APPENDIX H

Physical Environment

H-1 Topography, Geology and Soils Assessment

H-2 Preliminary Site Investigation Report

H-3 Surface Water Assessment

H-4 Hydrogeological Conceptual Model and Groundwater Impact Assessment Report for the Pipeline Alignment

H-5 Hydrogeological Investigation – Mulllaquana Desalination Plant Site

H-6 Watercourses of Interest Table

H-7 Stormwater Management Plan

Appendix H-1:

Topography, Geology and Soils Assessment



NORTHERN WATER PROJECT

Department for Infrastructure and Transport

Topography, Geology and Soils Assessment

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Northern Water Project – Topography, Geology and Soils

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Executive summary

Introduction

The Northern Water Project (the Project) aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the Project will involve the construction and operation of a 51 gigalitre per year (GL/year) seawater reverse osmosis desalination plant located at Mullaquana Station, and associated water transfer system (including pipelines, transfer pump stations, product water storages) and electricity infrastructure.

JBS&G Australia Pty Ltd (JBS&G) and Jacobs Group (Australia) Pty Ltd (Jacobs) have been engaged by Department for Infrastructure and Transport (DIT) to prepare and deliver the primary environmental assessments and approvals for all marine and terrestrial works to support the Project.

This Topography, Geology and Soils Report summarises the findings of a desktop assessment of topography, geology and soils related constraints and opportunities for the Project, together with a targeted field inspection and an assessment of key geohazards and proposed mitigation measures.

The objective of the desktop assessment is to assess potential impacts and risks to topography, geology and soils, and to identify mitigation measures to eliminate or minimise risks to the physical environment. The assessment considers potential impacts from construction activities such as earthworks, dewatering, stockpiling, vegetation removal and temporary workforce accommodation, as well as operation and maintenance of the desalination plant, transfer system and associated infrastructure.

Methodology

The Project Area definition for the Environmental Impact Statement is a 2.5 km buffer around the desalination plant footprint and either side of the centreline of linear infrastructure (i.e., a 5 km wide corridor). Linear infrastructure includes pipelines and transmission lines. The Project Area is divided into a southern section (kilometre point (KP) 0–195) and a northern section (KP 195–360) of the main transfer pipeline and includes the lateral branch pipeline (KP CA 0–46).

The topography assessment was undertaken through review of available land survey and spatial information, including LiDAR data. Geomorphology was assessed through desktop review of existing information to identify and characterise the landforms/land systems crossed by the transfer system infrastructure and electricity infrastructure, supported by targeted field inspection. The geology and soils assessment comprised a desktop review of available soils, geology and geotechnical information to assess likely ground conditions along the transfer system and at locations of associated infrastructure, and to identify potential geohazards and mitigation measures.

Topography, Geology and Soils

The topography of the Project Area is generally of low to moderate relief, with localised areas of higher relief. In broad terms, the southern section traverses lower-relief plains with gentle undulations, while the northern section transitions into more elevated and variable terrain with pronounced rises and intervening valleys. The lateral branch pipeline shows an overall net rise toward the Carrapateena mine delivery point, with the most pronounced ascent occurring in the final portion of the alignment.

Along the main transfer pipeline, ground surface elevations range from 5.97 m Australian Height Datum (AHD) at approximately KP 8.5 to 203.63 m AHD at approximately KP 251.3. Within the southern section, elevations range from 5.97 m AHD (approximately KP 8.5) to 138.12 m AHD (approximately KP 154.0). Within the northern section, elevations range from approximately 66.82 m AHD (approximately KP 196.7) to 203.63 m AHD

(approximately KP 251.3). Along the lateral branch pipeline, elevations range from 64.10 m AHD (approximately KP CA 21.3) to 222.46 m AHD (approximately KP CA 46.4).

The Project corridor traverses a range of geomorphic environments including coastal plains, alluvial plains and valleys, sandy and clayey plains, dune and swale systems, and low-lying salt lakes and clay pans. Vegetation is often more highly concentrated along drainage lines. Although erosion is generally limited at a landscape scale, localised erosion and scouring is evident where flows are concentrated, such as around roadside drainage systems and culvert features.

Surface geology along the transfer system includes extensive Quaternary aeolian and regolith deposits, with localised alluvial/fluvial sediments within drainage features and intermittent exposures of bedrock units. In the northern section, bedrock exposures become more prominent in places (including sandstones, quartzites, dolomites, shales and limestones), with aeolian sands continuing to mantle portions of the alignment. The lateral branch pipeline is underlain by a combination of aeolian and bedrock units consistent with the broader northern Project Area geology.

Geohazards

A geotechnical risk assessment of the potential environmental impacts of relevant geohazards during construction and operation of the Project has been undertaken. Initial and residual risks were assessed, and mitigation measures to reduce risks have been identified.

The geohazards considered relevant to the Project include shallow bedrock, indurated materials (including calcrete and calcareous soils), collapsible soils, expansive clays, karst, slope instability and landslides, soil erosion, soil aggressivity, and seismicity.

The initial risk rating for the majority of geohazards is Medium, with shallow bedrock assessed as High and slope instability and landslides assessed as Low. Following implementation of the proposed mitigation measures, the residual risk rating for the assessed geohazards is Low.

Mitigation measures typically include:

- Targeted geotechnical investigation if required and assessment of soil and rock properties.
- Consideration of pipeline materials, coatings and cathodic protection in aggressive soils.
- Consideration of alternative installation methods (including localised above-ground installation) where warranted by terrain, creek crossings, aggressive soils, shallow bedrock or potential karst features.
- Measures to maximise reuse of excavated materials while managing unsuitable materials to minimise environmental impacts.
- Pipe and joint design measures (and where appropriate, isolation valves) to mitigate impacts of expansive soils, potential loss of support, aggressive soils, buoyancy and seismic actions.

Geomorphology

The construction, operation and maintenance of the desalination plant, transfer system and associated infrastructure are not expected to present significant risk to regional geomorphic processes, provided that appropriate management measures are implemented. Key geomorphological risks are generally localised and can be managed through construction and operational controls.

The primary areas requiring focused management are:

- Aeolian (dunal) landforms, where disturbance can alter natural drainage pathways and increase localised erosion and scouring risk.
- Watercourses and drainage line crossings, particularly where larger flows and mobile beds may occur and where existing infrastructure (e.g., culverts) concentrates flow.

- Access tracks and disturbed areas, which may require inspection and maintenance following rainfall events, particularly in dune and swale environments, areas with collapsible soils and where drainage features interact with constructed assets.

These risks are considered manageable through appropriate design, standard construction methodologies and implementation of mitigation measures (including erosion and sediment controls, drainage management, progressive rehabilitation and maintenance programs) within relevant management plans.

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Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide an assessment of the topography, geology and soils constraints for the Project in accordance with the scope of services set out in the contract between Jacobs and the Client, JBS&G, and head client, DIT.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the head Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

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Acronyms and abbreviations

Acronym	Title
AS	Australian Standard
ASS	Acid sulfate soils
Bgl	Below ground level
CEMP	Construction Environmental Management Plan
DBOM	Design, build, operate and maintain
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEW	Department for Environment and Water
DP	Desalination plant
EIS	Environmental Impact Statement
EP	Eyre Peninsula
EPA	(South Australian) Environment Protection Authority
EP Act	*Environment Protection Act 1993* (South Australia)
GSSA	Geological Survey of South Australia
IBRA	Interim Biogeographic Regionalisation for Australia
LSA Act	*Landscape South Australia Act 2019*
KP	Pipeline kilometre point
m AHD	Metres above Australia Height Datum
m bgl	Metres below ground level
M_{max}	Magnitude of the largest possible earthquake
NFD	Neotectonic Features Database
NSHA	National Seismic Hazard Assessment
OEMP	Operational Environmental Management Plan
PGA	Peak ground acceleration
PS	Pump station
SA	South Australia
SAAL	South Australian Arid Lands
SARIG	South Australian Resources Information Gateway
SWRO	Seawater reverse osmosis (SWRO)
TBM	Tunnel Boring Machine

1. Introduction

The Northern Water Project (the Project) aims to provide a secure climate resilient water supply for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the Project will involve the construction and operation of a 51 gigalitre per year (GL/year) seawater reverse osmosis desalination plant located at Mullaquana Station (approximately 25 km south-west of Whyalla) and associated marine structures on the Upper Spencer Gulf, transfer system (including pipelines, pump stations, and storages) and electricity infrastructure.

The Project comprises the following key elements:

- A 51 GL/year seawater reverse osmosis desalination plant.
- Sea water intake and outfall pipelines within the marine tunnels extending underneath the seabed, and associated intake structure and pumps.
- Diffuser structures for discharge of return water.
- A transfer system consisting of:
  - a ~360 km main transfer pipeline, largely constructed underground terminating at the delivery point at the Olympic Dam copper-gold mine.
  - a ~46 km lateral branch pipeline to a delivery point at the Carrapateena copper-gold mine (which may be constructed above or below ground).
  - a transfer pump station and storage at the desalination plant.
  - three transfer pump stations and storages along the main transfer pipeline.
- High voltage electricity supply including new transmission and distribution lines and new network and facility substations to provide power to the desalination plant and transfer pump stations.
- Associated temporary construction-related infrastructure (e.g. construction camps, site offices and amenities, yards, storages and laydown areas).
- Access tracks including establishing new tracks and upgrading existing tracks.
- Enabling roadworks and road upgrades.

The purpose of this report is to summarise the findings of a desktop assessment of the existing environment in the Project Area concerning the topography, geology and soils, the findings of a field inspection, and the identification of key geohazards and proposed mitigation measures. This report will inform relevant chapters of the Project's Environmental Impact Statement (EIS), and other required environmental approvals.

The geomorphology assessment of this report reviews potential impacts from construction functions such as earthworks, dewatering, stockpiling, vegetation removal, and temporary workforce accommodation, as well as operations and maintenance of the Project.

2. Project description

This section provides a summary of the Project.

2.1 Project location

The Project locations are conceptually split into separate alignments which are summarised below (see **Figure 2-1**):

- Mullaquana Station (Crown lease) located 25 km south-west of Whyalla.
- Proposed site located ~14 km east of the Lincoln Highway. Currently accessed by unsealed local roads and private station tracks.
- Site is approximately 200 ha for the purposes of construction.
- Desalination plant site is ~1.5 km from the coastal waters of the Upper Spencer Gulf.
- Possible sensitive human receptors are:
  - Mullaquana Station homestead – 5 km north-west.
  - Cowleds Landing – 8 km north.
  - Murninnie Beach – 10.5 km south.

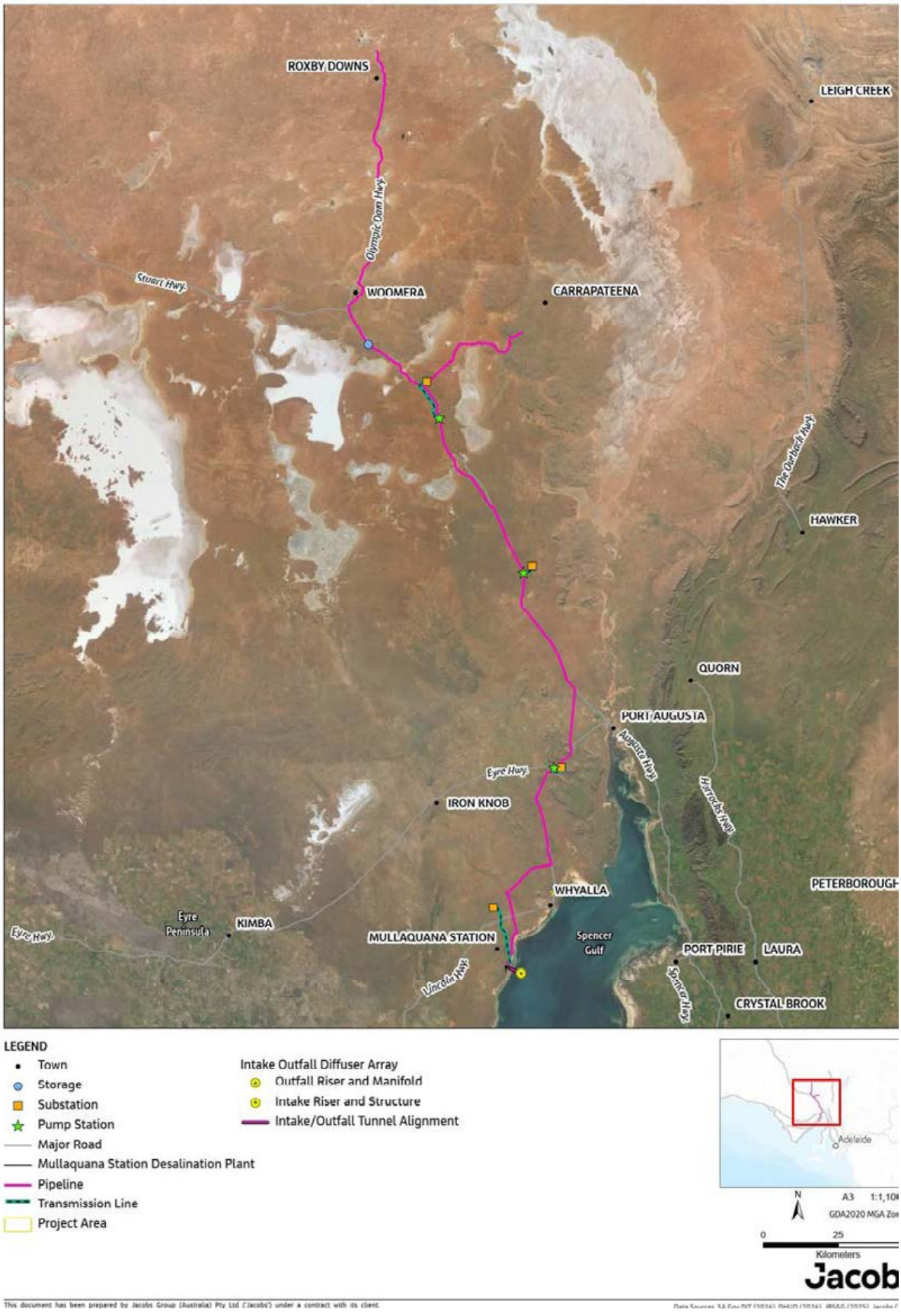


Figure 2-1. Project area and pipeline alignment

2.2 Key Project components

Key Project components include:

- A seawater reverse osmosis (SWRO) desalination plant:
  - Sized for up to 51/GL year capacity.
  - One pass RO system operating at 45% RO system recovery and 40% overall plant recovery.
- Seawater intake pipe extending into Spencer Gulf and associated intake structure and pumps.
- Outfall pipe with diffuser structures for discharge of return water into Spencer Gulf.
- Approximately 360 km main transfer pipeline extending north from the desalination plant to Olympic Dam and an approximately 46 km lateral branch pipeline.
- 4 new transfer pump stations:
  - PS 1 – Mullaquana Station pump station (desalination plant site).
  - PS 2 – Lincoln Gap pump station and 6 ML storage.
  - PS 3 – Kalaya pump station and 6 ML storage.
  - PS 4 – Mangata pump station and 6 ML storage.
- 1 new storage (Bimba storage tank) at Pimba at the overall high point on the main transfer pipeline.
- High voltage electricity supply including transmission lines and network and facility substations to provide power to the desalination plant and pump stations.
- New access tracks and upgrades of existing tracks.
- Enabling roadworks and road upgrades.
- Associated (temporary) construction-related infrastructure (e.g. construction camps, site offices and amenities, yards, laydowns and storages).

Relevant locations and regions referenced in this study are provided in in **Table 2-1**.

Table 2-1. Locations and regions that will be referred to in the EIS

Other locations	Description
Relevant LGAs	▪ Corporation of the City of Whyalla ▪ Unincorporated Area (UIA) Whyalla ▪ Port Augusta City Council ▪ Municipal Council of Roxby Downs
Population centres relevant to the assessment	▪ Cowleds Landing and Murninnie Beach ▪ Whyalla ▪ Port Augusta ▪ Woomera and Pimba ▪ Roxby Downs
Department of Defence land	▪ Cultana Training area ▪ Woomera Prohibited Area / Woomera Range Complex
Landscape Management Regions	▪ Eyre Peninsula ▪ South Australian Arid Lands

Other locations	Description
IBRA regions and subregions	▪ Gawler Region ▪ Myall Plains Subregion ▪ Gawler Lakes Subregion ▪ Arcoona Plateau Subregion ▪ Roxby Subregion

2.3 Project Area definition

The Project Area is based on a 2.5 km buffer of the alignment of linear infrastructure (i.e. a 5 km wide corridor). Linear infrastructure includes pipelines, transmission lines and the desalination plant intake and outfall. The buffer effectively incorporates all Project infrastructure for the purposes of approvals.

The Project Area will be used as a guide for the assessment of impacts. Final location of infrastructure is expected to remain inside this corridor.

The Project Area has been divided into southern and northern sections. The coverage and Project elements relevant to the present risk assessment that are situated within each section are included in **Table 2-2**.

Table 2-2. Project Area sections and descriptions

Section	Coverage	Project elements in the section	Approximate pipeline kilometre point
Southern	North of Munyaroo Conservation Park to Lake Dutton / Pernatty Lagoon. Coverage includes Murninnnie Beach, Cowleds Landing, Whyalla and Port Augusta.	▪ Desalination plant and marine infrastructure ▪ Mullaquana Station 132 kV transmission line ▪ Mullaquana Station substation (new) ▪ Southern section of main transfer pipeline ▪ PS 2 (Lincoln Gap pump station and storage) ▪ Pandurra 275 kV transmission line ▪ Corraberra Hill substation (existing) ▪ PS 3 (Kalaya pump station and storage) ▪ Bookaloo 132kV transmission line ▪ Kootaberra substation (new)	KP 0 – KP 195
Northern	Lake Dutton / Pernatty Lagoon to Olympic Dam. Coverage includes Carrapateena mine, Woomera, Pimba, Roxby Downs and Olympic Dam	▪ Northern section of main trunk pipeline ▪ PS 4 (Mangata pump station and storage) ▪ Oakden Hills transmission line ▪ Mount Gunson substation (existing) ▪ Lateral branch pipeline ▪ Bimba high point storage	KP 195 – KP 360

2.4 Construction method

The Project will require the construction of the desalination plant, pipeline, pump stations, storages, transmission lines, and other associated infrastructure as listed in Section **2.2**. Construction activities will include the establishment of construction compounds and accommodation camps, vegetation clearing, earthworks, foundation construction, trenching, under boring (of major roads, railways and potentially some watercourses), concrete works, and ancillary facilities within the construction corridor.

The main transfer and lateral branch pipelines are proposed to be buried, constructed using trench and cover fill for the majority of the alignment including road crossings. Average construction has been estimated as 500 linear m /day (spread length ~200 m) depending on the location and complexity of each pipeline section. Two pipeline installation crews are assumed on concurrent work fronts.

Trenchless installation (e.g. micro-tunnelling / auger boring) will be used for rail and some watercourse crossings. There may also be locations where the pipeline is required to be located above ground level for discrete sections where crossing of environments sensitive to excavation (e.g. preference of Traditional Owners or where rock is encountered).

The current estimates for trenchless crossings are:

- 9 locations for 'no go' zones.
- 6 locations for under railway crossings.

The proposed trenchless methodologies consist of:

- 10 locations for auger boring (crossings <60m).
- 5 locations for micro-tunnelling (crossings >60m).

Exact numbers of crossings may change through detailed design and further constructability optimisation.

The depth of the buried pipeline will depend on the diameter for the various sections of the pipeline, and in line with minimum cover values calculated using AS/NZS 2566.1:1998 Buried Flexible Pipelines. The minimum depth of cover will also vary with prevailing land use, with a minimum of 600 mm depth of cover provided in pastoral areas. Where the pipeline crosses major roads, cover will be minimum of 1000 mm.

The construction corridor width required over the length of the transfer system will vary based on topographical, geotechnical, pipe material and jointing method selected, required clearances from other services, and environmental and Aboriginal cultural heritage constraints. The standard width for the construction corridor is 40 m, which can be constrained in areas of high sensitivity (generally 25 m).

The site geotechnical data indicates that some of the Project Area has shallow rock levels. The excavatability of the rock is likely to range from hard digging to potentially requiring blasting.

Marine intake and outfall pipelines sizes are based on, and constructed, using tunnel boring machines (TBMs). The Reference Design contemplates construction of separate intake and outfall tunnels via tunnel boring from shore under the seabed to the intake and outfall locations.

The outfall diffuser structure comprises nozzles and the structure is to be attached to the end of the outfall pipe using a float and sink methodology.

An alternative construction method is being considered, involving a single tunnel option, with a combined intake/outfall tunnel to the intake location then placement of ~1000 m of submarine outlet pipe on the sea floor using the float and sink method and secured using piled collars.

The TBMs are to be launched from a temporary box cut and decline constructed in the south-east corner of the desalination plant construction site. A portion of the launch box will not be backfilled post tunnel completion but rather retained and constructed as the intake / outlet pump station.

Full details of the excavation for the Project pipeline alignment will be confirmed during detailed design to be prepared under the future design, build, operate and maintain (DBOM) contract.

The construction of the Project has the potential to impact soils and land systems, if appropriate management measures are not implemented, monitored, and maintained throughout the construction phase. Management measures are discussed in Section **8**.

Potential impacts to soils and land systems could occur through the following construction and commissioning activities:

- Soil erosion and dispersion due to water and wind and poor re-establishment of natural drainage systems along the disturbance corridor/s.
- Soil erosion and dispersion as a result of potential water losses during pressure testing and commissioning.
- Creation of new drainage features due to compaction of collapsible soils during construction (e.g. construction roads).
- Damage to the pipeline from soil movements, including collapsible and expansive soils.
- Impacts from noise and vibration (outside the scope of this report). Refer to separate EIS Noise and Vibration Impact Assessment for the Project.
- Settlement of trench backfill due to poor compaction.
- Removal of vegetation, including stripping of topsoil.
- Stockpiling of topsoils and vegetation.
- Earthworks and excavation for the pipeline trench, desalination plant site formation works, pump stations and storage areas and access tracks.
- Dewatering of excavations, where necessary
- Potential for leaks and spills
- Transportation of excavated materials and the movement of heavy vehicles across exposed earth
- Under boring at railway and watercourse crossings, and
- Earthworks for temporary workforce accommodation and laydown areas.

3. Relevant legislation

Legislation relevant to the soils and landforms aspects of the Project is summarised below.

3.1 Landscape South Australia Act 2019

The *Landscape South Australia Act 2019* (LSA Act) establishes an integrated scheme to manage South Australia's soil, as well as its water, pest plants and animals, and biodiversity across the state.

The LSA Act is the framework for Landscape SA, which is the name given to the system for managing South Australia's landscapes. Eight regional landscape boards and Green Adelaide work with partners to deliver practical, on-ground programs to manage landscapes. The Project lies within the Eyre Peninsula Landscape Board (EPLB) and South Australian Arid Lands Landscape Board (SAALB). The two Landscape Boards may require the preparation and implementation of action plans when there is an unreasonable risk of degradation of land.

In 2021, the EPLB's Regional Landscape Plan 2021-2026 was released. The Plan sets out the Board's vision and priorities for the region to achieve sustainable landscape management and identifies the following five priorities and related focus areas:

- Water – focus areas: effective water allocation planning in prescribed water areas, and managing water affecting activities.
- Sustainable Agriculture – focus areas: Reducing the risk of land degradation to protection the region's valuable soils, and facilitating regenerative land management to improve soil health.
- Pest Plants and Animals – focus areas: Supporting landowners to control prioritised pest plants and animals, and collaborating to reduce threats from impact-causing native species.
- Biodiversity – focus areas: Protecting and restoring prioritised coastal habitats, and maintain and enhance biodiversity in prioritised ecosystems.
- Community – focus areas: Community at the centre and actively engaged in landscape management, and effective decision-making and local government engagement.

The desalination plant, Mullaquna Station substation, Mullaquana transmission line and the southern-most 48 km of the main transfer pipeline are located within the EPLB.

The EPLB's Landscape Plan for beyond 2026 is anticipated to be finalised in June 2026 (Landscape SA, 2026).

The SAALLB Regional Landscape Plan 2021-2026 was developed in line with the requirements of the LSA Act and is based on significant environmental evidence, historical data, community planning processes, and an interconnectedness across landscapes, regions, land uses and values. It sets out the Board's vision for the region and identifies the following five strategic priorities:

- To be a climate resilient region.
- To manage water resources judiciously.
- To promote sustainable land management.
- To protect and enhance biodiversity.
- To collaborate with people and partnerships.

The pipelines and associated infrastructure are located in the Gawler Ranges, Kingoonya and Port Augusta – Quorn districts of the SAALLB. Each of these districts has its own District Plan.

3.2 Environment Protection Act 1993 (South Australia)

The South Australian *Environment Protection Act 1993* (EP Act) provides the regulatory framework to protect South Australia's environment, including land, air and water. As an activity of environmental significance, once approved under the *Planning, Development and Infrastructure Act 2016*, the desalination plant will require to be licensed under the EP Act.

In accordance with section 25 of the EP Act, all persons and organisations have a responsibility (General Environmental Duty (GED)) to take reasonable and practical measures to prevent or minimise environmental harm. Of relevance to the Project, this can include (but is not limited to) preventing the mobilisation of acid sulfate soils, avoiding erosion and the sedimentation of watercourses and achieving compliance with the Environment Protection (Water Quality) Policy 2015, and disposal of soils in accordance with the Standard for the production and use of Waste Derived Fill (EPA, 2013).

4. Methodology

4.1 Topography

This report includes an initial review of all land survey and spatial information prepared as part of the Project Reference Design (GHD, 2025); and includes review of LiDAR data. From this initial review Jacobs has:

- Estimated a level of uncertainty of the existing spatial data.
- Identified gaps in spatial datasets.
- Provided scope and recommendations to address any identified data gaps.
- Provided figures with appropriate map scale, contour intervals and colour along the proposed infrastructure, key landscape features and Study Area.

4.2 Geomorphology

The geomorphology study consisted of a desktop assessment and field inspection to identify and characterise the landforms/land systems intercepted by the Project, which informed targeted field work to inspect and assess the landforms/land systems, as follows:

- Assessment of the erosion potential of the landforms and potential impacts that the Project infrastructure may have on geomorphological processes operating in the landscape.
- The desktop assessment reviewed existing information on the geomorphology of the region in general and the landforms/land systems in particular. Past and current issues with soil erosion have been considered.
- The desktop assessment also considered suitable locations for the siting of the main transfer pipeline, potential impacts of the pipeline to the environment as well as identification of proposed management and mitigation measures.
- Topographic and geological maps, as well as available aerial imagery, were used to identify areas that warranted further investigation in the field.
- Targeted field work to inspect and assess the landform/land systems along the pipeline route and at the proposed desalination plant location. This provided the opportunity to assess the current geomorphological condition of the landforms, the nature of erosion and deposition processes, interactions with vegetation and therein potential to influence construction approach/es, and operational management. The field assessments were undertaken by a geomorphologist.
- Compilation of a report on geomorphological issues associated with the construction and operation of the Project infrastructure based on the desktop study and field investigations.
- Based on the desktop review and the fieldwork, an impact and risk assessment of the Project on the landscape was completed. This focused on the likelihood and consequence of changes to geomorphic stability and erosion arising from the construction and operation phases. Following this, proposed measures - to be implemented at the construction and operation phase - to avoid, minimise, mitigate, offset, manage and or monitor potential impacts were identified.
- The outcome of this task is a geomorphological impact pathway identification and risk assessment (refer to Section **7.2.1**) that documents current geomorphological condition of the landforms/land systems, the nature of erosion and deposition processes and their potential influence on construction and operations.

