mitigation measures)

	avoid or minimise significant effects on groundwater, waterway, wetland, estuarine, intertidal and marine waters.	
	Describe further potential and proposed design options and measures that could avoid or minimise significant effects on groundwater, waterway, wetland, estuarine, intertidal and marine waters during the project's construction and operation, including response measures for environmental incidents.	Section 13.0 (summary of mitigation, monitoring and contingency measures)
Assessment of likely effects	Identify and evaluate effects of the project on groundwater, waterway, wetland, estuarine, intertidal and marine waters potentially affected by project works, including with appropriate consideration of climate change scenarios and possible cumulative effects.	Section 9.0 to Section 12.0 (construction impact assessment to cumulative impact assessment)
Approach to manage performance	Describe and evaluate the approach to monitoring and the proposed contingency measures to be implemented in the event of adverse residual effects on groundwater, waterway, wetland, estuarine, intertidal and marine waters requiring further management.	Section 13.0 (summary of mitigation, monitoring and contingency measures)

4.0 Evaluation framework

The assessment will consider legislation, policy and standards relevant to groundwater along with specific assessment criteria that have been derived for the purposes of the study.

4.1 Legislation, policies, guidelines and standards

The legislation, policy, guidelines and standards relevant to this assessment are summarised in Table 4.

Table 4 Legislation, policy, guidelines and standards relevant to the assessment

Document title	Summary	Relevance to the project
Commonwealth government		
Environment Protection and Biodiversity Conservation Act 1999 (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 (that is, actions that are likely to have a significant impact on a MNES) are subject to assessment and approval under the EPBC Act.	On 2 June 2020, the delegate for the Commonwealth Minister for the Environment determined the project to be a controlled action due to potential significant impact on Ramsar sites, listed threatened species and ecological communities, listed migratory species, and Commonwealth marine areas.
National Strategy for the Management of Coastal Acid Sulfate Soils 2000	This National strategy document proposes a coordinated and comprehensive National approach to define the problem of coastal acid sulfate soil (ASS), prevent it from increasing and encourage remedial actions to reduce existing acid water runoff. The document sets out roles and responsibilities of stakeholders, as well as a hierarchy of objectives and management options for implementation.	The ASS assessment has been undertaken with reference to the National Strategy for the Management of Coastal Acid Sulfate Soils.
National Guidance on Acid Sulfate Soils: National Guidance for the Management of Acid Sulfate Soils in Inland Aquatic Ecosystems 2011	This document provides guidance on the identification and management of inland ASS to reduce or eliminate the risks they pose to the environment.	The ASS assessment has been undertaken with reference to this National guidance document. The document provides information on the distribution of inland ASS as well as management and mitigation options.
National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid	This document provides guidance on managing ASS when groundwater dewatering or	The ASS assessment has been undertaken with reference to this National guidance document.

Document title	Summary	Relevance to the project
sulfate soils in shallow groundwater environments 2018	removal of overburden to expose ASS present below the water table is required.	Dewatering in areas where potential ASS are likely to be present will need to be undertaken in line with the guidance provided in this document.
Victorian government		
Water Act 1989 (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 (SRW) 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 southern Victoria.
Environment Protection Act 2017 (EP Act)	The EP Act aims to protect Victoria's air, water and land by adopting a 'general environmental duty' which imposes a broad obligation on entities and individuals to take proactive steps to understand and minimise risks of harm to human health and the environment from pollution or waste. The Victorian Environment Protection Authority (EPA) administers the EP Act and subordinate legislation.	The EP Act regulates discharges to land, surface water and 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. The general environmental duty (GED) requires all reasonably practicable steps be taken to minimise impacts from the construction and operation of the project.
Environment Reference Standard (ERS)	The ERS was made 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. 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	The project would seek to minimise risks of harm to groundwater to ensure environmental values are protected.

Document title	Summary	Relevance to the project
	whether those objectives are being met.	
Victorian Coastal Acid Sulfate Soils Strategy 2009 (CASS Strategy)	The CASS Strategy provides the Victorian context in line with and alongside of the National Strategy for the Management of Coastal Acid Sulfate Soils. It sets out decision-making principles for managing CASS, objectives and actions, and roles and responsibilities of stakeholders.	The ASS assessment has been undertaken with reference to the CASS Strategy.
Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils 2010 (CASS BPMG)	The CASS BPMG provides a risk identification approach to assist stakeholders to make decisions about the assessment and management of CASS.	The ASS assessment has been carried out with reference to the risk identification and assessment approach outlined in the CASS BPMG.
Industrial Waste Management Policy (Waste Acid Sulfate Soils) 1999	This policy sets out the management regime for the offsite disposal and reuse of waste acid sulfate soils and specifies the responsibilities of those involved.	Management, reuse, and disposal of waste ASS must observe this Policy (and be in accordance with the EP Act and EP Regulations).
EPA Victoria, Information Bulletin, Acid Sulfate Soil and Rock (Publication 655)	This bulletin provides guidance about identifying, classifying and managing acid sulfate soils and rock. The publication also sets out the criteria for the classification of ASS in Victoria.	The ASS assessment has included a review of the existing ASS data for the project against the guidance set out in this publication.

4.2 General environmental duty

In Victoria, the EP Act came into effect in 2021 and is designed to prevent harm to human health and the environment from pollution and waste. At the centre of the EP Act is the general environmental duty (GED).

The GED requires that:

any person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.

The GED applies at all times, during construction and operation of the project, for any activities posing a risk of harm to human health and the environment. Meeting regulatory requirements does not mean that the GED has been met.

The following sections of the EP Act apply to the GED:

- Section 25(1) of the EP Act states that a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution (including noise, which includes sound and vibration) must minimise those risks so far as reasonable and practicable.
- Section 6 of the EP Act states that minimising risks of harm to human health and the environment requires the duty holder to eliminate risks of harm to human health and the environment so far as reasonably practicable and, if it is not reasonably practicable to eliminate those risks, then reduce those risks as far as reasonably practicable.
- Section 6(2) of the EP Act states factors to give regard to when determining what is reasonably practicable in relation to the minimising of risks to harm to human health and the environment.

4.3 Reasonably practicable

EPA Victoria Publication 1856 Reasonably Practicable provides guidance as to the factors to consider when defining proportionate controls to minimise harm, as follows:

- Eliminate first: Can you eliminate the risk?
- Likelihood: What's the chance that harm would occur?
- Degree (consequence): How severe could the harm be on human health or the environment?
- Your knowledge about the risks: What do you know, or what can you find out, about the risks your activities pose?
- Availability and suitability: What technology, processes or equipment are available to control the risk? What controls are suitable for use in your circumstances?
- Cost: How much does the control cost to put in place compared to how effective it would be in reducing the risk?

The items above have been considered when assessing the suitability of mitigation measures for the project.

4.4 Assessment criteria

Assessment criteria are used to assess the significance of an impact. In the case of groundwater, a significant impact would result if the 'environmental values' or suitable uses of groundwater were permanently changed over a regional area due to the impact of the project. 'Environmental values' of groundwater are defined in the ERS and summarised in Table 5 below.

Table 5 Environmental values of groundwater

Environmental values	Description
Water dependent ecosystems and species	Water quality that is suitable to protect the integrity and biodiversity of water dependent ecosystems. This integrity and biodiversity includes: • The integrity of riparian vegetation as it contributes to the health of water dependent ecosystems and bank stability. • Groundwater quality that does not adversely affect surface water ecosystems. • Groundwater quality that does not adversely affect natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis to maintain their communities of organisms, ecological processes and ecosystem services. This includes wetlands, rivers and streams reliant on groundwater baseflow, some terrestrial vegetation and some estuarine and near-shore marine systems, stygofauna and troglofauna. • Maintenance of fish passage.
Potable water supply	Groundwater quality that is suitable for raw or potable water supply.
Potable mineral water supply	Groundwater quality that is suitable for drinking and, in its natural state, contains soluble minerals and natural gases causing effervescence.
Agriculture and irrigation	Water quality that is suitable for agricultural activities such as stock watering and irrigation, as well as a range of other uses such as the irrigation of domestic gardens, commercial agriculture, parks and golf courses.
Industrial and commercial	Water quality that is suitable for industrial and commercial use.
Water-based recreation	Water quality that is suitable for primary contact recreation (for example swimming, diving, water skiing, caving and spas), secondary contact recreation (for example boating and fishing) and for aesthetic enjoyment.

Environmental values	Description
Traditional Owner cultural values	Water quality that protects the cultural values of Traditional Owners, having recognised primary responsibility for protecting the values of water for cultural needs, to ensure that Traditional Owner cultural practices can continue. Values may include traditional aquaculture, fishing, harvesting, cultivation of freshwater and marine foods, fish, grasses, medicines and filtration of water holes.
Buildings and structures	Groundwater quality that is not corrosive to buildings, structures, property and materials.
Geothermal properties	Groundwater quality that will not affect the natural thermal capacity (including temperature) of the groundwater.

Criteria, or ‘indicators’ against which the environmental value objectives can be enhanced or maintained are provided in the ERS, which also refers to the Australian and New Zealand guidelines for fresh and marine water quality (https://www.waterquality.gov.au/guidelines/anz-fresh-marine)

Additional assessment criteria, developed to protect current groundwater uses and groundwater dependent ecosystems from excessive drawdown during construction activities is described in Table 6 below and is considered consistent with intentions of the Water Act.

Table 6 Assessment criteria: extractive use wells and groundwater dependent ecosystems

Assessment criteria description	Acceptable limit	Comment
Reduction in groundwater level at extractive use well	10% of available drawdown	Available drawdown is the difference between the lowest possible pump intake setting and the water level in an extraction bore.
Reduction in groundwater level at groundwater dependent ecosystem	0.1 m	As outlined in the 2015 Ministerial guidelines for groundwater licensing and the protection of high value groundwater dependent ecosystems

The 10 percent available drawdown criterion in Table 6 is based on use in previous water supply and water resource assessments[1]. Shallow bores are those that would be at greater risk from the temporary, shallow dewatering that may be required as part of the project. These are offered greater protection by the 10 percent rule given they typically have smaller available drawdowns, and hence a smaller allowable drawdown impact would exceed the criterion.

The 0.1 metre criterion for groundwater level drawdown at a groundwater dependent ecosystem (in Table 6) is based on the consequence descriptions for risk assessment of high value groundwater dependent ecosystems in the 2015 *Ministerial guidelines for groundwater licensing and the protection of high value groundwater dependent ecosystems*[2]. The lowest consequence category of ‘minor’ specifies a water table decline of less than 0.1 metre. For comparison, a ‘moderate’ consequence specifies a decline of 0.1 to two metres and a ‘significant’ consequence specifies a decline of greater than two metres.

[1] 10% criterion originally adopted in RWC (1993)
[2] https://waterregister.vic.gov.au/about/news/185-release-of-ministerial-guidelines-for-protection-of-groundwater-dependent-ecosystems

5.0 Consultation and engagement

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

Consultation specific to groundwater has also been undertaken with identified stakeholders to inform this report. A summary of this engagement is provided below.

Engagement activities

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

- Direct engagement with landholders along the project's proposed transmission route; including phone calls, emails and meetings.
- Discussions with stakeholders and community members through meetings, phone calls, emails or visits to the Gippsland office.
- Sharing of information via the project's website, social media and monthly e-news
- Fact sheet containing information about the project's onshore site investigations
- Presence at community events and pop-up stalls across Gippsland
- Community information sessions.

Stakeholders

Key stakeholders identified and engaged on this report include:

- Landholders along the project's proposed transmission route
- Wellington Shire Council
- West Gippsland Catchment Management Authority
- General community.

Table 7 lists relevant issues raised by stakeholders and how feedback on these issues have been applied to the assessment of impacts on ground water.

Table 7 Summary of consultation issues raised relevant to groundwater

Stakeholder/partner and type of response	Issues raised	Response to issues raised and/or where considered within this report or associated appendices
General community	Any impact to groundwater on farm land from transmission construction.	Potential impacts to groundwater on farm land (and other land) due to onshore transmission construction are discussed in Section 9.0 (construction impact assessment).
	Any impact to groundwater quantity, quality or other impacts from transmission construction.	Potential impacts to groundwater quantity and quality from onshore transmission construction are discussed in Section 9.0 (construction impact assessment).
	Any associated impacts to farming activity, water availability and quality.	Potential impacts to groundwater availability (that is, groundwater levels) and groundwater quality are discussed in Section 9.0 (construction phase) and Section 10.0 (operation phase).

6.0 Methodology

As context to the assessment approach, the Star of the South Offshore Wind Farm is a large project that covers a wide geographic area and has the potential for significant influence across Commonwealth waters and Victorian coastal waters, the state of Victoria and in particular the central Gippsland region. Accordingly, the impacts (both positive and negative) of the project are assessed in terms of their materiality at the scale of Commonwealth waters and Victorian coastal waters, the state of Victoria and the central Gippsland region.

6.1 Overview of assessment framework

This section describes the framework used to assess potential environmental impacts and risks associated with the proposed project.

The assessment has been guided by an evaluation framework that comprises applicable legislation, policy, guidelines and standards, the Commonwealth EIS guidelines and the EES scoping requirements and study-specific assessment criteria. The approach generally aligns with guidance issued by the Australian National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for the Environmental Assessment of Major Offshore Infrastructure (Reference: *Environment Management Plan Content Requirement, 16/12/12022)* and the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (OPGGS Regulations).

An overview of the assessment framework is presented in Figure 6-1.

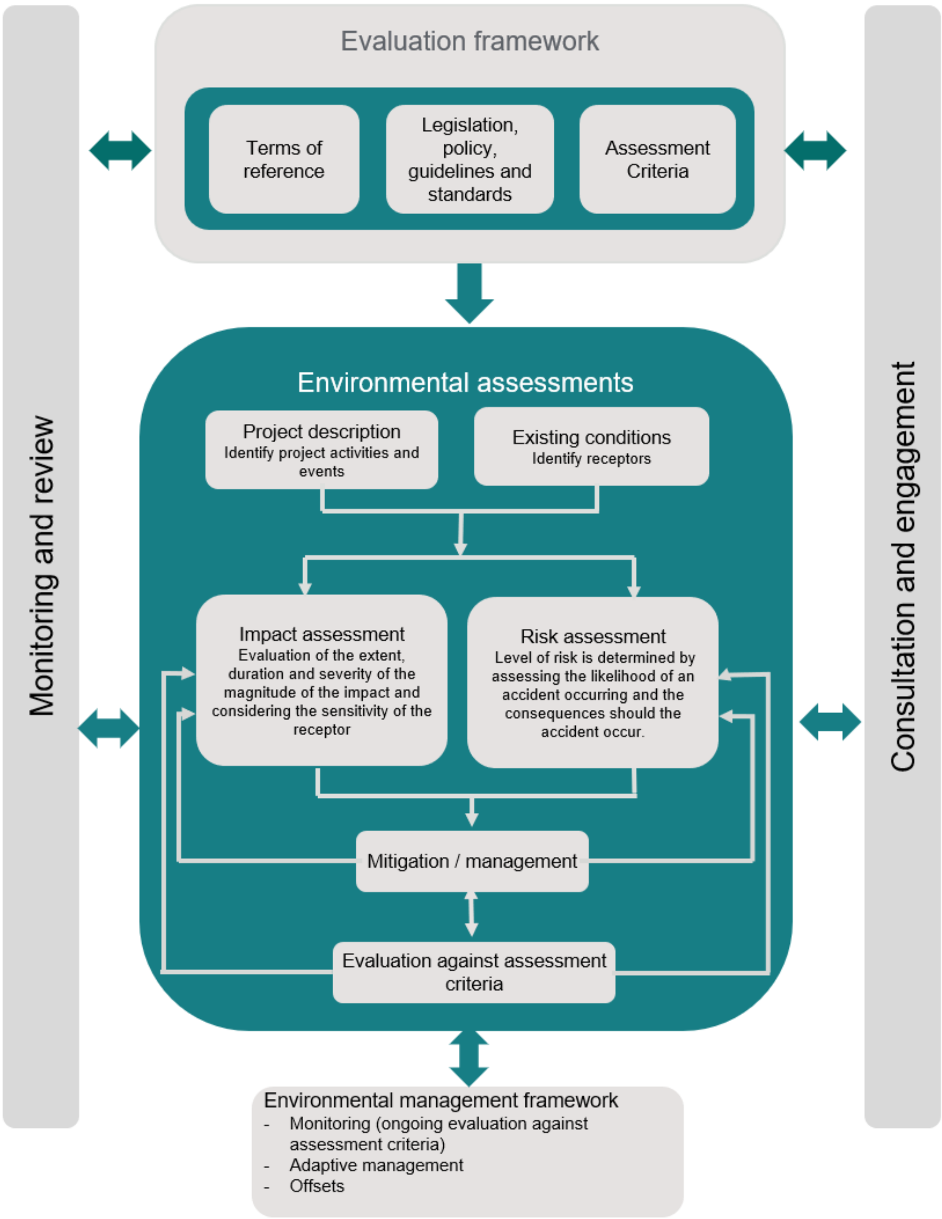

Figure 6-1 Overview of assessment framework

The environmental assessment in relation to groundwater was undertaken according to the following steps:

- **Existing conditions:** Characterisation of existing (baseline) environmental conditions and identification of sensitive assets, values and uses that may be affected by construction, operation and decommissioning of the project.
- **Project description:** Review of the key project components and proposed construction, operation and decommissioning activities to identify potential project interactions with sensitive receptors (i.e., events). This includes identification of the maximum design scenario for the purposes of impact and risk assessment, taking into account the parameter range within the project design envelope as outlined in Chapter 4 – Project description of the EIS for the whole of project assessment across the Commonwealth jurisdiction and Chapter 4 – Victorian works project

description of the EES for the Victorian jurisdiction and selection of the parameter value with potentially greatest impact or risk.

- **Impact assessment:** Assessment of consequences based on the predicted magnitude of the impacts and the sensitivity of potentially affected receptors, taking into account proposed mitigation measures and their likely effectiveness. The impact assessment methodology is described in Section 6.4.
- **Risk assessment**: Assessment of likelihood and consequences of accidents (i.e., events that are not certain to occur). The risk assessment methodology is described in Section 6.5.
- **Avoid, mitigate and manage:** Identification of mitigation measures to avoid, minimise and manage impacts or risks 4.4 and to address the GED as required under the EP Act.
- **Evaluation against assessment criteria:** Evaluation of predicted residual impacts or risks against assessment criteria set out in Section 4.4. If the impact or risk assessment indicates that the criteria is exceeded, then changes to the project design are made or further mitigation measures are introduced. Residual impacts and risks are those that remain following the implementation of all mitigation measures committed to by the project, taking into account their expected effectiveness.
- **Monitoring and review:** Continual checking for changes to legislation, policy, guidelines and standards and the project description and subsequent refinement and updating of assessments as required.
- **Consultation and engagement:** Consideration of feedback from community, stakeholders and regulators to ensure that concerns and expectations are met. Stakeholder consultation and engagement will continue throughout the life of the project.

For impacts (expected events) the likelihood of the event is considered to be certain, therefore only an evaluation of consequence is required. For risks (accidental events) both likelihood and consequences need to be considered. The evaluation of consequences for both impacts and risks takes into consideration the nature and scale of the effects, the predicted extent, severity and duration, the likely effectiveness of mitigation measures to reduce consequences as well as the sensitivity of the receptor.

Impact example

An example, ‘project activity’ is joint bay installation, and in this case the ‘event’ is excavation dewatering and the ‘consequence’ would be water table drawdown at a nearby existing groundwater user or groundwater dependent ecosystem. Joint bay excavation/installation is an expected event as these structures are a required component of the onshore transmission network and dewatering is required to allow the installation to be completed in a safe manner. Water table drawdown will occur within and beyond the excavation area.

Risk example

An example of an accidental event is where the ‘project activity’ is destruction of an existing well used for groundwater abstraction within the construction corridor. In this case the ‘event’ is ‘SOTS mobile plant driving over a groundwater well’ and the ‘consequence’ would be destruction of an asset used by a third party. This event unlikely to occur but is still possible.

6.2 Study area

The study area is defined as all locations where groundwater may potentially be impacted by project activities.

The groundwater study area encompasses the onshore project area, including the project easement and construction corridor, as well as a 200-metre-wide buffer area surrounding the construction corridor (that is, 200 metres from the outer edge of the construction corridor) (refer to Figure 7-1).

Groundwater may be encountered during intrusive works including construction of the onshore cable trenches, joint bays, transition joint bays and the shore crossing. For the purposes of this study, it is assumed that significant intrusive works will only occur in the project easement. Activities in the construction corridor include temporary laydown areas, temporary batch plants, and access tracks.

The 200-metre buffer area was chosen in order to encompass potential drawdown in groundwater levels as a result of temporary dewatering of the excavations required to install the onshore cable trenches, joint bays, and transition joint bays. Based on the very shallow extent of onshore activities and infrastructure, the study area extends to a depth of 10 metres below ground surface (35 metres at shore crossing).

This study area is considered sufficient to include the zone where groundwater levels, flows, or quality could be impacted by the project.

6.3 Methods to determine the existing environment

A desktop assessment was undertaken to understand the existing environment of the study area to inform the environmental impact assessment for the works. This included site-specific geotechnical and preliminary acid sulfate soil field investigations undertaken for the project. The datasets and literature used to define the existing environment are summarised in Table 8 below.