A desktop assessment was undertaken to identify and characterise the watercourses crossed by the main transfer pipeline. This involved:

- assessment of scour and stream avulsion potential of the watercourses crossed, including the potential for pipeline scour discharge during the commissioning and ongoing maintenance.
- assessment of the potential impacts the main transfer pipeline will have on the geomorphological processes operating on streams and other waterbodies.

The outcome of this geomorphic assessment is documented in **Section 7.3**, and includes the current geomorphic condition of watercourses and nature of erosion, as well as identification of proposed measures to mitigate and manage any impacts during the construction and operation phases. For assessment relating to surface water features within the Project locality, refer to Jacobs' Surface Water Impact Assessment (Jacobs, 2026).

4.3 Geology and soils

The geology and soils study includes a desktop review of available soils, geology and geotechnical information to assess the likely ground conditions at the desalination plant, along the pipeline routes and at locations of associated infrastructure. The public databases and other information sources reviewed include:

- Interim Biogeographic Regionalisation for Australia (IBRA), Version 6 (associations) and 7 (regions and subregions) (DCCEEW 2022).
- South Australia Regolith Map (Geological Survey of South Australia / GSSA, 2012).
- South Australia Geological Map (GSSA 2020).
- South Australian Resources Information Gateway (drillhole information).
- The Atlas of Australian Soils (CSIRO, 1991).
- Soil and Landscape Grid National Soil Attribute Maps – Depth of Regolith (CSIRO, 2015).
- The Australian Neotectonic Features Database (NFD) (Geoscience Australia, 2019).
- National Seismic Hazard Assessment (NSHA) Earthquake Epicentre Catalogue (Geoscience Australia, 2018).
- Olympic Dam EIS Project Soil Investigation (URS, 2006).

Based on the findings of the desktop review, this report:

- Provides a summary of the geological and soil conditions of the Project Area.
- Identifies potential geohazards together with proposed mitigation measures.
- Provides a high-level geohazard risk assessment.

The assessment of the occurrence of acid sulfate soils (ASS) and the potential environmental impacts associated with the construction of the proposed pipeline and associated infrastructure are addressed in the Northern Water Project Limited Preliminary Site Investigation report (JBS&G, 2026). The report highlighted isolated areas as having potential to contain ASS.

4.4 Risk assessment

A risk assessment was conducted to:

- Identify and describe the key risks and effect pathways resulting from construction and operation of the Project.

- Evaluate the significance of potential adverse effects.
- Develop measures to avoid or limit the adverse effects to acceptable levels.

The environmental performance objectives adopted for the risk assessment are to avoid or minimise impacts.

Geohazards and risks to landform values were assessed using the likelihood and consequence scales that are described in **Table 4-1** and **Table 4-2**.

The level of effort directed at investigating and managing potential adverse effects has been based on the evaluated risk ratings outlined in **Table 4-3**.

Table 4-1. Risk assessment likelihood criteria used to assess key risks associated with the construction and operation of the Project.

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

Table 4-2. Risk assessment consequence criteria

Consequence	Adverse effects on landscape and landforms
Severe	Long-term and possible permanent impact on landforms and supporting vegetation
Major	Substantial but reversible change to landforms and supporting vegetation
Moderate	Measurable but reversible change to landforms and supporting vegetation
Minor	Insignificant change to threatened landforms and supporting vegetation.
Negligible	No change in landforms and supporting vegetation.

Table 4-3. Risk rating matrix derived from likelihood and consequence assessments

Likelihood	Consequence				
	Severe	Major	Moderate	Minor	Negligible
Almost certain	Extreme	Extreme	Very High	High	Medium
Likely	Extreme	Very High	High	Medium	Medium
Possible	Very High	High	Medium	Medium	Low
Unlikely	High	Medium	Medium	Low	Low
Rare	Medium	Low	Low	Low	Low

5. Existing environment

5.1 Catchment overview

The Project is to span Spencer Gulf, Mambray Coast, Gairdner and Lake Torrens basins. For the purposes of the soil and geomorphological assessment, the Project crosses a number of regions with distinctive and varying slope processes. These have been summarised into the two following sections: Southern (KP 0 to KP 195), and Northern (KP 195 to KP 360 and KP CA 0 to KP CA 46.569), as illustrated in **Figure 5-1** and **Figure 5-2.**

5.1.1 Southern section

The southern section of the Project Area comprises the desalination plant at Mullaquana Station and marine infrastructure and the southern portion of the main transfer pipeline between KP 0 and KP 195. This section includes the Project corridor from north of Munyaroo Conservation Park to Lake Dutton / Pernatty Lagoon and incorporates the Whyalla and Port Augusta regions, as well as associated infrastructure (including the Mullaquana Station 132 kV transmission line, Lincoln Gap pump station, and Kalaya pump station.

Ground surface levels in the vicinity of the proposed desalination plant site range from approximately 4.15 m AHD at the intake pump station / marine infrastructure interface (near the coastal margin) to approximately 10 m AHD at the north-western extent of the site. Soils in the vicinity of the desalination plant have been characterised as hard red-brown texture contrast soils with alkaline subsoil and are anticipated to range from 6 m up to approximately 28 m where associated with surface water drainage features.

Topographically, the southern section is generally of low relief, with broad undulations and gentle slopes. Along the main transfer pipeline within KP 0–195, ground surface elevations range from 5.97 m AHD at approximately KP 8.5 to 138.12 m AHD near KP 154.0. The lowest-lying ground occurs in the southern coastal plain and low-lying drainage settings, while more elevated terrain is encountered progressively northward, with localised rises associated with upland margins and dissected terrain.

Catchments in this section are typically small (generally < 100 km^2), with longer and narrower catchment shapes and comparatively steeper slopes than the northern section. Climate and rainfall also vary across the southern section, with the southern end of the alignment typically experiencing higher rainfall and a more seasonal winter rainfall pattern relative to the drier northern portions of the Project Area.

5.1.2 Northern section

The northern section of the Project Area extends from Lake Dutton / Pernatty Lagoon to Olympic Dam and includes the northern portion of the main transfer pipeline between approximately KP 195 and KP 360, as well as the lateral branch pipeline between KP CA 0 and KP CA 46.569 to the Carrapateena mine delivery point. This section incorporates the Pimba, Woomera, Roxby Downs and Olympic Dam regions, and includes associated infrastructure, such as Mangata pump station, the Oakden Hills transmission line, the Mount Gunson substation and the Bimba storage.

The northern section south of Pimba is characterised by extensive sandy and clayey plains with salt pans and intermittent salt lakes, and more defined drainage lines where vegetation is typically concentrated. Although erosion is generally limited at the landscape scale, localised erosion is evident where flows are concentrated, including at roadside drains, culverts and other conveyance structures. Low-gradient terrain in this region promotes surface water ponding and evaporation, contributing to the concentration of salt and minerals in low-lying areas.

North of Pimba, the landscape transitions to gibber plains, extensive dunes, interdunal swales and clay pan depressions with generally low and sparse vegetation. Catchments in this area are typically larger and more rounded with flatter slopes than those in the southern section, although dune-bound catchments may be

smaller and can exhibit locally steeper slopes. Sandy dune materials are generally highly permeable and allow rapid infiltration during rainfall events; however, underlying clayey soils and clay pans limit drainage and promote ponding. The duration of inundation following rainfall can vary substantially, ranging from hours to weeks depending on rainfall intensity and antecedent conditions.

Topographically, the northern portion of the main transfer pipeline exhibits greater variability than the southern section, with a combination of depositional plains, low hills and localised rises and valleys. Along the main transfer pipeline within KP 195–360, ground surface elevations range from approximately 66.82 m AHD near KP 196.7 to 203.63 m AHD near KP 251.3, with a pronounced rise broadly occurring between approximately KP 200–260.

The lateral branch pipeline shows an overall net rise towards the delivery point, with ground surface elevations ranging from 64.10 m AHD near KP CA 21.3 to 222.46 m AHD near KP CA 46.4, with the most pronounced ascent occurring in the final portion of the alignment. Drainage networks along the lateral branch pipeline include broad, braided channels with sandbars and multiple flow paths; localised scouring is evident where flows concentrate, particularly adjacent to road drainage and culvert structures.

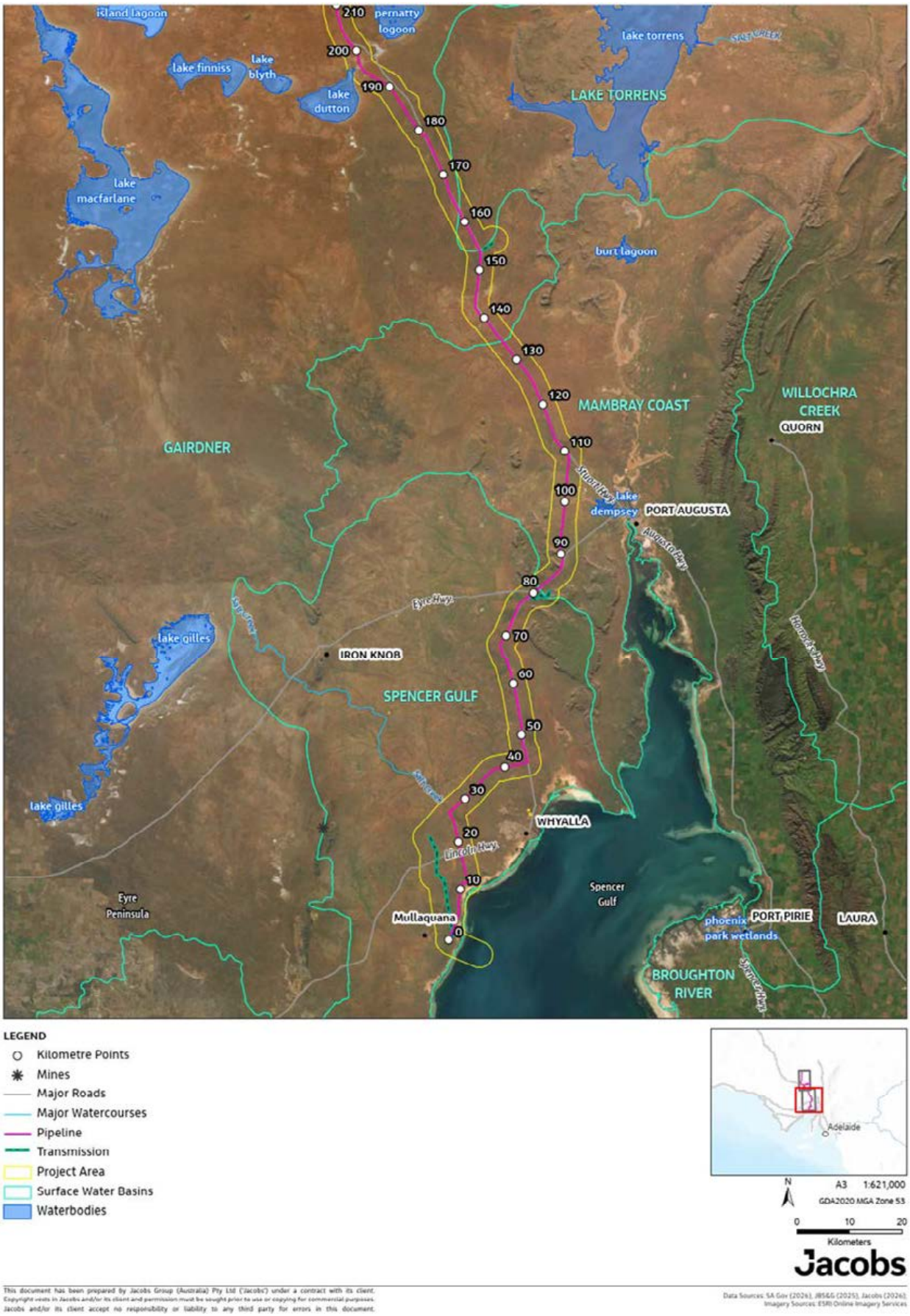


Figure 5-1. Catchment regions in the Project Area – southern Project Area

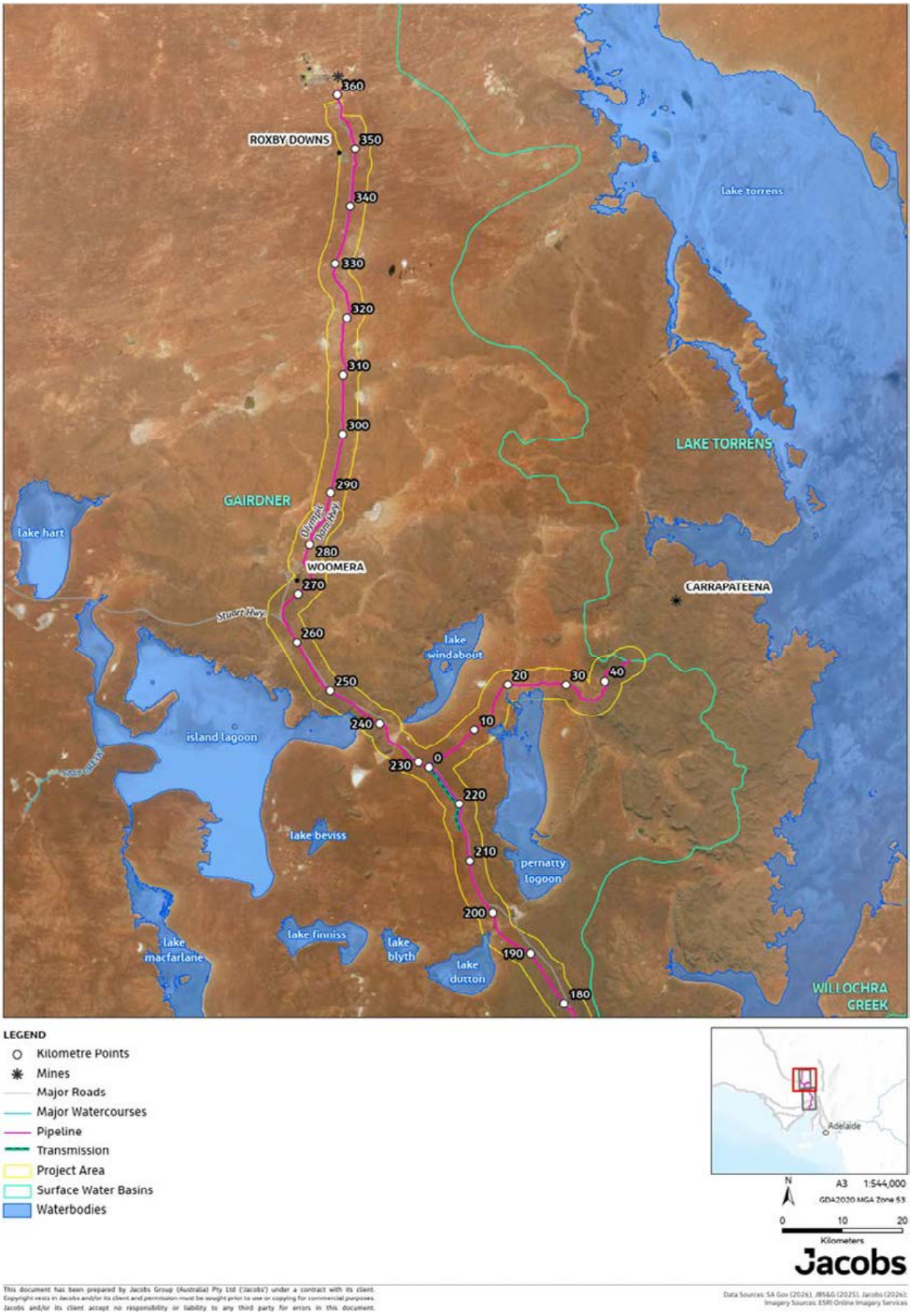


Figure 5-2. Catchment regions in the Project Area –northern Project Area

5.2 Topography

Surface elevation along the main transfer and lateral branch pipelines has been assessed using alignment long-section data extracted at 0.1 km intervals. Elevations are reported relative to m AHD and are referenced to the Project's southern and northern sections (southern: KP 0–195; northern: KP 195–360) of the main transfer pipeline, and the lateral branch pipeline (KP CA 0–46.569).

In broad terms, the southern section of the main transfer pipeline (KP 0–195) traverses lower-relief plains with gentle undulations, while the northern section (KP 195+) transitions into more elevated and variable terrain with several pronounced rises and intervening valleys. The lateral branch pipeline shows an overall net rise toward its northern end, with the steepest ascent concentrated in the final ~6 km.

Along the Main Pipeline, ground surface elevations range from 5.97 m AHD at approximately KP 8.5 to 203.63 m AHD at approximately KP 251.3.

The southern section (KP 0–195) is characterised by low-lying plains and broad undulations, rising to a southern high point of 138.12 m AHD near KP 154.0, while the northern section (KP 195+) is more elevated and variable, including a pronounced rise between approximately KP 200–260 culminating in the alignment high point.

The lateral branch pipeline ranges from 64.10 m AHD near KP 21.3 to 222.46 m AHD near KP 46.4, with the steepest ascent concentrated in the final portion of the alignment.

The topography of the Project Area is presented in **Figure 5-3** and **Figure 5-4**.

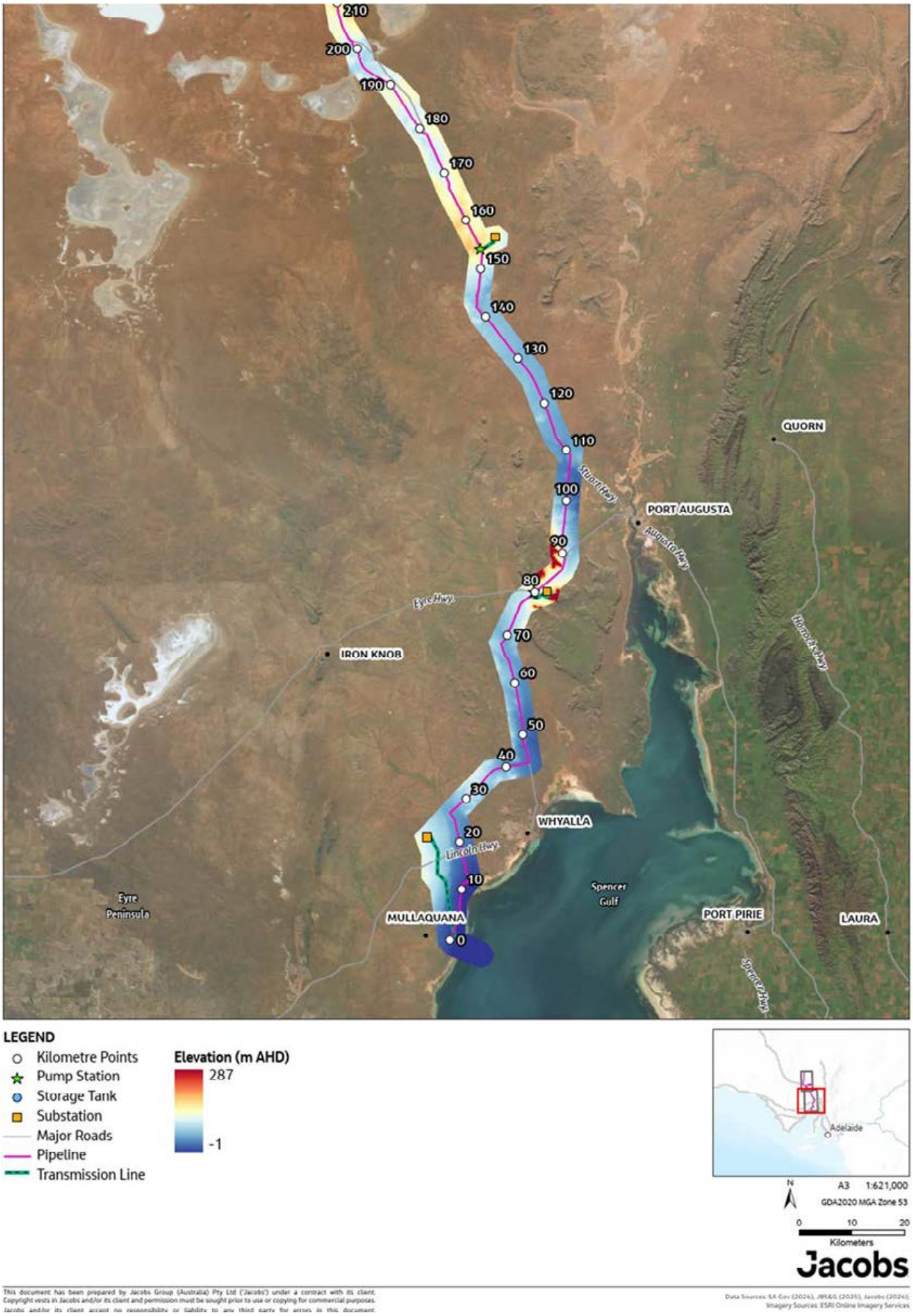


Figure 5-3. Topography in the southern Project Area

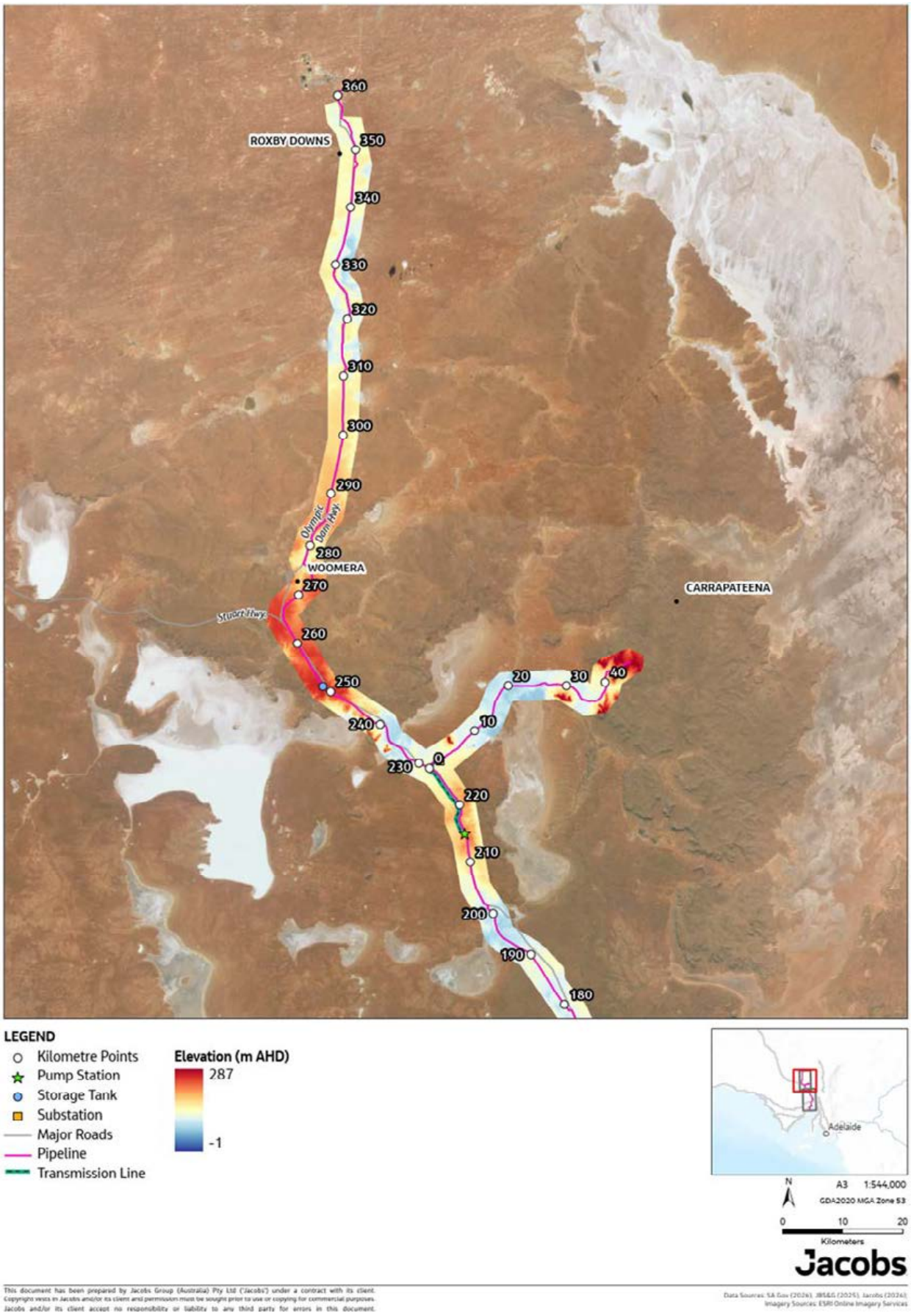


Figure 5-4. Topography in the northern Project Area

5.3 Biogeography, landforms and land systems

5.3.1 Biogeography

The IBRA was developed in 1993 as a key tool for identifying land for conservation under Australia's Strategy for the National Reserve System (Thackway and Cresswell 1995).

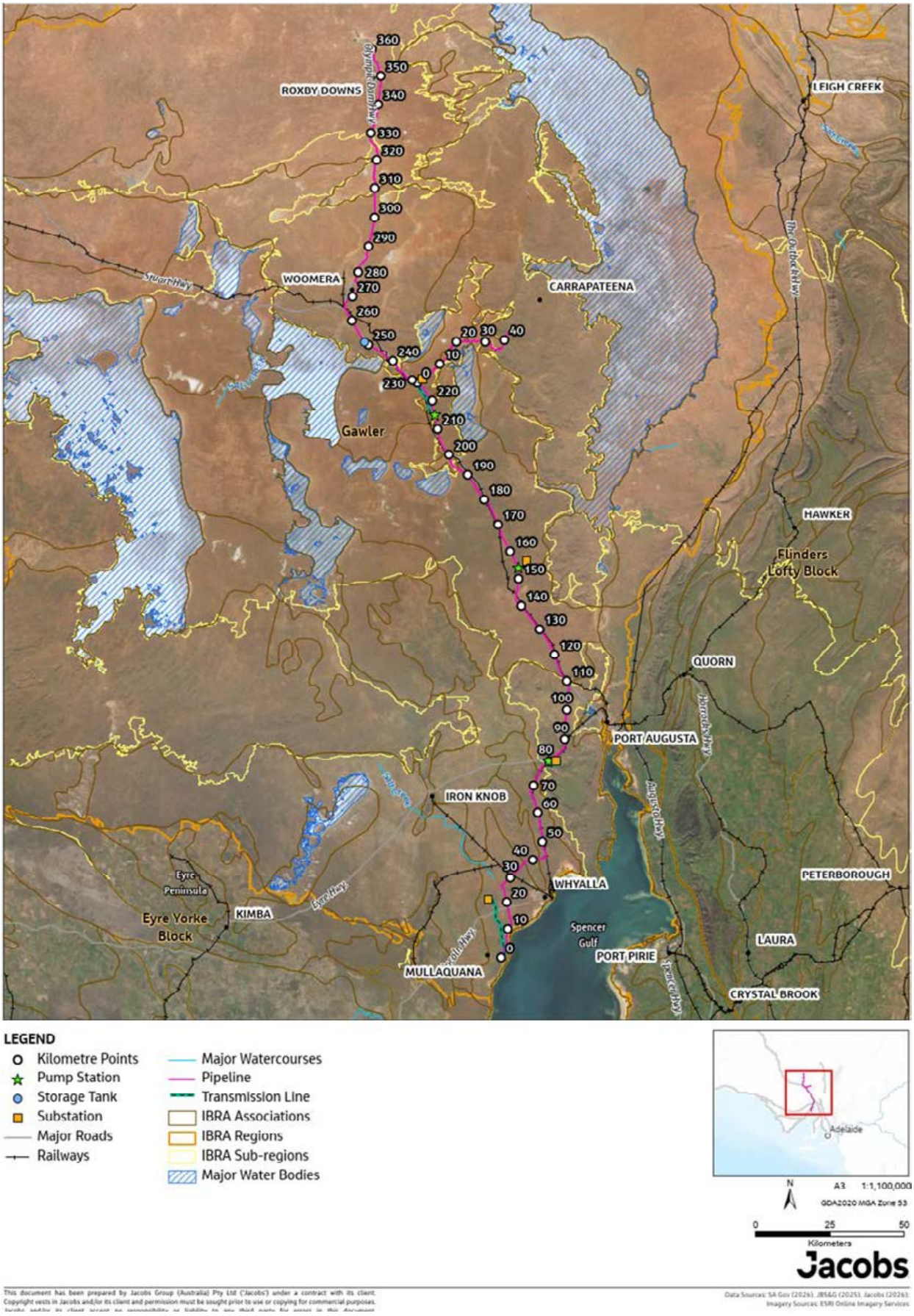
The IBRA version 7 divides Australia into 89 bioregions and 419 subregions (DCCEEW 2022). Each bioregion is a distinct area characterised by a combination of characteristics such as geology, landform patterns, climate, ecological features, and plant and animal communities.

The Project Area occurs within one IBRA bioregion (Gawler) (see **Figure 5-5**) and four IBRA subregions (Myall Plains, Arcoona Plateau, Gawler Lakes and Roxby).

The Gawler region is characterised by its semi-arid to arid climate and covers a wide range of land systems influenced by varying depositional and erosional processes. General descriptions of the Gawler biogeographical region are included in **Table 5-1**.

Table 5-1. Biogeography of the Project Area

Biogeographical region	Kilometre Point	Description	Approximate coverage area (% of EIS Study Area)
Gawler	KP 0 – KP 361 KP CA 0 – KP CA 46	Semi-arid to arid, flat-topped to broadly rounded hills of the Gawler Range Volcanics and Proterozoic sediments, depositional plains and salt-encrusted lake beds, with black oak (belah) and myall low open woodlands, open mallee scrub, bluebush/saltbush open chenopod shrublands, tall mulga shrublands on shallow loams, calcareous earths, and hard red duplex soils	100%



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Data Sources: SA Gov (2026), JBS&G (2025), Jacobs (2026)
Imagery Sources: ESRI Online Imagery Services

Figure 5-5. IBRA Regions

5.3.2 Land systems

Land systems are delineated based on similarities in attributes such as climate, lithology/geology, landform, flora, and fauna.

The land systems of South Australia are described by the Land Systems and Reports of southern South Australia dataset (DEW 2009) where the land use is predominantly agricultural, and the Pastoral District Land Systems dataset (DEW 2005) covering north-eastern South Australia where the land use is predominantly pastoral.

IBRA associations are informed by both datasets and provide a unified approach in describing the land systems that occur within the Project Area. A pie chart showing the predominant IBRA associations/land systems is included in **Figure 5-6**, with detailed descriptions included in **Table 5-2**.

Figure 5-7 and **Figure 5-8** show the distribution of the land systems within the Project Area. The descriptions adopted are based on IBRA version 7.

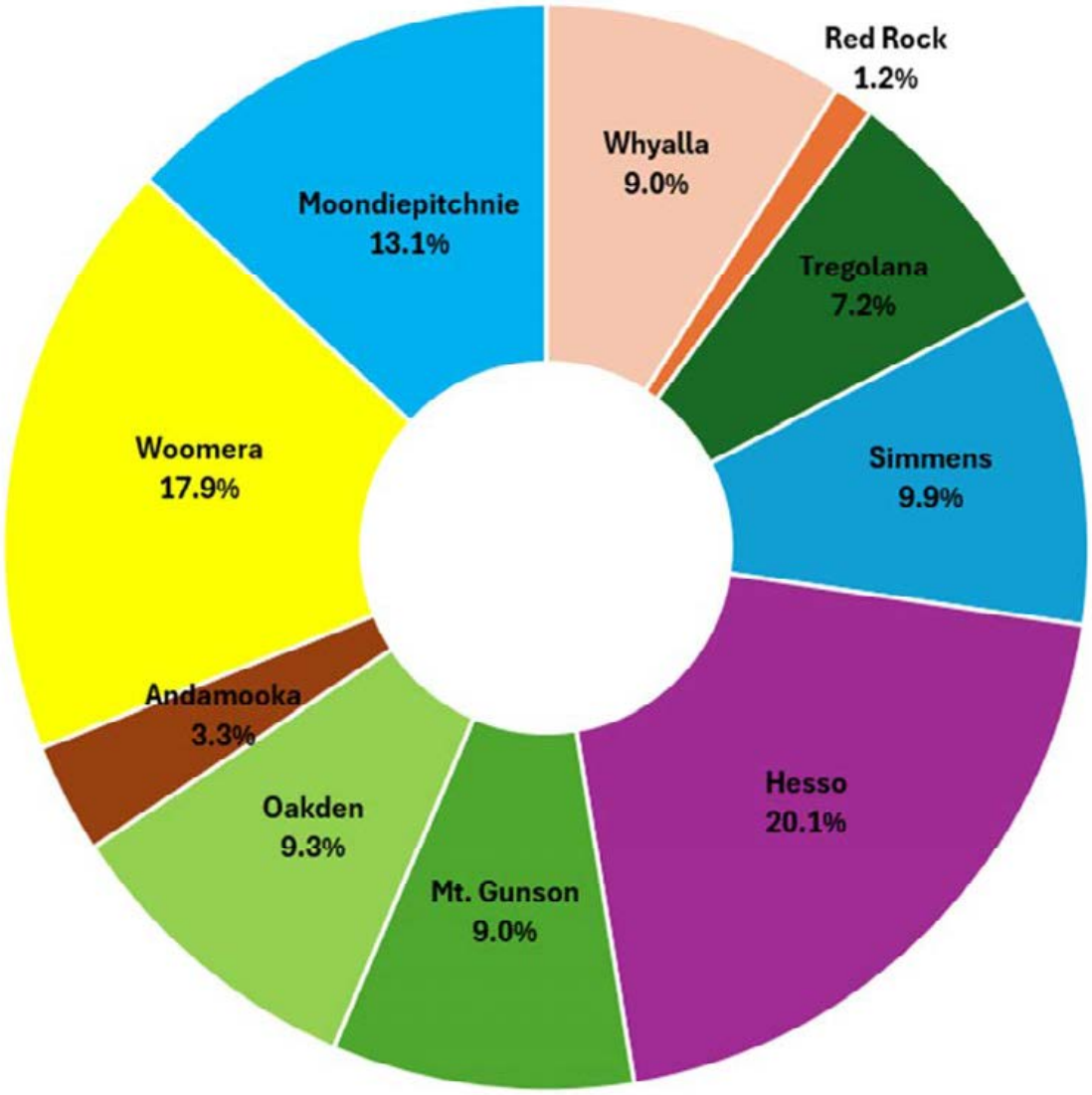


Figure 5-6. Pie chart showing IBRA association/land systems of the Project Area

Table 5-2. IBRA association/land systems of the Project Area

IBRA Association / Land System	Approximate Kilometre Point (Location S/N)*	Description	Approximate Coverage Area (% of EIS Study Area)
Whyalla	CH 0 - CH 36.7 (S)	Easterly sloping calcreted plain with occasional hills on outcropping conglomerate, and with mangrove flats along the coastal margin. Red calcareous earths, dense brown loams, grey calcareous loams and whitish calcareous sands.	9.0%
Red Rock	KP 36.7 - KP 42.1 (S)	Hills on conglomerate with long dissected footslopes. Dense brown loams, hard pedal red duplex soils and crusty red duplex soils.	1.2%
Tregolana	KP 42.1 - KP 71.5 (S)	Undulating plain with occasional low sand dunes and pans and some samphire or mangrove flats. Red calcareous earths, reddish sands, crusty red duplex soils and grey calcareous loams.	7.2%
Simmens	KP 71.5 - KP 111.7 (S)	Plateau with steep escarpments, and long footslopes partly mantled by aeolian sand. Powdery red calcareous loams, crusty red duplex soils, reddish sands, whitish calcareous sands and grey calcareous sands.	9.9%
Hesso	KP 111.7 - KP 193.6 (S)	Gently undulating sandy plain with isolated silcrete-capped rises and salt lakes. Red calcareous earths, crusty red duplex soils and reddish sands.	20.1%
Mt. Gunson	KP 193.6 - KP 221.7 (N) KP CA 10.6 - KP CA 16.6 (N) KP CA 22.0 - KP CA 24.6 (N)	Low hills with long slopes and broad floodplains. Powdery red calcareous loams and crusty red duplex soils.	9.0%
Oakden	KP 221.7 - KP 235.0 (N) KP CA 0 - KP CA 10.6 (N) KP CA 16.6 - KP CA 22.0 (N) KP CA 24.6 - KP CA 30.0 (N) KP CA 32.8 - KP CA 35.2 (N) KP CA 37.2 - KP CA 38.0 (N)	Undulating plain with some dunes and low hills on outcropping sandstones. Red calcareous earths, reddish sands, powdery red calcareous earths.	9.3%
Andamooka	KP CA 30.0 - KP CA 32.8 (N) KP CA 35.2 - KP CA 37.2 (N) KP CA 38.0 - KP CA 46.5 (N)	Gibber covered plateau with irregular surface and steep bounding slopes. Powdery red calcareous loams, crusty red duplex soils and reddish sands.	3.3%
Woomera	KP 235.0 - KP 308.2 (N)	Plateau with an undulating to hilly surface and steep marginal slopes in the south. Crusty red duplex soils and reddish sands.	17.9%
Moondiepitchnie	KP 308.2 - KP 361.4 (N)	Undulating plain with sand sheets, dunes and occasional low silcrete-capped rises. Red	13.1%

IBRA Association / Land System	Approximate Kilometre Point (Location S/N)*	Description	Approximate Coverage Area (% of EIS Study Area)
		calcareous earths, reddish sands and crusty red duplex soils.	

* S = Southern section of the Project Area, N = Northern section of the Project Area

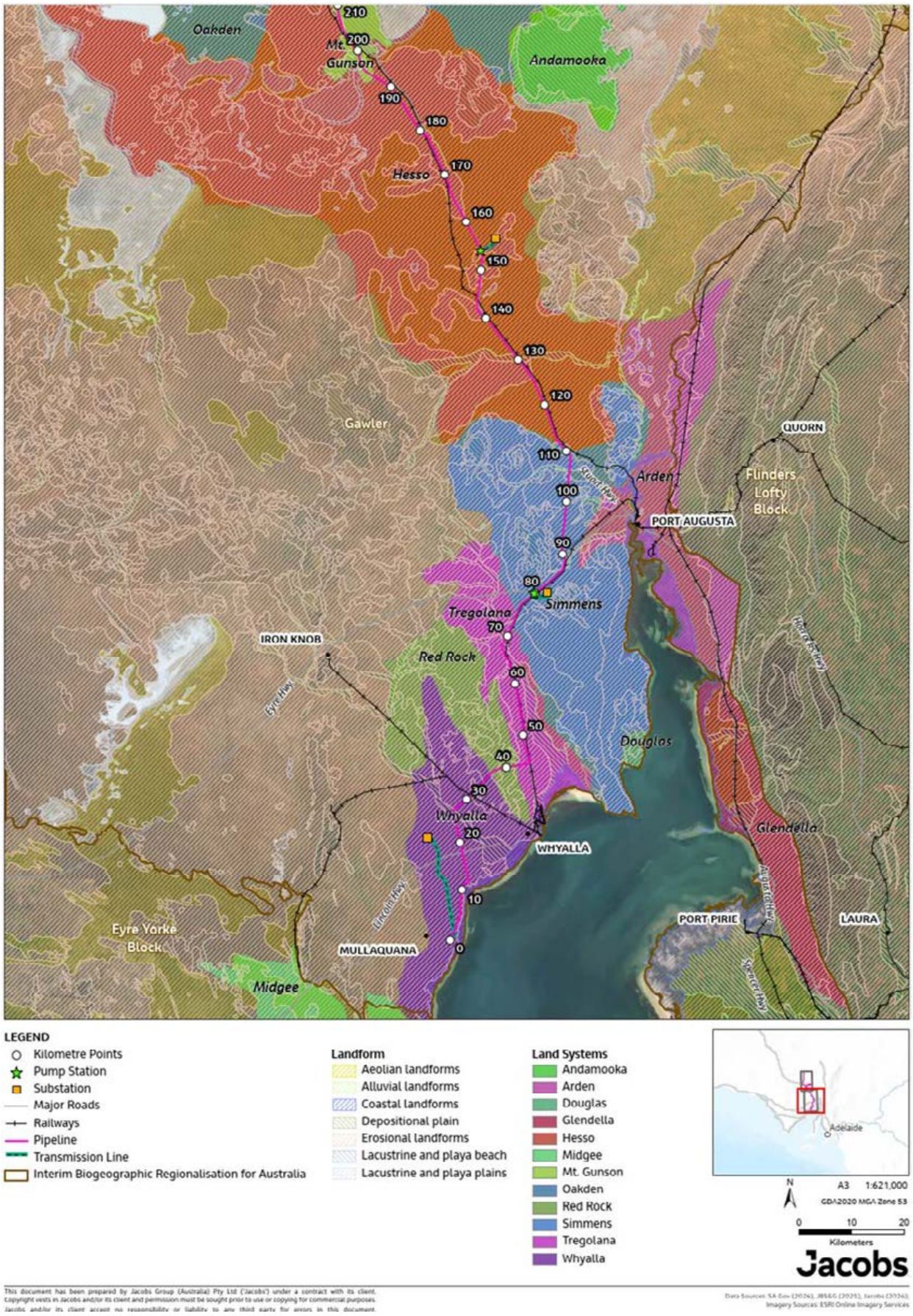


Figure 5-7. Geomorphological landforms and land systems of the southern Project Area

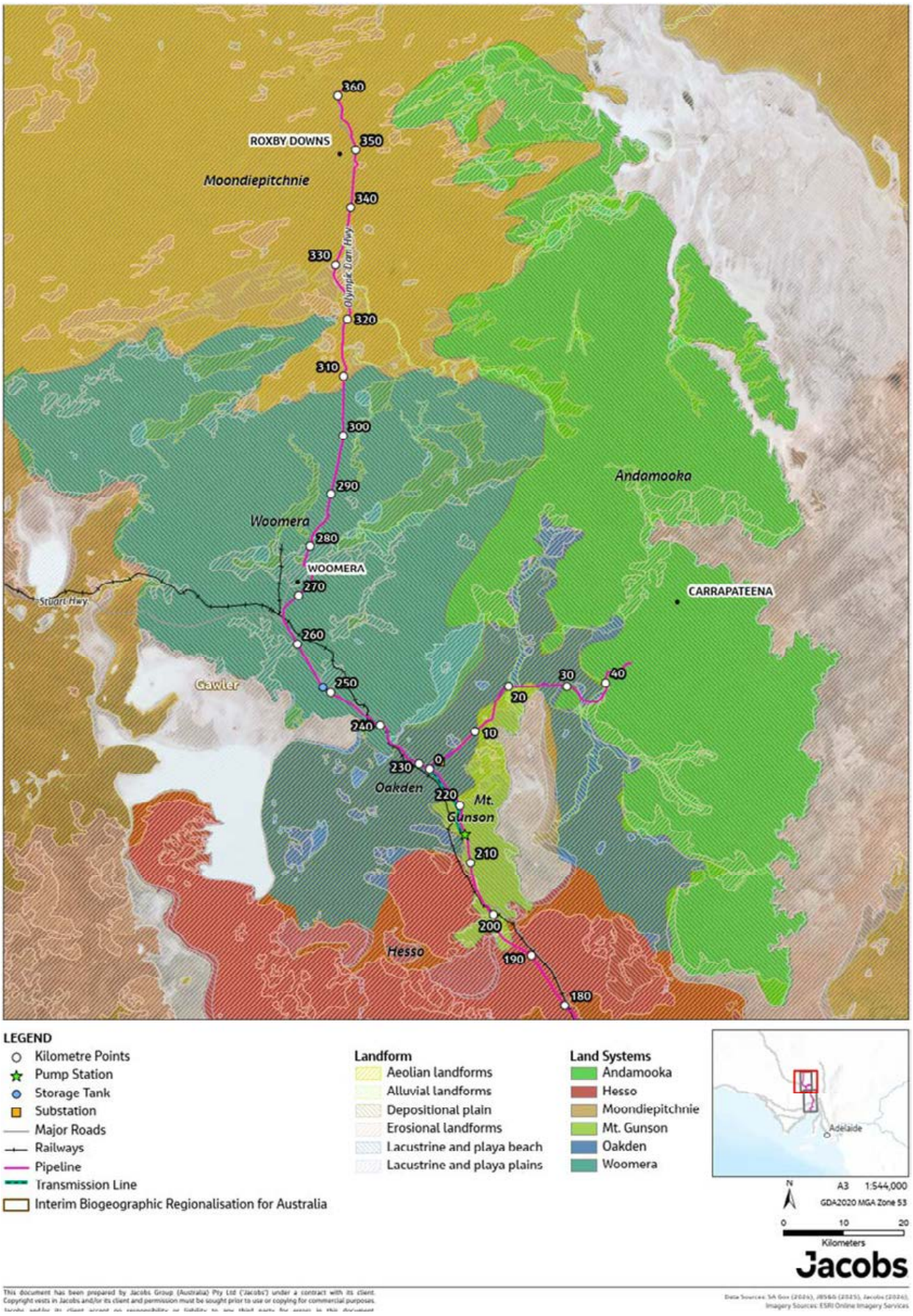


Figure 5-8. Geomorphological landforms and land systems of the northern Project Area

5.3.3 Landforms

Landforms within the Project area are described by their underlying physical geological processes. These processes have resulted in the current day landform and will continue to influence the Project Area in the future. These influences may be from the mobile bedload in stream channel or erosion and movement of dunes.

The dominant landforms within the Project Area are characterised by aeolian and erosional processes. Depositional landform is dominant in the northern section of the Project Area, including the main transfer pipeline north of KP 196.8 and the lateral branch pipeline, where the terrain is typically of extremely low relief.

Alluvial landforms, which are associated with the presence of ephemeral creeks and flow paths, account for less than 3% of the Project Area. The drainage lines in these areas vary from large, braided and well-defined creeks to smaller, less defined flow paths. The large conveyance structures (typically culverts) in these regions reflect the capacity of flow that traverses the creeks in larger and more intense rainfall events. Although erosion is not extensive, it is evident in areas where concentration of flow has occurred.

The landforms within the Project Area are summarised in **Table 5-3** and illustrated with hatching in **Figure 5-7** and **Figure 5-8**.

Table 5-3. Landforms of the Project Area

Landform	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Aeolian landforms	KP CA 0 – KP CA 13.1 (N) KP CA 14.4 - KP CA 20.9 (N) KP CA 21.8 - KP CA 28.9 (N) KP CA 33.4 - KP CA 34.6 (N) KP 105.3 - KP 106.0 (S) KP112.2 - KP 125.7 (S) KP 131.1 - KP 140.3 (S) KP 143.3 - KP 146.7 (S) KP 148.3 - KP 149.1 (S) KP 150.7 - KP 153.2 (S) KP 153.9 - KP 161.2 (S) KP 221.3 - KP 235.6 (N) KP 309.5 - KP 323.1 (N) KP 330.6 - KP 361.487 (N)	Landform pattern built up or locally excavated, eroded or aggraded by wind.	30.4%
Alluvial landforms	KP CA 20.9 – KP CA 21.8 (N) KP CA 34.6 – KP CA 35.7 (N) KP CA 37.8 – KP CA 39.2 (N) KP 25.7 - KP 26.9 (S) KP62.7 - KP 67.1 (S) KP 68.2 - KP 69.1 (S) KP 99.2 - KP 99.4 (S) KP 129.2 - KP 131.1 (S)	A complex landform pattern on valley floors with active, inactive or relict erosion and aggradation by channelled and overbank stream flow.	2.9%

Landform	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Depositional plain	KP CA 13.1 – KP CA 14.4 (N) KP CA 28.9 – KP CA 33.4 (N) KP CA 39.2 – KP CA 46.569 (N) KP 196.7 - KP 204.6 (N) KP207.6 - KP 221.3 (N) KP 236.4 - KP 250.0 (N) KP 252.6 - KP 275.1 (N) KP 281.1 - KP 309.5 (N) KP 323.1 - KP 326.4 (N) KP 327.6 - KP 328.9 (N)	Level landform pattern with extremely low relief formed by unspecified depositional processes.	25.5%
Erosional landforms	KP 0 - KP 25.7 (S) KP26.9 - KP 62.7 (S) KP 67.1 - KP 68.2 (S) KP 69.1 - KP 99.2 (S) KP 99.4 - KP 105.3 (S) KP 106.0 - KP 112.2 (S) KP 125.7 - KP 129.2 (S) KP 140.3 - KP 143.3 (S) KP 146.7 - KP 148.3 (S) KP 149.1 - KP 150.7 (S) KP 153.2 - KP 153.9 (S) KP 161.2 - KP 196.5 (S) KP 204.6 - KP 207.6 (N) KP 250.0 - KP 252.6 (N) KP 275.1 - KP 281.1 (N) KP 326.4 - KP 327.6 (N) KP 328.9 - KP 330.6 (N) KP CA 35.7 – KP CA 37.8 (N)	Landform pattern of very low to high relief and very gentle to steep slopes. The pattern is eroded by continuously active to slightly active or inactive geomorphic processes.	41.0%
Lacustrine and playa plains	KP 196.5 - KP 196.7 (N) KP235.6 - KP 236.4 (N)	Sediment deposited from solution and suspension in still water in an inland lake, playa or pan.	0.2%

* S = Southern section of the Project Area, N = Northern section of the Project Area

5.4 Soils

Descriptions of soil landscapes in the Project Area are summarised in **Table 5-4**. The descriptions are based on the Atlas of Australian Soils (CSIRO, 1991) and outline the common soil profiles within each soil landscape.

Table 5-4. Soil landscapes of the Project Area

Soil landscape	Approximate Kilometre Point (Location S/N)*	Description	Major soil unit	Minor soil unit	Approx. coverage area
A2	KP 0 - KP 9.7 (S)	Coastal dunes and plains with some swamps: dunes of calcareous sands and also siliceous sands; plains of various unclassified saline soils and lesser areas of brown calcareous earths.	Uc1.11 Uc1.22	Gc1.1 Gc1.2	2.4%
DD2	KP 9.7 - KP 70.3 (S) KP 86.5 - KP 89.9 (S)	Plains with more or less isolated tracts of dunes: broad plains of brown calcareous earths with areas of exposed caliche and crusty loamy soils with claypans, unclassified saline soils, swamps, and intermittent lakes in the lower-lying portions; dunes of brown sands and brown calcareous earths. Small areas of unclassified alluvial soils and hard alkaline red soils on outwash adjacent to Mt. Lofty ranges.	Gc1.12 Drl.33 Drl.13 Uc5.1	Dr2.33	15.6%
BB2	KP 70.3 - KP 80.2 (S) KP 89.9 - KP 114.2 (S)	Hills, dissected tablelands, and valleys: hills of shallow calcareous loamy soils; crusty loamy soils on tableland remnants; and small valleys of crusty loamy soils with brown calcareous earths.	Um5.11 Drl.13 Drl.33	Drl.43 Gc	8.4%
Na1	KP 80.2 - KP 86.5 (S)	Dissected tableland: undulating stony plains of crusty loamy soils which may form gilgais and also gilgai complexes with cracking brown clays; interspersed with mesas and buttes capped by shallow calcareous loamy soils and/or residues of past weathering cycles such as remnants of sandstone, gypsum, silcrete, laterite; traversed by broad shallow valley plains of deep calcareous loamy soils with saline flats, gypsum mounds, and swamps. Some brown sands and brown calcareous earths may also occur.	Drl.13 Drl.33 Ug5.3 Um5.11	Um5.12 Uc5.1 Gc	1.5%

Soil landscape	Approximate Kilometre Point (Location S/N)*	Description	Major soil unit	Minor soil unit	Approx. coverage area
DD1	KP CA 0 - KP CA 12.5 (N) KP CA 15.9 - KP CA 29.1 (N) KP CA 30.5 - KP CA 33.3 (N) KP 114.2 - KP 196.0 (S) KP 221.8 - KP 235.1 (N) KP 309.7 - KP 324.0 (N) KP 331.4 - KP 361.4 (N)	Dune formations with relatively small plains between dunes of brown calcareous earths, small areas of brown sands; plains of brown calcareous earths with crusty loamy soils in the lower-lying portions. Minor areas of soils common to other DD map units occur too. Yellow clayey subsoil may occur in small areas in proximity to the boundary with unit AA1.	Gc1.12 Gc1.22 Drl.33 Drl.43	Uc5.1 Dy5.83	41.2%
Nb42	KP CA 12.5 - KP CA 15.9 (N) KP 196.0 - KP 221.8 (N)	Remnants of stony downs often with prominent hills, mesas, and buttes: chief soils are crusty loamy soils, with cracking brown clays in gilgai complex on the rolling downs areas; shallow calcareous loams on the hills, mesas, and buttes; and areas of calcareous soils on areas of gentler relief. Any of these may be dominant locally.	Dr1.33 Dr1.13 Um5.11	Ug5.3 Gc1.12 Gc1.22	7.2%
Nb41	CH CA 29.1 - CH CA 30.5 (N) CH CA 33.3 - CH CA 46.5 (N) CH 235.1 - CH 309.7 (N) CH 324.0 - CH 331.4 (N)	Rolling stony downs mantled by a strew of stones and gravels; some mesas and buttes; shallow valleys; lakes: chief soils are crusty loamy soils, which may form gilgais and also gilgai complexes with cracking brown clays. Associated soils include shallow loams on mesas and buttes, together with residues of past weathering cycles, sandstone, gypsum, silcrete, and laterite. Small areas of unit DD1 may be included in low-lying sites.	Dr1.33 Dr1.13 Dr1.43	Ug5.3 Um5.11 Um1.43	23.7%

* S = Southern section of the Project Area, N = Northern section of the Project Area

A pie chart showing the soil landscape types in the Project Area is included as **Figure 5-9**.