Table 8 Datasets and literature used to define existing environment

Data	Source
Elevation	Vicmap elevation 10 metre digital elevation model spatial layer, available at: https://discover.data.vic.gov.au/dataset/vicmap-elevation-dem-10m.
Land use	The Victorian Land Use Information System 2016-2017 spatial layer (Department of Economic Development, Jobs, Transport, and Resources, 2017), available at: https://www.data.vic.gov.au/.
Climate	Context statement for the Gippsland Basin Bioregional Assessment (Yates et al., 2015).
Geology	Surface Geology of Victoria 1:250,000. Geological Survey of Victoria, Department of Primary Industries, 2011. Context statement for the Gippsland Basin Bioregional Assessment (Yates et al., 2015). Test pit logs reported in Coffey (2020) and test pit and bore logs reported by Douglas Partners (2022).
Aquifer units / hydrostratigraphy	Victorian Aquifer Framework definitions and three-dimensional surfaces (GHD, 2012). Context statement for the Gippsland Basin Bioregional Assessment (Yates et al., 2015).
Hydraulic properties	Context statement for the Gippsland Basin Bioregional Assessment (Yates et al., 2015). Gippsland groundwater model (Beverly, 2015).
Groundwater levels and flow dynamics	WMIS, Department of Energy, Environment and Climate Action (DEECA), available at: https://data.water.vic.gov.au/. Depth to water table spatial layer (Department of Environment and Primary Industries, 2014a). Test pit water levels reported in Coffey (2020). Groundwater monitoring well (GA20-BH01) reported by Golder (2020). Groundwater monitoring wells reported by Douglas Partners (2022)
Groundwater salinity	Water table salinity spatial data (Department of Environment and Primary Industries, 2014b). Grab samples from the groundwater monitoring well GA20-BH01 reported in Golder (2020).
Groundwater management	Yarram Water Supply Protection Area Groundwater Management Plan (SRW, 2010).
Registered well/wells	WMIS, DEECA, available at: https://data.water.vic.gov.au/.
GDEs	GDE Atlas (Bureau of Meteorology): http://www.bom.gov.au/water/groundwater/gde/map.shtml.

Data	Source
Groundwater - surface water interactions	Australian Hydrological Geospatial Fabric Surface Hydrology Catchments spatial layer, available at: https://discover.data.vic.gov.au/dataset/groundwater-surface-water-interaction. Victorian Water Asset Database (VWAD) spatial layers (point, polyline, and polygon), available at: https://www.data.vic.gov.au/

6.4 Impact assessment method

An impact is where a project activity or activities in any of the project phases (construction, operation or decommissioning) results in a change in the existing environment.

The impact assessment has been based on a maximum design scenario which enables a realistic and conservative approach to considering possible impacts that could occur due to the construction, operation or decommissioning of the project. Impacts can be positive or negative, direct or indirect. Impacts are described following the application of mitigation measures (residual impact).

Whether an impact results in a consequence to environmental receptors depends on the sensitivity of receptors and the magnitude of the impact.

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

As environmental assets, values and uses are interconnected, sometimes an impact will give rise to a follow-on (secondary or indirect) impact which has also been considered as part of the assessment.

The impact assessments have involved identifying the magnitude of changes to the environment, positive or negative, that the project may have on the existing conditions. The method used has been specific to each individual technical study in accordance with relevant guidelines and standards. The technical reports each contain a section that describes their impact assessment method in detail, in particular the modelling or analysis that has been undertaken to predict the changes that may occur due to the implementation of the project.

The factors that have been considered when assessing the consequences of the project are as follows:

- Severity, extent and duration
- Sensitivity of the affected receptors
- Assessment criteria
- The principles of ecologically sustainable development as defined in the Ministerial guidelines for assessment of environmental effects (Department of Transport and Planning, 2023) and in section 3A of the EPBC Act
- Stakeholder input and feedback
- The likely effectiveness of measures to avoid, minimise and manage impacts
- Assumptions and uncertainties associated with the assessment.

The impact assessments have considered the potential for combined impacts generated by the project on the one receptor but resulting from different actions. For example, shorebirds and seabirds are potentially affected by the loss of habitat within the transmission corridor, together with bird strike associated with the operation of the wind farm (referred to as inter-related impacts in the technical reports). The combined impact of these changes is assessed within the shorebird and seabird assessment. The approach to cumulative impact assessment is outlined in Section 6.8 below.

For the purposes of the impact assessment the project description defined a project design envelope (PDE). The PDE comprises ranges for certain design parameters (for example, an upper and lower limit for wind turbine generator heights). This allows for flexibility in the eventual design for the project that is necessary within an evolving industry where technology is rapidly changing. The impact and risk assessment has been based on a maximum design scenario (MDS) which enables a realistic and conservative approach to considering possible impacts and risks that could occur due to the construction, operation or decommissioning of the project. The MDS consists of a defined set of project parameters from within the PDE that represent the greatest potential impact to an identified sensitive receptor or receptor group. As the MDS is defined based on specific impacts, the MDS assessed will vary between the impacts and risks assessed. See Section 9.0, Section 10.0 and Section 11.0 for the MDS used for this assessment.

Groundwater impact assessment

Impacts to groundwater are assessed by undertaking a desktop study, that is relying on review of project-specific and publicly available information to inform the potential impacts to groundwater. This level of assessment is considered suitable for groundwater because:

- The groundwater assessment is restricted to onshore areas
- The proposed disturbance area is small compared to the regional groundwater system area
- Groundwater is not proposed to be abstracted for long-term Project use
- The proposed disturbance areas are shallow and generally above the groundwater level in most water table aquifers and a confined aquifer will not be intersected by the Project.

The assessment is conducted by reviewing the proposed Project area alignment spatial extent against the locations of the project-specific and publicly available information to identify any potential impacts. Where a potential impact is identified a decision is made to either obtain site-specific groundwater information or rely on site-specific information from other studies (e.g., soil and waste) or investigations (e.g., geotechnical).

To assess the potential impacts at receptors from excavation dewatering and the resultant water table drawdown the Theis (1935) model equations are used, with excavation input parameters provided by SOTS.

6.4.1 Assigning a sensitivity level

To assign a sensitivity level, the existing environment is described and 'receptors' are identified. For example, a groundwater receptor could be a groundwater dependent ecosystem or a groundwater user (e.g., for stock watering).

A sensitivity level of high, medium or low is assigned to the receptors based on specific criteria developed by the specialist undertaking the assessment.

A sensitivity level is assigned to the receptors that have been identified in the baseline characterisation presented in Section 7.0. The sensitivity of each of the receptors has been determined to be either high, medium or low according to the descriptions relevant to groundwater presented in Table 9. Assigning receptor sensitivity includes consideration of the following factors:

- Adaptability
- Tolerance to disturbance
- Recoverability from impact
- Protection status.

Table 9 Groundwater receptor sensitivity

Sensitivity (to impact)	Description
High	Limited tolerance to disturbance and limited ability to adapt and recover.
Medium	Some tolerance to disturbance and some ability to adapt and recover.
Low	Tolerant to disturbance with ability to adapt and recover.

6.4.2 Assigning a magnitude level

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

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

The magnitude of a specific impact is based on clear criteria determined by the specialist undertaking the assessment and are defined relevant to groundwater in Table 10 and Table 11.

Table 10 Magnitude criteria

Terms		Description
Extent	Localised	Within 100 m
	Medium scale	Within 500 m
	Large scale	Within 2 km
	Regional	Within 10 km
Duration	Short-term	Up to 2 months
	Medium-term	Less than 2 years
	Long-term	Greater than 2 years
Severity	Permanent	Change to the water table elevation or groundwater quality that are substantial and irreversible
	Reversible	Changes to water table elevation or groundwater quality that are noticeable and are reversible once the activity has ceased
	Unlikely to be detectable	Changes to water table elevation or groundwater quality that are within natural variability

Table 11 Magnitude description

Magnitude	Description
Negligible	Impacts to groundwater that are unlikely to be detectable above natural conditions.
Low	Impacts to groundwater that are localised, short-term, and quickly reversible.
Medium	Impacts to groundwater that are medium-term and reversible over time.
High	Impacts to groundwater that are medium scale or above, medium to long term and reversible over time.
Very high	Impacts to groundwater that are large to regional scale, long-term, and permanent.

6.4.3 Assigning a consequence level

Consequence is the potential outcome of an event affecting a receptor. It is determined by combining magnitude of the impact and sensitivity of the receptor. The consequence level is assigned based on the receptor sensitivity level and magnitude level using the matrix in Table 12.

Consequences are assigned based on the maximum credible impact for each pathway. Where uncertainty exists, a conservative approach to assessing consequence is adopted.

Table 12 Consequence level matrix

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

6.4.4 Residual impacts

While there are clear steps in the assessment process, it may not always follow a linear progression. Typically, assessment requires multiple iterations of impact evaluation considering the assessment criteria and application of mitigation measures as the technical studies progress and additional information becomes available. The completed impact assessments are based on the final mitigation measures that will be implemented, and therefore describe the residual impacts. The residual impacts constitute the predicted consequences following the implementation of the mitigation measures and take into account the expected effectiveness of these measures.

6.5 Risk assessment method

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

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

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

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

6.5.1 Assigning a likelihood level

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

Likelihoods are assigned with consideration of mitigation and management measures according to the levels presented in Table 13.

Table 13 Guide to likelihood levels

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

6.5.2 Risk matrix

Risk is defined as combination of the likelihood of an event occurring (using Table 13) and the consequence of that event occurring (using Table 12).

A risk rating is then determined by these factors using the risk matrix, presented in Table 14.

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

Table 14 Risk matrix

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

6.6 Avoidance and minimisation through design

The impact assessment process is iterative and the design of the transmission alignment has been informed by earlier versions of environmental assessments in order to avoid and minimise potential impacts, including during:

- Pre-referral corridor selection
- Post-referral corridor selection
- Post feasibility licence award
- Post VicGrid establishment corridor selection.

At each decision point, the project, where reasonably practicable has sought to avoid and minimise impacts to a suite of environmental, heritage, socio-economic and landholder values. Avoid and minimise principles have materialised through reduced construction footprints and re-routing where sensitive values have been identified. These strategic considerations, informed by site validation have resulted in the footprint under which the onshore project is being assessed.

Relevant to this topic, the following measures have been adopted in relation to the design, construction and operation of the project to avoid and minimise impacts:

- Shallow trenching to avoid or minimise intersection with groundwater.
- Avoiding changes to hydrogeological processes.

6.7 Avoidance, mitigation and management

Once avoidance and minimisation measures have been exhausted, the next step is management of the residual impacts and risks. In the case of risks, the mitigation measures can be applied prior to the event occurring and/or after the event. The residual impacts and risks are evaluated against the assessment criteria to ensure impacts and risk are of an acceptable level.

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

6.8 Cumulative impact assessment

Cumulative impacts arise when the effects of a single project on a single receptor are considered alongside the effect of other projects on the same receptor. The project has considered the potential for cumulative impacts associated with other proposed projects. It is noted that projects that are operational are considered as part of the baseline environment, and the cumulative impact assessment focuses on proposed or future actions.

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

- Stage 1 Identifying potentially cumulative projects or actions
- Stage 2 Shortlisting identified projects or actions
- Stage 3 Gathering information
- Stage 4 Assessment

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

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

The cumulative impact assessment has followed a staged approach (as shown in Figure 6-2 and described in detail in EIS Chapter 6 - Assessment Framework and EES Chapter 6 - Assessment Framework).

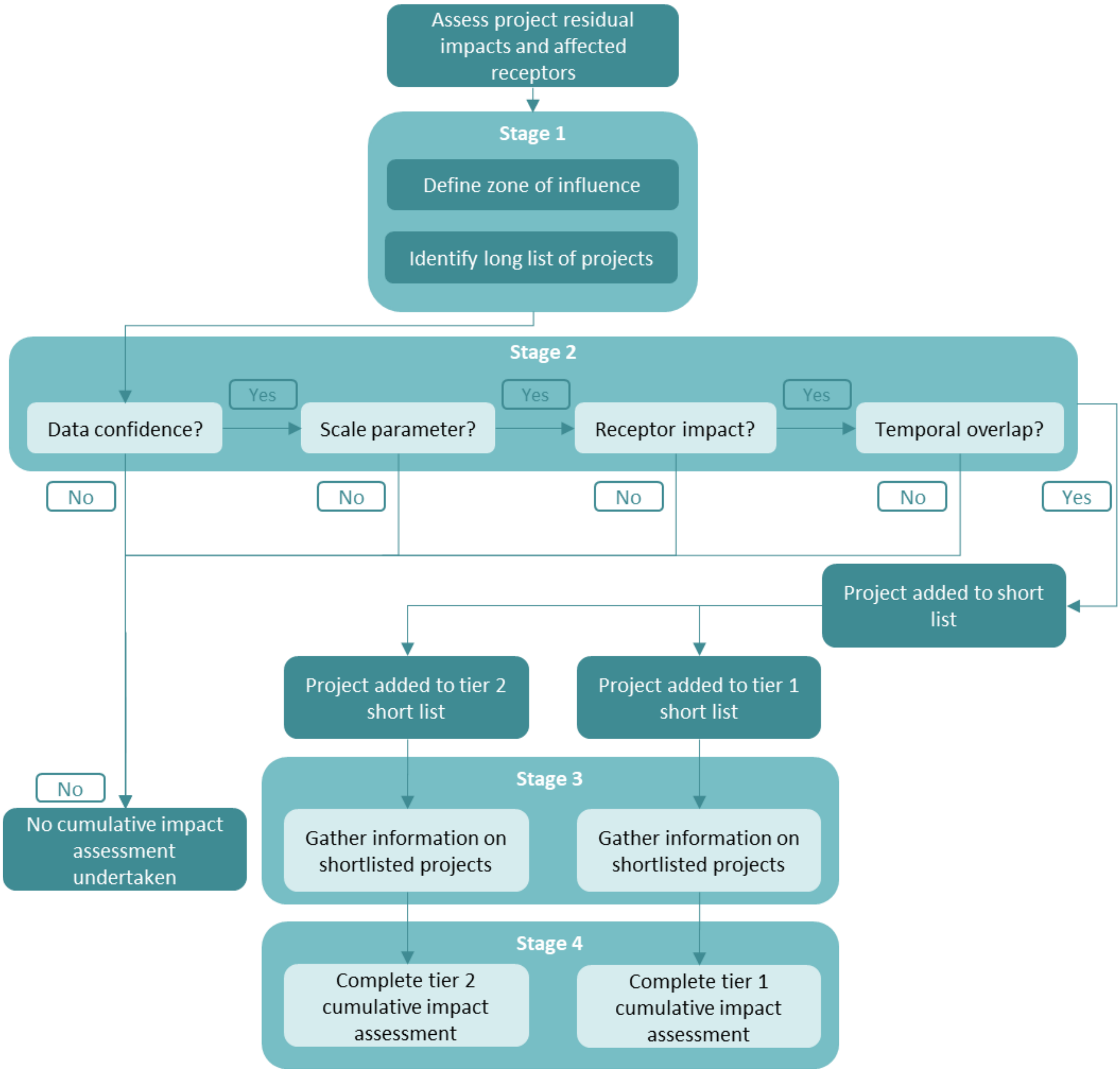

Figure 6-2 Cumulative impact assessment process

The EIS scoping guidelines for the project states that the assessment should 'address the potential cumulative impact of the proposed action on ecosystem resilience'. Both the EIS and EES scoping guidelines state that climate change impacts must also be considered. Ecological resilience is generally defined as "the ability of ecosystems to resist permanent structural change and maintain ecosystem functions" (DAWE, 2016). An assessment of ecosystem resilience including an assessment of climate change is addressed in the assessment of Ecosystem Resilience contained within the EIS Chapter 24 - EIS Summary and conclusions.

6.9 Limitations, uncertainties and assumptions

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

- No field work was undertaken for this assessment.
- The desktop assessment was limited to publicly and readily available information and studies conducted by Star of the South, 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.

- Details of registered wells are described as provided in the WMIS database (such as mapped location, use and construction). These have not been verified by way of site visit or discussions with landowners.
- The presence (or otherwise) of unregistered wells within the study has not been confirmed as part of this assessment.
- The onshore cable alignment is assumed to be trenched excepting the unnamed waterway behind the shore crossing where trenchless methodologies are proposed.
- The project will be constructed, operated, and decommissioned as presented in the assumptions throughout this report.
- Mitigation measures outlined in Section 13.0 will be employed as described.

6.10 Linkages to other technical reports

This report has interdependencies with the report in relation to the assessment of impacts associated with:

- Alterations to groundwater hydrology during construction leading to a decline in the extent and health of GDEs, including stygofauna (*Technical report G - Onshore ecology*)
- Groundwater is extracted and released to the surface where it can enter and pollute receiving waterways (*Technical report I - Surface water*)
- Intersection, handling, storage and/or disposal of contaminated groundwater during construction affects human health via direct and secondary contact and/or the environment (*Technical report J - Soil and waste*).
- Handling, storage and/or disposal of non-contaminated dewatering water that does not meet relevant discharge criteria (e.g., acidic and/or brackish water) affects the soil or surface water quality (*Technical report J - Soil and waste*).
- Dewatering results in mobilisation of contaminant plumes from outside of the project area which in turn affects human health and/or the environment (*Technical report J - Soil and waste*).

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

7.0 Existing environment

7.1 Study area setting

The study area (as defined in Section 6.2) is located in the Gippsland Basin south of Sale. The study area is within a region termed the 'Gippsland plains' because it is relatively flat and low-lying. The Strzelecki Ranges lie to the northwest of the study area. Surface elevation ranges from approximately 50 metres above sea level in the north of the study area to sea level along the coastline near the shore crossing.

The study area is located within the South Gippsland river basin and crosses several named and unnamed waterways between the Reeves Beach shore crossing site and the proposed VicGrid connection hub in Giffard. Named waterways include Morris Creek, Warrigal Creek, Sunville Creek, and Hoddinott Creek. These waterways are described in *Technical report I – Surface water*.

There are no Ramsar Wetlands or nationally important wetlands[3] in the study area. However, the small unnamed waterway located in the vicinity of the shore crossing forms a connection between Freshwater Swamp and the Corner Inlet Ramsar Site located approximately six kilometres to the south of the study area at the mouth of Bruthen Creek estuary. This unnamed waterway is described further in *Technical report I – Surface water*.

The climate in the study area is classed as temperate under the Koppen-Geiger climate classification scheme. Mean annual rainfall in the area is approximately 600-800 millimetres per year and potential evapotranspiration ranges from over 200 millimetres per month in summer to less than 50 millimetres per month in winter (Yates et al., 2015). The Gippsland plains are prone to flooding following significant rainfall events. Additional information on surface water and flooding is included in *Technical report I: Surface water*.

7.2 Geology

7.2.1 Gippsland Basin

The study area is located in the Gippsland Basin. The basin began to form in the late Jurassic as a result of rifting along the southern Australian plate margin and covers an area of approximately 46,000 square kilometres including onshore and offshore portions (Geoscience Australia, 2014). The main deposition centres in the offshore portion of the basin contain around 12 kilometres of sediments, and these have been a significant source of oil and gas for Australia since discovery in the 1960s (Yates et al., 2015). The study area is within an area of the basin termed the Seaspray Depression.

7.2.2 Study area

The surface geology in the study area is shown in Figure 7-1 sourced from the 1:250,000 seamless geology mapping (Department of Jobs, Precincts and Regions, 2014). The study area crosses various Quaternary deposits including unnamed coastal dune deposits near the coastline, unnamed swamp and lake deposits, unnamed alluvium, and unnamed dune deposits.

[3] Nationally important wetlands are those listed in the Directory of Important Wetlands in Australia (Department of Agriculture, Water and the Environment, 2005).

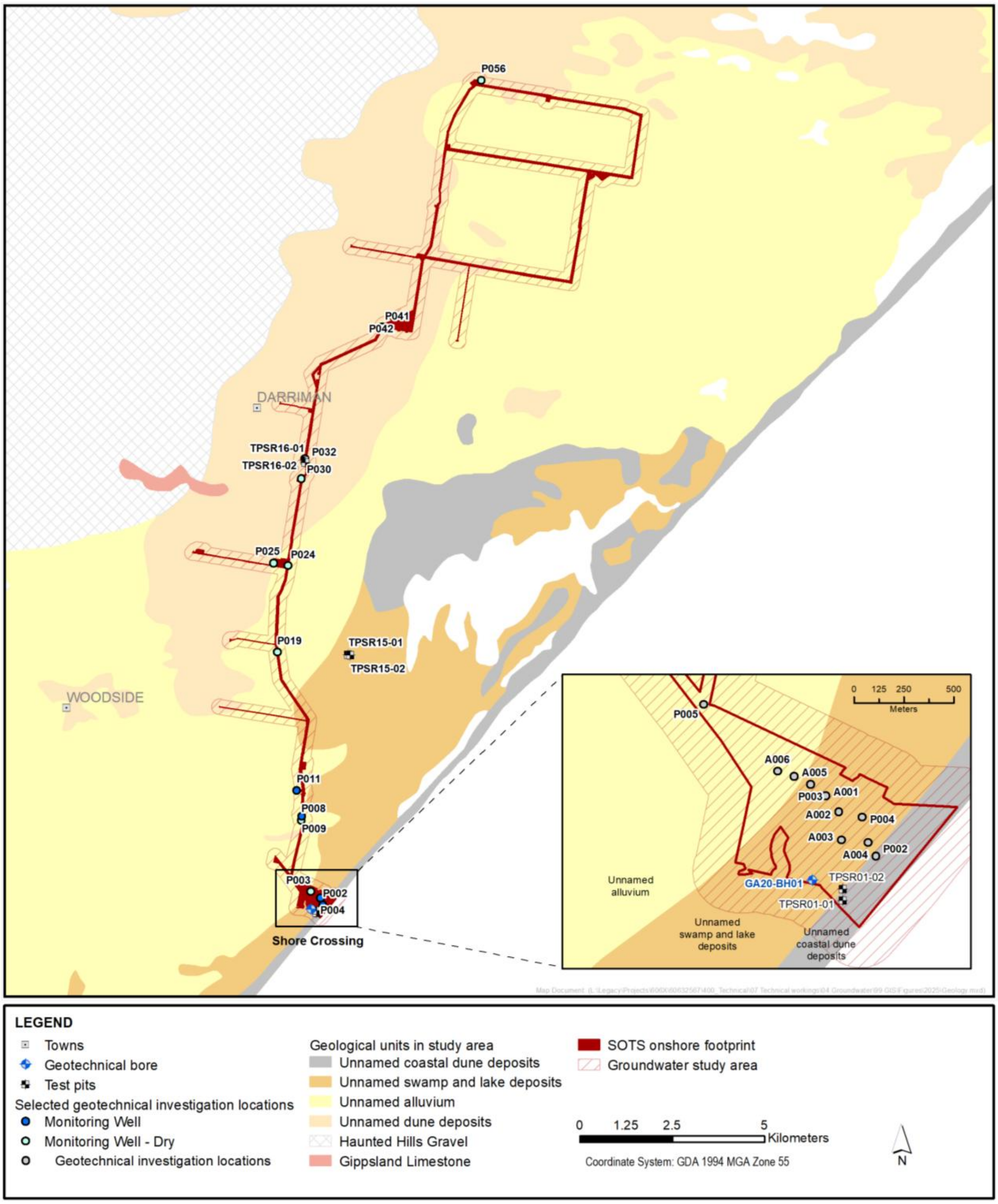

Figure 7-1 Geology and investigation locations

The unnamed coastal dune deposits (Qdl1) near the coast are described as aeolian and littoral dune sands with some swamp deposits and beach sand. A well advanced into this lithology as part of the preliminary geotechnical investigation (P002; Douglas Partners, 2022) intersected fine to coarse grained silty sand with clay to a depth of 5 metres below ground level.

Unnamed swamp and lake deposits (Qg) are approximately 230 - 550 metres from the coastline are described as paludal silts and clays. Hand auger wells (A001 to A004; Douglas Partners, 2022) within this lithology intersected fine to medium silty and clayey sand to a depth of approximately 1.5 metres below ground level.

The unnamed alluvium (Qa2) is described as fluvial gravels, sands, and silts. Two hand auger wells (A005 and A006) and multiple test pits (P005-P013, P017-P026, P052-P055) and three wells (P019, P024, P025) were advanced into the unnamed alluvium and intersected sandy and silty clay, with minor gravel to a depth of 3.0 metres below ground level (Douglas Partners, 2022).

The unnamed dune deposits (Qd2) are described as aeolian dune deposits including sand, clay, and calcareous sand. Multiple test pits and well holes advanced this lithology predominantly intersected sandy and silty clay to a depth of at least 12 metres below ground level.

7.3 Aquifers

The Victorian Aquifer Framework defines the major aquifers and aquitards in the state (GHD, 2012). Hydrogeological units defined as aquifers are those that can transmit usable quantities of water, meaning that they are more permeable (for example, sand). Hydrogeological units defined as aquitards are less permeable and inhibit the movement of water (for example, clay).

The relationships between the geological units, hydrogeological units, and aquifers within the Victorian Aquifer Framework are shown in Table 15 below. The Quaternary age geological units are all part of the quaternary aquifer (QA) which forms the water table across the entire study area.

Table 15 Victorian Aquifer Framework relationships in the study area

VAF Geological Unit (GU)	Equivalent Unit in Coffey (2020)	VAF Hydrogeological Unit (HGU)		VAF Aquifer			Bioregional Assessment Aquifer Naming Convention
		Code	Name	Name	Code	Number	
Unnamed coastal dune deposits	Unit A	1002	Various fluvial/ lacustrine/ alluvial/ colluvial sediments	Quaternary Aquifer	QA	100	Upper aquifer system
Unnamed swamp and lake deposits	Unit G						
Unnamed alluvium	Unit F						
Unnamed dune deposits	Unit C	1001	Various aeolian deposits				

Notes:

1. *VAF = Victorian Aquifer Framework*
2. *The Victorian Aquifer Framework is described in GHD (2012).*
3. *The Bioregional Assessment aquifer naming system is described in Yates et al (2015).*
4. *The units described in Coffey (2020) were investigated using test pits for the purposes of acid sulfate soil assessment.*

The Victorian Aquifer Framework three-dimensional aquifer mapping suggests that the QA ranges from approximately three to 20 metres in thickness in the study area. The QA is unconfined to semi-confined.

There is no site-specific data available on the hydraulic properties of the QA in the study area, such as hydraulic conductivity (a measure of how easily water can pass through soil or rock) and storativity (a measure of the capacity of an aquifer to release groundwater under pumping).

The hydraulic properties are likely to be highly variable across the aquifer based on the different depositional environments. For instance, low energy depositional environments (such as a swamps) have more silt and clay and subsequentially a lower hydraulic conductivity. High energy depositional environments (such as a beaches) have a higher hydraulic conductivity. Test pits installed close to the Reeves Beach shore crossing site (TPSR01-01 and TPSR01-02) were observed to fine to coarse grained sand and groundwater flowing into the pit at a 'relatively high' flow rate (Coffey, 2020), which is consistent with a high hydraulic conductivity.

Hydraulic properties are also likely to vary significantly with depth because the Quaternary deposits were typically deposited in layers where the depositional environment changes over time. This is termed vertical heterogeneity and it inhibits or enhances the vertical flow of groundwater.

Sand and gravel beds within the QA in the Gippsland Basin can have hydraulic conductivities of 0.1 to more than 50 metres per day (Beverly et al., 2015). Specific yield ranges from 0.04 to 0.25 (unitless) in the unconfined areas and specific storage ranges from 1×10^{-5} to 1×10^{-4} per metre in the semi-confined or confined portions (Beverly et al., 2015).

In calibrating the Gippsland groundwater model, a hydraulic conductivity of 6.5 metres per day and storativity of 0.1 (for unconfined areas) were adopted for the aquifer overall (Beverly et al., 2015).

7.4 Groundwater levels and flow

7.4.1 Groundwater flow

Groundwater in the water table aquifer (the QA) tends to flow from high to low elevation. Flow paths tend to be shorter (termed local flow systems) in higher relief areas and longer (termed intermediate or regional flow systems) in the coastal plains (SRW, 2012). Vertical groundwater flow is generally significantly slower than horizontal flow in the water table aquifer in the Gippsland Basin (SRW, 2012).

Recharge is via rainfall infiltration. In floodplains and adjacent to waterbodies, recharge also occurs via watercourse leakage and flood recharge (Yates et al., 2015).

Discharge from the water table aquifers occurs via downwards infiltration to deeper aquifers and via discharge to waterbodies including along the coastline.

7.4.2 Depth to water table

Defining the depth to groundwater in the study area is important for the impact assessment because this will inform whether groundwater is likely to be intercepted during intrusive works. Depth to groundwater will also inform an understanding of the likely key groundwater receptors.

Regional Mapping

The modelled groundwater elevation in the water table aquifer beneath the study area shown in Figure 7-2 is from the Victorian Government 2016 10 metre digital elevation model and Victorian Aquifer Framework (Department of Primary Industries, 2014a).

Groundwater is shallow (less than two metres below ground surface) near the coastline and adjacent to present-day streams. Groundwater is deeper elsewhere and is greater than 20 metres below ground surface in places. This regional mapping of groundwater level is based on a combination of groundwater observation well data and digital elevation modelling and therefore is subject to uncertainty.

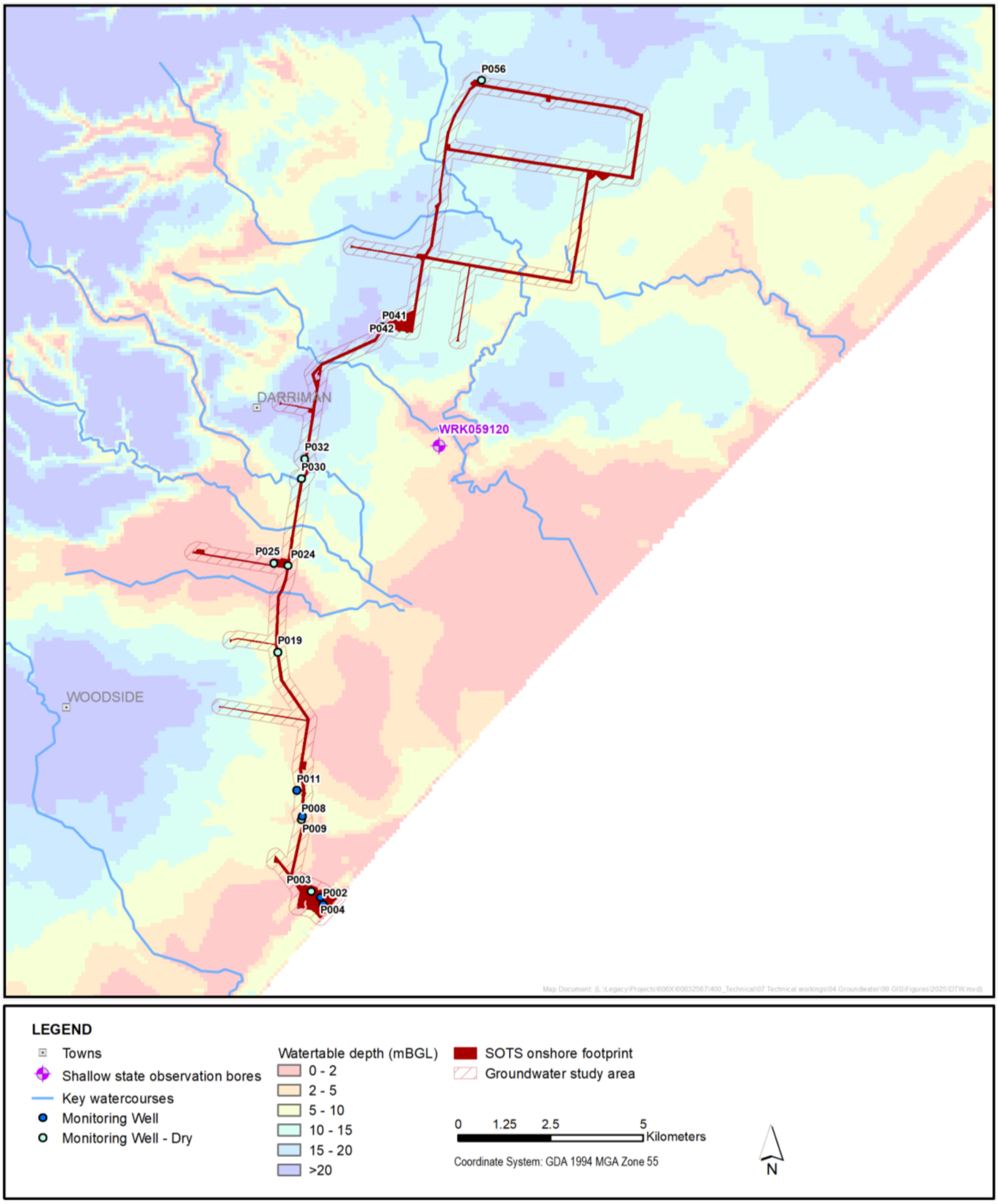

Figure 7-2 Depth to water table

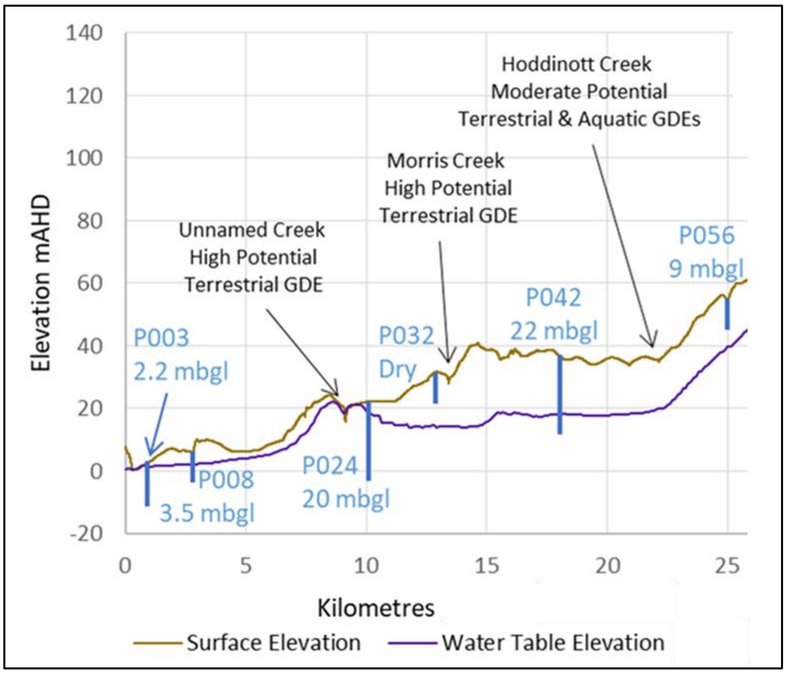

Figure 7-3 Watertable elevation cross section showing modelled depth to water table and Douglas Partners (2022) groundwater monitoring well installation locations. Surface elevation is from the Victorian Government 10 m digital elevation model. Blue line represents installation depth. The measured depth to water within each well is shown as metres below ground level (mbgl).

The depth to water in the monitoring wells installed by Douglas Partners (2022) in some cases agree with the modelled water table elevation and in other cases do not agree with the modelled water table elevation (refer to Figure 7-3). However, it is noted that based on well construction depths and well logs some wells may not be screened within an aquifer below the water table aquifer.

Site Investigations – Shore Crossing Area

During the geotechnical investigation (Douglas Partners, 2022) one monitoring well was installed near the near the Reeves Beach shore crossing, within the unnamed swamp and lake deposits . The well log indicates that during drilling groundwater was intersected at 3.0 metres below ground level. A water level logger was installed in the well with water level data measured on an hourly interval between November 2022 and September 2023. The measured water level ranged between 2.1 and 2.5 metres below ground level, which is deeper than estimated depth to water table by the regional model (0.1 metres below ground level). In the shore crossing area shallow groundwater was also observed in P002 and P004 (0.2 metres, 185 and 390 metres from the coastline), A004 (1.2 metres, 275 metres from the coastline) and A002 (0.3 metres, 380 metres from the coastline).

The well log for P003 indicates that between 4.6 and 8.5 metres below ground level there is approximately 4 metres of moist clay below which is wet silty sand and clayey sand to 15.5 metres below ground level. The well is screened between 8.5 and 15.0 metres below ground level, suggesting that the measured level could be a different (confined or semi-confined) water bearing unit. During the monitoring period there was a minor 10 centimetre sinusoidal tidal influence on the water level.

The depth to groundwater within the study area is summarised Table 16; well locations are shown in Figure 7-1.

Table 16 Groundwater levels within study area

ID	Nearest Kilometre Marker (km)	Surface Geology	Well Depth (mbgl)	Surface Elevation (mAHD)	Depth to Water (mbgl)	Potentiometric Elevation (mAHD)
GA20	0	Qg	-	-	1.0	-
P004	0	Qg	-	1.35	6.7	-
P005	0	Qg	-	1.40	5.0	-

ID	Nearest Kilometre Marker (km)	Surface Geology	Well Depth (mbgl)	Surface Elevation (mAHD)	Depth to Water (mbgl)	Potentiometric Elevation (mAHD)
P003	1	Qg	15	3.67	3.0 and 8.5	-
P003	1	Qg	15	3.67	2.08 to 2.45	1.22 to 1.59
P008	3	Qa2	15	5.06	4.5	-
P008	3	Qa2	15	5.06	3.22 to 4.07	0.99 to 1.84
P009	3	Qa2	-	5.10	6.0	-
P011	4	Qa2	-	7.55	3.7	-
P024	10	Qa2	10	24.15	19.92 to 20.28	3.87 to 4.23
P032	13	Qd2	25	34.33	Dry to 9.2 mbgl	<25
P042	18	Qd2	10	34.63	21.5 to 21.7	12.93 to 13.13
P046	20	Qd2	-	33.79	0.9	-
P056	25	Qd2	25	51.82	9.1 to 9.21	42.61 to 42.72

Notes:
GA20 is from Golder (2020) with the depth to water measured between the 5th and 6th of May 2020 other data are from Douglas Partners (2022).
Underlined text represents water strikes during drilling/test pitting.

Site Investigations – Onshore Transmission Corridor

Shallow groundwater (less than five metres below ground level) was encountered in only one geotechnical investigation point (P011) advanced in June 2022 along the remainder of the onshore transmission corridor (Douglas Partners, 2022). At the majority of locations, the depth to groundwater was greater than five metres below ground level at the time of the investigation.

The uncertainty in groundwater levels beneath the study area is dealt with in the impact assessment using the precautionary approach whereby conservative assumptions have been made on initial groundwater levels (see Section 9.2).

7.4.3 Seasonal fluctuation

Understanding seasonal variability in groundwater levels is important for the impact assessment because this will inform whether groundwater is likely to be intercepted during intrusive works. Seasonal variability in groundwater levels will also inform potential impacts to terrestrial GDEs (that is, vegetation that relies on groundwater) as discussed in *Technical Report G - Onshore ecology*.

Groundwater levels associated with upper (unconfined) aquifers are typically more sensitive to seasonal rainfall recharge variability. Shallow groundwater, i.e., less than 5 metres below ground level was observed in two monitoring wells within the study area; P003 and P008. Hydrographs (that is, time series groundwater levels) for these wells are shown in Figure 7-4 and Figure 7-5.

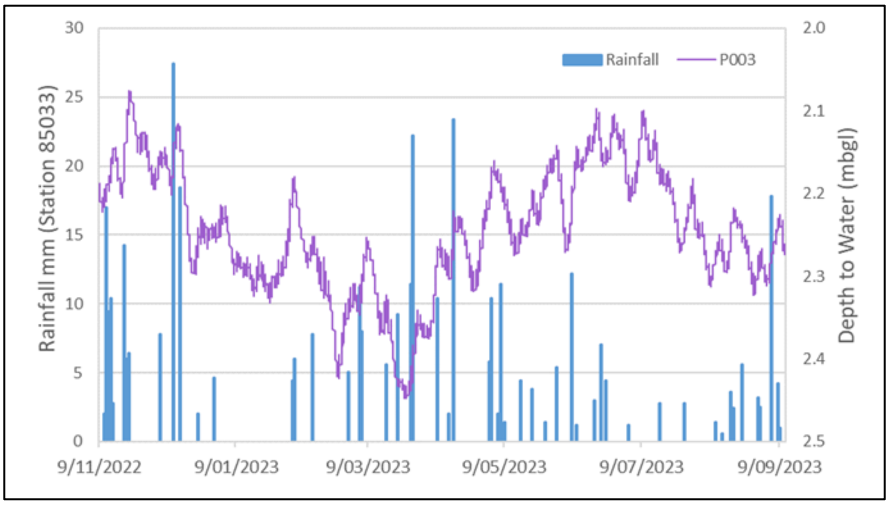

Figure 7-4 P003 depth to water and rainfall (Bureau of Meteorology Station Giffard [85033])

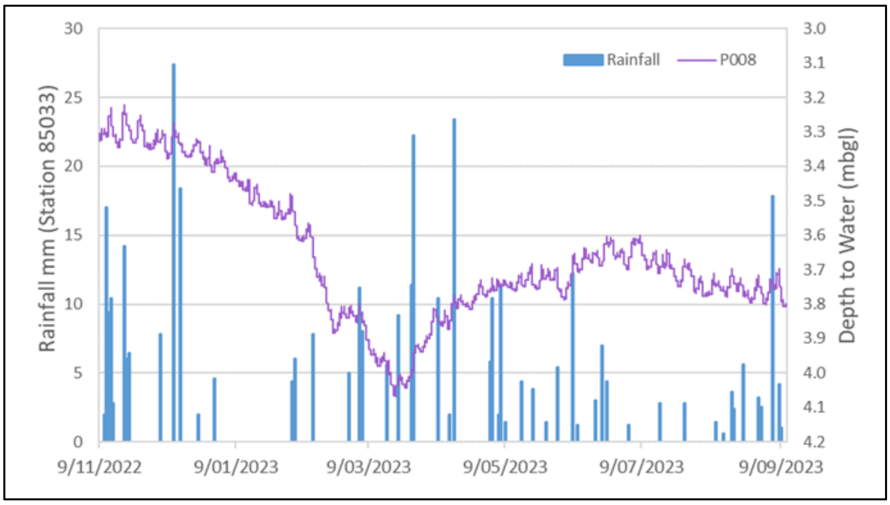

Figure 7-5 P008 depth to water and rainfall (Bureau of Meteorology Station Giffard [85033])

As indicated on the hydrographs the depth to water in the wells exhibit minimal variation, generally less than 1 metre and the depth to water decreases during the summer months and increases during the winter months.