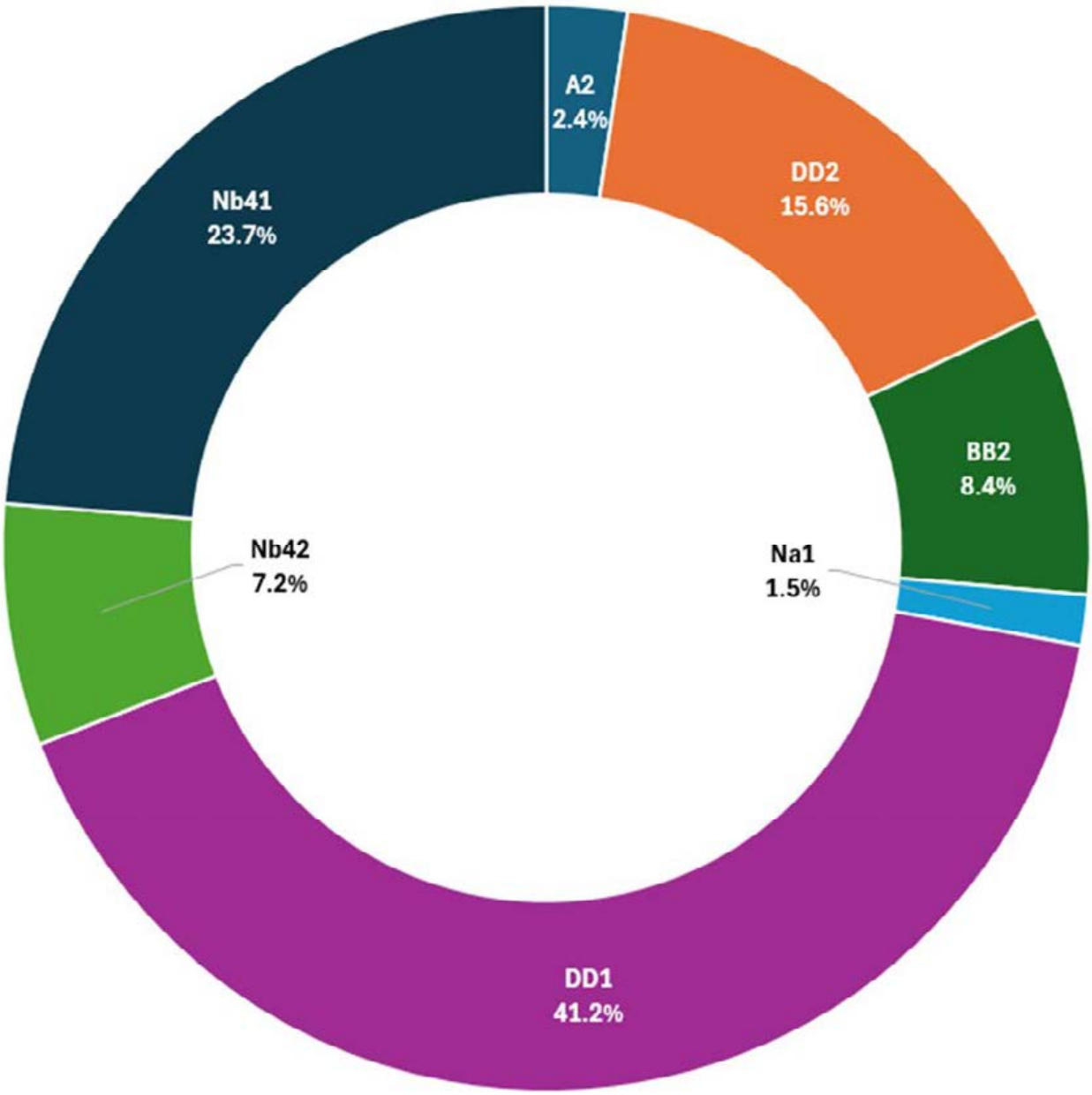


Figure 5-9. Soil landscapes of the Project Area (refer to Table 5-4 for soil landscape classification)

The part of the Project Area located on the eastern coast of the Eyre Peninsula, between KP 0 and KP 9.7, is characterised by coastal aeolian soil landscapes. The predominant soil landscapes in this area are A2 along the coastal areas, which is characterised by calcareous or siliceous sands of minimal development, and DD2 in inland areas, where soils are commonly calcareous throughout with concentrated calcium carbonate at depth.

In the Lincoln Gap area, the predominant soil landscapes are BB2 and Na1 with friable soils commonly calcareous throughout with weakly defined profile features.

The soil landscape between Lincoln Gap and Roxby Downs, is typically calcareous (DD1) with concentrated calcium carbonate horizons at varied depths. Across the Arcoona Ranges, approximately between KP 196.3 and KP 331.4, the soils are typically crusty loamy soils and red clayey subsoils with readily separable thin crusts (Nb41 and Nb42 soil landscapes).

The distribution of the soil landscapes is shown in **Figure 5-10** and **Figure 5-11**.

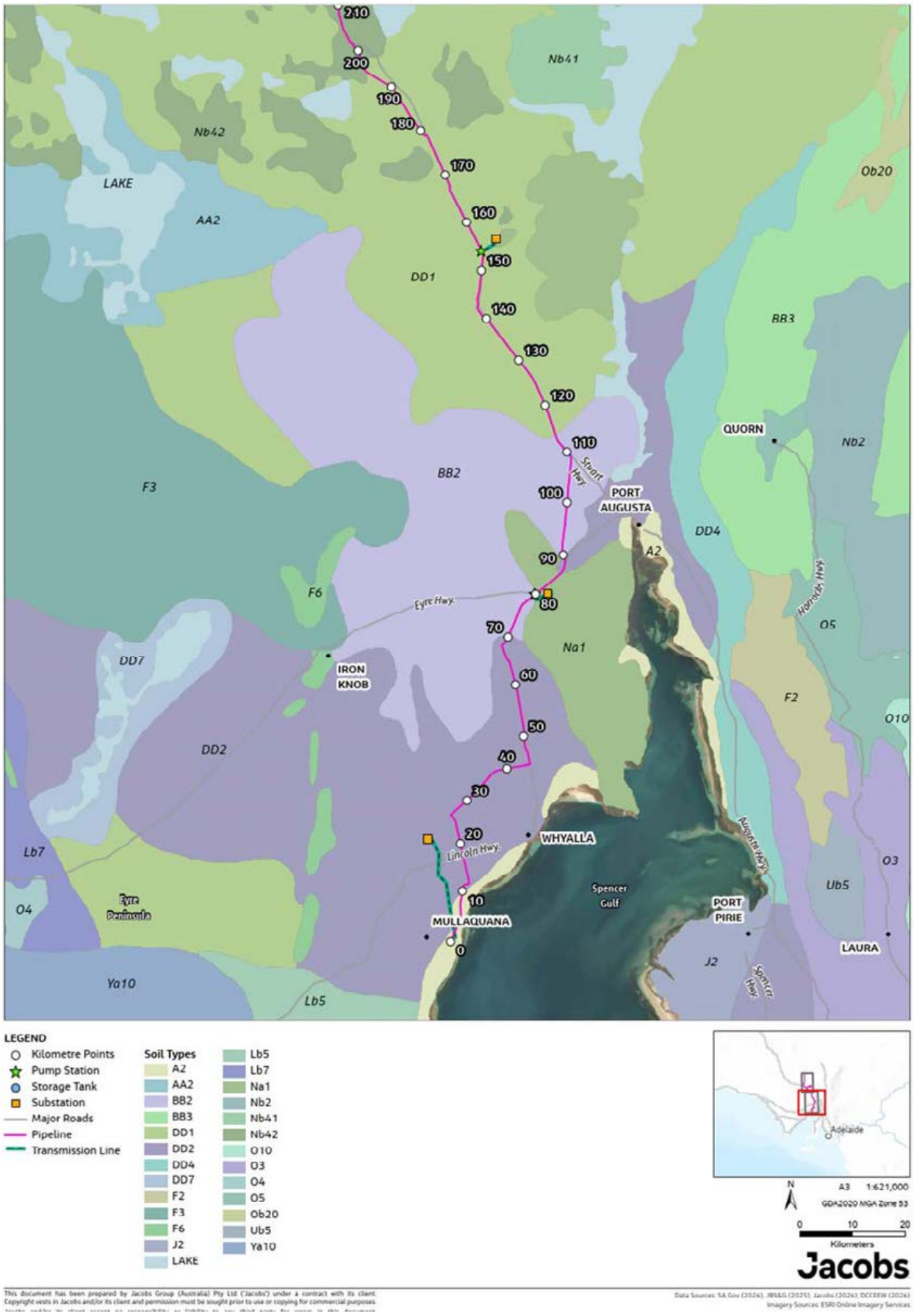


Figure 5-10. Soil landscapes of the southern Project Area

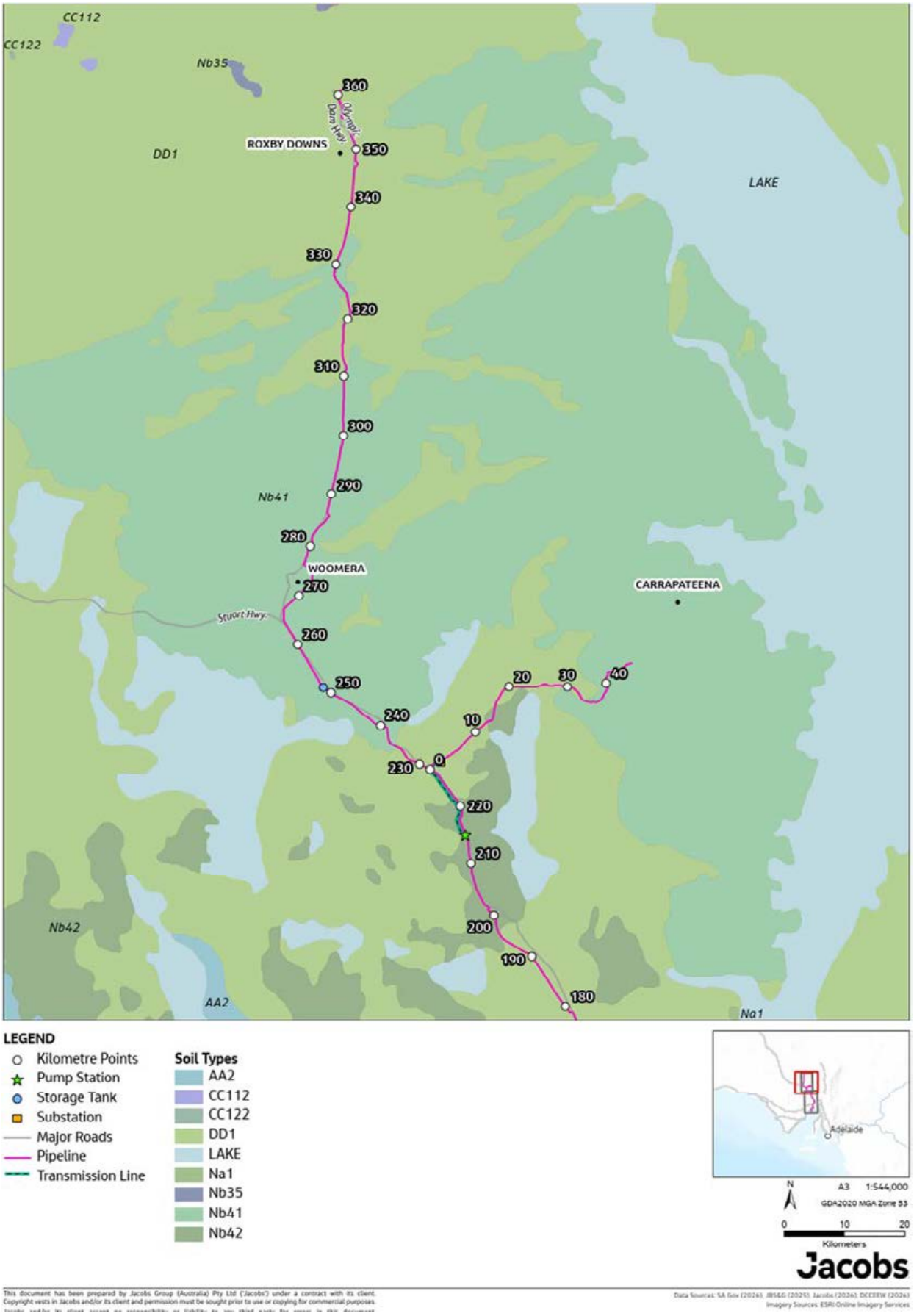


Figure 5-11. Soil landscapes of the northern Project Area

5.5 Geology

5.5.1 Correlation between soils and geology

The correlation between geological units, soil landscapes (landforms as described in Section **5.3.3**) and land systems (as described in Section **5.3.2**) is summarised in **Table 5-5**. The correlation is derived from comparison of geological, soil landscapes and land system maps, and has allowed a series of terrain units to be defined.

Table 5-5. Correlation between geology, soil landscape and IBRA association/land system

Terrain Unit	Geological unit	Soil landscape	IBRA association land system
Quaternary soils of alluvial plains	Holocene alluvial/fluvial sediments (Qha)	A2	Whyalla
Crusty calcareous soils	Pleistocene regolith/colluvial unit 4 (Qpr4)	DD2	Whyalla
Shallow soils overlying Moonabie Formation and Padurra Formation	Pleistocene regolith/colluvial unit 4 (Qpr4) Moonabie Formation (Lmm) Pandurra Formation (M-p)	DD2	Whyalla
Quaternary Colluvium soils	Pleistocene regolith/colluvial sediments (Qpr) Pleistocene regolith/colluvial unit 4 (Qpr4)	DD2	Red Rock Tregolana
Quaternary soils overlying Simmens Quartzite	Quaternary regolith/colluvial unit 6 (Qr6) Quaternary regolith/colluvial unit 10 (Qr10) Pleistocene alluvial/fluvial unit 12 (Qpa12) Pleistocene alluvial/fluvial unit 15 (Qpa15) Simmens Quartzite Member (Nsts)	Na1	Simmens
Quaternary dune sand	Quaternary aeolian unit 1 (Qe1)	DD1 BB2	Hesso
Sand dunes with interdunal clay pans	Quaternary aeolian unit 1 (Qe1)	DD1	Oakden
Shallow soils overlying Simmens Quarzite and Bulldog Shale	Simmens Quartzite Member (Nsts) Bulldog Shale (Kmb)	Nb41	Woomera
Sand dunes with interdunal clay pans	Quaternary aeolian unit 1 (Qe1) Andamooka Limestone (Eha)	DD1	Moondiepitchnie

5.5.2 Surface geology

The surface geology along the pipeline alignment from KP 0 to approximately KP 38 is dominated by transported Quaternary deposits. The most extensive unit within this section is Pleistocene regolith/colluvial unit 4 (Qpr4), which occurs intermittently but persistently between KP 0.1 and KP 37.7 and comprises gravel, clay, silt and sand with soft carbonate overlying nodular to tabular calcrete. These regolith deposits are interbedded with frequent occurrences of Holocene alluvial/fluvial sediments (Qha) and Holocene alluvial/fluvial unit 5 (Qha5), particularly within drainage lines and low-lying areas, reflecting active and relict fluvial processes. Minor Holocene lacustrine/playa sediments (Qhl1) are present locally between approximately KP 24.6 and KP 25.0.

Between KP 31.1 and KP 35.3, isolated outcrops of Gluepot Granite (Lzmg) occur, representing intrusive Proterozoic basement exposed beneath a thin Quaternary cover. These are spatially limited and surrounded by regolith-dominated terrain. Very minor occurrences of Tertiary silcrete (Tsi) are also present locally between KP 29.2 and KP 32.2.

From approximately KP 38 to KP 57.8, the surface geology transitions into a mixed sequence of Pleistocene regolith/colluvial sediments (Qpr) and Holocene alluvial/fluvial unit 5 (Qha5). These units represent undifferentiated colluvial plains and alluvial flats developed across gently undulating terrain. Small, isolated outcrops of the Pandurra Formation (M-p) occur near KP 38.7 to KP 38.9, where Proterozoic sandstone locally daylights through the Quaternary cover.

Between KP 57.9 and KP 73.6, the alignment is underlain predominantly by Quaternary regolith/colluvial unit 6 (Qr6) and subordinate Qha5, comprising clay, silt and sand deposited as sheetwash and sand plain sediments. Minor occurrences of Qpr4 and Qha continue to coincide with ephemeral drainage features.

From approximately KP 74.8 to KP 95.9, the surface geology becomes more variable and includes Pleistocene aeolian unit 4 (Qpe4) between KP 74.8 and KP 78.2, representing coastal plain dune sands. This is followed by extensive development of Quaternary regolith/colluvial unit 10 (Qr10) between KP 78.8 and KP 95.5, described as sand on flat-lying plains with dendritic drainage patterns and incipient tiger-bush development. Localised Pleistocene alluvial/fluvial unit 15 (Qpa15) occurs between KP 86.7 and KP 90.6, reflecting high-angle alluvial fan deposits. Minor Simmens Quartzite Member (Nsts) outcrops are present near KP 87.4 to KP 87.7.

From KP 96 to approximately KP 105, the alignment crosses several discrete intervals of Pooraka Formation (Qpap), interspersed with Holocene alluvial/fluvial sediments (Qha) and Holocene alluvial/fluvial unit 1 (Qha1). These units comprise clay, sand and carbonate-rich sediments with gravel lenses, typically confined to drainage corridors. The Corraberra Sandstone Member (Nstc) occurs locally between KP 104.3 and KP 105.0.

Between KP 106.3 and KP 191.8, the dominant surface geological unit is Quaternary aeolian unit 1 (Qe1), which forms extensive dune-field sands across this section of the alignment. This unit is locally interrupted by Pandurra Formation (M-p) between KP 191.9 and KP 192.6 and again between KP 195.4 and KP 196.2, where Proterozoic sandstones, mudstones and conglomerates are exposed. Minor occurrences of Whyalla Sandstone (Neh) are present between KP 153.1 and KP 155.1, and isolated Holocene alluvial/fluvial unit 1 (Qha1) intervals occur at drainage crossings.

From approximately KP 196.8 to KP 201.4, the pipeline traverses carbonate-dominated bedrock of the Woocalla Dolomite Member (Nntw), described as yellow brown to grey dolomite with massive bedding, oolitic textures and stromatolitic development. This unit is interbedded with short intervals of Qe1 and Pandurra Formation (M-p).

Between KP 201.5 and KP 222.8, the Pandurra Formation (M-p) becomes the dominant surface geological unit, forming extensive bedrock exposures. From KP 218.8 to KP 219.1, a narrow interval of the Tregolana Shale Member (Nstt) is present. Aeolian sands of Qe1 occur intermittently between bedrock exposures.

From KP 222.9 to approximately KP 246.4, the alignment is underlain by alternating intervals of Qe1 and Corraberra Sandstone Member (Nstc), with sandstone becoming more prominent toward the northern end of this section. Minor Holocene alluvial/fluvial sediments (Qha) occur locally within drainage features.

Between KP 246.5 and KP 309.6, the surface geology is dominated by the Simmens Quartzite Member (Nsts), with extensive exposures of blocky quartzite and sandstone. This section is interspersed with significant intervals of Bulldog Shale (Kmb) between KP 248.1 and KP 275.6 and again between KP 324.7 and KP 330.4, reflecting fine-grained marine sedimentation. Short intervals of Qe1 persist where aeolian sands mantle the bedrock.

From KP 309.7 to KP 323.6, Qe1 remains widespread, with minor occurrences of the Eyre Formation (Taee) between KP 311.0 and KP 312.3, comprising carbonaceous, pyritic sands and clays deposited in braided stream environments.

Between KP 323.7 and KP 352.3, the alignment crosses alternating bedrock units of Simmens Quartzite Member (Nsts), Andamooka Limestone (Eha), and Bulldog Shale (Kmb). The Andamooka Limestone, present between KP 325.9 and KP 337.3 and again between KP 350.7 and KP 352.3, comprises recrystallised and locally dolomitised limestone deposited in peritidal to subtidal shelf environments.

Overall, the surface geology along the main transfer pipeline is characterised by extensive Quaternary aeolian, regolith and alluvial deposits, with intermittent bedrock exposures of Proterozoic sandstones, quartzites, dolomites and shales where Quaternary cover thins or is absent. Alluvial and fluvial units are consistently confined to overland flow paths and ephemeral drainage channels.

The geology in the Project Area is illustrated in **Figure 5-13** and **Figure 5-14** and summarised in **Table 5-6**. **Figure 5-12** shows the surface geology units within the Project Area.

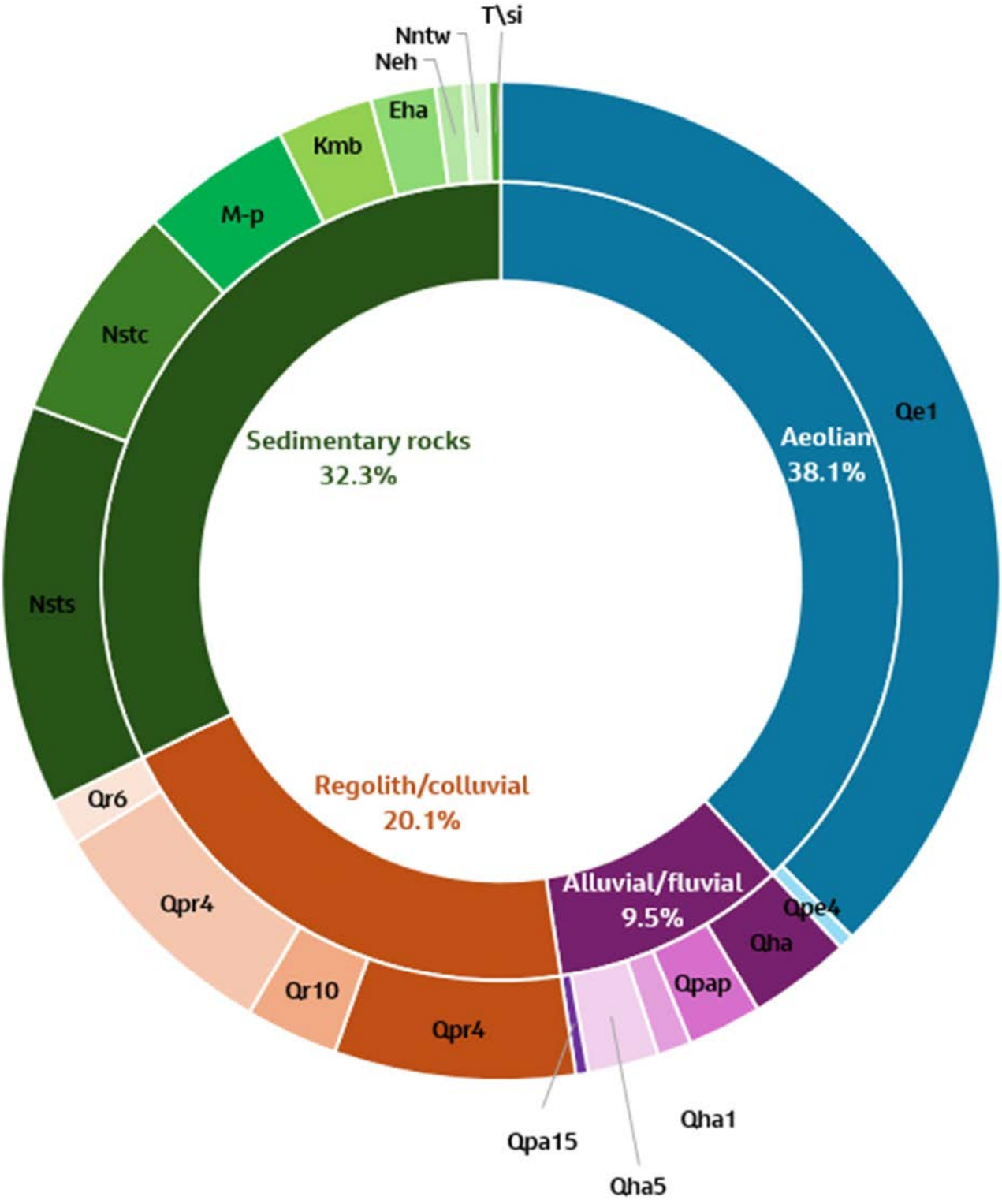


Figure 5-12. Pie chart of surface geology units of the Project Area

Table 5-6. Generalised Surface geology of the Project Area

Dominant surface geological unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Pleistocene regolith/colluvial unit 4 (Qpr4)	KP 0.1 – KP 0.2 (S) KP 0.8 – KP 2.2 (S) KP 3.2 – KP 3.5 (S) KP 5.4 – KP 5.7 (S) KP 6.3 – KP 6.4 (S) KP 8.6 – KP 8.8 (S) KP 10.0 – KP 11.1 (S) KP 12.5 – KP 25.4 (S) KP 26.0 – KP 29.1 (S) KP 29.2 – KP 29.6(S) KP 29.9 – KP 31.8 (S) KP 32.2 – KP 34.3 (S) KP 34.7 – KP 37.7 (S) KP 38.0 – KP 38.3 (S) KP 64.4 – KP 68.5 (S) KP 68.9 – KP 71.6 (S)	Pleistocene gravel, clay, silt and sand with soft carbonate, overlying nodular/tabular calcrete.	7.8%
Pooraka Formation (Qpap)	KP 95.9 – KP 99.1 (S) KP 99.5 – KP 102.0 (S) KP 102.4 – KP 103.8 (S) KP 107.6 – KP 109.5 (S) KP 140.3 – KP 140.9 (S) KP 142.7 – KP 143.8 (S)	Clay, sand and carbonate earth, silty, with gravel lenses.	2.4%
Holocene alluvial/fluvial sediments (Qha)	KP 0 – KP 0.1 (S) KP 0.2 – KP 0.8 (S) KP 1.4 – KP 1.5 (S) KP 2.2 – KP 3.2 (S) KP 3.5 – KP 5.4 (S) KP 5.7 – KP 6.3 (S) KP 6.4 – KP 8.6 (S) KP 8.8 – KP 10.0 (S) KP 11.1 – KP 12.5 (S) KP 25.4 – KP 25.9 (S) KP 240.6 – KP 240.8 (N) KP CA 20.8 – KP 21.3 (N) KP CA 22.6 – KP 23.4 (N) KP CA 32.6 – KP 35.6 (N) KP CA 38.8 – KP 39.1 (N)	Undifferentiated Holocene alluvial/fluvial sediments.	3.3%
Pandurra Formation (M-p)	KP 38.6 – KP 38.9 (S) KP 191.8 – KP 192.6 (S)	Sandstone, quartz and lithic, poorly sorted; sandstone, well-	4.9%

Dominant surface geological unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
	KP 195.3 – KP 196.2 (N) KP 201.4 – KP 205.6 (N) KP 207.5 – KP 218.7 (N) KP 219.1 – KP 221.2 (N) KP 221.4 – KP 222.8 (N)	sorted, conglomerate, granule to pebble; mudstone; siltstone. Red, brown or purple with reduction spotting or mottling. Fluvial, large-scale cross-bedding and liesegang banding. Maximum deposition 1424±51 Ma (Rb-Sr).	
Pleistocene regolith/colluvial sediments (Qpr)	KP 38.9 – KP 41.7 (S) KP 42.0 – KP 44.9 (S) KP 45.8 – KP 49.8 (S) KP 50.7 – KP 51.7 (S) KP 52.7 – KP 54.6 (S)	Undifferentiated Pleistocene colluvial/regolith sediments.	7.8%
Holocene alluvial/fluvial unit 5 (Qha5)	KP 37.7 – KP 38.0 (S) KP 38.3 – KP 38.6 (S) KP 41.7 – KP 42.0 (S) KP 44.9 – KP 45.8 (S) KP 49.8 – KP 50.7 (S) KP 51.7 – KP 52.7 (S) KP 54.6 – KP 57.8 (S) KP 62.8 – KP 64.4 (S) KP 68.5 – KP 68.9 (S) KP 73.6 – KP 74.7 (S) KP 75.1 – KP 75.4 (S)	Holocene alluvial plain sediments.	2.3%
Pleistocene aeolian unit 4 (Qpe4)	KP 74.7 – KP 75.1 (S) KP 75.4 – KP 78.2 (S)	Pleistocene coastal plain dune sand.	0.5%
Quaternary regolith/colluvial unit 6 (Qr6)	KP 57.8 – KP 62.8 (S) KP 71.6 – KP 73.6 (S)	Clay, silt and sand, as sheetwash and on sand plains.	1.5%
Quaternary regolith/colluvial unit 10 (Qr10)	KP 78.7 – KP 79.1 (S) KP 79.7 – KP 85.3 (S) KP 85.4 – KP 86.6 (S) KP 88.9 – KP 89.6 (S) KP 89.8 – KP 89.9 (S) KP 90.6 – KP 95.5 (S)	Sand, on flat-lying plains with superficial, densely mulga-vegetated dendritic drainage pattern and (incipient) tiger-bush patterns in intervening areas.	3.0%
Pleistocene alluvial/fluvial unit 15 (Qpa15)	KP 86.6 – KP 87.3 (S) KP 87.7 – KP 88.7 (S) KP 89.6 – KP 89.8 (S) KP 89.9 – KP 90.6 (S)	Pleistocene sand and gravel of high angle alluvial fans.	0.4%

Dominant surface geological unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Holocene alluvial/fluvial unit 1 (Qha1)	KP 25.9 – KP 26.0 (S) KP 34.3 – KP 34.7 (S) KP 78.2 – KP 78.7 (S) KP 79.1 – KP 79.7 (S) KP 85.3 – KP 85.4 (S) KP 88.7 – KP 88.9 (S) KP 95.5 – KP 95.9 (S) KP 99.1 – KP 99.5 (S) KP 102.0 – KP 102.2 (S) KP 103.8 – KP 104.2 (S) KP 105.0 – KP 106.2 (S) KP 110.5 – KP 111.0 (S) KP 129.9 – KP 130.2 (S)	Present day Holocene alluvium; current bedload.	1.1%
Quaternary aeolian unit 1 (Qe1)	KP 106.4 – KP 107.6 (S) KP 109.5 – KP 110.5 (S) KP 111.0 – KP 129.9 (S) KP 130.2 – KP 140.3 (S) KP 143.8 – KP 153.0 (S) KP 153.2 – KP 153.4 (S) KP 155.1 – KP 160.2 (S) KP 160.3 – KP 191.8 (S) KP 192.6 – KP 195.3 (S) KP 196.2 – KP 196.7 (N) KP 199.1 – KP 199.7 (N) KP 205.6 – KP 207.5 (N) KP 221.2 – KP 221.4 (N) KP 222.8 – KP 235.2 (N) KP 309.6 – KP 310.9 (N) KP 311.3 – KP 311.8 (N) KP 312.3 – KP 323.2 (N) KP 323.4 – KP 323.6 (N) KP 337.3 – KP 346.9 (N) KP 347.5 – KP 350.6 (N) KP 352.3 – KP 361.487 (N) KP CA 0 – KP 13.0 (N) KP CA 14.7 – KP 14.8 (N) KP CA 15.5 – KP 20.8 (N) KP CA 21.3 – KP 22.6 (N) KP CA 23.4 – KP 24.5 (N) KP CA 25.0 – KP 26.6 (N) KP CA 26.9 – KP 28.8 (N)	Quaternary dune-field sands.	37.6%

Dominant surface geological unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Tertiary silcrete (T\si)	KP 29.1 – KP 29.2 (S) KP 29.6 – KP 29.9 (S) KP 31.8 – KP 32.2 (S) KP 140.9 – KP 142.7 (N)	Undifferentiated Tertiary silcrete.	0.4%
Whyalla Sandstone (Neh)	KP 153.0 – KP 153.2 (S) KP 153.4 – KP 155.1 (S) KP 160.2 – KP 160.3 (S) KP CA 13.0 – KP 14.7 (N) KP CA 14.8 – KP 15.5 (N)	Sandstone, coarse-grained, bimodal, with large-scale crossbedding, sand grains very well rounded, spherical.	0.9%
Woocalla Dolomite Member (Nntw)	KP 196.7 – KP 199.1 (N) KP 199.7 – KP 201.4 (N)	Dolomite, yellow-brown, grey, massive bedding, oolitic, stromatolitic in part.	0.8%
Corraberra Sandstone Member (Nstc)	KP 104.2 – KP 105.0 (S) KP 235.2 – KP 240.6 (N) KP 240.8 – KP 246.4 (N) KP 275.6 – KP 281.1 (N) KP CA 26.6 – KP 26.9 (N) KP CA 28.8 – KP 32.5 (N) KP CA 35.6 – KP 38.8 (N) KP CA 39.1 – KP 44.3 (N)	Sandstone, red, purple, slumped, silty. Some shale.	7.1%
Simmens Quartzite Member (Nsts)	KP 87.3 – KP 87.7 (S) KP 246.4 – KP 248.0 (N) KP 248.4 – KP 250.0 (N) KP 255.3 – KP 259.0 (N) KP 261.3 – KP 275.2 (N) KP 281.1 – KP 309.6 (N) KP 323.2 – KP 323.4 (N) KP 323.6 – KP 324.6 (N) KP 346.9 – KP 347.5 (N) KP CA 44.3 – KP 46.569 (N)	Quartzite, blocky; sandstone, cream.	13.0%
Andamooka Limestone (Eha)	KP 325.8 – KP 326.6 (N) KP 330.4 – KP 337.3 (N) KP 350.6 – KP 352.3 (N)	Limestone, grey, off-white, brown, buff, pink, recrystallised, commonly dolomitised, locally sandy or pyritic. Intraclastic or oolitic interbeds; siliciclastics at base. Local trilobite fragments, archaeocyatha, calcimicrobes. Peritidal/subtidal shelf.	2.1%

Dominant surface geological unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Bulldog Shale (Kmb)	KP 248.0 – KP 248.4 (N) KP 250.0 – KP 255.3 (N) KP 259.0 – KP 261.3 (N) KP 275.2 – KP 275.6 (N) KP 324.6 – KP 325.8 (N) KP 326.6 – KP 330.4 (N)	Mudstone, grey, bioturbated, fossiliferous and shaly; minor silt to very fine-grained sandstone intervals.	3.1%

Notes: S = Southern section of the Project Area, N = Northern section of the Project Area

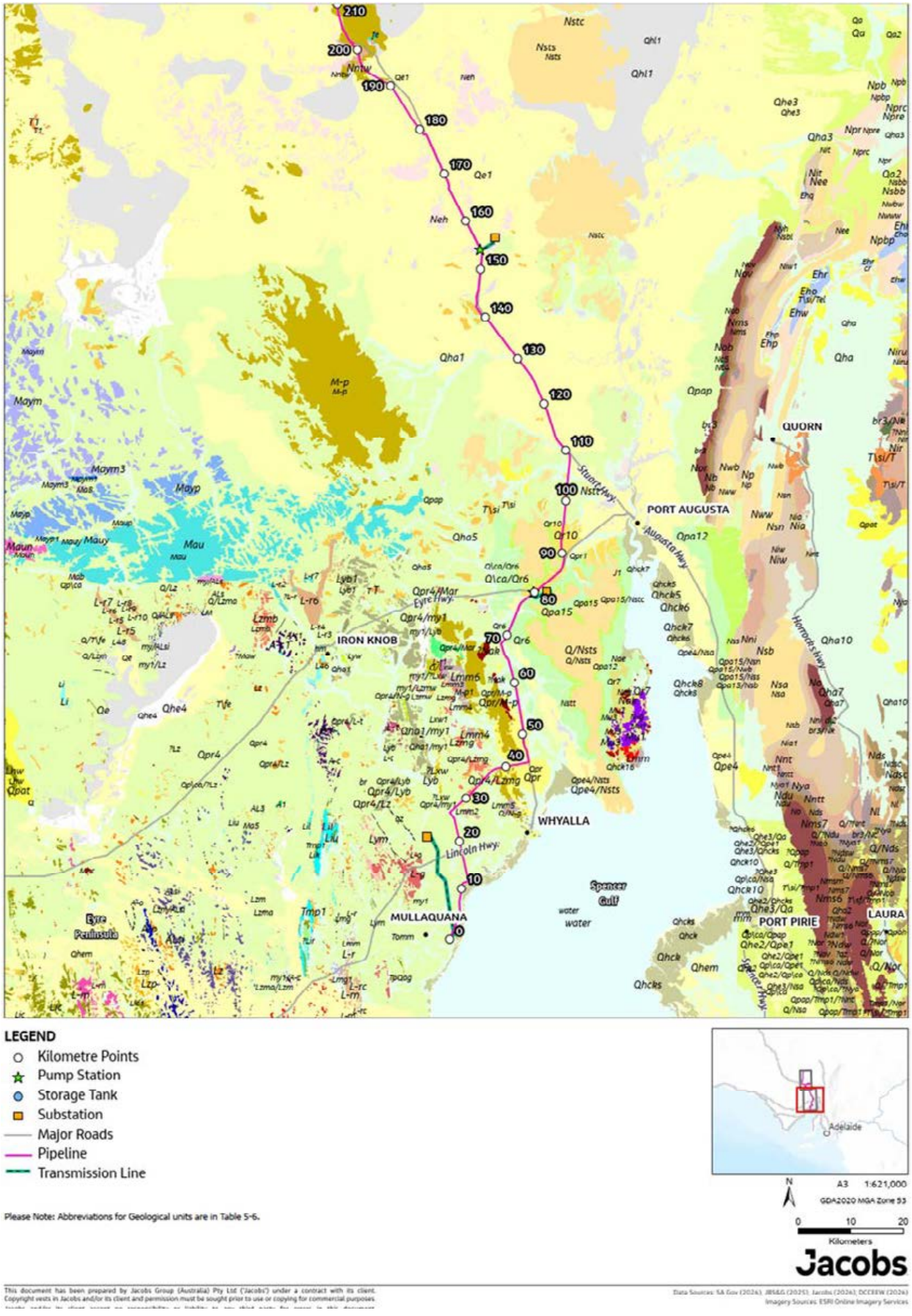


Figure 5-13. Surface geology of the southern Project Area

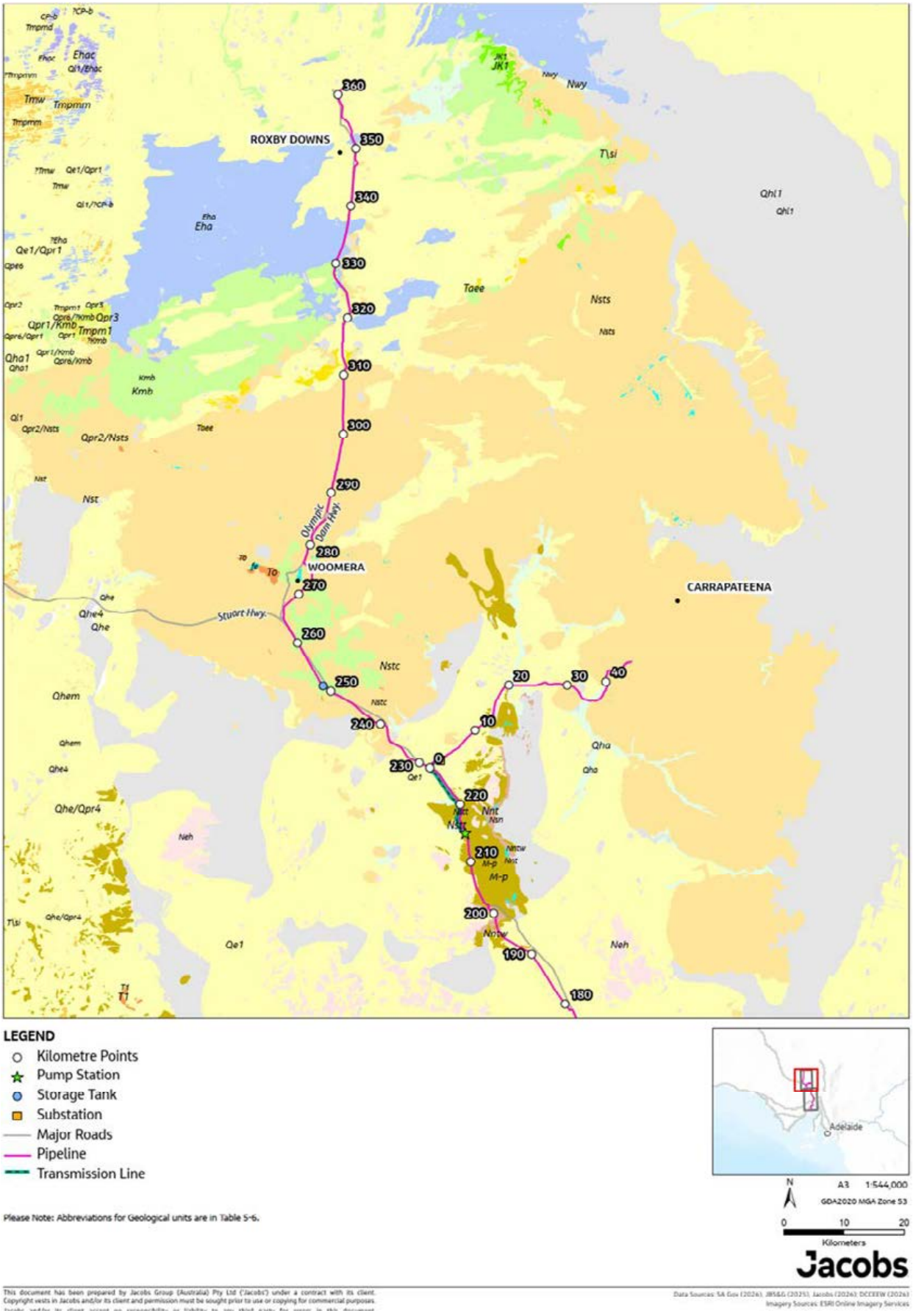


Figure 5-14. Surface geology of the northern Project Area

5.5.3 Regolith

The GSSA regolith map (GSSA 2012) classifies surface deposits in South Australia into different regolith units based on their underlying geomorphological processes as outlined in **Table 5-7** and illustrated in **Figure 5-15** and **Figure 5-16**. Regolith transported by means of aeolian, alluvial, fluvial and colluvial processes accounts for approximately 94% of the Project Area.

Table 5-7. Dominant regolith units of the Project Area

Regolith Unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Colluvial sediments	KP 0 - KP 25.7 (S) KP 26.9 - KP 31.5 (S) KP 32.5 - KP 34.7 (S) KP 37.8 - KP 62.7 (S) KP 67.0 - KP 68.2 (S) KP 69.1 - KP 73.3 (S) KP 86.6 - KP 89.9 (S) KP 90.7 - KP 91.5 (S) KP CA 35.6 - KP CA 37.8 (N)	Heterogeneous material of variable grain size accumulated on slopes by gravity, creep, sheet flow, rain-wash, mudflows or solifluction.	16.8%
Alluvial sediments	KP 25.7 - KP 26.9 (S) KP 62.7 - KP 67.0 (S) KP 68.2 - KP 69.1 (S) KP 99.2 - KP 99.4 (S) KP 102.0 - KP 102.1 (S) KP 129.2 - KP 131.1 (S) KP CA 20.9 - KP CA 21.8 (N) KP CA 34.6 - KP CA 35.6 (N) KP CA 37.8 - KP CA 39.2 (N)	Sediments deposited by channelled and over-bank stream flow confined to a channel or valley floor.	2.9%
Residual material	KP 31.5 - KP 32.5 (S) KP 34.7 - KP 37.8 (S) KP 140.3 - KP 143.2 (S) KP 346.8 - KP 347.5 (N)	Material derived from in situ weathering of bedrock of undifferentiated origin (incl. Cenozoic formations) without significant lateral movement of solid weathered products and material volume loss. Includes residual clay and sand.	1.9%

Regolith Unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Sheet flow deposits	KP 73.3 - KP 86.6 (S) KP 89.9 - KP 90.7 (S) KP 91.5 - KP 99.2 (S) KP 99.4 - KP 102.0 (S) KP 102.2 - KP 104.2 (S) KP 106.0 - KP 112.2 (S) KP 125.7 - KP 129.2 (S) KP 143.2 - KP 148.3 (S) KP 149.1 - KP 150.7 (S) KP 161.2 - KP 196.5 (S) KP 204.6 - KP 207.6 (N) KP CA 33.8 - KP CA 34.6 (N)	Distal slope sediments deposited by unconfined sheet flow or a network of rills. Often characterized by distinct contour banding-tiger bush surface pattern. Subunit of colluvial sediments.	19.9%
Aeolian sediments	KP 105.3 - KP 106.0 (S) KP 112.2 - KP 125.7 (S) KP 131.1 - KP 140.3 (S) KP 143.2 - KP 146.7 (S) KP 148.3 - KP 149.1 (S) KP 150.7 - KP 153.2 (S) KP 153.9 - KP 161.2 (S) KP 221.3 - KP 235.6 (N) KP 309.5 - KP 323.1 (N) KP 330.6 - KP 346.8 (N) KP 347.5 - KP 361.487 (N) KP CA 0 - KP CA 13.1 (N) KP CA 14.4 - KP CA 20.9 (N) KP CA 21.8 - KP CA 28.9 (N)	Sediment deposited from transport by wind, forming inland and coastal dunes, dune fields, sand sheets and interdunal areas.	29.7%
Moderately to highly weathered bedrock	KP 102.1 - KP 102.2 (S) KP 104.2 - KP 105.3 (S) KP 153.2 - KP 153.9 (S) KP 250.0 - KP 252.6 (N) KP 275.1 - KP 281.1 (N) KP 326.4 - KP 327.6 (N) KP 328.9 - KP 330.6 (N)	Moderately to highly weathered bedrock on erosional plains, rises, low hills, hills, mountains and plateau surfaces.	3.3%
Lacustrine sediments	KP 196.5 - KP 196.7 (N) KP 235.6 - KP 236.4 (N)	Sediment deposited from solution and suspension in still water in an inland lake, playa or pan.	0.2%

Regolith Unit	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Transported sediments	KP 196.7 - KP 204.6 (N) KP 207.6 - KP 221.3 (N) KP 236.4 - KP 250.0 (N) KP 252.6 - KP 275.1 (N) KP 281.1 - KP 309.5 (N) KP 323.1 - KP 326.4 (N) KP 327.6 - KP 328.9 (N) KP CA 13.1 - KP CA 14.4 (N) KP CA 28.9 - KP CA 33.8 (N) KP CA 39.2 - KP CA 46.569 (N)	Materials deposited by terrestrial geomorphic processes, including undifferentiated sediments of mixed colluvial, alluvial, aeolian, lacustrine or unknown origin, some Cenozoic formations and paleochannel sediments.	25.3%

* S = Southern section of the Project Area, N = Northern section of the Project Area

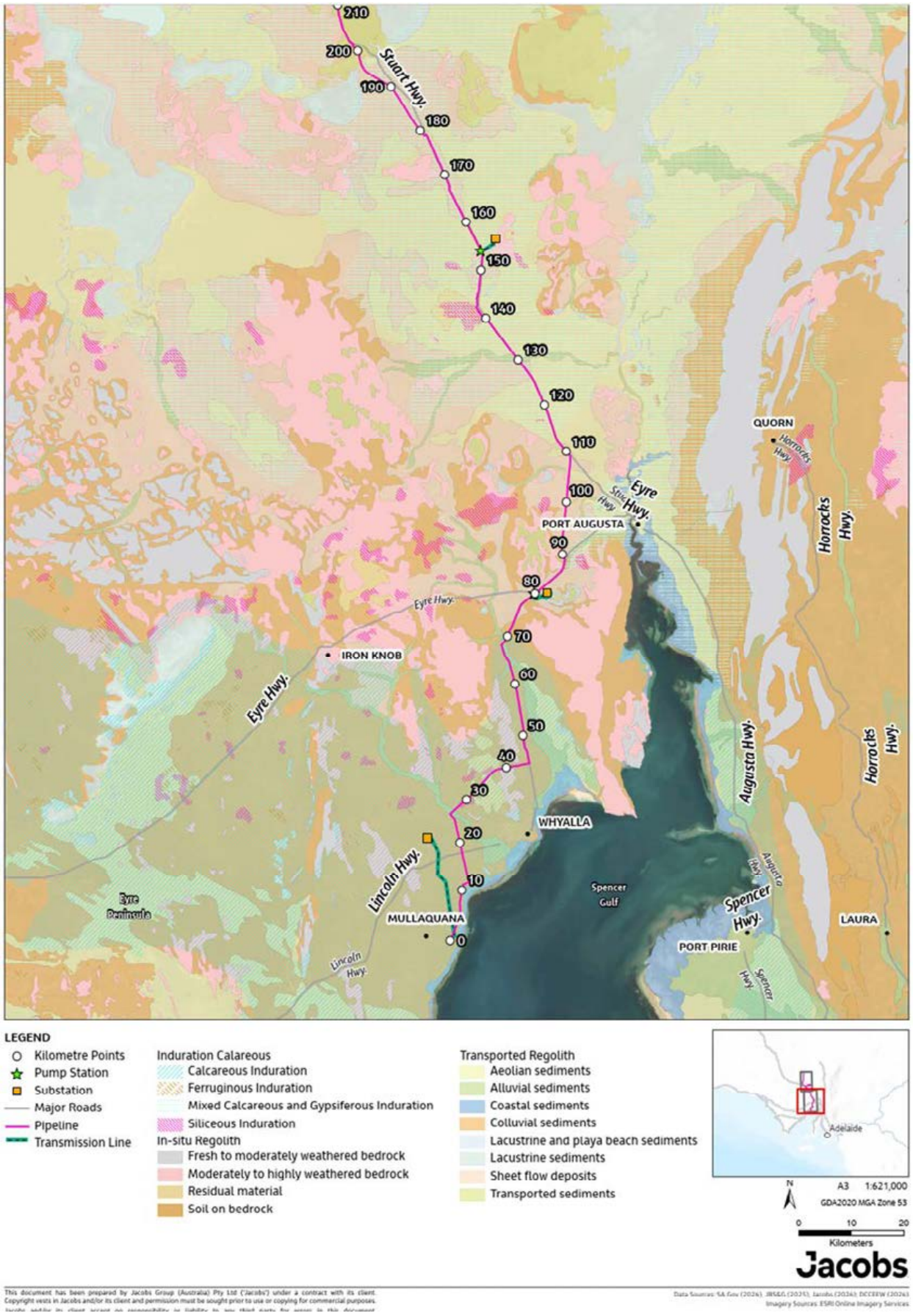


Figure 5-15. Regolith of the southern Project Area

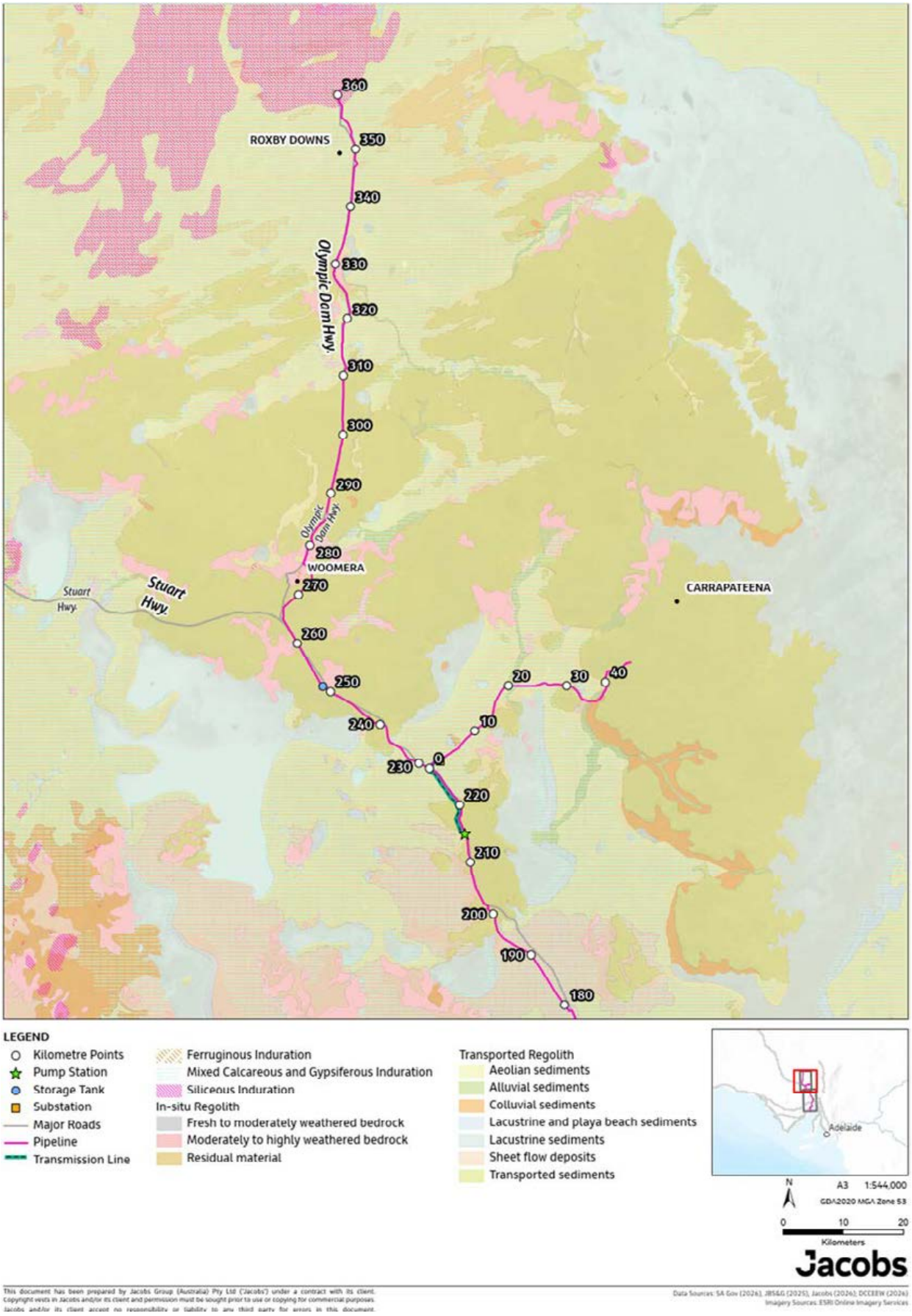


Figure 5-16. Regolith of the northern Project Area

5.5.4 Indurated soils

Induration can be defined as the introduction and precipitation of silica, iron oxides, carbonates and sulphate (gypsum) which tends to harden the soil. The regolith map of South Australia (GSSA 2012) classifies the induration of regolith materials into six categories including calcareous, ferruginous, siliceous, gypsiferous, mixed calcareous and gypsiferous, and undifferentiated induration types. Three types of induration are present in the Project Area, and the locations where they appear within the Project Area are shown in **Figure 5-15** and **Figure 5-16** and summarised in **Table 5-8**.