State Observation Bore Network data was reviewed in order to identify whether greater variations than observed in P003 and P008 during 2022 and 2023 could be expected. There are no shallow State Observation Wells available in the groundwater study area, however eight wells were identified within 20 kilometres of the study area installed to depths of less than or equal to 30 metres below ground level. Hydrographs for two of these wells are shown in Figure 7-6 and Figure 7-7 below. WRK059120 is screened at a depth of 18 to 24 metres below ground level and located approximately 3.5 kilometres east of the groundwater study area. WRK059121 is screened at a depth of 17 to 20 metres below ground level and located approximately 20 kilometres west of the groundwater study area. The wells have been gauged on a monthly basis since 2011. The screened aquifer for these bores is not listed in the SOBN database; however, a lithology log exists for WRK059121 and lists the geology at the screen as "sand".

The WRK059120 hydrograph indicates a seasonal depth to water fluctuation of approximately 0.5 metres per year.

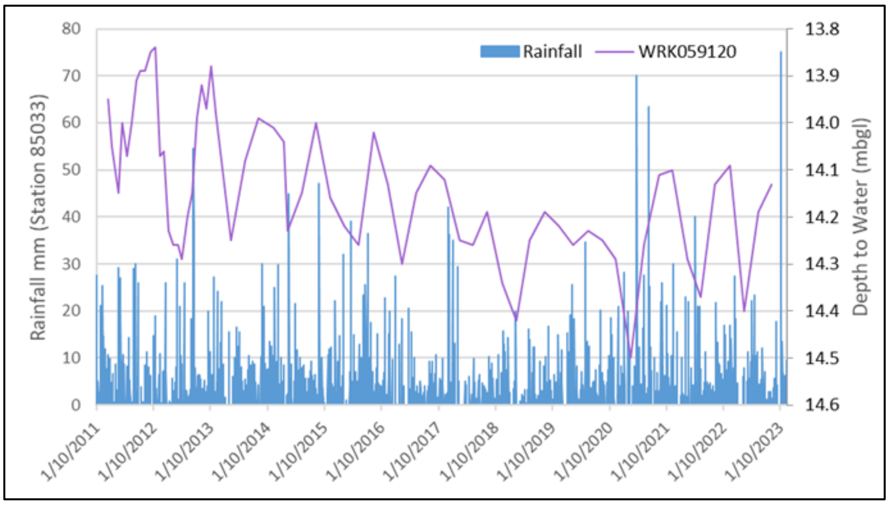

Figure 7-6 Long-term groundwater levels at state observation well WRK059120

In contrast to the WRK059120 hydrograph the WRK059121 hydrograph (Figure 7-7, below) the depth to water does not show an any seasonal correlation. This lack of correlation may be related to the installation location, adjacent to Spring Creek suggesting the creek is losing stream (i.e., the waterway constantly recharges the aquifer).

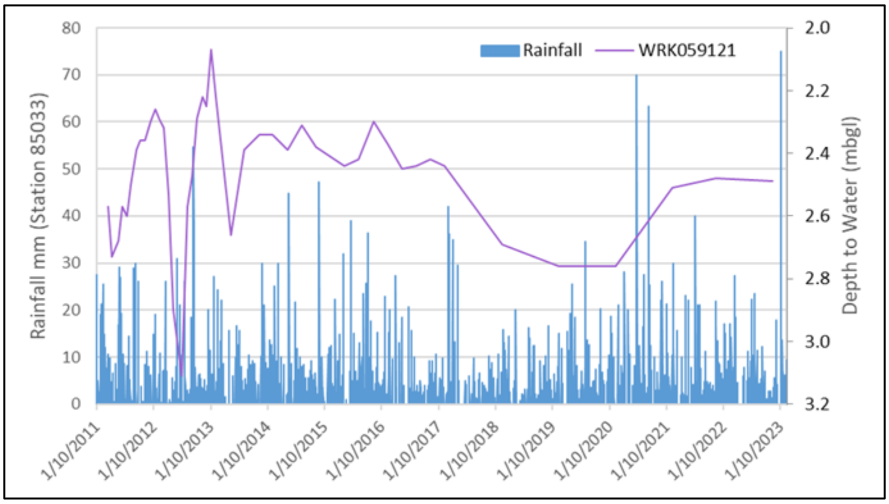

Figure 7-7 Long-term groundwater levels at state observation well WRK059121

Seasonal fluctuations tend to be greater in shallow groundwater. Based on the screened depth of the two SOBN bores, it is possible that they do not capture the magnitude of seasonal fluctuation in groundwater levels at the watertable in low lying areas.

Groundwater level variability in the water table aquifers of the Gippsland Basin is a result of seasonal rainfall recharge variability, flood recharge, and seasonal groundwater extraction (SRW, 2012).

The WRK059120 hydrograph also shows a modest long-term decline in groundwater depth. This may impact the ability of terrestrial GDEs (that is, vegetation that relies on accessing groundwater during dry periods) to survive with short term groundwater level declines.

Although groundwater levels in the deep aquifers (below the study area) have decreased significantly due to offshore oil and gas extraction, it is believed that this has not impacted water levels in the water table aquifers (Yates et al., 2015).

7.5 Groundwater quality

Defining the quality of groundwater in the study area is important for the impact assessment because this will inform the relevant environmental values to be achieved and maintained.

There is limited information available on the hydrogeochemistry of the aquifer in the Gippsland Basin (Yates et al., 2015). An investigation of major ion chemistry, stable hydrogen, carbon and oxygen isotopes and strontium isotopes suggested that the main hydrogeochemical process in the basin is evapotranspiration of rainfall infiltration, with minor silicate and carbonate weathering (Hofmann and Cartwright, 2013).

A regional groundwater salinity (total dissolved solids - TDS) interpolation in groundwater from wells installed less than 50 metres below ground in the study area is shown in Figure 7-8 below. The interpolation is presented in categories that align with groundwater segments (as discussed in Section 7.6 below). Groundwater TDS in most of the study area falls in the 1,201-3,100 milligrams per litre category, with a portion in the centre of the study area in the 3,101-5,400 milligrams per litre category.

Two grab samples were collected from geotechnical well GA20-BH01 in the Reeves Beach shore crossing area (Golder, 2020) are consistent with groundwater TDS measurements from nearby wells (Table 17).

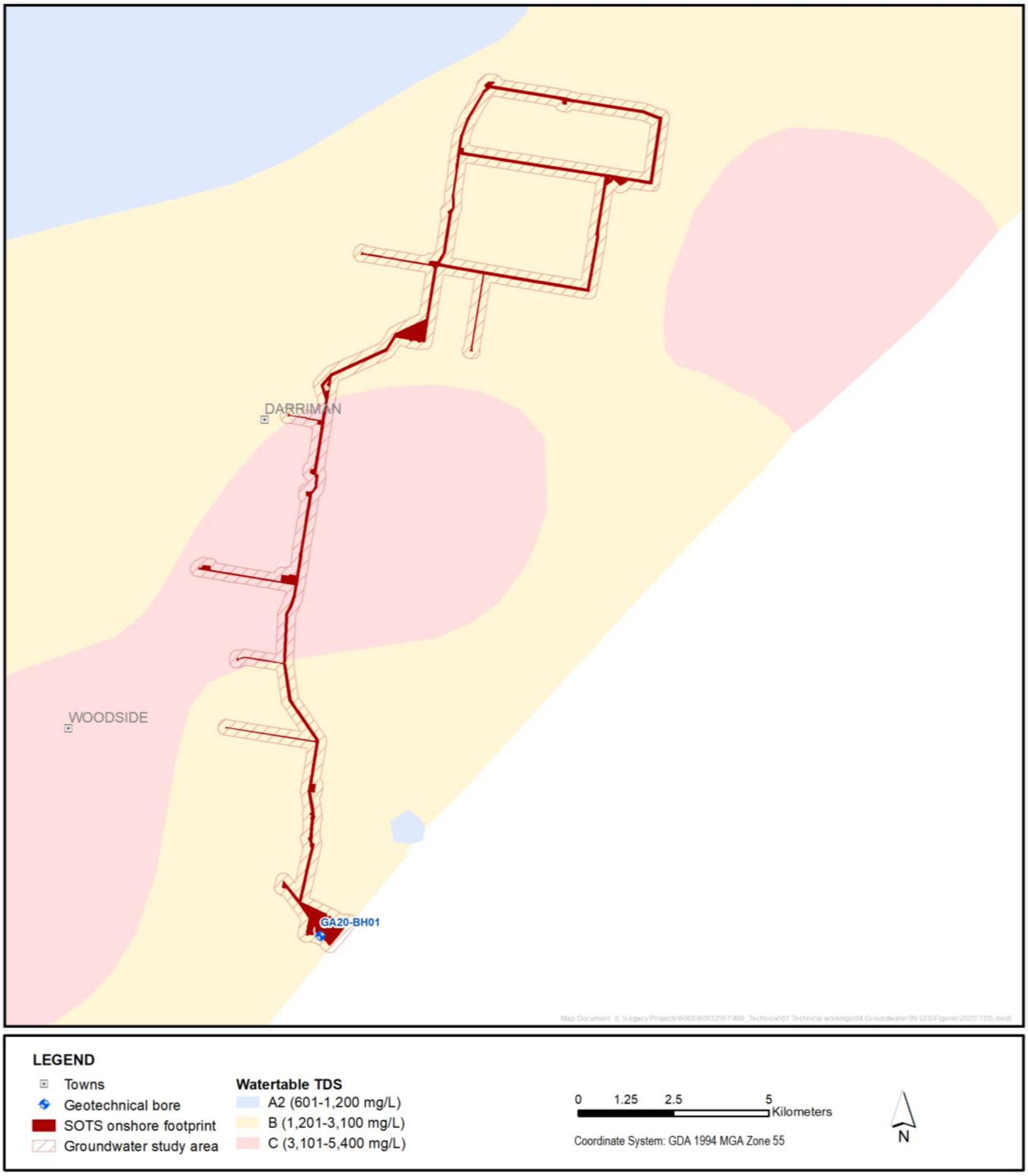

Figure 7-8 Watertable total dissolved solids concentration

Table 17 Groundwater quality grab samples at geotechnical well GA20-BH01

Monitoring point	Sample depth (mbgl)	Electrical conductivity (µS/cm)	pH (pH units)
GA20-BH01	8.25	5,830	7.01
GA20-BH01	16.25	3,420	6.66

7.6 Environmental values

The ERS is put into effect under Section 93 of the EP Act. 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.

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. The ERS divides groundwater across Victoria into seven 'segments'. These segments are defined by salinity ranges measured as TDS. Within each segment (or range of TDS) a number of environmental values are identified that need to be achieved and maintained.

Based on the regional TDS mapping discussed in Section 7.5 above, the study area falls within Segment B and Segment C. Therefore, Segment B has conservatively been assigned to the study area overall. The environmental values will be achieved and maintained by identifying monitoring and mitigation measures (where required) in line with the GED, ERS and 'State of Knowledge' considerations as required under the EP Act.

The environmental values that need be achieved and maintained for Segment B groundwater are shown in Table 18. Potable mineral water supply and geothermal properties are not considered relevant as the shallow groundwater has not been reported to naturally effervesce or have temperatures above 30 degrees.

Table 18 Environmental values of groundwater

Environmental values	Segment (TDS mg/L)						
	A1 (0-600)	A2 (601-1200)	B (1,201-3,100)	C (3,101-5,400)	D (5,401-7,100)	E (7,101-10,000)	F (>10,000)
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	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

7.7 Groundwater management areas

The study area is not within any Groundwater Management Areas (GMAs) or Water Supply Protection Areas (WSPAs) and is therefore classed as an 'unincorporated area'. Unincorporated areas are typically where no significant development of the groundwater resource has occurred. This is usually because the groundwater resource is low yielding, or its quality has traditionally severely limited its use.

The boundaries of the Giffard GMA and Yarram WSPA (Zone 1) do cover the study area; however, these apply to depths greater than 25 metres below ground level, and so are not applicable.

7.8 Groundwater users

Based on a search of the WMIS database[4] conducted on 3rd March 2025, there are seven registered groundwater wells within the study area (that is, the 200 metre buffer area). The well uses are:

- Domestic and/or stock: four wells.
- Not known: three wells.

The Douglas Partners (2022) and Golder (2020) wells are not listed in the WMIS well search.

Further details on the registered groundwater wells in the groundwater study area are provided in Table 19 and their locations are shown in Figure 7-9.

None of the registered wells are located in the project easement or construction corridor. The approximate distance of the wells from the edge of the easement are listed in Table 19.

It is acknowledged that there is some potential for existing wells to have incorrect coordinates and/or wells that are unregistered to actually exist within the study area. This risk is considered and mitigation measures included to account for this potential.

[4] Search of the WMIS database was undertaken on the VVG database: https://www.vvg.org.au/

Table 19 Registered wells in study area

Well ID	Installed Year	Easting	Northing	Depth (mbgl)	Use	Within easement	Within construction footprint	Approximate distance from edge of easement	Alignment options
47315	1968	495717.4	5733481	46.71	Not Known	No	No	190 m	All
WRK103215	2017	495030	5737657	53	Domestic	No	No	190 m	All
WRK103883	2018	495623	5744019	101	Not Known	No	No	130 m	All
WRK111004	2019	495010	5739061	60	Not Known	No	No	140 m	All
58495	1983	497863.4	5748434	38.44	Domestic, stock	No	No	900 m *	All
58489	1975	499711.4	5746627	33.6	Domestic, stock	No	No	1400 m *	A
64348	1983	501565.4	5750689	54.8	Domestic, stock	No	No	170 m	B

Notes:
* Bores 58495 and 58489 are within 200 m of access roads, hence they are within the groundwater study area even though they located relatively far away from the project easement.

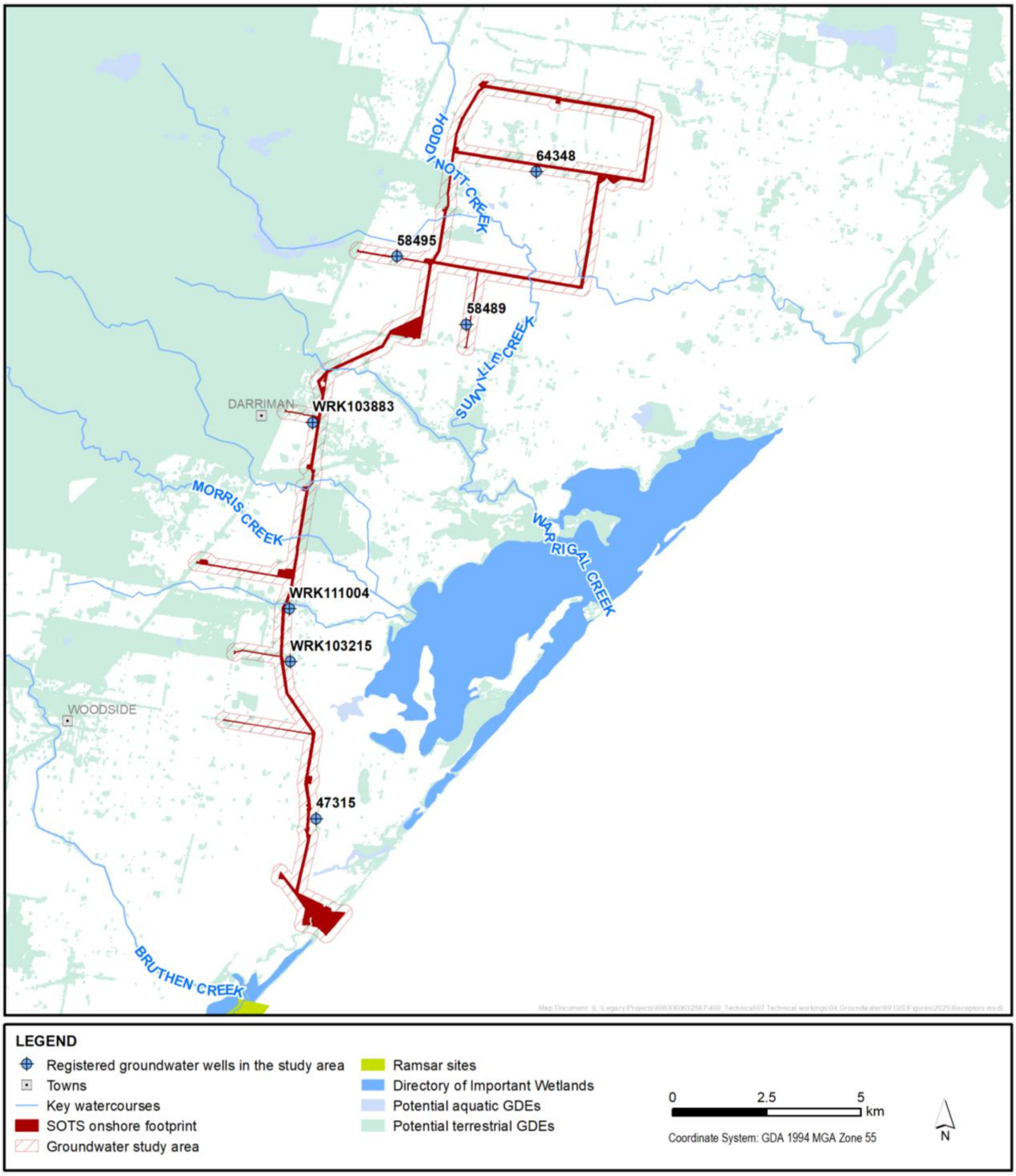

Figure 7-9 Groundwater users and receptors

7.9 Groundwater dependent ecosystems

The assessment on defining the potential GDEs within the study area relies primarily on regional mapping reported in the GDE Atlas (Doody et al., 2017). Site-specific surveys of onshore flora and fauna, including those that may be groundwater-dependent, are reported in *Technical report G - Onshore ecology*.

The GDE Atlas was developed as a national dataset of Australian GDEs. The GDE Atlas contains information about aquatic ecosystems that may rely on groundwater that discharges to the surface, including rivers, springs and wetlands. The GDE Atlas also contains information about terrestrial ecosystems that may rely on the subsurface presence of groundwater, including vegetation.

It is important to note that the identification of potential GDEs in the GDE Atlas does not confirm that a particular ecosystem is groundwater dependent.

Potential aquatic and terrestrial GDEs from the GDE Atlas are shown Figure 7-9 and are discussed further below.

7.9.1 Aquatic

These are four watercourses in the study area classed as potential GDEs in the GDE Atlas. These are: Morris Creek, Warrigal Creek, Hoddinott Creek, and Sunville Creek. Morris Creek and Warrigal Creek are classed as 'high' potential GDEs. Hoddinott Creek and Sunville Creek are classed as 'moderate' potential GDEs.

There are no potential aquatic GDEs listed in the GDE Atlas within the Reeves Beach shore crossing area.

7.9.2 Terrestrial

There are eight ecological vegetation classes (EVCs) in the study area that have been identified as potential terrestrial GDEs in the GDE Atlas. It is noted that there have been no regional GDE assessments undertaken in the study area, with all GDE classification derived from the national assessment. The EVC types that are listed as potential GDEs in the study area are listed in Table 20.

Table 20 EVC types in the study area that are listed as potential GDEs

EVC type	GDE Potential		
	Low	Moderate	High
Coast Banksia Woodland			✓
Damp Sands Herb-rich Woodland		✓	✓
Estuarine Wetland		✓	✓
Lowland Forest	✓	✓	
Lowland Forest/Heathy Woodland Mosaic	✓	✓	
Plains Grassy Forest	✓	✓	✓
Riparian Scrub	✓	✓	✓
Swamp Scrub		✓	✓

The following potential terrestrial GDEs (listed in the GDE Atlas) are located in the Reeves Beach shore crossing area:

- Coast Banksia Woodland, associated with Corner Inlet to the south.
- Estuarine Wetland, associated with the vegetated coastal dune system.
- Damp Sands Herb-rich Woodland, associated with the small unnamed waterway located in the vicinity of the shore crossing.

7.9.3 Subterranean

The GDE Atlas does not include subterranean GDEs in Victoria.

A regional baseline stygofauna survey was conducted in the Gippsland Basin by the Geological Survey of Victoria (Bold et al., 2020). Stygofauna are fauna that permanently inhabit below ground ecosystems that rely entirely on groundwater.

Twenty State Observation Wells were sampled as part of the baseline survey, including two wells screened in the QA. One out of the 20 groundwater samples contained stygofauna, made up of five individuals from one taxon collected from a QA screened well, in the alluvial floodplain of the Mitchell River near Bairnsdale. Sample locations are shown in Figure 7-10 below.