The GSSA regolith map does not indicate the concentration level of material indurations across the Project Area. However, based on the descriptions of the overarching land system and surface geological units, the indurated materials can range from loose to moderately cemented soil horizons to calcrete or silcrete layers.

Table 5-8. Induration type of the Project Area

Induration type	Approximate Kilometre Point (Location S/N)*	Description	Approximate coverage area (% of EIS Study Area)
Calcareous	KP 0 - KP 28.2 (S) KP 31.1 - KP 31.8 (S) KP 32.3 - KP 70.2 (S)	Material induration as a result of the introduction and precipitation of calcium carbonate. Concentration of the material produces calcrete.	16.4%
Mixed calcareous-gypsiferous	KP 86.2 - KP 89.8 (S) KP 114.1 - KP 141.0 (S) KP 142.8 - KP 196.4 (S) KP 221.6 - KP 235.2 (N) KP 309.7 - KP 323.9 (N) KP 331.5 - KP 358.1 (N) KP CA 0 - KP CA 12.3 (N) KP CA 15.8 - KP CA 29.0 (N) KP CA 30.3 - KP CA 33.5 (N)	Material induration as a result of the introduction and precipitation of calcium carbonate and calcium sulfate. Concentration of the material produces calcrete or gypsum.	41.0%
Siliceous	KP 28.2 - KP 31.1 (S) KP 31.8 - KP 32.3 (S) KP 141.0 - KP 142.8 (S)	Material induration as a result of the introduction and precipitation of silica. Concentration of the material produces chert.	2.1%

* S = Southern section of the Project Area, N = Northern section of the Project Area

5.5.5 Depth of regolith

Geoscience Australia (2015) indicates that the depth of regolith material (in situ or transported material overlaying unweathered bedrock) ranges from approximately 0 m to 51.4 m below ground level (bgl) in the Project Area. This data has been combined with the topography data to provide an indicative profile of unweathered bedrock along the main trunk line alignment, as shown in **Figure 5-17**, **Figure 5-18** and **Figure 5-19**.

The regolith data provides only indicative depths to unweathered bedrock and has a mean error of approximately 6 m and a spatial resolution of 80 m while the topography profiles are based on LiDAR digital terrain data, which has a spatial resolution of 1 m.

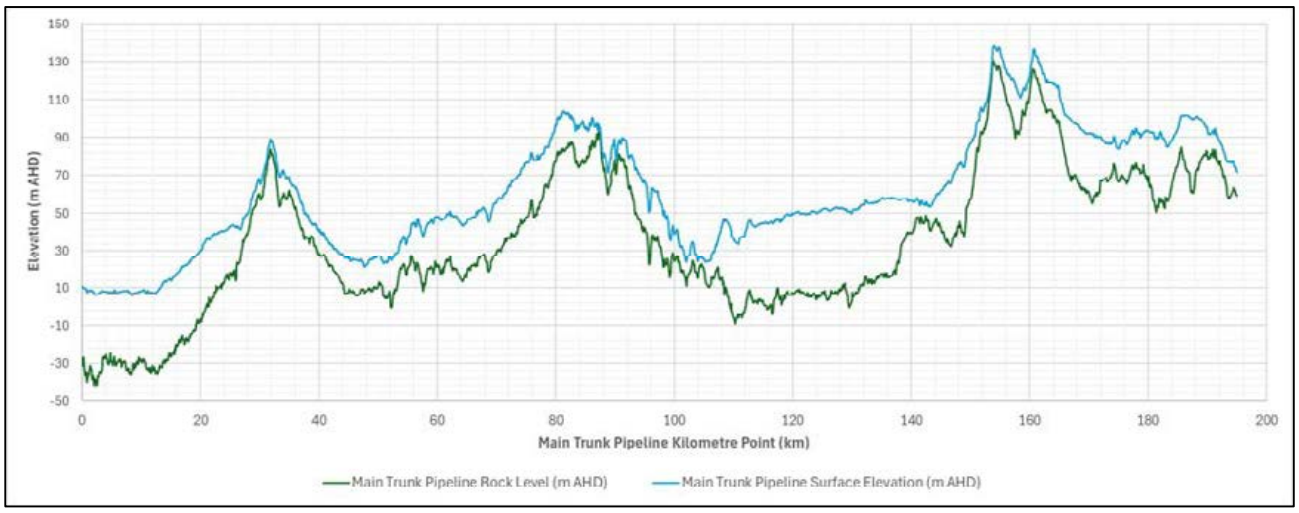


Figure 5-17. Topography and rock profiles of the southern Project Area

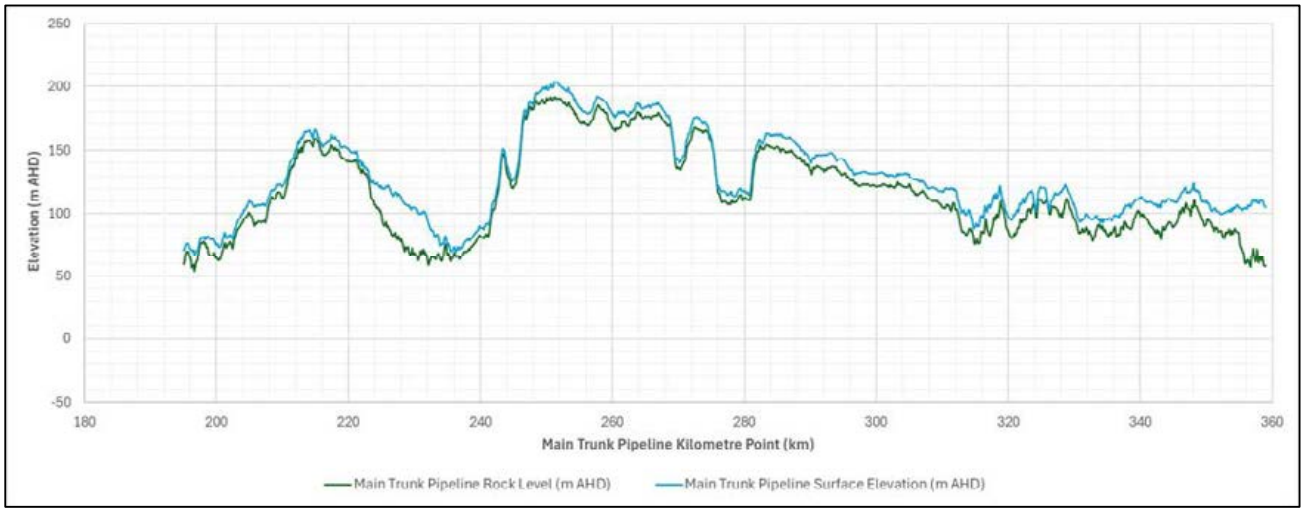


Figure 5-18. Topography and rock profiles of the northern Project Area

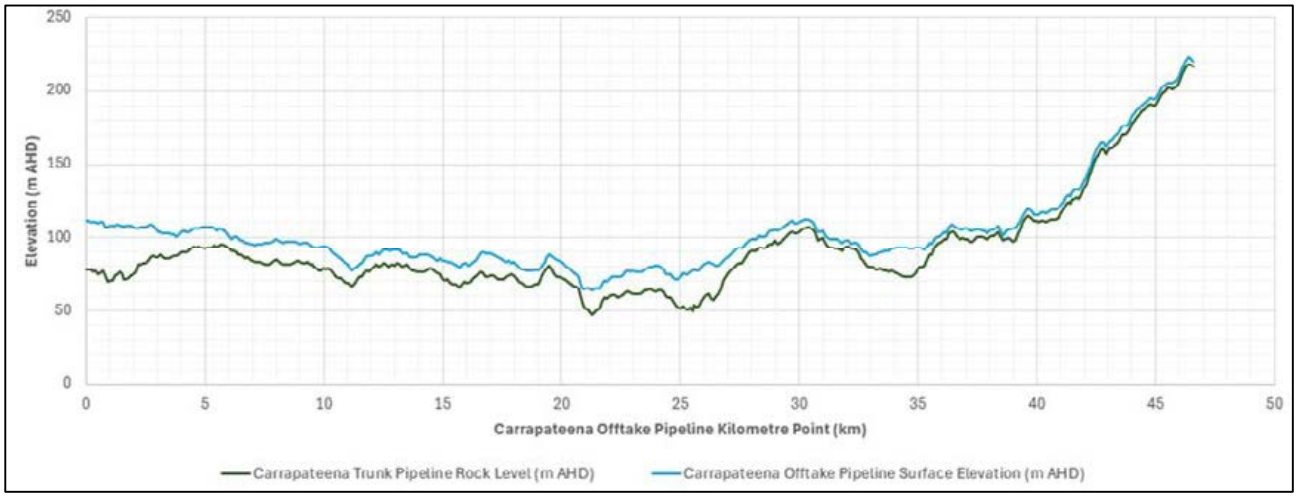


Figure 5-19. Topography and rock profiles of the lateral branch pipeline

5.5.6 Structural geology

The Project is located within the Gawler Craton, a neotectonic domain that exhibits broadly similar physical and seismo-tectonic characteristics in response to imposed tectonic forces (Geoscience Australia, 2019). The underlying architecture is described as Archaean and unreactivated Paleoproterozoic crust. The Kalinjala Mylonite Zone, which is the crustal boundary associated with the Gawler Craton lies close to the pipeline within the northern Project Area, crossing the pipeline at approximately KP 248.7 and KP 291.8.

Neotectonic features are the geological characteristics considered to relate to large earthquakes within the past 5 to 10 million years and are often active faults. From a review of the Geoscience Australia Earthquake catalogue, four groups of neotectonic features have been identified as being relevant to the Project:

- **Northeast Eyre Peninsula group** located southeast of the Gawler Craton, which includes a number of sub-parallel and intersecting faults with evidence of Quaternary-aged displacements.
- **Southern Flinders Ranges group** located along the eastern boundary of the Gawler Craton, which includes a series of sub-parallel reverse faults forming the western range front of the southern Flinders Ranges.
- **Northern Flinders Ranges group** located along the northeastern boundary of the Gawler Craton, which includes three reverse faults with associated Quaternary-aged displacements.

Descriptions of the neotectonic features that are part of the groups are summarised in **Table 5-9** based on the Australian Neotectonic Features Database (Geoscience Australia, 2019), and shown in **Figure 5-20** and **Figure 5-21**.

The published surface geological maps (GSSA, 2020) highlight the locations of other surface faults that are not captured by the Geoscience Australia catalogue, which are also shown in **Figure 5-20** and **Figure 5-21**.

Table 5-9. Summary of neotectonic features

Feature Name	Feature Group	Description
Randell Scarp	Northeast Eyre Peninsula group	One of a series of essentially northeast-southwest trending fault scarps up to 70 km in length defining the western margin of the Pirie Basin, and characterised by vertical fault displacements of 100-150 m. The Randell Scarp thrusts Palaeoproterozoic Lincoln Complex granitoids over Late Pleistocene Randell Formation sediments. Pliocene Melton Limestone outcropping up to 80 m beyond the scarp front on the coastal plain suggests that the scarp front has undergone substantial retreat from the location of the Randell Fault. An M_{max} value of 6.8 was estimated for the structure at a recurrence interval of 216 to1740 years.
Nonowie Scarp	Northeast Eyre Peninsula group	One of a series of essentially north-south trending fault scarps along the eastern side of the Eyre Peninsula coincident with the western margin of the Pirie Basin, the more north-south trending Nonowie Scarp is mapped as an un-named fault on the Whyalla geological sheet. The fault thrusts Palaeoproterozoic Wertigo Granite of the Lincoln Complex over Late Pleistocene Randell Formation. An M_{max} of 6.6 at a recurrence interval of 23,000 to 46,000 years was estimated for the Nonowie Scarp. The initiation of the scarp was inferred as 250 to 450 kilo annum before present.

Feature Name	Feature Group	Description
Ash Reef Scarp	Northeast Eyre Peninsula group	A 23 km long, 3-4 m high, northwest-trending scarp representing one of several mapped faults with scarp expression on the Eyre Peninsula scarps. A number of easterly flowing drainage lines have ponded against the scarp. A Thermo-luminescence age of 14+-5 ka from 0.7 m depth was obtained in one of these ponds. The age of damming cannot be estimated due to lack of information about the depth of the pond. However, an extrapolated sedimentation rate suggested that initial damming occurred at ca. 130 ka. The ponding suggests a relatively recent displacement event, and incision into the upthrown block provides evidence for prior events.
Roopena Scarp	Northeast Eyre Peninsula group	The Roopena Scarp is a 29.5 km long and 3-5 m high fault scarp within a family of fault scarps on the eastern side of the Eyre Peninsula. Two trenches excavated across the scarp revealed evidence for three morphogenic palaeo-earthquakes in the last ca. 200 ka, involving up to approximately 4 m slip per event. In contrast to nearby scarps, the present relief across the scarp is all that is apparent across Precambrian bedrock. Pronounced temporal clustering of events is implied.
Crystal Brook Fault	Southern Flinders Ranges group	The Crystal Brook Fault is associated with the marked topographic step of the western range front of the southern Flinders Ranges over a distance of approximately 64 km. There is no surface expression of the trace of the Crystal Brook Fault across the many gullies and alluvial fans occurring at the toe of the scarp. However, close proximity of footwall gravels and hanging wall, Emeroo Quartzite in one gully suggests a subvertical or easterly dipping reverse fault. Neotectonic throw is estimated to be in the order of 250 m. The fault is considered to be neotectonic by analogy with the Wilkatana Fault, which occupies a similar range front position to the north.
Nectar Brook Scarp	Southern Flinders Ranges group	The Nectar Brook Fault is associated with the marked topographic step of the western range front of the southern Flinders Ranges over a distance of approximately 38 km. Most of the gullies crossing the inferred position of this fault have been investigated and no exposures of the fault trace was found. However, by analogy to the Wilkatana Fault it is inferred to be an easterly dipping reverse fault. Neotectonic throw is estimated to be in the order of 200 m. The fault is considered to be active by analogy to the Wilkatana Fault, which occupies a similar range front position to the north.

Feature Name	Feature Group	Description
Wilkatana/Depot Creek Fault	Southern Flinders Ranges group	Mapped also as the Arden Fault, the Wilkatana and Depot Creek faults underlie the western range front of the southern Flinders Ranges over a distance of approximately 60 km. Very large apparently single event displacements identified during a study of the 25.3 km long Wilkatana Fault (3.8 m to 11 m) suggests that this fault and the 37.5 km Depot Creek Fault ruptured simultaneously. This is structurally plausible in that the faults are sub-parallel and the southern tip of the Wilkatana Fault is only several hundred metres from the northern tip of the Depot Creek Fault. However, dating of undeformed materials in the Depot Creek Fan suggested that the Depot Creek Fault may not have ruptured in unison with the Wilkatana segment in the last ca. 71 ka (the latter having accumulated approximately 15 m of slip during this). Considered individually, the faults are capable of events larger than Mw6.8, and together approximately Mw7.3 to Mw7.5.
Ediacara Scarp	Northern Flinders Ranges group	Seismic reflection profiling reveals that the Ediacara Fault is the frontal thrust to the Western Flinders Ranges. There is a difference in elevation of 100 m to 250 m between the base of the Oligocene to Miocene Neuroodla Formation at the eastern margin of the Torrens Basin compared to the adjacent Flinders Ranges, across the Ediacara scarp. It was interpreted that the uplift on the Ediacara Range to have taken place in the Quaternary. This is supported by the seismic reflection data. While a significant portion of this uplift must be attributed to the Ediacara Fault, the Mount Deception Fault is likely to have shared strain in the south, while the Norwest Fault may have shared strain in the north. However, it was suggested that the Norwest Fault has not been active since the formation of silcrete, which may date to the Miocene.
Norwest Fault	Northern Flinders Ranges group	Northeastern bounding fault of the Tertiary Torrens Basin. Approximately 50 m of displacement of the base of the Quaternary section across this fault was noted, based upon drillhole data. The Mount Deception and Ediacara Faults terminate against this structure. It has been associated with mound spring activity and mantle Helium 3 and CO_2 degassing. Kinematically the fault might accommodate east-west shortening across the northern Flinders Ranges by strike slip motion.

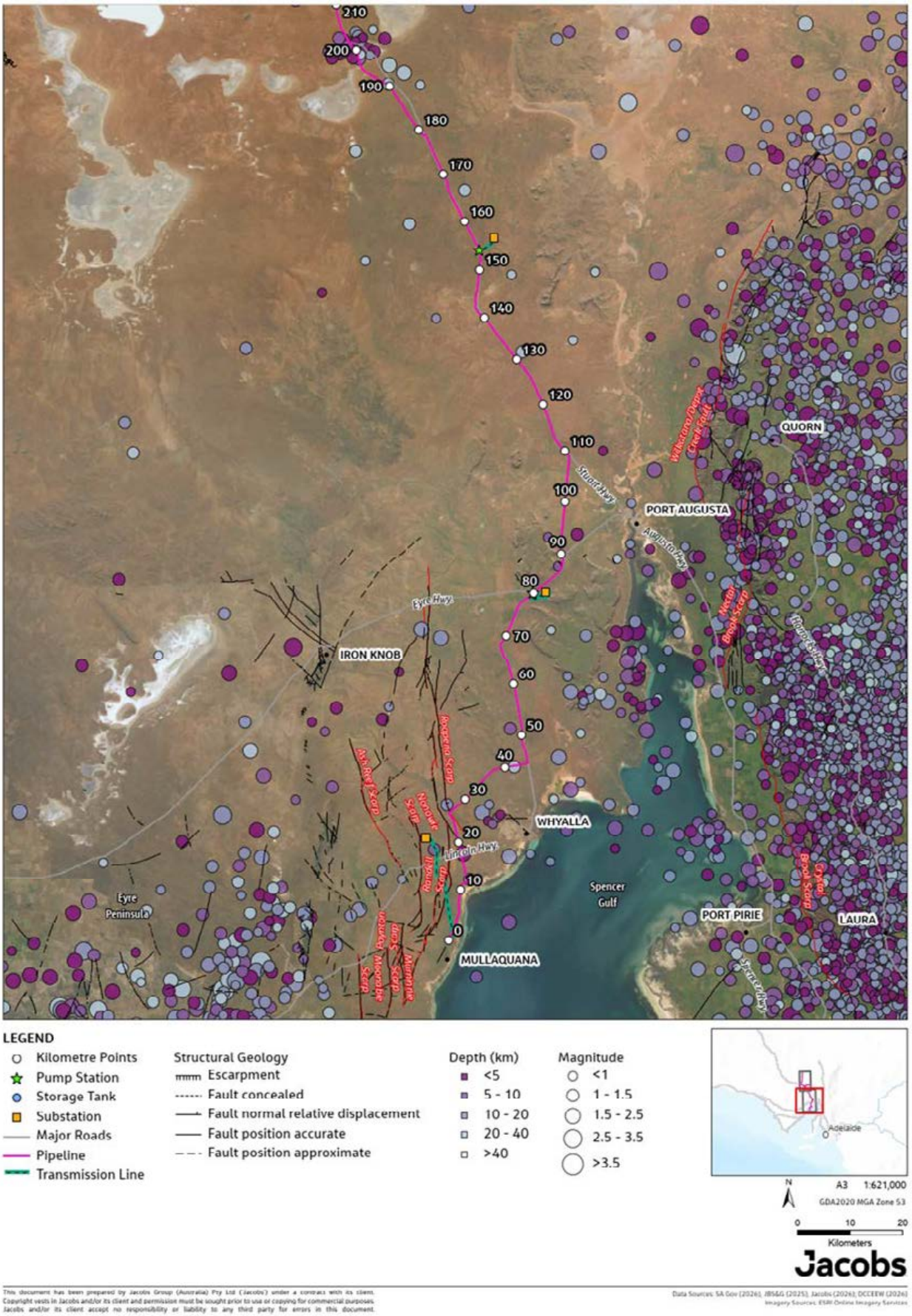
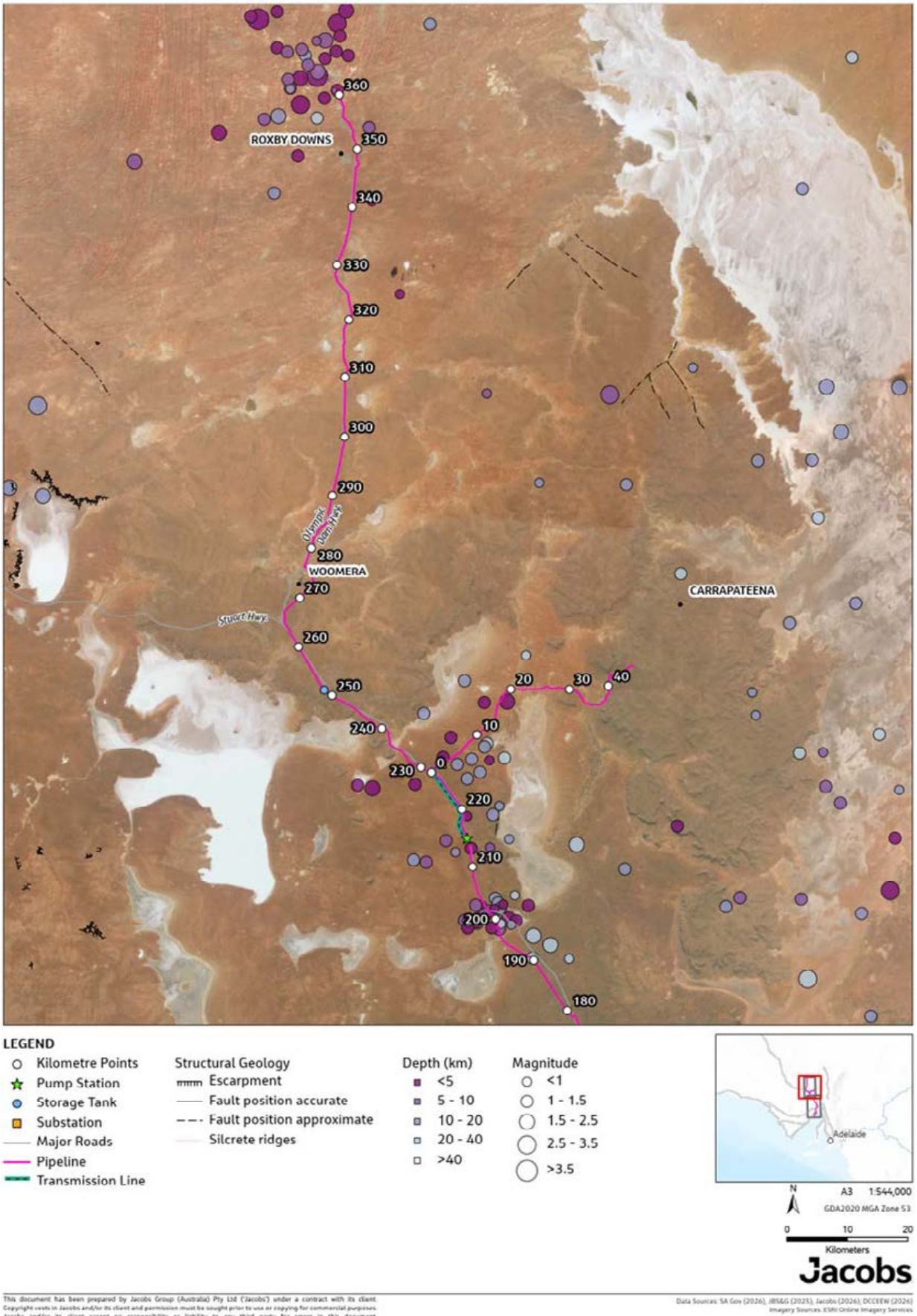


Figure 5-20. Geological features of the southern Project Area



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Data Sources: SA Gov (2026), IBS&G (2025), Jacobs (2026), DCCEEW (2026)
Imagery Sources: ESRI Online Imagery Services

Figure 5-21. Geological features of the northern Project Area

5.6 Previous geotechnical investigations

The following previous geotechnical investigation information has been utilised to assess the subsurface conditions in the Project Area:

- 88 No. test pits to depths of maximum 3.4 m bgl carried out by URS between July and August 2006 for the Olympic Dam expansion project (URS, 2006). The test pit locations approximately coincide with the main trunk pipeline alignment (and associated Project infrastructure) between KP 44.4 and KP 361.487.
- 180 No. historical mineral, water and stratigraphy boreholes from the SARIG database covering the Project Area between KP 0 and KP 361.487, and KP CA 0 and KP CA 46.569.

The locations of the previous geotechnical investigations are shown in **Figure 5-22** and **Figure 5-23**.

It is noted that the quality of the information presented in the SARIG borehole logs is variable and is typically of a lower quality than required by current standards.

It is noted that the following additional geotechnical investigations were undertaken concurrently with this assessment; however, their associated results and findings were not incorporated into the assessment:

- geotechnical investigations by CMW along the pipeline alignment.
- geotechnical investigations by WSP offshore.
- geotechnical investigations and information for the Mullaquana Station Desalination Site by Kleinfelder.