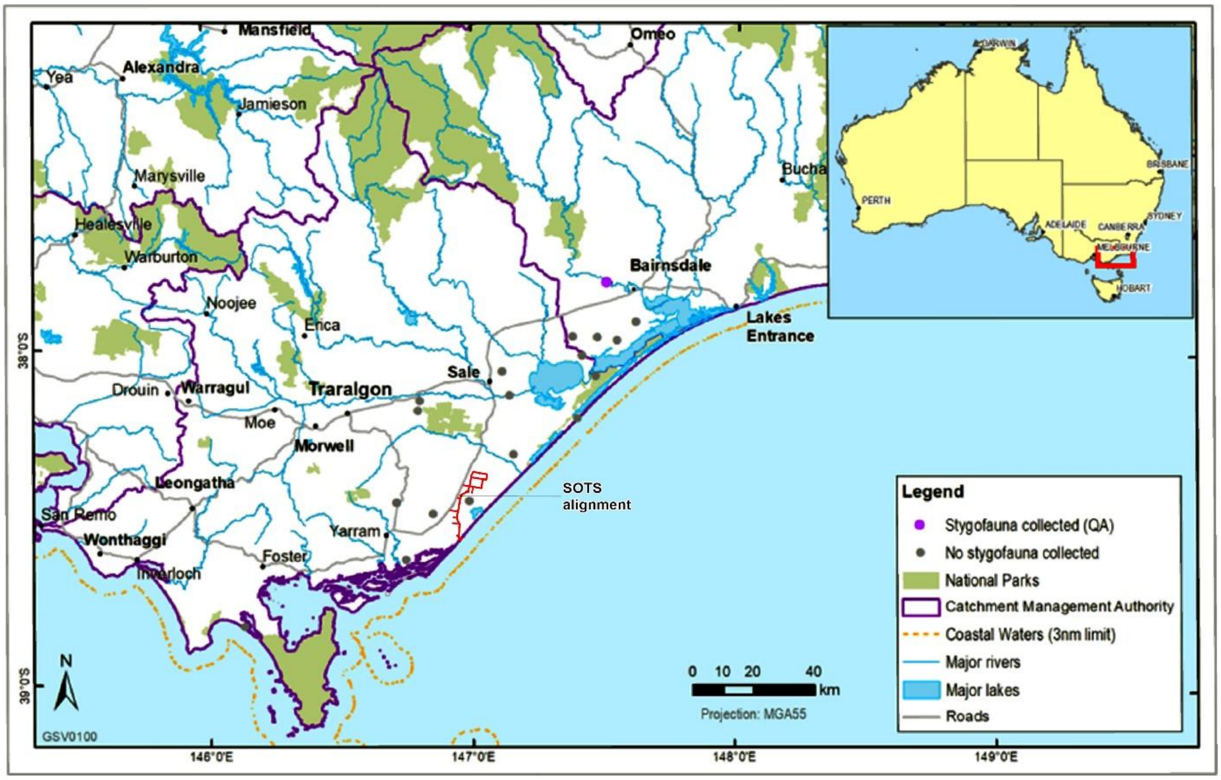

Figure 7-10 Gippsland Basin regional stygofauna baseline survey sampling locations (Bold et al., 2020)

The report concluded that 'the abundance of stygofauna taxa was low compared to other state surveys', which was attributed to the fine-grained sediments of the aquifers tested in the regional baseline survey.

It is possible that stygofauna exist within the study area, and there has been no site-specific stygofauna sampling undertaken as part of this assessment.

7.10 Groundwater – surface water interactions

Some surface waterbodies termed 'gaining systems' receive groundwater discharge. A gaining waterbody can be perennial meaning that it flows even during low rainfall periods. However, an ephemeral waterbody can also be gaining for short periods following a rainfall event and then dry up. Some waterbodies termed 'losing systems' act as groundwater recharge sources. Surface waterbodies can change from gaining to losing over time and variable distances.

7.10.1 Watercourses

There are four named watercourses listed in Victorian Water Asset Database (VWAD) that intersect the study area. These are Morris Creek, Warrigal Creek, Hoddinott Creek, and Sunville Creek.

Where a watercourse is identified in the GDE Atlas as a potential GDE, this indicates it is potentially a gaining system, that is, to some extent relying on groundwater discharge. All named watercourses listed in the paragraph above are included in the GDE Atlas (refer to Section 7.9.1).

The unnamed waterway in the shore crossing area is likely to be in connection with groundwater given the shallow depth to watertable in this area (refer to Section 7.4.2). There is no evidence available on the nature of this connection. However, waterways in shallow groundwater environments can fluctuate between being losing (following a large rainfall event) to gaining (at other times).

7.10.2 Wetlands

A search of the VWAD shows that there are two wetlands in the study area. There is no information available in VWAD on whether these features are connected to groundwater.

7.10.3 Springs

There are no springs listed in VWAD in the study area.

7.11 Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring sediments containing reduced inorganic sulfides. When disturbed or exposed to air via excavations or dewatering, these soils can oxidise and generate acidic and/or metalliferous drainage, which can affect surface water and groundwater quality.

Actual acid sulfate soils (AASS) are those that have oxidised, or partially oxidised, to produce acidic soil horizon(s). Potential acid sulfate soils (PASS) are those that contain appreciable amounts of reduced inorganic sulfur that has not yet oxidised but could pose an environmental hazard if disturbed.

A preliminary ASS hazard assessment has been undertaken in accordance with Stage A of the CASS BPMG and is reported in *Technical report J - Soil and waste*. The key outcomes of the assessment are that:

- PASS has been identified in the unnamed swamp and lake deposits in the vicinity of the transition joint bays in the shore crossing area. The highest PASS results were identified in this area consistent with the geological setting.
- AASS and PASS has been identified in the unnamed alluvium.
- PASS has been identified in the unnamed dune deposits.

7.12 Existing environment summary

The water table is within the Quaternary Aquifer (QA) and includes various Quaternary coastal dune, swamp and lake, alluvial, and aeolian dune deposits. The permeability of the QA varies from high in some of the clean sand deposits to low in the clay dominant sediments. The variability reflects the varying depositional environments.

The water table is mapped as shallow (less than two metres below ground surface) near the coast and in the vicinity of present-day streams. Geotechnical and acid sulfate soil investigations and two groundwater monitoring wells (GA20-BH01 and P003) installed near the coast confirm that groundwater is shallow in this location (0.3 – 2.1 metres below ground surface). Geotechnical and acid sulfate soil investigations further inland suggest that groundwater is usually at depths greater than three metres below ground surface. In P003 the shallowest water table was observed in November and July, whereas in P008 the shallowest water table was observed in November. Combined with the water table depth from the State Observation Wells, the water table is observed to fluctuate seasonably.

The estimated water table groundwater total dissolved solids concentration in the study area varies from Segment B (1,201-3,100 milligrams per litre) to Segment C (3,101-5,400 milligrams per litre). Segment B has been conservatively adopted for the study area and therefore there are several environmental values that need to be achieved and maintained. These include water dependent ecosystems and species, potable mineral water supply, agriculture and irrigation, industrial and commercial water use, water-based recreation, Traditional Owner cultural values, buildings and structures and geothermal properties. Potable mineral water supply and geothermal properties are not considered relevant as the shallow groundwater has not been reported to naturally effervesce or have temperatures above 30 degrees.

There are seven registered groundwater wells in the study area based on a WMIS search conducted in March 2025, including domestic and/or stock water supply (four wells) and unknown uses (three wells). None of the registered wells are located in the project easement or construction corridor. It is possible that wells with incorrect coordinates and/or unregistered wells may also exist within the study area.

There are four watercourses listed as potential GDEs may receive groundwater discharge and could therefore be classed as ‘gaining’ streams. There are no Ramsar sites, nationally important wetlands, or springs mapped in the study area; however the unnamed waterway in the shore crossing area discharges into Corner Inlet (a Ramsar site). There are eight vegetation classes in the study area that are classified as potential terrestrial GDEs. A regional baseline survey of stygofauna in the Gippsland

Basin suggests that the abundance of stygofauna taxa is low, possibly due to the fine-grained nature of the water table aquifer at the locations assessed in the regional baseline survey.

A preliminary ASS hazard assessment has been undertaken and is reported in *Technical report J - Soil and waste*. The assessment concluded that PASS exist within the study area.

8.0 Issues for assessment

Groundwater (that is, water found underground in spaces between soil and rock) is an important resource in the region and all reasonably practicable steps must be taken to minimise potential impacts to groundwater from the project.

The issues for assessment were identified by reviewing the project description for interactions between the key project components and the proposed construction, operations and decommissioning activities and sensitive receptors. These cause and effect pathways were designated as either impacts or risks based on whether the issues relate to situations that are expected or accidental.

The identified issues are presented in Table 21 and for each, a maximum design scenario has been defined as the basis for the assessments presented in Section 9.0, Section 10.0 and Section 11.0. The table also includes the residual impact and risk levels arising from the assessment undertaken, following incorporation of mitigation measures.

The complete impact and risk register for this study is presented in Appendix A.

Table 21 Groundwater assessment issues

Impact or risk ID	Impact or risk pathway	Residual impact rating	Residual risk rating
Construction			
GWM-I001	Dewatering reduces groundwater levels at water supply wells	Negligible	-
GWM-I002	Dewatering near the coast causes saline intrusion that affects groundwater quality	Negligible	-
GWM-R003	Poor quality overland flow recharges groundwater via excavations	-	Very low
GWM-I004	Existing wells are damaged or destroyed during onshore construction activities	Minor	-
GWM-R005	Excavation and dewatering of acid sulfate soils affects groundwater quality	-	Low
Operation			
GWM-I006	Subsurface infrastructure impedes groundwater flow	Negligible	-
GWM-I007	Onshore trench backfill creates preferential groundwater flow paths	Negligible	-

The following issues were also considered but were deemed too insignificant to be included in the impact and risk register:

- Preferential flow paths created by shore crossing ducts (which would be installed using HDD), in the event that the annulus (that is, the space between the edge of the wellhole and the casing) was not properly sealed.
- Preferential flowpaths created by trenchless waterway crossings (which would be installed using HDD, thrust boring, or micro-tunneling) in the event that the annulus was not properly sealed.

These issues are not considered material given that shore crossing and waterway crossing annuli are considered highly unlikely to be leaky. Drilling fluids used to advance the well include bentonite, polymers and loss-circulation gels and fibrous material. These produce a ‘filter cake’ around the hole to prevent/minimise loss of drilling fluids to the formation during drilling and prevent/minimise ingress of groundwater into the well upon completion. Also, fines (for example, clays) in the formation being drilled through, where above the water table are likely to swell and create a hydraulic barrier to seal the annulus.

The potential impact of dewatering on GDEs, including terrestrial, aquatic, and subterranean (that is, stygofauna) GDEs, is included in *Technical report G - Onshore ecology*. The risk assessment is included in that report as FFM-R013: Alterations to groundwater hydrology during construction leading to a decline in the extent and health of Groundwater Dependent Ecosystems. An outcome of the assessment is a commitment to the following mitigation measure: FFM-M014: Prepare and implement a Dewatering Plan. Following implementation of the mitigation measure, the residual risk rating is assessed as ‘Low’ (refer to *Technical report G - Onshore ecology*).

The potential impact from leaks and spills is included in *Technical report J - Soil and waste*.

9.0 Construction assessment

This section discusses the potential impacts and risks associated with the project as a result of construction activities and the associated mitigation measures that aim to reduce impacts and risks to as low a level as possible. Mitigation measures referred to are summarised in Section 13.0.

This assessment has identified risks and proportional mitigation measures to minimise risk of harm to human health and the environment from pollution and waste by adopting controls that are proportionate to identified risks as required under the EP Act (via the GED). EPA guidance has been considered and adhered to where relevant, including:

- Publication 1820.1 – Construction guide to preventing harm to people and the environment.
- Publication 1834.1 – Civil construction, building and demolition guide.

The assumptions below in Section 9.2.1 provide a conservative approximation of the dewatering activities anticipated based on the installation of up to eight circuits.

9.1 Project parameters that form the basis of impact assessment

Table 22 specifies the maximum design scenario that has been assessed for construction. These represent the values of project parameters from ranges specified in the project design envelope that represent the greatest potential impact to an identified sensitive receptor or receptor group.

Table 22 Maximum design scenario - construction

Impact/Risk	Key parameter values	Justification
GWM-I001, GWM-I002, GWM-R003, GWM-I004, GWM-R005	The works and infrastructure are located within the onshore construction project area, which is defined by the area required for construction of the following: • Onshore transmission infrastructure: ○ Up to eight underground cable circuits with the following upper limit footprints: ▪ Underground transmission system contained in 40 m wide cable easement requiring up to a 60 m wide temporary footprint during construction. ○ Up to 370 onshore joint bay locations along the alignment with upper limit footprints of ▪ 15 m x 4.9 m x 3 m (L x W x D) for individual bays. ○ Other temporary construction infrastructure including access roads. • Shore crossing infrastructure: ○ HDD drilled from landside with maximum length of 1,400 m and a depth of up to 35 m below entry elevation. ○ Up to 8 HDD entry pits to a maximum depth of 2 meters. ○ Up to 8 parallel transition bays with upper limit footprints: ▪ Individual transition bay dimensions: 30 m x 10 m x 5 m (L x W x D).	The onshore construction project area defines the maximum land area to be directly impacted by construction of the project, defining the extent where groundwater may be encountered.

To assess potential impacts associated with the project, the assessment has also considered the following assumptions and indicative construction techniques:

- That groundwater is at, or close to, ground surface.
- The shore crossing for the transmission cables would be completed using HDD.

- All waterway crossings would be trenched, except the unnamed water behind the shore crossing where trenchless crossing methodologies would be used.
- Where groundwater is intersected by excavation for onshore trenches, joint bays and transition joint bays then short-term dewatering (that is, removal of groundwater to maintain a dry excavation) would be required in the easement.
- Shallow excavation may occur in the construction corridor (outside of the cable easement) to prepare the ground, but no dewatering would be required outside of the cable easement.
- Once construction has been completed no ongoing dewatering would be required.

Groundwater may be used by the contractor for project construction water supply. It is assumed that this would consist of existing groundwater entitlements that have already been assessed and approved. Therefore, there would be no additional impacts associated with this.

9.2 Impact assessment

9.2.1 Dewatering reduces groundwater levels at water supply wells (GWM-I001)

There are many different methods that can be used to ensure that a dry working base is maintained during excavation. Dewatering lowers the groundwater level at the pumped location adjacent to it (also known as drawdown). The groundwater drawdown propagates outwards from the pumped location as dewatering continues, forming a temporary and localised ‘cone of depression’ (i.e., area of reduced groundwater level). Groundwater levels then rebound to previous levels following cessation of dewatering activities. Dewatering therefore has the potential to temporarily reduce groundwater levels and groundwater flow to nearby receptors such as water supply wells and GDEs.

The extent and magnitude of drawdown due to dewatering largely depends on the following:

- Permeability (or hydraulic conductivity) of the saturated material.
- Dewatering duration.
- Depth of intersected groundwater that needs to be dewatered.

A description of key assumptions to inform approximation of dewatering activities is provided below for each of the excavation types.

Trench

- Typical open sections of trench would be 120 metres (L) x 2.2 metres (W) x two metres (D).
- Four parallel trenches would be constructed within the easement with two trenches dewatered simultaneously.
- Where groundwater is at or close to the surface, a maximum drawdown of two metres would be required to maintain a dry excavation floor.
- Assumed dewatering dimensions: 120 metres x 10.4 metres x two metres to account for the two parallel trenches being dewatered at once, with a six metre spacing between.
- Up to 1.5 days total of continuous dewatering would be required for any trench section.

Joint bays

- Four in-line joint bays aligned across the easement at each jointing location along the alignment constructed concurrently:
  - Individual joint bay dimensions 15 metres (L) x 4.9 metres (W) x three metres (D)
- Where groundwater is at or close to surface, a maximum drawdown of three metres would be required to maintain a dry excavation floor.
- Dewatering occurs simultaneously at all four parallel joint bays at a single location.
- Maximum duration of continuous dewatering is 30 days (with groundwater level recovery between events).

- Assumed dewatering dimensions: 15 metres (L) x 40 metres (W) x three metres, to account for all four parallel joint bays being dewatered at once.
  - This is a conservative, simplifying assumption that the entire area (including the four parallel joint bays) would be effectively dewatered as if they were one larger excavation.

Shore crossing works and transition jointing

- Construction and installation of eight transition bays, eight HDD entry pits, and temporary connection trenches between each HDD entry pit and transition bay, in the shore crossing area.
- Individual transition bay excavation dimensions: 30 metres (L) x 10 metres (W) x five metres (D).
- Spacing between transition bays: up to 40 metres.
- Individual HDD entry pit dimensions: 12 metres (L) x five metres (W) x two metres (D).
- Spacing between transition bays and HDD entry pits: 20 metres.
- Groundwater is at or close to surface, therefore up to five metres would be required to maintain a dry excavation floor.
- Assumed dewatering dimensions, including all transition bays, HDD entry pits, and temporary connection trenches: 62 metres (L) x 360 metres (W) x five metres (D).
  - This is a conservative, simplifying assumption that the entire area (including the transition bays, HDD entry pits, and temporary connection trenches) would effectively be dewatered as if they were one larger excavation.
- Maximum duration of continuous dewatering is 90 days.
  - This is a conservative, simplifying assumption that the entire area would be dewatered simultaneously.
  - There will be multiple periods of dewatering for various stages of construction activities in the shore crossing area; however, for the purposes of this impact assessment, 90 days has been assumed as the maximum period of continuous dewatering without groundwater recovery.
  - The staging of dewatering activities will be complex, and may include fewer excavations being dewatered simultaneously and then time allowed for groundwater recovery while other activities are undertaken. Additional details on excavation and dewatering staging will be documented in the ASS management plan (refer to Section 9.3.2).

The Theis analytical solution (Theis, 1935) allows an approximation of the extent of groundwater level drawdown created by the proposed construction dewatering activities.

The Theis approximation is based on a range of assumptions associated with the nature of the material being dewatered and is considered a reasonable method for conservatively estimating the potential extent of drawdown.

To approximate dewatering activities a series of ‘extraction wells or spears’ are simulated along the nominated trench alignment, transition joint bay and joint bay to produce required dry conditions for construction. The cumulative drawdown from all wells was then considered at varying distances from the excavation to generate an estimate of potential drawdown magnitude and extent.

A summary of the maximum excavation dimensions, drawdown requirement and duration of dewatering is provided in Table 23 for each excavation type:

Table 23 Excavation and dewatering assumptions

Excavation Type	Assumed Dewatering Dimensions			Maximum Dewatering Duration
	Length	Width	Depth	
	Metres	Metres	Metres	Days
Trench	120	10.4	2	1.5

Joint bays	15	40	3	30
Shore crossing works and transition jointing	62	360	5	90

Although as discussed in Section 7.4, there is sufficient water table depth data available within the study area to estimate the depth to water along the transmission easement for groundwater level drawdown it has been conservatively assumed that groundwater is at, or close to the ground surface, which may be reasonable for some study areas, such as near the foreshore (P003). The full excavation depth would therefore need to be dewatered which provides the greatest estimated extent and magnitude of drawdown (that is, the most conservative scenario).

The Theis equation, to estimate drawdown requires hydraulic conductivity and storativity estimates of the sediments being dewatered. A hydraulic conductivity value of one metre per day was chosen as a reasonable estimate, based on literature values for silty sands, fine sands and well-sorted sands (Fetter, 1994). Where greater proportions of silts and clays are present the hydraulic conductivity would typically be orders of magnitude less than one metre per day. Although higher permeability 'clean', coarser sand intervals (often referred to as 'stringers') may be present within the silt or clay profile, these are typically not vertically or laterally extensive, and not representative of the bulk sediment hydraulic conductivity. It is also noted that the prefabricated liner installed in joint and transition joint bays (refer to Figure 9-1, below) will limit groundwater inflow, thereby decreasing connectivity between the bay and aquifer, and reducing the magnitude and extent of drawdown away from the excavations, until construction is completed.

Figure 9-1 Example of joint bay prefabricated liner

A storativity value of 0.10 was adopted for an unconfined storage value ('specific yield') based on literature values that include average specific yields of 0.18 to 0.26 for silt, fine sand and medium sand (Fetter, 1994). The adopted storativity value is consistent with the value used in the Gippsland groundwater model for the water table aquifer (Beverly et al., 2015).

A summary of the distances at which a drawdown of approximately 0.1 and 0.5 metres might be expected due to construction dewatering of trenches, joint bays, and transition bays is provided in Table 24 using the approach described above. These distance drawdown values are estimates only and provide an indication of the groundwater level response to dewatering and are based on assumptions and uncertainties inherent in the simplification of a complex hydrogeological system.

Distance drawdown calculations are provided in Appendix C.

Table 24 Construction dewatering drawdown estimates

Excavation Type	Dewatering Duration	Estimated Distance from Excavation Edge	
		Drawdown 0.5 m	Drawdown 0.1 m
Trench	1.5 days	6 m	10 m
Joint bays	30 days	33 m	63 m
Shore crossing works and transition jointing	90 days	103 m	161 m

Notes: An assessment of impacts to potential terrestrial, aquatic, and subterranean GDEs based on these predicted drawdown extents is provided in Technical report G - Onshore ecology.

Impact

Construction dewatering would temporarily lower groundwater levels in the immediate vicinity of the excavation and may reduce the available drawdown in nearby water supply wells. This could result in a temporary reduction in yield from the wells. The assessment criteria for a material drawdown at a water supply well is a reduction of more than 10 percent of available drawdown (refer to Section 4.4).

If it is conservatively assumed that a water supply well has at least five metres of available drawdown, then a 10 percent reduction would equate to a drawdown of 0.5 metres at the well due to dewatering activities. Based on the distance drawdown estimates in Table 24 a shallow water supply well within approximately six metres of a trench, 33 metres of a joint bay, or 103 metres of a transition bay could be temporarily impacted.

As discussed in Section 7.8, there are seven registered groundwater wells in the study. Based on the excavation and dewatering estimates in Table 24 above, none of these registered wells are within the area estimated to be temporarily impacted by construction dewatering. However, it is possible that wells with incorrect coordinates, wells installed after the database search was conducted, and/or unregistered wells could be present. This potential impact will be managed via the mitigation measure outlined below.

Mitigation

GWM-M001: Assessment and make good arrangements to manage temporary water level drawdown at water supply well(s)

Following detailed design and prior to construction, the potential for temporary water level drawdown at existing water supply well(s) due to dewatering will be managed as follows:

1. Confirm existing wells

The location, construction details, and intended uses of wells on land adjacent to the easement will be confirmed through liaison with appropriate landowners. This will include wells that may be present in the study area but are not in the registered well database.

2. Drawdown assessment

An assessment of the potential for adverse dewatering impacts on water supply wells will be completed based on the well's distance from dewatering activities with consideration to drawdown estimates contained herein, well construction and available drawdown (difference between standing water level and pump depth).

3. Make good arrangements

If the potential for an impact is identified, then make good arrangements between the proponent and landholder/well owner will be agreed and implemented during temporary dewatering activities (if required).

Residual Impact

With the implementation of the mitigation measure, any residual impact at a water supply well would be temporary and readily managed (if required). The residual impact ‘consequence level’ is assessed as ‘negligible’ (refer to Appendix A).

Additional measures to verify the dewatering predictions are not considered warranted based on the receptors assessed under the scope of this impact (that is, groundwater bores), and based on the conservative assumptions and predicted magnitude, extent, and duration of residual impacts.

9.2.2 Dewatering near the coast causes saline intrusion that affects groundwater quality (GWM-I002)

Impact

In coastal areas, due to density differences fresher (less saline) groundwater forms a layer above more saline water, sometimes known as the ‘freshwater lens’. This saline groundwater beneath coastal areas is in connection with seawater and is called the 'saltwater wedge’.

Pumping large volumes of groundwater in coastal areas can induce reductions in groundwater levels in the fresher water, such that upward flow from the underlying salt wedge occurs. This can then increase salinity within the freshwater lens and may impact on groundwater.

Transition joint bays are proposed at the shore crossing area approximately 310 metres from the coastline, hence the potential for saline intrusion has been considered as a potential groundwater risk event.

The Ghyben-Herzberg theory states that for each metre of freshwater lens thickness above sea level, the freshwater lens extends 40 metres below sea level. This is due to the relative density difference between freshwater and seawater.

Geotechnical well GA20-BH01 (Golder, 2020) is located near the proposed Reeves Beach shore crossing site and adjacent to the proposed transition joint bay installation locations. The depth to groundwater was measured at approximately 1.0 metre below ground surface, which is approximately 0.5 mAHD. This suggests a freshwater lens in the order of 20 metres thick.

As discussed in Section 9.2.1, construction dewatering activities at the transition joint bays would result in localised, small scale and temporary reductions in groundwater levels.

Adverse impacts to environmental values and groundwater users, due to groundwater quality changes from induced lateral flow from the coast (approximately 310 metres away) or upward flow from the underlying salt wedge (at a depth of approximately 20 metres), are not anticipated over the dewatering timeframe.

Mitigation

No mitigation measures are proposed.

Residual Impact

Impacts to groundwater quality from induced lateral flow from the coast or upward flow from the underlying salt wedge are not anticipated from the temporary dewatering during construction. The residual impact ‘consequence level’ is assessed as ‘negligible’ (refer to Appendix A).

9.2.3 Existing wells are damaged or destroyed during onshore construction activities (GWM-I004)

Impact

Existing wells within the construction footprint have the potential to be damaged, lost (i.e., destroyed), or to become inaccessible during construction. This could permanently or temporarily prevent or limit the landowner (or well owners) ability to access the groundwater resource.

There are no registered groundwater wells within the project construction footprint (Section 7.8). However, it is possible that wells with incorrect coordinates, wells installed after the database search was conducted, and/or unregistered wells could also be present.

Access to other existing wells outside the construction corridor may also be temporarily affected during construction if access is prevented or made more difficult.

Mitigation

GWM-M002: Replacement of lost or damaged well(s)

Following detailed design and prior to construction, the potential for existing wells to be lost or damaged will be managed as follows:

1. Confirm existing wells

The location, construction details, and intended uses of wells within the construction corridor will be confirmed through liaison with appropriate landowners Iin consultation with the landowner, wells that will be damaged, lost or become inaccessible will be confirmed.

2. Make good arrangements

In instances where a well is deemed to be impacted by the project, make good arrangements between the proponent and landholder/well owner will be agreed and implemented (subject to any approvals required).

Residual Impact

With the implementation of the mitigation measure, any residual impact at a well would be temporary and be readily managed (if required). The residual impact 'consequence level' is assessed as 'minor' (refer to Appendix A).

9.3 Risk assessment

9.3.1 Poor quality overland flow recharges groundwater via excavations (GWM-R003)

Impact

If there is a rainfall event while excavations are open prior to backfilling, then surface water runoff could flow into the excavation. This runoff water could be of low quality (such as having elevated nutrient concentrations) and potentially infiltrate into groundwater via the excavation; thereby adversely affecting groundwater quality.

The greatest potential for this to occur is at or near trench crossings across waterways. Here surface water flow would be expected due to drainage patterns, and alluvial sediments with higher permeability may transmit trench water into the adjacent aquifer readily than surrounding lower permeability sediments. It is anticipated that trenching across each waterway would take on the order of days to weeks to complete. This includes trench excavation, laying the conduits, TSB installation and backfill reinstatement.

It is understood that open excavations need to be dry during construction and installation. Therefore, runoff water entering excavations would typically be removed within a short timeframe to allow construction to continue. The opportunity for discharge into the adjacent groundwater system via the excavation would therefore be temporary and of limited duration.

Mitigation

Flooding of construction sites will be managed in accordance with SUM-M001: Managing flood risk at construction sites (*Technical report I - Surface water*).

Trenching across waterways will be carried out in accordance with SUM-M004: Preventing pollution from trenched waterway crossings (*Technical report I -Surface water*).

The storage and handling of fuels, chemicals and wastes will be in accordance with SOL-M011: Management of chemicals and fuels (*Technical report J - Soil and waste*).

No additional mitigation measures are proposed.

Residual Impact

With the implementation of the mitigation measures listed above (and outlined in *Technical report I - Surface water* and *Technical report J - Soil and waste*), residual impacts are unlikely to occur. The residual impact 'risk level' is assessed as 'very low' (refer to Appendix A).

9.3.2 Excavation and dewatering of acid sulfate soils affects groundwater quality (GWM-R005)

Impact

ASS are naturally occurring sediments containing reduced inorganic sulfides. When disturbed or exposed to air via excavations or dewatering, these soils can oxidise and generate acidic and/or metalliferous drainage, which can affect groundwater quality.

A preliminary ASS hazard assessment has been undertaken and is reported in *Technical report J - Soil and waste* and summarised in Section 7.11. The key outcomes of the assessment are that:

- PASS has been identified in the unnamed swamp and lake deposits in the vicinity of the transition joint bays in the shore crossing area. The highest PASS results were identified in this area consistent with the geological setting.
- AASS and PASS has been identified in the unnamed alluvium.
- PASS has been identified in the unnamed dune deposits.

PASS may be intersected and disturbed during project construction activities, including:

- Excavation for the installation of onshore trenches, joint bays, transition bays, and HDD entry pits.
- Temporary dewatering of the above excavations.

Sulfide oxidation of the PASS that are exposed to air in these excavations and in the cone of depression (that is, the area where groundwater levels drop due to dewatering) could result in release of acidity and metals. When groundwater levels rebound following cessation of dewatering, this acidity and metals could be mobilised and transported in the direction of groundwater flow. Other groundwater quality changes associated with ASS include nutrient release, deoxygenation, and increased salinity (Shand et al., 2018). The change to groundwater quality could impact the environmental values of groundwater, downgradient groundwater dependent ecosystems, and downgradient surface water features that receive groundwater.

Although the oxidation process would cease once the excavations are backfilled and the groundwater has fully recovered, the acidity and metals that were generated during oxidation would continue to dissolved in the recovering groundwater and be transported to downstream environments for a longer period of time.

Factors that could reduce the impact on groundwater quality include:

- The natural buffering capacity of the aquifer;
- Natural attenuation of metals and other dissolved solutes within the aquifer via processes such as sorption and dispersion.
- Natural fluctuation in groundwater levels, whereby reduced inorganic sulfides in parts of the aquifer that seasonally dewater naturally have already oxidised in the past.

Technical report J - Soil and waste noted that for the purpose of the CASS BPMG Stage A ASS assessment, based on the volume of soil to be excavated, the project would be considered a high risk activity.

The *National Acid Sulfate Soils Guidance, Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (Shand et al., 2018) identifies three management levels based on the duration and extent of dewatering of ASS. The project falls within management level two, based on dewatering duration of greater than seven days and a radial extent of the cone of groundwater depression of greater than 50 metres (refer to dewatering estimates in Section 9.2.1). Management actions for level two include the following, among others:

- Staging of disturbance and dewatering to limit the groundwater cone of depression to less than 100 metres;
- Installation of groundwater monitoring bores upgradient and downgradient of dewatering and monitoring of groundwater quality pre-dewatering (that is, baseline monitoring), during dewatering, and post-dewatering;
- Monitoring of actual drawdown levels and dewatering effluent quality;
- Dewatering operations to cease immediately if the groundwater quality results indicate that any environmental impact has occurred as a result of project works; and
- Development of an ASS Management Plan (ASSMP) to capture the above actions before the commencement of site works.

Mitigation

GWM-M003: Preventing impacts to groundwater quality from excavation and dewatering of acid sulfate soils

An Acid Sulfate Soil Management Plan will be prepared and implemented for the project (refer to SOL-M005 in *Technical Report J - Soil and waste* and SUM-M006 in *Technical report I - Surface water*). For the purposes of groundwater impacts, the Acid Sulfate Soil Management Plan will be prepared and implemented in accordance with the *National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (Shand et al., 2018). The Acid Sulfate Soil Management Plan will include, but not be limited to, the following actions in areas confirmed to contain potential acid sulfate soil:

- Staging of disturbance and dewatering to limit the groundwater cone of depression to less than 100 metres from the edge of excavations;
- Installation of groundwater monitoring bores upgradient and downgradient of dewatering and monitoring of groundwater quality pre-dewatering (that is, baseline monitoring), during dewatering, and post-dewatering;
- Real-time monitoring of drawdown levels and dewatering discharge quality during construction dewatering;
- Contingency measures that include immediate cessation of dewatering if the groundwater quality results indicate that environmental impact has occurred as a result of project works.

The Victorian Environment Protection Authority will be consulted on the Acid Sulfate Soil Management Plan prior to construction commencement.

Residual Impact

With the implementation of the mitigation measure above, residual impact to groundwater quality would be unlikely to occur. The residual impact 'risk level' is assessed as 'low' (refer to Appendix A).

9.4 Summary of residual impacts

Residual impacts are those that remain once mitigation measures have been implemented.

Groundwater impacts due to temporary dewatering, loss or damage to existing wells, overland flow entering onshore trenches, and disturbance and dewatering of ASS have been considered for the project construction phase.

Residual groundwater impacts during construction are assessed as 'negligible', 'very low', and 'low' following the adoption the mitigation measures presented in this report.

10.0 Operation assessment

This section discusses the potential impacts and risks associated with the project as a result of operation of the project and the associated mitigation measures that aim to reduce impacts to as low a level as possible. Mitigation measures referred to are defined in Section 13.0.

10.1 Project parameters that form the basis of impact assessment

Table 25 specifies the maximum design scenario that has been assessed for operation.

Table 25 Maximum design scenario - operation

Impact/Risk	Key parameter values	Justification

GWM-I006, GWM-I007	The works and infrastructure are located within the onshore operation project area, which is defined by the area required for the following:
	• Onshore transmission infrastructure:
	  ○ Up to eight underground cable circuits with the following upper limit footprints:
	    ▪ Underground transmission system contained in 40 m wide cable easement.
	  ○ Up to 46 onshore joint bay locations along the alignment with upper limit footprints of
	    ▪ 15 m x 4.9 m x 3 m (L x W x D) for individual bays.
	• Shore crossing infrastructure:
	  ○ HDD drilled from landside with maximum length of 1,400 m and a depth of up to 35 m below entry elevation.
	  ○ Up to 8 parallel transition bays with upper limit footprints:
	    ▪ Individual transition bay dimensions: 30 m x 10 m x 5 m (L x W x D).
		The onshore operation project area defines the maximum land area to be utilised by the operation of the project, defining the extent where groundwater may be encountered.

Trenches would be backfilled with either thermally stable backfill (TSB) or thermal sand and then overlain by a layer of compacted backfill and a layer of topsoil. TSB is similar to concrete and consists of aggregate, sand, cement, water and a fluidising agent. It would therefore have a low permeability. Thermal sand is a type of 'clean' sand and would therefore have a higher permeability. There are potential groundwater impacts associated with each possible trench fill material and therefore these options are addressed separately in the impact assessment below.

Additional assumptions considered in the assessment are detailed in the sections below.

10.2 Impact assessment

10.2.1 Subsurface infrastructure impedes groundwater flow (GWM-I006)

The design assessed assumes that there will be up to four parallel cable trenches excavated to a depth of approximately two metres below ground level. There is an option for trenches to be backfilled with thermally stable backfill (TSB) surrounding the cables (refer to Figure 10-1, below). In this case, the backfill would have a lower permeability than the surrounding undisturbed sediments. Where the TSB in trenches intersects groundwater, there would be a potential for groundwater flow to be impeded and groundwater flow patterns and/or levels to be altered.

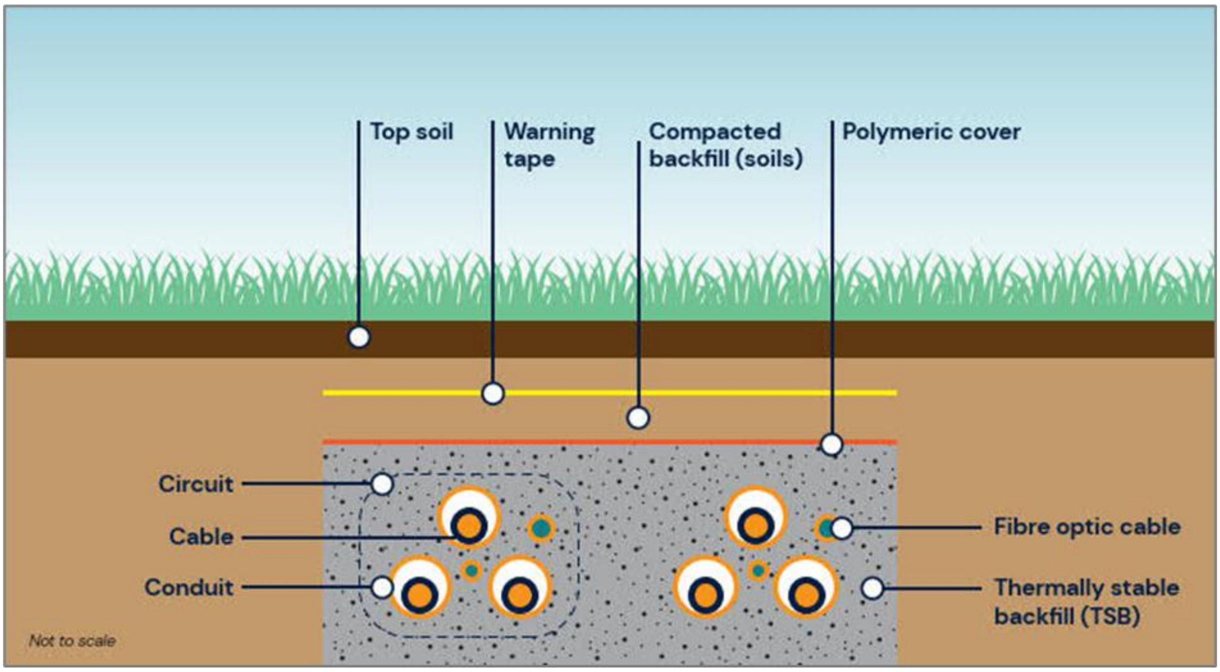

Figure 10-1 Example profile of a backfilled trench

Joint bays would be installed at approximate one kilometre intervals along the onshore cable alignment. Joint bays consist of pre-cast concrete bays with a maximum dimensions of 15 metres long, 4.9 metres wide and three metres deep. The bays are open-topped and backfilled with TSB and excavated material once the joining work has been completed. Where the joint bays intersect groundwater, there is a potential for groundwater flow to be impeded and groundwater flow patterns and/or levels to be altered.

Transition joint bays installed in the shore crossing area join the offshore to onshore cables. There are proposed to be a maximum of eight pre-cast concrete bays that have the maximum dimensions of 30 meters long, 10 metres wide and five meters deep. Where the joint bays intersect groundwater, there is a potential for groundwater flow to be impeded and groundwater flow patterns and/or levels to be altered.

Impact

The subsurface infrastructure described above would likely result in a permanent but low disruption in groundwater flow patterns and/or levels in a localised area surrounding the infrastructure. The potential impacts are not expected to be material given:

- The trench is proposed to be shallow and not keyed into underlying low permeability sediments. Therefore, groundwater would be able to flow beneath the trench, if it is intersected at all.
- The trench is proposed to be backfilled with excavated material above the TSB and groundwater would be able to flow through this material if groundwater levels are shallow.
- Other subsurface infrastructure (joint bays and transition joint bays) are proposed to be limited in length, width and depth. Groundwater will flow around and/or beneath this subsurface infrastructure, resulting in minor impact.

Mitigation

No mitigation measures are proposed.

Residual Impact

Impacts to groundwater levels and flow from low permeability subsurface infrastructure are likely to be minimal and highly localised. The residual impact 'consequence level' is assessed as 'negligible' (refer to Appendix A).

10.2.2 Onshore trench backfill creates preferential groundwater flow paths (GWM-I007)

There is a potential for backfill in the onshore trench excavations to act as a preferential flowpath for groundwater and thus alter flow patterns and/or levels in the following circumstances:

1. Thermal sand (which would have higher permeability that surrounding material) is used to backfill onshore trenches as discussed in Section 10.1; or
2. TSB is used to backfill onshore trenches, but the groundwater levels are above the TSB in the compacted backfill or topsoil (which could have a higher permeability than surrounding material).

Impact

There is a potential to create a permanent drain effect where groundwater preferentially flows along backfill material if it has a higher permeability than the surrounding undisturbed sediments. Thermal sand will have a higher permeability than surrounding material and therefore this impact is more likely to occur if thermal sand is used (rather than TSB).

The overlying compacted backfill and topsoil layers are proposed to be comprised of material previously excavated from the trench or imported material if required. It is possible that this backfill could have a higher permeability than the surrounding undisturbed sediments. This risk is minimised where the backfill is comprised of material previously excavated from the trench or where the imported material is of a similar soil type. The risk is also minimised if the backfill is compacted, which would reduce its permeability.

If the trench were to act as a preferential drainage line, the potential effect would be to lower the water table in the trench and cause a reduction in groundwater levels away from the trench (within the adjacent water table aquifer). For this to occur a low lying 'discharge point' in the landscape would be required where a lower water table elevation creates a 'driving head' along the trench and higher permeability sediments are intersected by the trench that would readily transmit water out of the trench.

However, based on the project design and hydrogeological conditions this impact is considered unlikely to be significant because:

- The onshore trench intersects only one aquifer; that is, the Quaternary Aquifer (refer to Section 7.3).
- Local flow systems in the Quaternary Aquifer mean that groundwater flow paths are relatively short (refer to Section 7.4.1).
- The onshore trench would follow local topography and therefore any change in groundwater levels levels is likely to be localised and limited in magnitude.
- There is no credible pathway of freely draining from low points in the topography.

Mitigation

No mitigation measures are proposed.

Residual Impact

Impacts to groundwater levels and flow from high permeability trench backfill are likely to be localised and limited in magnitude. The residual impact 'consequence level' is assessed as 'negligible' (refer to Appendix A).

10.3 Summary of residual impacts

Residual impacts are those that remain once mitigation measures have been implemented.

Ongoing groundwater impacts due to low permeability subsurface infrastructure and high permeability trench backfill have been considered for the project operation phase.

Groundwater impacts during operation are assessed as 'negligible' and no mitigation measures are considered warranted.

11.0 Decommissioning assessment

This section discusses the potential impacts and risks associated with the project as a result of decommissioning activities and the associated mitigation measures that aim to reduce impacts to as low a level as possible.

Decommissioning intent for below ground onshore infrastructure (including underground cable, joint bays, transition joint bays and HDD shore crossing) is difficult to predict with certainty into the future (approximately 30 years). To minimise disturbance, it is anticipated that most of the below ground transmission equipment would be left in place with cable ends cut, sealed and securely buried as a precautionary measure. In this case, then potential impacts would be the similar as those identified during the operation phase (Section 10.0).

It has been assumed that decommissioning of the project (in approximately 30 years based on design life) would require and adhere to regulatory approval at that time.

Potential impacts and risks associated with the decommissioning phase would be managed in accordance with a Decommissioning Environmental Management Plan (DEMP).

11.1 Decommissioning environmental management plan

The environmental management framework chapter of the EIS/EES commits to preparation of a DEMP. The details of the plan will be finalised towards the end of the infrastructure life when regulatory requirements and decommissioning methods are better known. The DEMP will encompass a range of environmental topics including groundwater.