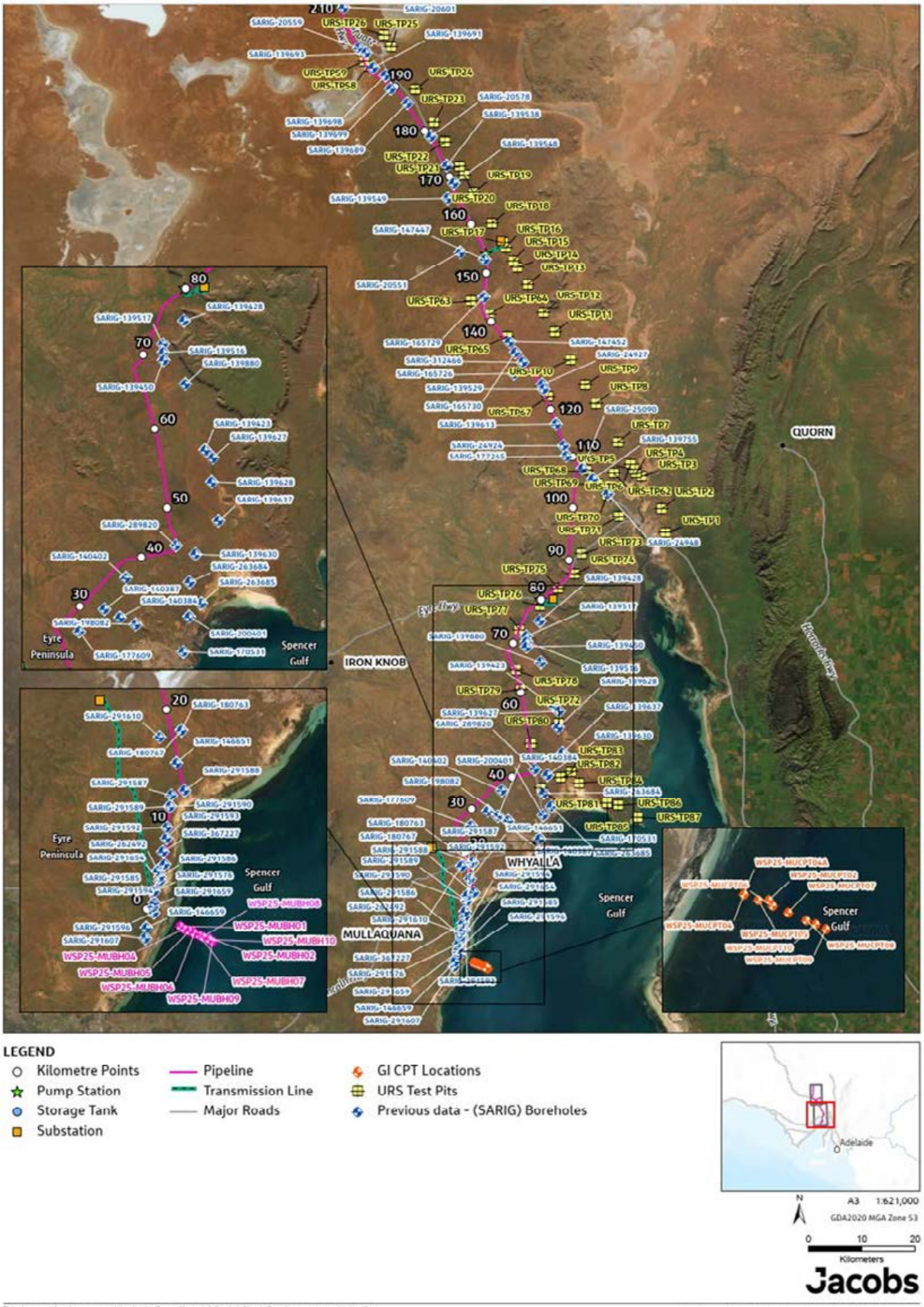


Figure 5-22. Previous geotechnical investigation locations – southern Project Area

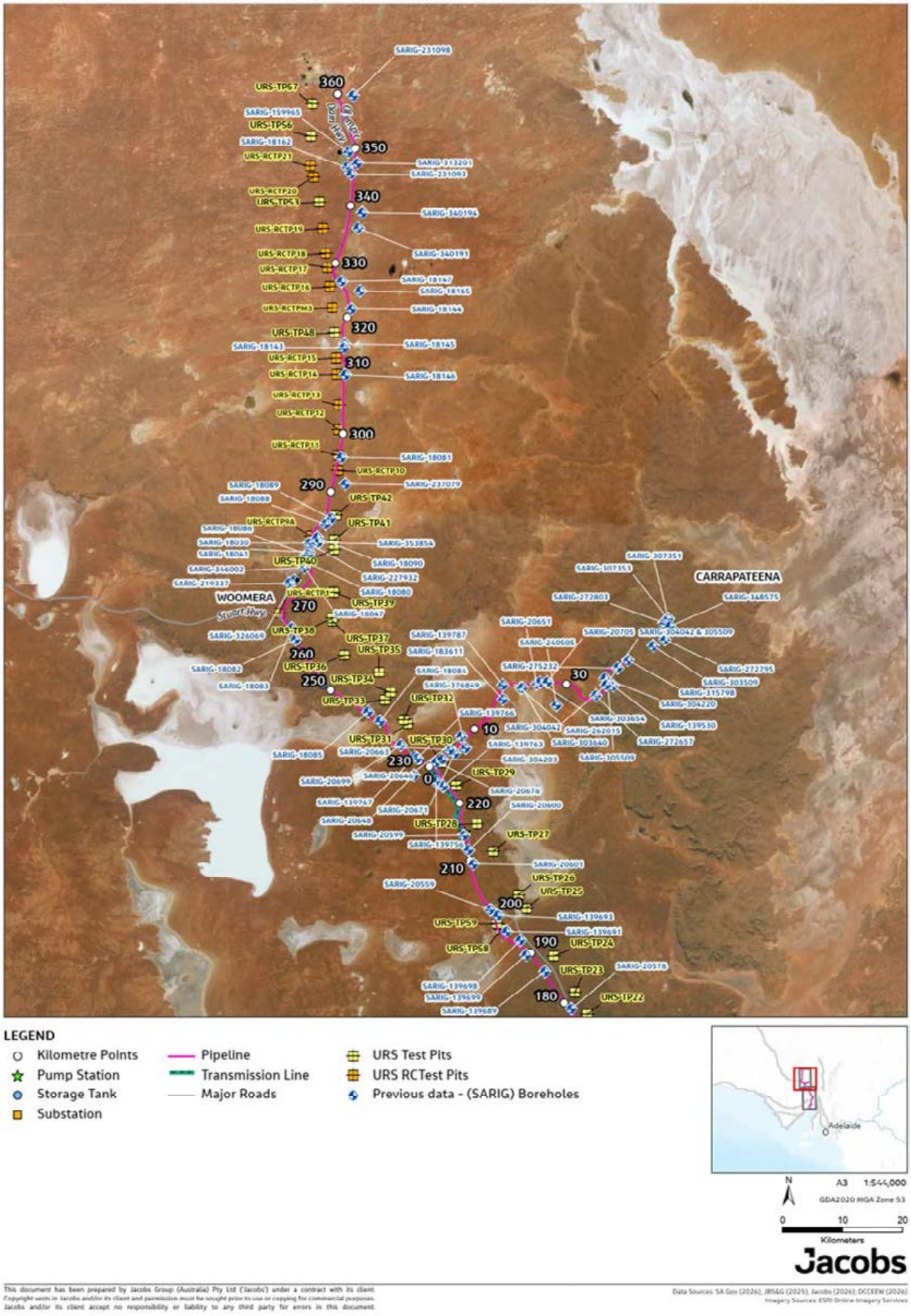


Figure 5-23. Previous geotechnical investigation locations – northern Project Area

5.6.1 Subsurface conditions

A summary of the typical sub-surface profiles in the Project Area is presented in **Table 5-10**. The soil and rock profiles described are summaries of the previous geotechnical investigation records examined, which should be considered as indicative only of ground conditions along the pipeline. The soil-rock interface values presented are based on the borehole/test pit records and are in general agreement with the CSIRO (2015) regolith map.

Consistent with AS1726-2017, soil descriptions in URS (2006) have been interpreted as below:

- Clay loam and loam are interpreted to be sandy clay.
- Sandy clay loam, sandy loam and loamy sand are interpreted to be clayey sand.

Table 5-10. Summary of subsurface conditions

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 0 - KP 9.0	Holocene alluvial/fluvial sediments (Qha)	Calcareous silt or clay (6–28 m) transitioning into weathered calcareous claystone (possible gypsum)	6 – 28	SARIG-291596 SARIG-291659 SARIG-291585 SARIG-291576 SARIG-291654 SARIG-291586 SARIG-262492 SARIG-291594 SARIG-367227 SARIG-291593 SARIG-291592 SARIG-291590 SARIG-291589 SARIG-291587 SARIG-291588
KP 9.0 - KP 24.0	Pleistocene regolith/colluvial unit 4 (Qpr4)	Variable clayey sand / sandy clay (32–38 m), calcareous gravel throughout	32 – 38	SARIG-146651 SARIG-291610 SARIG-180763 SARIG-180767
KP 24.0 - KP 35.5	Pleistocene regolith/colluvial unit 4 (Qpr4)	Sand/clayey sand (1–10 m) overlying igneous rocks	1 – 10	SARIG-177609 SARIG-140387 SARIG-140402
KP 35.5 - KP 44.5	Undifferentiated Pleistocene colluvial/regolith sediments (Qpr)	Silty sand to clayey silt	> 20	SARIG-289820 SARIG-139630

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 44.5 - KP 71.5	Quaternary regolith/colluvial unit 6 (Qr6) / Quaternary regolith/colluvial unit 10 (Qr10) / Pleistocene alluvial/fluvial unit 12 (Qpa12)	Medium plasticity clay (1.5–2 m) over clayey sand (>1 m) with calcareous gravel throughout the top 3 m; overlying interbedded residual clay and fine-grained sand / weathered siltstone or sandstone	26 – 56	URS-TP82 URS-TP83 URS-TP72 URS-TP78 URS-TP79 SARIG-139637 SARIG-139628 SARIG-139627 SARIG-139423 SARIG-139880 SARIG-139450 SARIG-139516
KP 71.5 - KP 109.0	Quaternary regolith/colluvial unit 6 (Qr6) / Pleistocene alluvial/fluvial unit 15 (Qpa15) / Quaternary regolith/colluvial unit 10 (Qr10) / Quaternary aeolian unit 1 (Qe1)	Low to medium plasticity clay (1–1.5 m) overlying clayey sandstone gravel and boulders / weathered sandstone.	0 – 10	URS-TP77 URS-TP76 URS-TP75 URS-TP74 SARIG-139517 SARIG-139428 SARIG-24948 SARIG-139755 SARIG-25090
KP 109.0 - KP 144.0	Quaternary aeolian unit 1 (Qe1)	Clayey sand (0.5–1 m) overlying medium plasticity clay (1–20 m), underlain by sandstone or siltstone	2 – 28	URS-TP67 URS-TP65 URS-TP64 SARIG-177245 SARIG-24924 SARIG-139613 SARIG-139529 SARIG-24927 SARIG-165726 SARIG-312466 SARIG-165730 SARIG-147452

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 144.0- KP 191.5	Quaternary aeolian unit 1 (Qe1)	Sand (0.5-1.5 m) overlying clayey sand with calcareous gravel (2–8 m), underlain by sandstone or siltstone	2-9	URS-TP63 URS-TP13 URS-TP14 URS-TP15 URS-TP16 URS-TP17 URS-TP18 URS-TP19 URS-TP20 URS-TP21 URS-TP22 URS-TP23 URS-TP24 SARIG-165729 SARIG-147447 SARIG-20551 SARIG-139549 SARIG-139548 SARIG-139538 SARIG-20578 SARIG-139689
KP 191.5- KP 221.0	Pandurra Formation (M-p)	Medium to high plasticity clay (0.5 m) overlying clayey sand (1–18 m), calcareous gravel throughout	8 – 20	URS-TP59 URS-TP25 URS-TP26 URS-TP27 URS-TP28 SARIG-139699 SARIG-139698 SARIG-139691 SARIG-139693 SARIG-20559 SARIG-20601 SARIG-20600 SARIG-20599

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 221.0- KP 235.0 KP CA 0 - KP CA 13.5	Quaternary aeolian unit 1 (Qe1)	Fine-grained sand with calcareous gravel (5–10 m) overlying extremely weathered sandstone/residual clay of high plasticity (0–30 m)	5 – 30	URS-TP29 URS-TP30 URS-TP31 SARIG-139763 SARIG-139756 SARIG-139766 SARIG-139767 SARIG-20699 SARIG-20676 SARIG-304203 SARIG-20663 SARIG-20671 SARIG-376849 SARIG-20646 SARIG-183611 SARIG-139787 SARIG-262015 SARIG-303640 SARIG-20651 SARIG-20705
KP CA 13.5 - KP CA 33.5	Corraberra Sandstone Member (Nstc)	Weathered siltstone	0	SARIG-240505
KP CA 33.5 - KP CA 39.5	Holocene alluvial/fluvial sediments (Qha)	Clay (6 m) overlying siltstone	0 – 6	SARIG-272657
KP CA 39.5 - KP CA 46.569	Simmens Quartzite Member (Nsts)	Medium plasticity clay (2–6 m) overlying sandstone or siltstone	0 – 6	SARIG-139530 SARIG-305509 SARIG-304042 SARIG-304220 SARIG-275232 SARIG-315798 SARIG-303509 SARIG-272795 SARIG-348575 SARIG-272803 SARIG-307351 SARIG-307353

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 235.0 - KP 249.0	Corraberra Sandstone Member (Nstc)	Medium to high plasticity clay / sandy clay with gravel and boulders (residual soil of weathered siltstone / sandstone)	16 – 24	URS-TP32 URS-TP33 URS-TP34 URS-TP35 URS-TP36 URS-TP37 URS-TP38 SARIG-18085 SARIG-18084
KP 249.0 - KP 255.0	Bulldog Shale (Kmb)	High plasticity clay (1–1.5 m) overlying gravelly clayey sand (> 0.5 m)	1.5 – 2	URS-TP35 URS-TP36

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 255.0 - KP 310.0	Simmens Quartzite Member (Nsts)	High plasticity clay (1–1.5 m) overlying low to medium plasticity calcareous gravelly clay (> 1 m), underlain by sandstone or siltstone	3	URS-TP39 URS-RCTP1 URS-RCTP9A URS-TP42 URS-RCTP10 URS-RCTP11 URS-RCTP12 URS-RCTP13 SARIG-18146 SARIG-18081 SARIG-237079 SARIG-18089 SARIG-18088 SARIG-18090 SARIG-227932 SARIG-353854 SARIG-227932 SARIG-18030 SARIG-18041 SARIG-18086 SARIG-118047 SARIG-18080 SARIG-346200 SARIG-326069 SARIG-219337 SARIG-18083 SARIG-18082
KP 310.0 - KP 326.0	Quaternary aeolian unit 1 (Qe1)	Fine-grained sand (2–8 m) overlying sandstone/quartzite; calcrete and gypsum gravels at 2–6 m	2 – 8	URS-RCTP14 URS-RCTP15 URS-TP48 URS-RCTPM3 SARIG-18146 SARIG-18143 SARIG-18145 SARIG-18144 SARIG-18165

Kilometre Point (Location S/N)*	Dominant surface geological unit	Typical soil profile and thickness	Soil-rock interface (m bgl)	Reference boreholes and test pits
KP 326.0 - KP 337.0	Andamooka Limestone (Eha)	Clay (1.5–2.5 m) overlying sandy clay (> 1m) with gravel and boulders	6	URS-RCTP16 URS-RCTP17 URS-RCTP18 URS-RCTP19 SARIG-18147 SARIG-340191
KP 337.0 - KP 361.487	Quaternary aeolian unit 1 (Qe1)	Sand / clayey sand (0.5–1 m) overlaying sandy clay (0–2.5 m) underlain by highly fractured (Andamooka) limestone	1 – 4	URS-TP53 URS-RCTP20 URS-RCTP21 URS-TP56 URS-TP57 SARIG-340194 SARIG-340193 SARIG-18162 SARIG-313201 SARIG-159965 SARIG-231098

5.6.2 Groundwater

Groundwater conditions for the Project are being assessed and will be documented in a dedicated EIS Groundwater Impact Assessment report (EIS Appendix H-4).

However, based on groundwater data from SARIG mineral, water, and stratigraphy boreholes available through the SA WaterConnect online database (www.waterconnect.sa.gov.au), groundwater levels across the Project Area are anticipated to vary between approximately 1 m bgl and 20 m bgl. Groundwater levels appear to be generally shallower in the southern Project Area, particularly in coastal settings. Groundwater levels deepen to the north along the main transfer pipeline approaching Roxby Downs and Olympic Dam.

It must be noted that shallow groundwater levels along the main transfer pipeline will vary with significant rainfall events. The significance and duration of the shallow groundwater on the construction will depend on the porosity of the local geology (e.g. the fluvial material, fluvial sediments and the playa lakes (salt lakes)) and the size of the rainfall event. Consideration of the local geology for susceptible shallow ground water impacts should be considered during the detailed geotechnical investigations.

6. Field assessment

Field inspections to visually assess topography, geology and geomorphology (including field considerations of surface water and groundwater) were undertaken in November 2023 and December 2023. The majority of the main transfer pipeline alignment and the associated infrastructure sites were inspected. Small sections of the alignment, such as the eastern end of the lateral branch pipeline into the Carrapateena mine site, and areas with no access tracks, predominantly around Whyalla, were not inspected. Areas which were not directly inspected were viewed from road crossings and aerial imagery. Given the nature of the local environment, this was considered appropriate for these studies. Key findings are discussed below and detailed notes (including photos) from the field work are documented in **Appendix A**.

The field notes were the only site investigation observations for topography, geology, geomorphology surface water and groundwater, therefore, comments were made on the site across all of these fields. Issues, risks and potential solutions for the installation of the pipeline were considered. Note, that the comments were broader than the reference design given the isolation and distance to site to assist in any consideration of changes to the reference design. This approach was considered important as the terms of reference for the EIS were not finalised during the inspections.

Topographically, the main transfer pipeline alignment generally traverses flat to undulating country. Where the pipeline interacts with watercourses from steeper terrain, there is a risk that the integrity of the pipe may be compromised.

Based on the field assessment, this risk is greatest where the pipeline alignment passes through Lincoln Gap. Other areas include adjacent the western slopes of the Cultana defence training area (north of Whyalla) and Arcoona.

At Lincoln Gap, the stream power is evidenced by the large-sized bedload. As such, as part of the detailed design phase of the Project, it will be important to consider that the depth of pipe burial is sufficient, and/or engineering measures be adopted to ensure the integrity of the pipe is not compromised during heavy rain events.

The short catchments of the Lincoln Gap Hills also mean that any storm event could rapidly impact the construction site.

Parallel linear dunes were observed along the northern end of the alignment, approximately between KP 331.2 and KP 357.9 where the geology map indicates Quaternary aeolian unit 1 (Qe1). Of the extents covered by the field inspection, the dunes appear to be vegetation stabilised.

Calcrete beds were regularly observed during the field inspection south of Port Augusta with varying thickness from 100 mm to 350 mm.

During the field inspection, mobile geomorphic features such as dunes and watercourses with a variety of bed loads were observed. Localised areas of erosion were also observed, principally at the interface of constructed assets, such as the Carrapateena Road. This level and type of erosion would also be expected in other parts of these watercourses caused by loss of significant vegetation, channel blockage or rock outcrop. The watercourses in the Study Area are dynamic and will respond to flow events. There was no clear evidence such as tunnel erosion typical of highly dispersive soils. Therefore, based on the field assessment and the often-mobile nature of soils in arid environments, it was not considered to be a significant issue or risk for construction of the Project (see Section **8.2** for mitigation measures). Given the large Project Area, appropriate testing for dispersive soils will be considered as part of any further geotechnical investigation.

The landforms and associated vegetation define distinctive areas throughout the alignment (see Section **5.3**), described below:

- **Aeolian landforms** (Dunal Landforms) – located predominantly in the northern part of the alignment, they support significant vegetation with the dunes acting as a water reservoir and allowing more

significant vegetation to become established and survive during extended dry periods; the vegetation also stabilises the landform.

- **Alluvial landforms** – these are concentrated along watercourses; the level and type of vegetation is controlled by the amount of water and frequency of flows. The density and size of vegetation also act as a controlling stabilising influence of these sediments in and adjacent to the channel. The vegetation in these environments is also influenced by any localised saline water bodies.
- **Depositional plain** – typically associated with the northern area of the Project alignment with the level of vegetation dependent on the amount of rainfall. The soils in these environments will often act as a seed bank that will respond with vegetation that takes advantage of the significant rainfall events.
- **Erosional landforms** – such as the gibber plains in the northern part of the alignment. The soils in semi-arid environments will often act as a seed bank that will respond with vegetation that takes advantage of the significant rainfall events and in the case of the gibber plains (the gibbers/stones) also armour and protect the underlying soil and seed bank.
- **Lacustrine and playa plains** – a depositional environment associated with salt lakes along the entire alignment, north of Lincoln Gap that are dependent upon rainfall and runoff for any water to occur. The current alignment crosses Lake Windabout and the upper reaches of Pernatty Lagoon will potentially influence the Carrapateena spur

The key areas of concern for construction work, and to a lesser extent, operations, were confirmed during the field work as the waterway crossings (see Jacobs, 2026) and the Aeolian Landforms (see **Table 6-1**). An overview of the surface water features and surface water basins in the Project Area is provided below.

In Spencer Gulf Basin (**Figure 5-1**), the surface water features include:

- Land subject to inundation consisting of intertidal samphire wetlands along the coast between Mullaquana Station and Whyalla,

In the Lincoln Gap catchment region the surface water features include:

- A single main drainage feature Pine Creek.
- Many minor drainage lines present across the Project Area

In the Gairdner Basin, the surface water features include:

- Large intermittent salt lakes including Lake Dutton, Pernatty Lagoon, Lake Windabout, and Island Lagoon. Also, smaller intermittent lakes are scattered along the extent of the pipeline alignment.
- Many watercourse lines that drain into Pernatty Lagoon and Lake Torrens run adjacent to and sometimes intersect the lateral branch pipeline. The main drainages include Elizabeth Creek and Pernatty Creek (Pernatty Lagoon catchment).
- Pipeline alignment intermittently transects and / or runs adjacent to land between Woomera and Roxby Downs that may be subject to flooding and ponding following significant rain events.
- Ephemeral creeks running adjacent and sometimes transecting the main transfer pipeline alignment. The main drainages intersected include Wirrawirralu Creek and Black Oak Creek,..Coorlay and Sanders Creek where not inspected by run adjacent to proposed pipeline alignment
- Ephemeral creeks running adjacent and sometimes transecting the lateral branch pipeline alignment. The main drainages include Elizabeth Creek, Carra Creek, and Yeltacowie Creek.

In the Lake Torrens Basin, the surface water features include:

- Multiple minor watercourse lines that drain into Lake Torrens. None of the Lake Torrens Basin watercourses are crossed by the Project. The nearest watercourses, unnamed tributaries of Eliza Creek, are approximately 2 km from the lateral branch pipeline at Carrapateena Mine.

Table 6-1. Summary of Key Geomorphic Sites – Field Inspection

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
195	Black Oak Creek 1	Channel connecting two salt lakes. Salt lake crossing, alluvial clays, silty clays, corrosive. Lacustrine sediments appear to be shallow given the apparent lack of embankment for the road crossing.	No geomorphic reason not to trench. Under boring dependent on geotechnical investigation principally around the bedrock and the depth of sediment. Design to follow relevant standards to achieve durability requirements. Given risks/impacts identified, constructing the pipeline above ground may be a suitable solution.	The site is highly suspectable to flash flows and flooding. Construction will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the channel system; this will need to be confirmed by geotechnical investigations. Any under boring at this location will be complicated due to the length required to cross the entire channel system.	 Black Oak creek crossing –  Highly corrosive environment.

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
198.3	Black Oak Creek 2	Minor channel with silty and sandy bed stringers (not enough to consider a full bedload). Partially vegetated, not a mobile bed. Saline water and concrete corrosion on pillars. Potential for Acid Sulphate Soils based on the observed highly corroded concrete (this is in addition to the locations identified in JBS&G 2026).	No geomorphic reason not to trench. Under boring dependent on geotechnical investigation. Design to follow relevant standards to achieve durability requirements. Given risks/impacts identified, constructing the pipeline above ground may be a suitable solution.	The site is highly suspectable to flash flows and flooding during construction. Construction will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the channel system; this will need to be confirmed by geotechnical investigations. Any under boring at this location will be complicated due to the length required to cross the entire channel system as it is inset into the surrounding landscape.	 Channel scouring adjacent to the current channel crossing  Highly corrosive environment

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
233.8	Lake Windabout	Large salt lake crossing.	Current alignment adjacent to the road considered extremely difficult to trench given the lacustrine sediments. Trenching potentially possible along the western shoreline of the lake.	The site is highly suspectable to flash flows and flooding during construction. Construction will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the channel system; this will need to be confirmed by geotechnical investigations.	 Potential trenching alignment  Current alignment adjacent to the road

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
308.2	Dunal material (Aeolian Landforms)	Dunal material with no discernible channels. Occasional small salt pans associated with small, enclosed catchments.	Vegetation stabilised dunal sands. No geomorphic reason not to trench.	The concentration of flows adjacent to the road is causing erosion within the dunal system. Erosion of the dunal system where flows are concentrated will need to be considered during construction and post construction so that channels do not develop above the pipeline and along the construction and access tracks. The dunal system may be more susceptible to "significant" amounts of compaction with regards to access tracks – this may exacerbate any erosion by concentrating any overland flow after larger rainfall events.	 Highly vegetated Aeolian deposits (eg Dunes)

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
KP CA 20.9	Carrapateena Access Road	Saline channel – base level control by Pernatty Lagoon – Salt lake.	Requires consideration of trenching methodology through channel due to potential groundwater influence from Pernatty Lagoon. Under boring under the drainage line will be dependent on geotechnical investigation which will need to take into account bedrock and depth of in channel alluvial sediments and any requirement for the drilling to interface between.	The management of groundwater/instream flows will be critical for all crossings. The water (surface and groundwater) will most likely have an elevated salinity. Construction will need to consider the unconsolidated nature of the river alluvial sediments due to the limited or nil cohesive strength when saturated. Any under boring will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the river channel.	 Channel crossing on the lateral branch pipeline alignment. It was unclear if this was the furthest extent of the Pernantty Laggon or just heavily influnced by the Lagoon controlling the base level of the ground and surface water levels.

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
KP CA 26.5	Dunal material – eroding drainage	Example of concentrated flows due to road drainage.	Eroding dunal system – construction issue.	The concentration of flows adjacent to the road is causing erosion within the dunal system. Erosion of the dunal system where flows are concentrated will need to be considered during construction and post construction so that channels do not develop above the pipeline and along the construction and access tracks.	 Incised flow channel adjacent to road

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
KP CA 34.9	Large Active Channel Crossing	Large braided stream with multiple sand bars and multiple channels. Sediment in the channel is graded with the base of the channel consisting of a gravel to cobble bedload covered by a finer sand bedload. This tends to indicate that the more frequent (and smaller) flows activate the sand bedload, while the less frequent ("flood flows") activate the entire bed load. The channel is incised into the surrounding colluvium. This tends to indicate that the channel sediment will not have a large depth (estimated to be 2.5 to 3.5m) but this will vary along the channel. The presence of the overstory eucalypt	No geomorphic reason not to trench. Under boring under the river will be dependent on geotechnical investigation which will need to consider bedrock and depth of in-channel alluvial sediments. There is not expected to be any requirement for the drilling to interface between these differing units.	Given the mobility of the bedload in the channel, trenching will need to ensure that the pipeline is protected either through depth of installation or protective measures. It is unknown if the frequency of large flow events and development of pools (and if they last long enough) can support any invertebrate or amphibious aquatic fauna (for further assessment, see Jacobs, 2026a). The ability of the weathered colluvium to contain any blowouts into the channel will need to be considered if under boring is considered.	 Braided sand bed channel with islands stabilised by overstory vegetation.

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
KP CA 34.9 cont.		vegetation indicates the presence of significant flows or water being retained in the channel, including its bedload for longer periods to allow for their survival. The depth of the scour pool, coupled with the eucalypt overstory, indicates that there is the potential for semi-permanent pools developing in the channel.			 Channel bank appears to be incised into collvium, note the cobble bedload associated with the eroding bank.  Heavy upstream scouring in channel ~1.70m in depth note the exposed cobble bedload.