The DEMP will be prepared in accordance with the following principles:

- Consideration of current legislation and policy at the time of decommissioning activities
- Consultation with relevant regulators
- Avoiding, minimising and mitigating environmental impacts
- Best practice approaches to decommissioning offshore wind infrastructure at the time of the proposed activities.

A DEMP will be prepared and implemented in accordance with FFM-M012 (*Technical report G - Onshore ecology*).

The DEMP will be subject to regulatory approval prior to the commencement of decommissioning activities.

12.0 Cumulative impact assessment

This section provides an assessment of cumulative impacts with other proposed developments in the region. The method to consider cumulative impacts has been described in Section 6.8 and Chapter 6 - Assessment Framework within both the EIS and EES.

12.1 Projects within zone of influence

For the purpose of evaluating cumulative impacts, this assessment has identified other projects that are located within the zone of influence of this study. The zone of influence for this study has been defined as the project footprint and a one kilometre buffer, to a depth of 10 metres (35 metres depth at shore crossing).

The list of projects that fall within the zone of influence for groundwater are presented in Table 26. Each of the projects in Table 26 have been evaluated against the cumulative assessment criteria to determine whether there is the potential for cumulative impacts with the project and sufficient information available to undertake a meaningful assessment.

In assessing the potential cumulative impacts for the Star of the South project it is important to consider that some developments, predominately those ‘proposed’ (referred) or identified in development plans, may not actually be taken forward, or fully built out. There is therefore a need to build in some certainty (or uncertainty) with respect to the potential impacts that may arise from such proposals, which is done by allocating projects into ‘tiers’. This approach allows appropriate weight to be given to each tier when considering the potential cumulative impacts.

Two potential projects within the zone of influence of the project were assessed as a Tier 2 (medium certainty) projects: the Gippsland Offshore Wind Transmission 2GW Project (VicGrid) and the Great Eastern Offshore Wind Farm (Corio). The potential for SOTS to result in cumulative impacts when combined with these project has been considered in the following sections with respect to severity, extent and duration. The location of the projects in relation to SOTS is shown in Figure 12-1.

Six potential offshore wind projects were assessed as Tier 3 (low certainty) projects and therefore are screened out of the cumulative impact assessment due to insufficient information.

Table 27 describes the projects screened in to be taken forward for the cumulative impact assessment.

Table 26 Cumulative impacts – projects in zone of influence

Project or action	Data confidence	Scale parameter	Receptor impact	Temporal overlap	Conclusion
(within the zone of influence)	Certainty tier	Is the project or action of sufficient scale to warrant inclusion?	Will the project/action adversely affect the same receptors as the project? And have a spatial overlap	Will the project/action result in adverse impacts to the same receptors as the project at the same time or on a timescale that could result in a cumulative impact?	Is the long list project/action shortlisted for assessment of cumulative impacts?
Aurora Green (Iberdrola)	Tier 3 – proposed				Screened OUT – due to insufficient data available
Blue Mackerel North (Parkwind)	Tier 3 – proposed				Screened OUT – due to insufficient data available
Gippsland Offshore Wind Farm 1 (Ørsted)	Tier 3 – proposed				Screened OUT – due to insufficient data available
Gippsland Offshore Wind Farm 2 (Ørsted)	Tier 3 – proposed				Screened OUT – due to insufficient data available
Gippsland Offshore Wind Transmission 2GW Project (VicGrid)	Tier 2 – seeking approval (EPBC and State referrals have been lodged)	Yes – impacts considered to be of similar scale to SOTS impacts	Yes – project may impact the shallow watertable aquifer (and associated receptors) in the vicinity of SOTS	Yes – construction periods may overlap and operational periods will overlap	Screened IN
Great Eastern Offshore Wind Farm (Corio)	Tier 2 – seeking approval (Environment Report to be prepared)	Yes – impacts considered to be of similar scale to SOTS impacts	Yes – project may impact the shallow watertable aquifer (and associated receptors) in the vicinity of SOTS	Yes – construction timing is unknown, operational period will overlap	Screened IN
High sea wind (Ocean Winds)	Tier 3 – proposed				Screened OUT – due to insufficient data available
Kent Offshore Wind (RWE)	Tier 3 – proposed				Screened OUT – due to insufficient data available

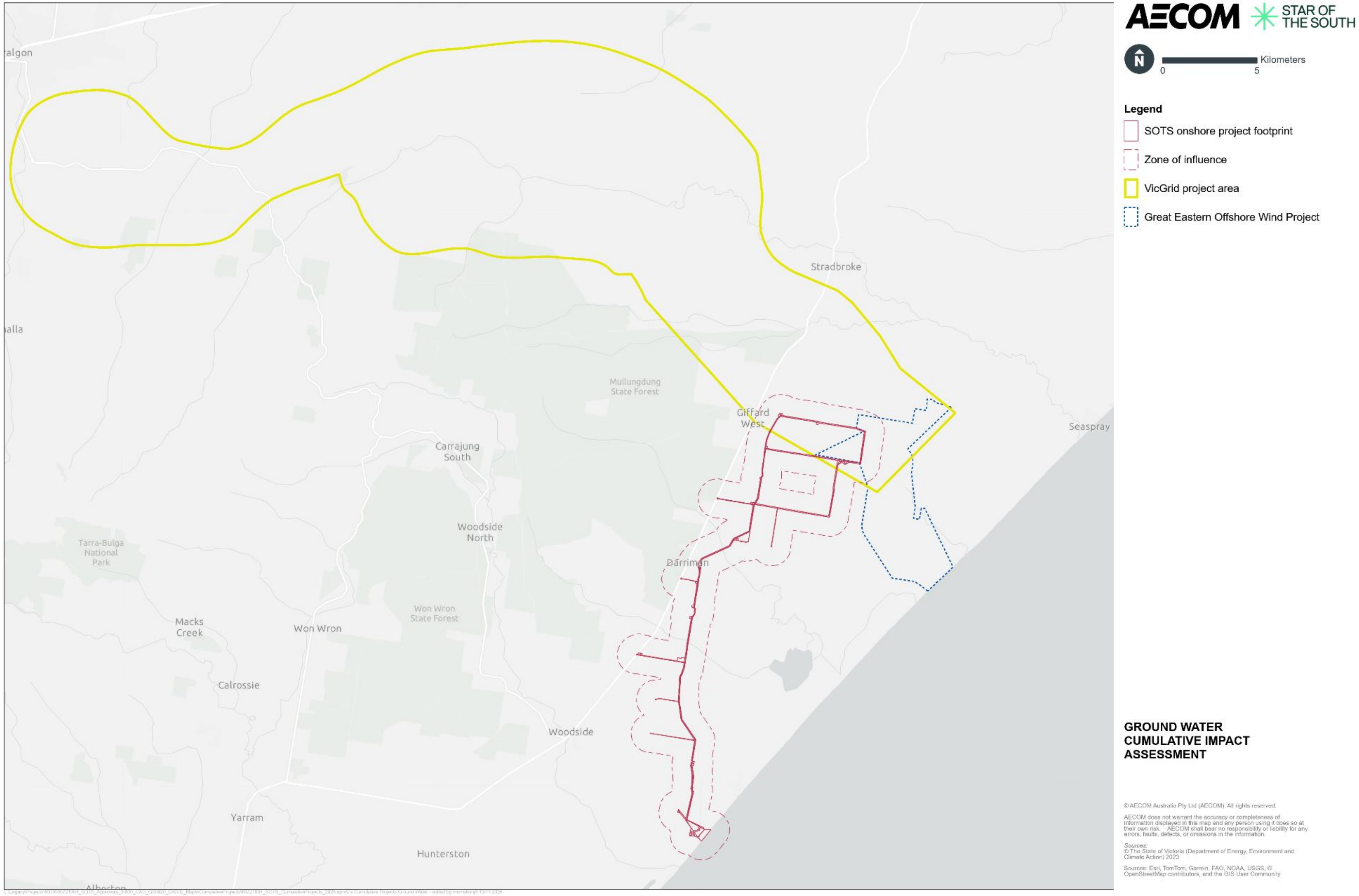

Figure 12-1 **Cumulative impact zone of influence and projects further assessed**

Table 27 Projects assessed for cumulative impacts

Project or action	Stage	Project description	Relevance to this assessment	Certainty	Assessment assumptions
Gippsland Offshore Wind Transmission 2GW Project (VicGrid)	Referred	The proposed Gippsland Offshore Wind Transmission 2GW Project is a new overhead transmission line from the Latrobe Valley to a new onshore connection hub in Giffard. The proposed VicGrid connection hub would comprise a high-voltage substation plant and equipment, including transformers, synchronous condensers and switchgear. Construction is planned to commence in 2028 subject to planning and environmental approvals.	Spatial relevance: the SOTS onshore transmission system is proposed to connect in with the VicGrid connection hub in Giffard, therefore the projects will be directly adjacent. Groundwater impacts from both projects would apply to shallow groundwater. Temporal relevance: based on the project timeframes, it is possible that construction periods could overlap. Operational periods will overlap. Potential cumulative risk pathway: construction and operation of the VicGrid connection hub could impact local groundwater quality, levels and flow in the watertable aquifer in the vicinity the SOTS onshore transmission system near Giffard. This is discussed further in Section 12.1.1.	Tier 2 (Medium)	There is uncertainty around whether construction of the VicGrid connection hub would occur at the same time as construction of the SOTS onshore transmission system (in the vicinity of the connection hub). Therefore, it is conservatively assumed that there could be an overlap. For the purposes of this assessment it is assumed that connection hub foundations (e.g. piles) would not require dewatering of groundwater.
Great Eastern Offshore Wind Farm (Corio)	Referred	The proposed Great Eastern Offshore Wind Farm is a new offshore wind farm off the central Gippsland coast the aims to generate up to 2.5 GW of electricity for Australia's energy grid. The onshore footprint of the project would include a trenchless shore crossing, an onshore cable transition	Spatial relevance: the Corio project is proposed to connect in with the VicGrid connection hub in Giffard and there will be a relatively small area of potential overlap with SOTS (refer to Figure 12-1). Groundwater impacts from both projects would apply to shallow groundwater.	Tier 2 (Medium)	The timing of construction for the onshore component of this project is unknown. Therefore, it is conservatively assumed that there could be an overlap.

Project or action	Stage	Project description	Relevance to this assessment	Certainty	Assessment assumptions
		joint bay, and onshore transmission cables to a depth of 1-2 m. Preliminary investigations are due to commence in 2025.	Temporal relevance: construction timing is unknown. Operational periods will overlap. Potential cumulative risk pathway: construction and operation of the onshore portion of the Corio project could impact local groundwater quality, levels and flow in the watertable aquifer in the vicinity the SOTS onshore transmission system near VicGrid. This is discussed further in Section 12.1.1.		

12.1.1 Cumulative groundwater impacts

Construction of the VicGrid and Corio projects could result in loss or damage of existing well(s) in the vicinity of the SOTS construction corridor, near the point of connection of the three projects. It is assumed that VicGrid and Corio would mitigate this impact by agreeing and implementing a “make good” arrangement with the landholder/well owner, and therefore the residual potential for cumulative impact would be low.

Subsurface foundations beneath the VicGrid and Corio projects (for example, piles and transmission cables) could result in a permanent but highly localised change to groundwater levels in the immediate vicinity of the infrastructure, as groundwater is forced to flow around the low permeability material. Given the highly localised effect of subsurface infrastructure on groundwater flow, this would not result in a cumulative effect with the SOTS subsurface infrastructure.

There is no spatial overlap between the two project and SOTS in the vicinity of the SOTS shore crossing, and therefore there are no cumulative impacts associated with that area, including the transition joint bay dewatering.

13.0 Summary of mitigation, monitoring and contingency measures

13.1 Mitigation measures

The mitigation measures that are proposed to avoid, mitigate or manage groundwater impacts associated with the project are summarised in Table 28. In addition to the proposed mitigation measures, additional controls were considered and assessed for practicability. An assessment of practicability on additional control measures not adopted for the project is included in Appendix B.

Table 28 Mitigation measures relevant to groundwater

Measure ID	Mitigation measure	Phase	Related Impact/Risk ID
GWM-M001	**Assessment and make good arrangements to manage temporary water level drawdown at water supply well(s)** Following detailed design and prior to construction, the potential for temporary water level drawdown at existing water supply well(s) due to dewatering will be managed as follows: **1. Confirm existing wells** The location, construction details, and intended uses of wells on land adjacent to the easement will be confirmed through liaison with appropriate landowners. This will include wells that may be present in the study area but are not in the registered well database. **2. Drawdown assessment** An assessment of the potential for adverse dewatering impacts on water supply wells will be completed based on the well's distance from dewatering activities with consideration to drawdown estimates contained herein, well construction and available drawdown (difference between standing water level and pump depth). **3. Make good arrangements** If the potential for an impact is identified, then make good arrangements between the proponent and landholder/well owner will be agreed and implemented during temporary dewatering activities (if required).	Construction	GWM-I001
GWM-M002	**Replacement of lost or damaged well(s)** Following detailed design and prior to construction, the potential for existing wells to be lost or damaged will be managed as follows: **1. Confirm existing wells** The location, construction details, and intended uses of wells within the construction corridor will be confirmed through liaison with appropriate landowners. **2. Make good arrangements** In instances where a well is deemed to be impacted by the project, make good arrangements between the proponent and landholder/well owner will be agreed and	Construction	GWM-I004

Measure ID	Mitigation measure	Phase	Related Impact/Risk ID
	implemented (subject to any approvals required).		
GWM-M003	**Preventing impacts to groundwater quality from excavation and dewatering of acid sulfate soils** An Acid Sulfate Soil Management Plan will be prepared and implemented for the project (refer to SOL-M005 in and SUM-M006). For the purposes of groundwater impacts, the Acid Sulfate Soil Management Plan will be prepared and implemented in accordance with the *National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (Shand et al., 2018). The Acid Sulfate Soil Management Plan will include, but not be limited to, the following actions in areas confirmed to contain potential acid sulfate soil: • Staging of disturbance and dewatering to limit the groundwater cone of depression to less than 100 metres from the edge of excavations; • Installation of groundwater monitoring bores upgradient and downgradient of dewatering and monitoring of groundwater quality pre-dewatering (that is, baseline monitoring), during dewatering, and post-dewatering; • Monitoring of drawdown levels and dewatering discharge quality during construction dewatering; • Contingency measures that include immediate cessation of dewatering if the groundwater quality results indicate that environmental impact has occurred as a result of project works.	Construction	GWM-R005

In addition to the mitigation measures above, mitigation measures in *Technical report I - Surface water*, *Technical report J - Soil and waste*, and *Technical report G: Onshore ecology* are relevant to reducing the potential groundwater impacts caused by the project, including the following:

- Flooding of construction sites will be managed in accordance with SUM-M001: Managing flood risk at construction sites (*Technical report I - Surface water*).
- Trenching across waterways will be carried out in accordance with SUM-M004: Preventing pollution from trenched waterway crossings (*Technical report I - Surface water*).
- The storage and handling of fuels, chemicals and wastes will be in accordance with SOL-M007: Management of chemicals and fuels, and SOL-M011: Operational management of fuels and chemicals (*Technical report J - Soil and waste*).
- The management of dewatering discharge will be in accordance with SOL-M001: Management of dewatering discharge (*Technical report J - Soil and waste*).

- A DEMP will be prepared and implemented in accordance with FFM-M012 (*Technical report G - Onshore ecology*).

13.2 Monitoring and contingency measures

The monitoring and contingency measures that are proposed to assess groundwater impacts associated with the project are summarised in Table 29.

Table 29 Monitoring and contingency measures relevant to groundwater

Measure ID	Monitoring or contingency measure	Phase	Impact/Risk ID
GWM-M004	**Acid Sulfate Soil Management Plan Implementation** Monitoring and contingency measures documented in the Acid Sulfate Soil Management Plan (refer to GWM-M003) will be implemented.	Construction	GWM-R005
GWM-M005	**Onshore trench route inspection** The Onshore Operation Environmental Management Plan will include the following monitoring measure: In the event that thermal sand is used to backfill the onshore trench, the onshore trench route will be inspected following the first winter post-construction in order to check for areas of waterlogging that could be a result of groundwater discharge along preferential pathways. A suitably qualified person will determine whether any waterlogging identified is likely to be caused by trench (taking into account landscape location and pre-construction conditions), and if so, recommend contingency measures to address the impact.	Operation	GWM-I007

As noted in Section 8.0, the potential impact from leaks and spills is included in *Technical report J: Soil and waste*. The following monitoring and contingency measure in *Technical report J: Soil and waste*, is also relevant to groundwater:

- SOL-M013: Monitoring and contingency measures in the event of a leak or spill.

14.0 Summary of implications under relevant legislation

This study has assessed the impacts and risks of construction, operation and decommissioning of the project on groundwater assets and environmental values to be protected.

The significance of the impacts and risks has been assessed in accordance with the evaluation framework, based on applicable legislation, policy and standards and the evaluation objectives and environmental significance guidelines arising from the government terms of reference established to guide the assessments.

The following sections summarise these identified impacts and risks under the relevant Commonwealth and Victorian legislation.

14.1 Commonwealth

In relation to the evaluation objectives set out in the Star of the South EIS Guidelines, they largely relate to the offshore components of the project and impacts on Matters of National Environmental Significance.

The groundwater impacts, including temporary water level drawdown due to construction dewatering, are located over two kilometres from the closest Ramsar wetland (Corner Inlet) with no likelihood of direct impact on these receptors, and thus concluded to have no direct impact on MNES.

The indirect impacts of predicted groundwater impacts on the Matters and National Environmental Significance are addressed in *Technical Report G - Onshore Ecology*.

14.2 Victorian

In relation to the evaluation objectives set out in the Star of the South EES Scoping Requirements, the project would not have significant impacts and risks on groundwater for the following reasons:

- Dewatering required for construction of the onshore trenches, joint bays, and transition joint bays would result in water level drawdowns that are localised and temporary. There are no registered groundwater wells located within the estimated temporary water level drawdown footprint; however, it is possible that wells with incorrect coordinates, wells installed after the database search was conducted, and/or unregistered wells could be present. This potential impact would be managed through additional assessment and make good arrangements during temporary dewatering activities, if required.
- The risk of wells in the construction corridor being damaged or destroyed would be managed via continued liaison with landholders and make-good arrangements if required.
- Dewatering is unlikely to cause saline intrusion based on the hydrogeological setting and project description. Any (unexpected) effects on shallow groundwater quality would be temporary and negligible.
- Excavations would be kept open for as little time as practicable and overland flow diverted away from excavations to reduce the potential of poor-quality overland flow recharging groundwater and impacting on local groundwater quality.
- The potential for oxidation of ASS due to excavation and dewatering will be assessed, managed, and monitored in accordance with an ASSMP.
- The potential for backfilled onshore trenches to create permanent preferential flow paths would be negligible.
- Groundwater level and flow changes associated with infrastructure impeding groundwater flow would be negligible.

15.0 Conclusion

The purpose of this report is to assess the potential groundwater impacts and risks associated with Star of the South Offshore Wind Farm to inform the preparation of the EIS/EES required for the project.

In relation to the evaluation objectives set out in the Star of the South EIS Guidelines, this assessment has identified no direct impact on MNES. The indirect impacts of predicted groundwater impacts on the MNES are addressed in *Technical Report G - Onshore Ecology*.

In relation to the evaluation objectives set out in the Star of the South EES Scoping Requirements, this assessment has identified limited risks and proportional mitigation, management or response measures to address the GED as required under the EP Act. An assessment of practicability on control measures not adopted for the project is included in Appendix B.

Five potential construction phase impact/risk pathways were identified:

i) Dewatering reduces groundwater levels at water supply wells.

ii) Dewatering near the coast causes saline intrusion that affects groundwater quality.

iii) Poor quality overland flow recharges groundwater via excavations.

iv) Existing wells are damaged or destroyed during onshore construction activities.

v) Excavation and dewatering of acid sulfate soils affects groundwater quality.

The potential impact of dewatering on GDEs, including terrestrial, aquatic, and subterranean (that is, stygofauna) GDEs, is included in *Technical report - Onshore ecology*.

With the implementation of mitigation measures, residual impacts during construction are assessed as being negligible to minor and residual risks are assessed as being very low to low.

Two potential impacts were identified for the operational phase of the project:

i) Subsurface infrastructure impedes groundwater flow.

ii) Onshore trench backfill creates preferential groundwater flow paths.

Based on hydrogeological conditions and the project design, both operational phase residual impacts are assessed as being negligible.

Mitigation, management or response measures are summarised in Table 30.

Table 30 Mitigation measures relevant to groundwater

Measure ID	Mitigation measure	Phase	Related Impact/ Risk ID
GWM-M001	**Assessment and make good arrangements to manage temporary water level drawdown at water supply well(s)** Following detailed design and prior to construction, the potential for temporary water level drawdown at existing water supply well(s) due to dewatering will be managed as follows: **1. Confirm existing wells** The location, construction details, and intended uses of wells on land adjacent to the easement will be confirmed through liaison with appropriate landowners. This will include wells that may be present in the study area but are not in the registered well database. **2. Drawdown assessment** An assessment of the potential for adverse dewatering impacts on water supply wells will be completed based on the well's distance from dewatering activities with consideration to drawdown estimates contained herein, well construction and available drawdown (difference between standing water level and pump depth). **3. Make good arrangements**	Construction	GWM-I001

Measure ID	Mitigation measure	Phase	Related Impact/ Risk ID
	If the potential for an impact is identified, then make good arrangements between the proponent and landholder/well owner will be agreed and implemented during temporary dewatering activities (if required).		
GWM-M002	**Replacement of lost or damaged well(s)** Following detailed design and prior to construction, the potential for existing wells to be lost or damaged will be managed as follows: **1. Confirm existing wells** The location, construction details, and intended uses of wells within the construction corridor will be confirmed through liaison with appropriate landowners. **2. Make good arrangements** In instances where a well is deemed to be impacted by the project, make good arrangements between the proponent and landholder/well owner will be agreed and implemented (subject to any approvals required).	Construction	GWM-I004
GWM-M003	**Preventing impacts to groundwater quality from excavation and dewatering of acid sulfate soils** An Acid Sulfate Soil Management Plan will be prepared and implemented for the project (refer to SOL-M005 and SUM-M006). For the purposes of groundwater impacts, the Acid Sulfate Soil Management Plan will be prepared and implemented in accordance with the *National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (Shand et al., 2018). The Acid Sulfate Soil Management Plan will include, but not be limited to, the following actions in areas confirmed to contain potential acid sulfate soil: • Staging of disturbance and dewatering to limit the groundwater cone of depression to less than 100 metres from the edge of excavations; • Installation of groundwater monitoring bores upgradient and downgradient of dewatering and monitoring of groundwater quality pre-dewatering (that is, baseline monitoring), during dewatering, and post-dewatering; • Monitoring of drawdown levels and dewatering discharge quality during construction dewatering; • Contingency measures that include immediate cessation of dewatering if the groundwater quality results indicate that environmental impact has occurred as a result of project works.	Construction	GWM-R005

Measure ID	Mitigation measure	Phase	Related Impact/ Risk ID
	The Victorian Environment Protection Authority will be consulted on the Acid Sulfate Soil Management Plan prior to construction commencement.		

The monitoring and contingency measures that are proposed to assess groundwater impacts associated with the project are summarised in Table 31.

Table 31 Monitoring and contingency measures relevant to groundwater

Measure ID	Monitoring or contingency measure	Phase	Impact/Risk ID
GWM-M004	**Acid Sulfate Soil Management Plan Implementation** Monitoring and contingency measures documented in the Acid Sulfate Soil Management Plan (refer to GWM-M003) will be implemented.	Construction	GWM-R005
GWM-M005	**Onshore trench route inspection** The Onshore Operation Environmental Management Plan will include the following monitoring measure: In the event that thermal sand is used to backfill the onshore trench, the onshore trench route will be inspected following the first winter post-construction in order to check for areas of waterlogging that could be a result of groundwater discharge along preferential pathways. A suitably qualified person will determine whether any waterlogging identified is likely to be caused by trench (taking into account landscape location and pre-construction conditions), and if so, recommend contingency measures to address the impact.	Operation	GWM-I007

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Appendix A

Impact and Risk Register

Appendix A Impact and Risk Register

Impact or Risk ID	Impact or risk pathway	Initial mitigation	Initial impact or risk level					Final mitigation	Residual impact or risk level				
			Receptor sensitivity	Magnitude	Consequence level	Likelihood	Risk level		Receptor sensitivity	Magnitude	Consequence level	Likelihood	Risk level
Construction													
GWM-I001	*Dewatering reduces groundwater levels at water supply wells*	*None*	*Medium*	*Low*	*Minor (D)*	-	-	***GWM-M001: Assessment and make good arrangements to manage temporary water level drawdown at water supply well(s)*** *Following detailed design and prior to construction, the potential for temporary water level drawdown at existing water supply well(s) due to dewatering will be managed as follows:* *1. Confirm existing wells* *The location, construction details, and intended uses of wells on land adjacent to the easement will be confirmed through liaison with appropriate landowners. This will include wells that may be present in the study area but are not in the registered well database.* *2. Drawdown assessment* *An assessment of the potential for adverse dewatering impacts on water supply wells will be completed based on the well's distance from dewatering activities with consideration to drawdown estimates contained herein, well construction and available drawdown (difference between standing water level and pump depth).* *3. Make good arrangements* *If the potential for an impact is identified, then make good arrangements between the proponent and landholder/well owner will be agreed and implemented during temporary dewatering activities (if required).*	*Medium*	*Negligible*	*Negligible (E)*	-	-
GWM-I002	*Dewatering near the coast causes saline intrusion that affects groundwater quality*	*None*	*Medium*	*Negligible*	*Negligible (E)*	-	-	*None*	*Medium*	*Negligible*	*Negligible (E)*	-	-
GWM-R003	*Poor quality overland flow recharges groundwater via excavations*	*None*	*Medium*	*Low*	*Minor (D)*	*Unlikely*	*Low*	*Flooding of construction sites will be managed in accordance with SUM-M001: Managing flood risk at construction sites (Technical report I - Surface water).* *Trenching across waterways will be carried out in accordance with SUM-M004: Preventing pollution from trenched waterway crossings (Technical report I - Surface water).* *The storage and handling of fuels, chemicals and wastes will be in accordance with SOL-M011 - Management of chemicals and fuels (Technical report J - Soil and waste).* *No additional mitigation measures are proposed.*	*Medium*	*Low*	*Minor (D)*	*Rare*	*Very Low*
GWM-I004	*Existing wells are damaged or destroyed during onshore construction activities*	*None*	*Medium*	*Medium*	*Moderate (C)*	-	-	***GWM-M002: Replacement of lost or damaged well(s)*** *Following detailed design and prior to construction, the potential for existing wells to be lost or damaged will be managed as follows:* *1. Confirm existing wells*	*Medium*	*Low*	*Minor (D)*	-	-

Impact or Risk ID	Impact or risk pathway	Initial mitigation	Initial impact or risk level					Final mitigation	Residual impact or risk level				
			Receptor sensitivity	Magnitude	Consequence level	Likelihood	Risk level		Receptor sensitivity	Magnitude	Consequence level	Likelihood	Risk level
								The location, construction details, and intended uses of wells within the construction corridor will be confirmed through liaison with appropriate landowners. *2. Make good arrangements* *In instances where a well is deemed to be impacted by the project, make good arrangements between the proponent and landholder/well owner will be agreed and implemented (subject to any approvals required).*					
GWM-R005	*Excavation and dewatering of acid sulfate soils affects groundwater quality*	*None*	*Medium*	*High*	*Major (B)*	*Possible*	*High*	***GWM-M003: Preventing impacts to groundwater quality from excavation and dewatering of acid sulfate soils*** *An Acid Sulfate Soil Management Plan will be prepared and implemented for the project (refer to SOL-M005 and SUM-M006). For the purposes of groundwater impacts, the Acid Sulfate Soil Management Plan will be prepared and implemented in accordance with the National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments (Shand et al., 2018). The Acid Sulfate Soil Management Plan will include, but not be limited to, the following actions in areas confirmed to contain potential acid sulfate soil:* • *Staging of disturbance and dewatering to limit the groundwater cone of depression to less than 100 metres from the edge of excavations;* • *Installation of groundwater monitoring bores upgradient and downgradient of dewatering and monitoring of groundwater quality pre-dewatering (that is, baseline monitoring), during dewatering, and post-dewatering;* • *Monitoring of drawdown levels and dewatering discharge quality during construction dewatering;* • *Contingency measures that include immediate cessation of dewatering if the groundwater quality results indicate that environmental impact has occurred as a result of project works.* *The Victorian Environment Protection Authority will be consulted on the Acid Sulfate Soil Management Plan prior to construction commencement.*	*Medium*	*Medium*	*Moderate (C)*	*Unlikely*	*Low*
Operation													
GWM-I006	*Subsurface infrastructure impedes groundwater flow*	*None*	*Medium*	*Negligible*	*Negligible (E)*	*-*	*-*	*None*	*Medium*	*Negligible*	*Negligible (E)*	*-*	*-*
GWM-I007	*Onshore trench backfill creates preferential groundwater flow paths*	*None*	*Medium*	*Negligible*	*Negligible (E)*	*-*	*-*	*None*	*Medium*	*Negligible*	*Negligible (E)*	*-*	*-*

Impact or Risk ID	Impact or risk pathway	Initial mitigation	Initial impact or risk level					Final mitigation	Residual impact or risk level				
			Receptor sensitivity	Magnitude	Consequence level	Likelihood	Risk level		Receptor sensitivity	Magnitude	Consequence level	Likelihood	Risk level

Notes:

The potential impact of dewatering on GDEs is included in *Technical report G - Onshore ecology* (refer to risk ID FFM-R013).

The potential impact from leaks and spills is included in *Technical report J - Soil and waste* (refer to risk IDs SOL-R008 and SOL-R009).

Appendix B

Assessment of practicability

Appendix B Assessment of practicability

Mitigation measure		Location	Factor to consider (EPA Victoria Publication 1856)	Commentary on practicability	Effectiveness	Adopted?
Minimise the time excavations are open in order to minimise dewatering durations		Onshore trenches, joint bays, and transition joint bays	Elimination	This would reduce the risk of dewatering temporarily reducing groundwater levels at water supply wells and the risk of inducing saline intrusion.	This mitigation measure would be effective at reducing the risk associated with dewatering the onshore trenches, joint bays, and transition bays, because this would directly reduce the duration of dewatering required. However, it is not feasible due to the minimum construction periods required installation of the subsurface infrastructure required for the project.	No
			Likelihood	Unlikely (GWM-I001 – water supply wells) Rare (GWM-I002 – saline intrusion)		
			Degree / Consequence	Minor (GWM-I001 – water supply wells) Moderate (GWM-I002 – saline intrusion)		
			Knowledge	Risks associated with reducing groundwater levels at water supply wells (GWM-I001) and inducing saline intrusion near the coast (GWM-I002) have been semi-quantitatively assessed using the available groundwater data (Section 9.0).		
			Availability	This mitigation measure is not feasible to implement because minimum time periods (as noted in Section 9.2.1) are required for construction.		

			Cost	Cost of this mitigation measure would likely be minimal.		
Construction of temporary bunds adjacent to all excavations including onshore trenches, joint bays, and transition bays		Onshore trenches, joint bays, and transition joint bays	Elimination	This would significantly reduce the risk of low-quality overland flow entering excavations and impacting local groundwater quality.	This mitigation measure would be effective at reducing the potential for poor quality overland flow to enter excavations following rainfall events. However, it is not feasible to implement, and the costs would not be commensurate with the assessed risk level.	No
			Likelihood	Possible (GWM-R003 – overland flow)		
			Degree / Consequence	Minor (GWM-R003 – overland flow)		
			Knowledge	There is no information available on the potential water quality or volumes of surface runoff that may enter excavations. There is limited information available on local groundwater quality (Section 7.5).		
			Availability	This mitigation measure would not be feasible to implement because bunds would reduce the accessibility of trenches for plant and other equipment required to install the required subsurface infrastructure.		
			Cost	The potential costs of this mitigation measure are not commensurate with the risk level, which was assessed as 'Low' (refer to Appendix A).		

Appendix C

Dewatering Drawdown Estimates

Appendix C Dewatering Drawdown Estimates

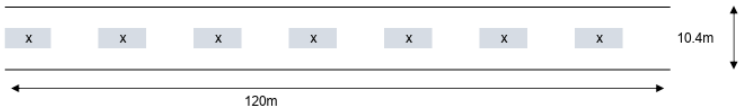
Trench

Client :	**Star of the South Windfarm Pty Ltd**	Location :	**Gippsland**
Project :	**Technical Report H: Groundwater**		
Calculate Drawdown (s) for known Discharge (Q)	THEIS Analytical Solution (Theis, 1935)		

DEWATERING ESTIMATE: TRENCH

120.0 bores
3.48 flow rate per bore (cu.m/day)
417.6 m3/day (total)

4.83 L/sec



aquifer thickness	2	m
hydraulic conductivity	1	m/day
T	**2**	**m2/day**

Spacing	1	m			
Pit length	120	m	Pit width	10.4	m
No. Bores	120.0		Half pit width	5.2	m

Distance drawdown estimates

Edge of trench 5.2 — **Ddn** **2.00** m

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
5.2	5.3	5.6	6.0	6.6	7.2	7.9	8.7	9.5	10.4	11.3	12.2	13.1	14.0	14.9	15.9	16.8
0.16	0.15	0.14	0.13	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00

Distance from centre of trench 6.5 — **Ddn** **1.50** m

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
6.5	6.6	6.8	7.2	7.6	8.2	8.8	9.6	10.3	11.1	11.9	12.8	13.6	14.5	15.4	16.3	17.3
0.11	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00

Distance from centre of trench 8 — **Ddn** **1.04** m

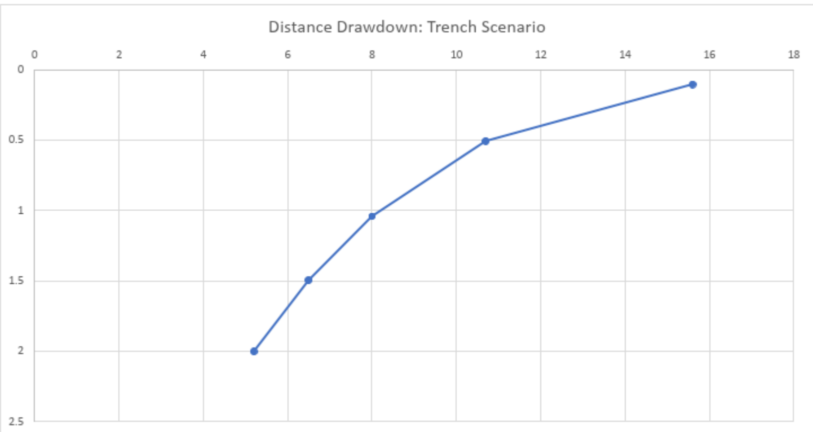
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
8.0	8.1	8.2	8.5	8.9	9.4	10.0	10.6	11.3	12.0	12.8	13.6	14.4	15.3	16.1	17.0	17.9
0.07	0.07	0.07	0.06	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00

Distance from centre of trench 10.7 — **Ddn** **0.51** m
Distance from edge **5.5**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
10.7	10.7	10.9	11.1	11.4	11.8	12.3	12.8	13.4	14.0	14.6	15.3	16.1	16.8	17.6	18.4	19.2
0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00

Distance from centre of trench 15.6 — **Ddn** **0.10** m
Distance from edge **10.4**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
15.6	15.6	15.7	15.9	16.1	16.4	16.7	17.1	17.5	18.0	18.5	19.1	19.7	20.3	21.0	21.6	22.3
0.007	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		



Joint bays

Client :	Star of the South Windfarm Pty Ltd	Location :	Gippsland
Project :	Technical Report H: Groundwater		

Calculate Drawdown (s) for known Discharge (Q) THEIS Analytical Solution (Theis, 1935)

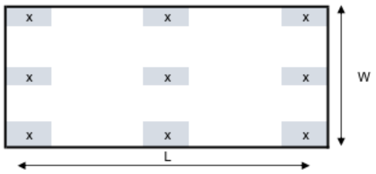
DEWATERING ESTIMATE: JOINT BAY

9.0 bores
4.06 flow rate per bore (cu.m/day)
36.5 m3/day (total)

0.42 L/sec

Excavation dimensions
40 m Length
15 m width
600 sq.m area
24.5 m : Eqvlnt square
x shallow spearpoint well

aquifer thickness	3	
hydraulic conductivity	1	m/day
T	**3**	**m2/day**
Pit wdth	24.5	m
Pit length	24.5	m
No. Bores	9.0	



Distance drawdown estimates

Drawdown at each perimeter well 0.1 **Ddn** **3.00** m

x1	x3	x2	x1	x2
0.1	12.2	17.3	24.5	27.4
1.32	0.28	0.21	0.15	0.13

Centre of foundation **Ddn** **3.31** m

x1	x4	x4
0.1	12.2	17.3
1.32	0.28	0.21

Distance from foundation edge (m) 10 **Ddn** **1.49** m

x1	x1	x1	x2	x2	x2
10.0	22.2	34.5	15.8	25.4	36.6
0.33	0.17	0.09	0.23	0.14	0.08

Distance from foundation edge (m) 20 **Ddn** **0.93** m

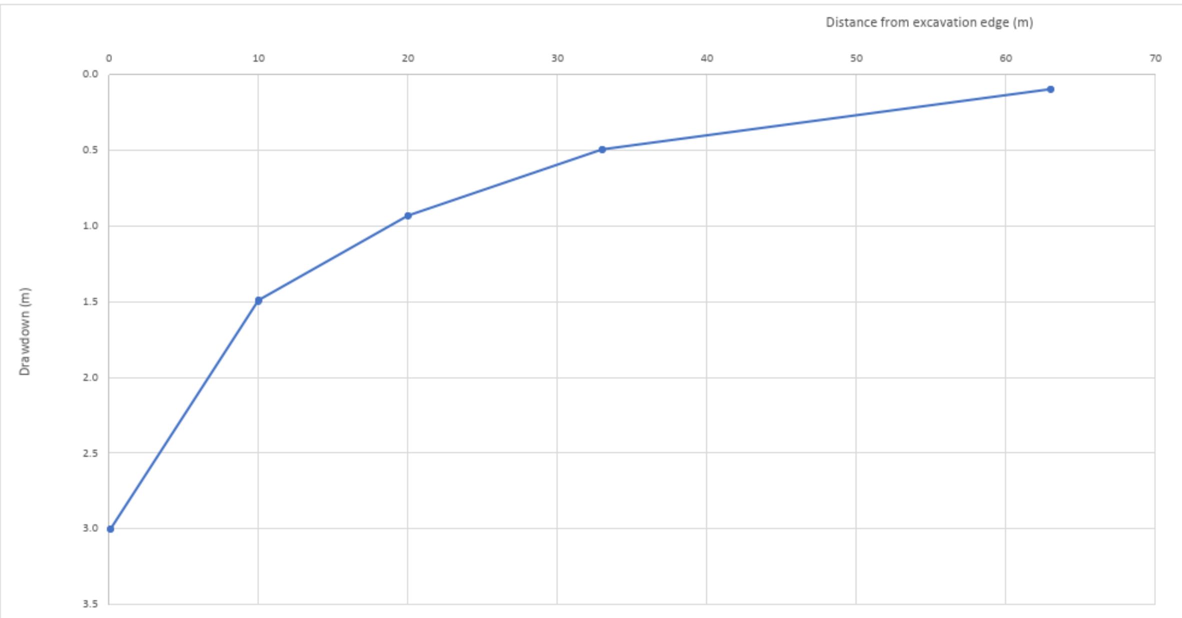
x1	x1	x1	x2	x2	x2
20.0	32.2	44.5	23.5	34.5	46.1
0.19	0.10	0.05	0.16	0.09	0.05

Distance from foundation edge (m) 33 **Ddn** **0.50** m

x1	x1	x1	x2	x2	x2
33.0	45.2	57.5	35.2	46.9	58.8
0.097	0.05	0.03	0.09	0.05	0.03

Distance from foundation edge (m) 63 **Ddn** **0.10** m

x1	x1	x1	x2	x2	x2
63.0	75.2	87.5	64.2	76.2	88.3
0.02	0.01	0.00	0.02	0.01	0.00



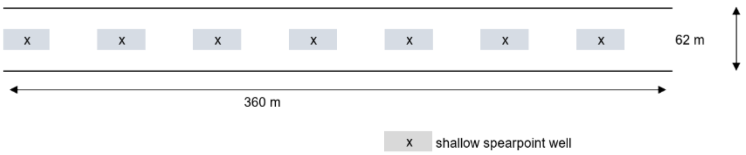
Transition bays

Client :	**Star of the South Windfarm Pty Ltd**	Location :	**Gippsland**
Project :	**Technical Report H: Groundwater**		
Calculate Drawdown (s) for known Discharge (Q)	THEIS Analytical Solution (Theis, 1935)		

DEWATERING ESTIMATE: TRANSITION BAYS

180.0 bores
4.46 flow rate per bore (cu.m/day)
802.8 m3/day (total)

9.29 L/sec



aquifer thickness	5	m
hydraulic conductivity	1	m/day
T	**5**	**m2/day**

Spacing	2	m			
Pit length	360	m	Pit width	62	m
No. Bores	180.0		Half pit width	31	m

Distance drawdown estimates

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
		Ddn	31.0	31.1	31.3	31.6	32.0	32.6	33.2	34.0	34.9	35.8	36.9	38.0	39.2	40.5	41.8	43.1	44.6
Edge of trench	31	**5.00** m	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.12

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
		Ddn	50.0	50.0	50.2	50.4	50.6	51.0	51.4	51.9	52.5	53.1	53.9	54.6	55.5	56.4	57.3	58.3	59.4
Distance from centre of trench	50	**3.33** m	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
		Ddn	80.0	80.0	80.1	80.2	80.4	80.6	80.9	81.2	81.6	82.0	82.5	83.0	83.5	84.1	84.8	85.4	86.2
Distance from centre of trench	80	**1.75** m	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
		Ddn	134.0	134.0	134.1	134.1	134.2	134.4	134.5	134.7	135.0	135.2	135.5	135.8	136.1	136.5	136.9	137.3	137.8
Distance from centre of trench	134	**0.50** m	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Distance from edge	**103**																	

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
		Ddn	192.0	192.0	192.0	192.1	192.2	192.3	192.4	192.5	192.7	192.8	193.0	193.3	193.5	193.8	194.0	194.3	194.6
Distance from centre of trench	192	**0.10** m	0.003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Distance from edge	**161**