Location (km Point)	Site Name	Site Description	Comments	Risks/Impacts	Photos
KP CA 39	Large Active Channel Crossing	Large braided stream with multiple sand/gravel bars and multiple channels. Sediment in the channel is predominantly a gravel to cobble bedload with a finer sand bedload associated with the more heavily vegetated islands. The channel is incised into the surrounding colluvium. This tends to indicate that the channel sediment will not have a large depth. The presence of the overstory eucalypt vegetation indicates significant flows or water being retained in the channel for longer periods to allow for their survival.	No geomorphic reason not to trench. Under boring under the river will be dependent on geotechnical investigations, which will need to consider bedrock condition and depth of in channel alluvial sediments. There is not expected to be any requirement for the drilling to interface between these differing units at this site.	Given the mobility of the bedload in the channel, trenching will need to ensure that the pipe is protected either through depth of installation or protective measures. The ability of the weathered colluvium to contain any blowouts into the channel will need to be considered if under boring is considered.	 Cobble bedload, partially vegetated

7. Risk assessment

7.1 Geotechnical impact pathway identification and risk assessment

The following geotechnical impact pathways associated with identified geohazards and their influence on the desalination plant, main transfer and lateral branch pipelines, pump stations and storages, transmission lines, and substations, are considered relevant to the Project:

- Shallow bedrock.
- Indurated materials, such as calcrete and calcareous soils.
- Collapsible and expansive soils.
- Karst.
- Slope instability.
- Soil erosion and dispersion.
- Shallow groundwater.
- Seismicity (earthquakes and associated potential fault movement/rupture).

The impact assessment considers the above geohazards in the Project Area and does not differentiate or target the specific locations of different infrastructure.

The construction activities that could result in potential impacts to soils and land systems as a result of the identified geohazards are described in Section **2.4**.

The nature of these geohazards, and assessments of the risks they pose to the environment, are described in more detail in the following sections.

7.1.1 Shallow bedrock

There is potential for shallow bedrock to be encountered during pipeline trench excavation. The locations are where substantial earthworks in soil and rock may be required. Earthworks would also be required to enable the construction of pump stations, storages and substations.

The potential for shallow bedrock to be present has been assessed based on the CSIRO Depth of Regolith map (CSIRO, 2015). Where shallow bedrock is encountered, it will be more difficult and costly to excavate than soil and may require the use of specialised equipment, such as hydraulic breakers or potentially blasting. Excavation of rock will generate noise and dust which will require management by appropriate construction controls. Excavated rock may be unsuitable for backfilling of pipe trenches without processing and suitable backfill materials may need to be imported.

The bedrock level has been taken as the depth of regolith. The regolith data provides only indicative depths to unweathered bedrock and has a mean error of approximately ±6 m. Spot checks were undertaken to compare depths to bedrock included in borehole logs with CSIRO (2015) depths of regolith; the checks confirmed that comparisons between depths to bedrock indicated by the boreholes and CSIRO regolith depths were within the CSIRO mean error values.

Based on the constructability memoranda prepared by Systra (2025), the excavation depth required to install the main transfer pipeline is assumed to vary between 1.95 m and 2.15 m. This range is derived from an assumed minimum cover depth of 0.6 m, a cover allowance of 0.2 m (to ensure no cover issues are encountered with undulating ground and to keep the pipeline vertical alignment consistent with the design), pipe diameters ranging from 1.0 m to 1.2 m, and a bedding thickness of 0.15 m.

The lateral branch pipeline adopts a similar trench depth assessment methodology; however, a smaller pipe diameter of 0.45 m has been assumed, resulting in an indicative trench depth of approximately 1.4 m.

Excavation to a depth of up to 3.28 m bgl will be required locally at the termini of major water crossings where horizontal drilling is proposed for pipeline installation. These deeper excavations are spatially limited and have therefore not been considered further in this assessment.

The indicative pipe diameters and trench depths used to assess the potential for encountering bedrock within trench excavations are shown in **Table 7-1**.

Table 7-1. Indicative pipe trench depths

From KP (km)	To KP (km)	Pipe Diameter (mm)	Cover Depth - min (m)	Cover Allowance (m)	Bedding thickness (m)	Trench Depth (m)
0	31.555	1200	0.6	0.2	0.15	2.15
31.555	80.073	1100	0.6	0.2	0.15	2.05
80.073	215.122	1000	0.6	0.2	0.15	1.95
215.122	251.573	1100	0.6	0.2	0.15	2.05
251.573	361.701	1000	0.6	0.2	0.15	1.95
0 (CA)	46.527 (CA)	450	0.6	0.2	0.15	1.4

The locations where the depth of excavation is estimated to be deeper than the rock head level include KP 268.9 – KP 269.5, KP 274.7 – KP 275.9, KP 323.9 – KP 324.1, and KP 325.9 – KP 326.2.

Comparison between base of trench excavation level and rockhead level in the Project Area is shown in **Figure 7-1** to **Figure 7-3.**

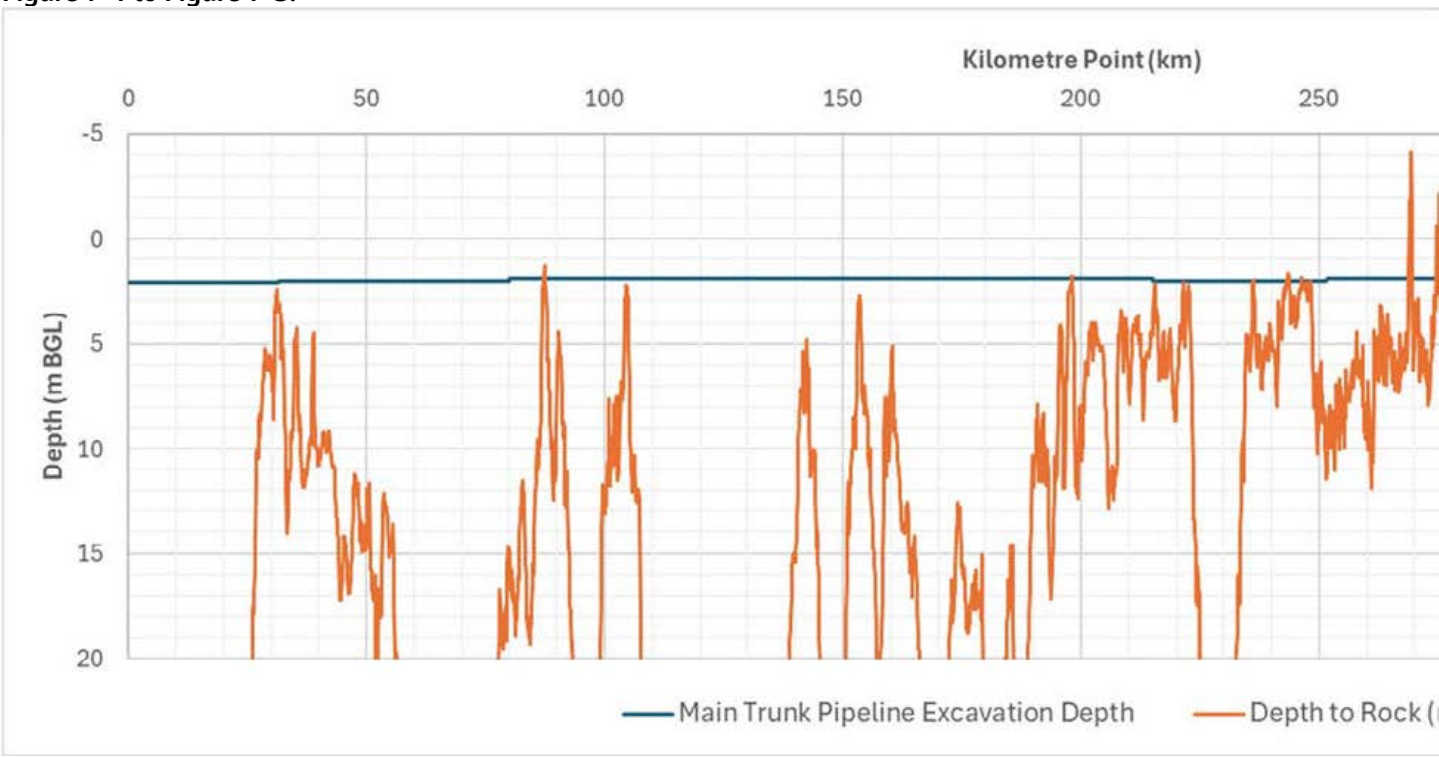


Figure 7-4 shows the approximate depth of excavation and depth to rockhead along the main trunk pipeline.

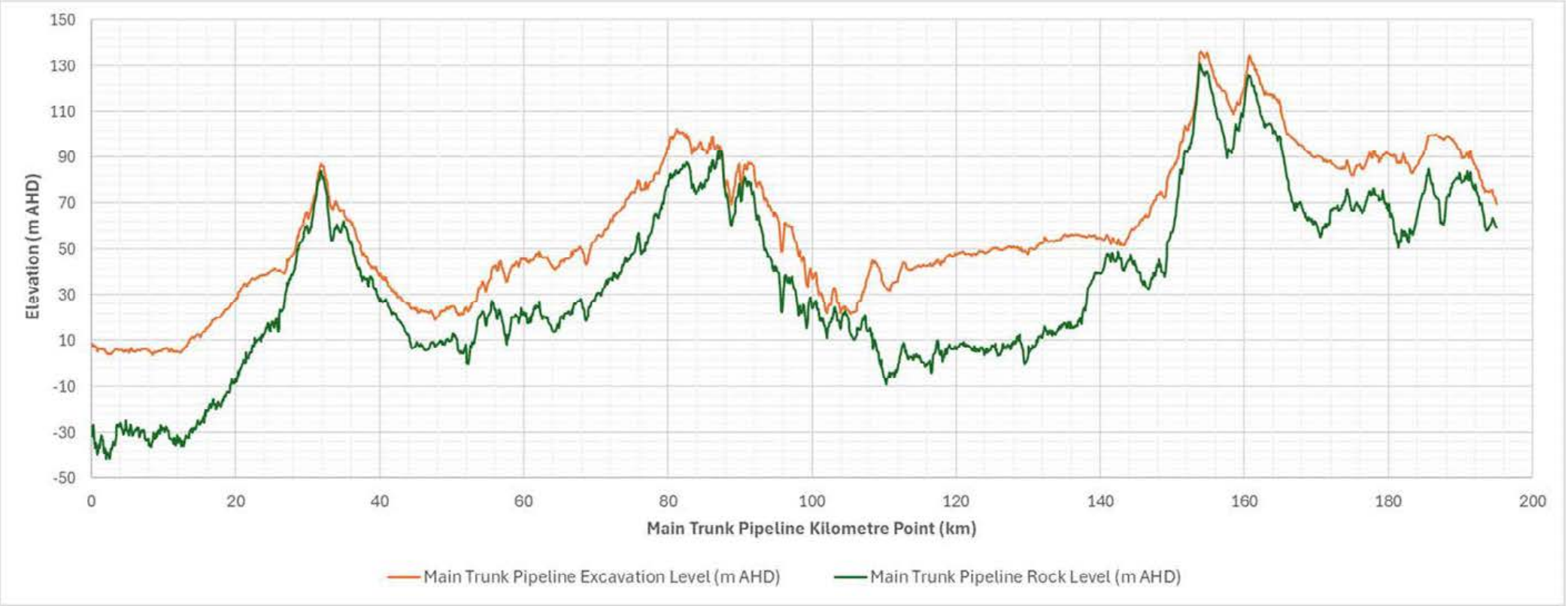


Figure 7-1. Base of trench excavation level and rockhead level – Southern Project Area

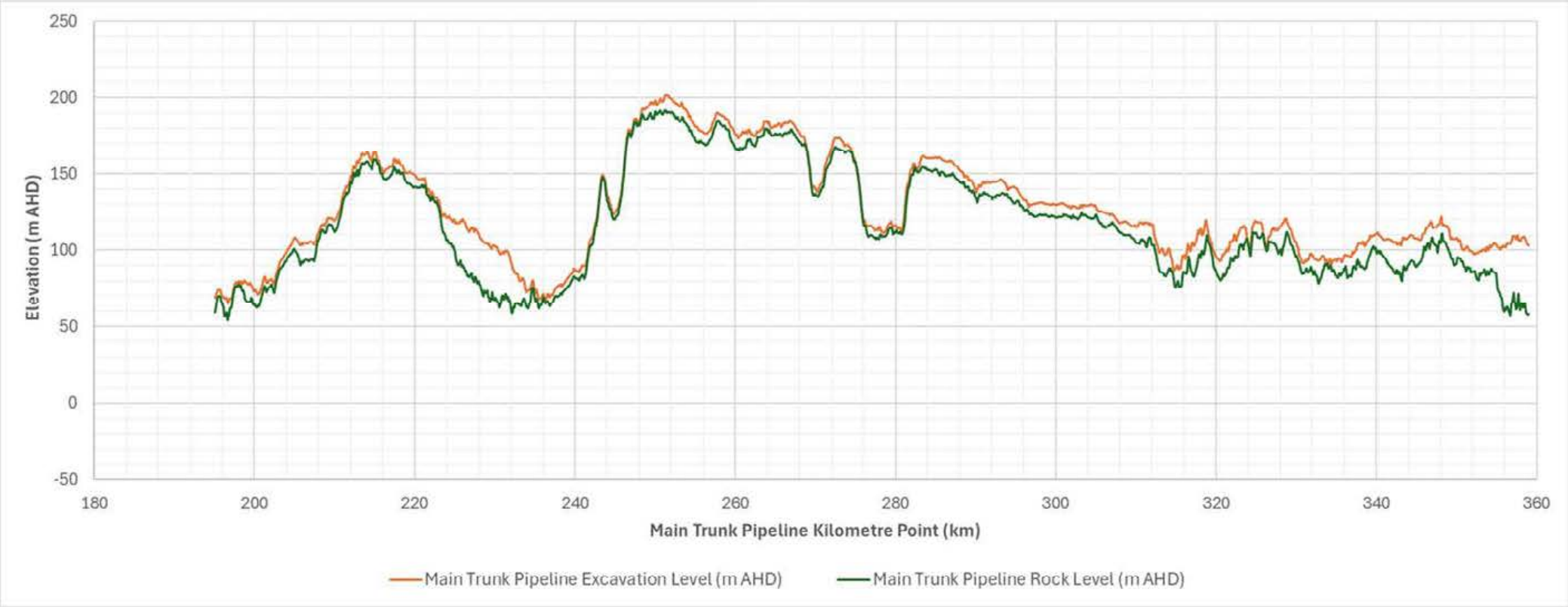


Figure 7-2. Base of trench excavation and rockhead level - Northern Project Area

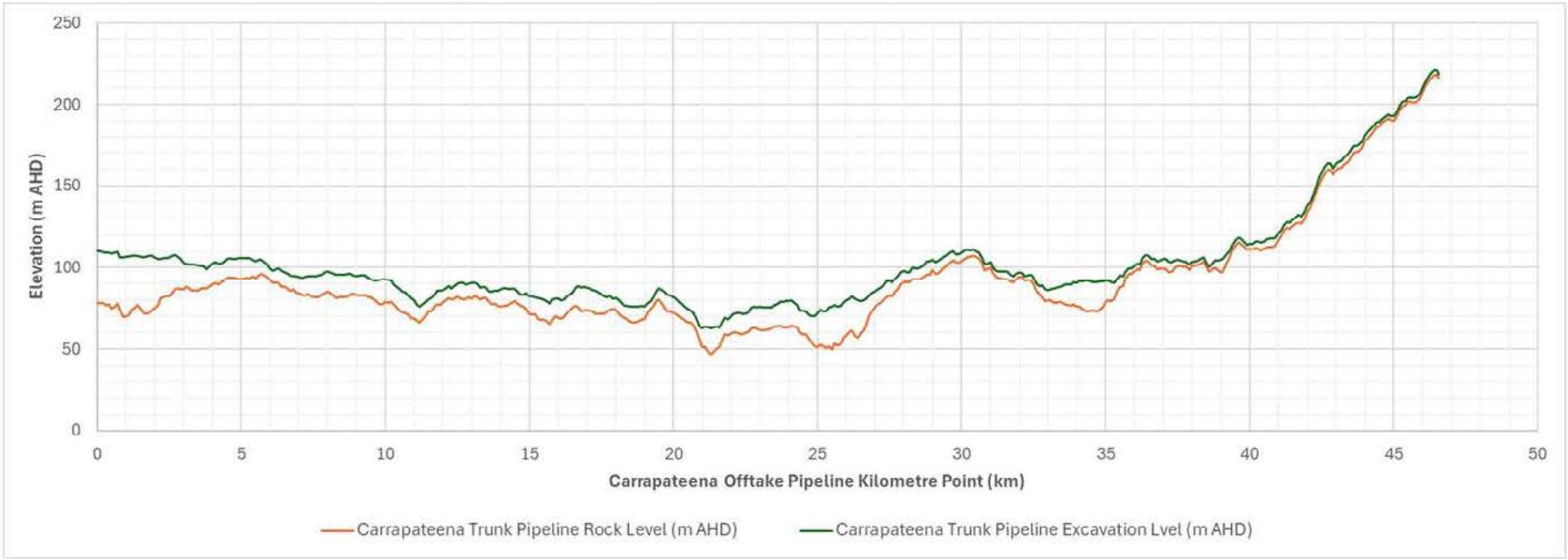


Figure 7-3. Base of trench excavation level and rockhead level – Lateral branch Project Area

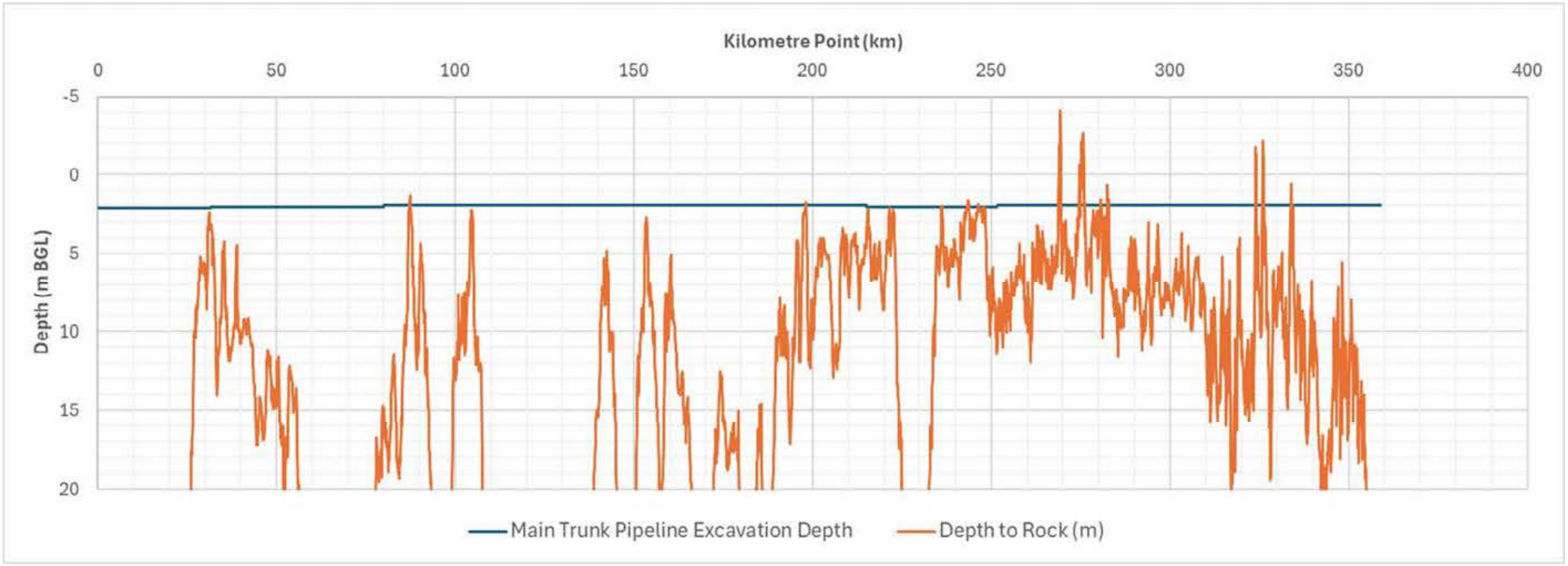


Figure 7-4. Approximate depth of trench excavation and depth to rockhead

7.1.2 Indurated materials

Regolith induration is common in the Project Area, affecting approximately 59.4% of the length of the pipeline alignment, as discussed in Section **5.5.4**. The potential influence of indurated materials on construction and the environment is similar to the potential influence of shallow bedrock as described in Section **7.1.1**. However, as indurated materials are typically weaker and of limited thickness compared to bedrock, the influence is expected to be less. The red duplex soils of the gibber plains cover extensive sections of the pipeline to the north of Whyalla.

The occurrence of indurated materials is reported frequently in the SARIG borehole logs examined. Calcareous and gypsiferous indurations of varying thickness and strength account for the majority of indurated materials. For example, the records of boreholes SARIG-14435 and SARIG-256375 indicate that the degree of induration ranges from calcareous soils to cemented duricrust akin to rock. Ferruginous induration and the presence of ferricrete were also reported in several SARIG boreholes and URS (2006) test pits.

The calcretes encountered in the URS (2006) geotechnical investigation are typically described as fine to medium-grained gravels. There were also frequent occurrences of calcareous sandstone/limestone fragments within quaternary geological units (e.g., URS test pit TP79), consistent with calcareous duricrust. The size of such calcareous sandstone fragments ranged from gravel size (2mm to 63 mm) to boulders up to 300 mm.

It is noted that 49 No. of the 88 No. test pits excavated during the 2006 URS investigation (refer to Section **5.6**), were terminated at depths of between 0.5 m and 3.25 m, which were shallower than the target depths. The test pits were terminated due to high resistance to digging using an 8-tonne excavator. Only 3 No. of the 88 No. test pits had to be terminated before reaching their target depth as a result of collapsing soils during excavation.

The presence, depth, thickness and typical strength of the indurated materials should be established by a targeted geotechnical investigation if required to determine the excavatability of the materials.

7.1.3 Collapsible soils

South Australian collapsible soils are typically of aeolian origin, unsaturated, of low density, possess considerable dry strength due to calcareous cementation, and consist of silts and/or fine sands. However, the cementation between particles is weakened upon wetting, and the soils cannot support the weight of overburden or imposed load and thus have a tendency to collapse. This description of collapsible soils is consistent with the descriptions of:

- Quaternary aeolian unit 1 (Qe1), which is typical in the inland arid area of South Australia. The Project Area where the Quaternary aeolian unit 1 (Qe1) is present, in the form of parallel dunes perpendicular to the main trunk pipeline alignment, lies between approximately KP 106.3 and KP 350.6. The area where the Quaternary aeolian unit 1 (Qe1) appears is shown by Geoscience Australia to have calcareous-gypsiferous induration.

The collapsible soils may appear to have adequate strength upon excavation and loading when dry but are prone to collapse upon wetting. Water sources could be rainfall or a leaking pipe. Where trench excavations are open temporarily and rainfall causes surface run-off to collect in the base of the trench, there is a potential for previously dry soil to lose strength and become unstable. This could be managed by the use of safe batter slope angles, benching, temporary shoring to support excavations, and limiting the extent of open trench lengths. Poorly compacted backfill placed above the pipeline could also be prone to collapse settlement.

Where structures, such as pump stations and above ground pipeline sections, are founded on footings and in areas where collapsible soils are present, geotechnical investigation will be required to assess the collapse

potential. Collapse potential can be reduced by pre-wetting of soils and densification by compaction or impact rolling plant. As water inundation will adversely affect structures constructed on these soils, designs should incorporate drainage measures to ensure that stormwater cannot pond adjacent to footings.

The presence of soils with the potential to be collapsible should be established by a targeted geotechnical investigation, if required.

7.1.4 Expansive clays

Expansive clays are soils that undergo volumetric change as a result of variations in soil moisture. The magnitude of the movement is dependent on the moisture changes within the soil profile and the expansiveness of the soil. The distribution of expansive clays across Australia is discussed in the Australian Soil Classification (Isbell, 2021), and is linked to cracking clay soils common to the following soil landscapes:

- Na1, which is present between Whyalla and Port Augusta. The Project Area characterised by the Na1 landscape is approximately between KP 80.2 and KP 86.5. Cracking clay soils are present within gilgais on dissected tableland.
- Nb41, which is present northeast of Pimba, approximately between KP 235.1 and KP 309.7, KP 324.0 and KP 331.4, and KP CA 29.1 and KP CA 46.569. Cracking clay soils are present within gilgais on weathered rocks of the Simmens Quartzite Member (Nsts).
- Nb42, which is present south of Pimba, approximately between KP 196 and KP 221.8, and KP CA 12.5 and KP CA 16.0. Cracking clay soils are present within gilgais on weathered rocks of the Pandurra Formation (M-p).

The Australian Soil Classification (Isbell, 2021) describes the presence of cracking clay soils in those areas as “common but not dominant”.

Soils of medium to high plasticity are generally more expansive as a result of changes in soil moisture content than low plasticity soils. As part of the URS soil investigation (2006), 11 No. clay samples were tested for their plasticity. 6 No. were of medium plasticity, and 4 No. were of high plasticity. 3 No. of the high plasticity clays encountered are within the Nb41 landscape and 1 No. is within the Nb42 landscape.

Potential shrink-swell movements associated with expansive clays can cause damage to buildings and infrastructure if not considered in design. Design should be carried out in accordance with AS 2870-2011 Residential slabs and footings.

Potential shrink-swell movements associated with expansive clays used as trench backfill can cause damage to underground pipework. Such impacts could be greater for smaller diameter pipes.

7.1.5 Karst

Kellett et al. (1999) report that the Andamooka Limestone (Eha) is a dolomitic limestone with typical carbonate dissolution textures on weathered surfaces. The limestone is well jointed and exhibits karstic features beneath dune swales such as dolines (also termed sink holes). The dolines consist of dune sand infilled pipes up to 2 m to 3 m in diameter. The side slopes are typically steep, with the depressions sometimes forming lakes or ponds where the drainage paths have been plugged by sediments and which fill with water during major rainfall events.

The geological map (GSSA 2020) indicates that the Andamooka Limestone (Eha) is present intermittently between KP 325.9 and KP 352.3. It is noted that previous geotechnical investigations such as SARIG-231093 and URS-TP57 encountered dolomite or limestone at shallow depths. This suggest that Andamooka Limestone (Eha) may be present beyond the extent indicated by the geological map.

Karst features are difficult to identify and can impact on infrastructure and pipelines by collapsing suddenly as a result of prolonged dry periods or severe storm events. Where the depth to limestone is below the

pipeline trench depth, the likelihood of karst features impacting construction will be reduced, if stormwater infiltration into the trench is minimised. The depth to the soil-limestone interface can be irregular where karst is present, which could be problematic for trench excavation.

7.1.6 Slope stability and landslides

Slope stability assessment is a complex issue. These assessments involve detailed inspection and investigation of individual slopes and their surroundings, as well as the underlying stratigraphy. However, a steep slope angle is indicative of slope instability risks. Where pipelines cross mid-slope locations are known or have potential zones of instability, they run the risk of being severed if ground movement or a landslide were to occur. This could also lead to loss of ground support or over stressing of the pipe caused by the weight of debris above the pipe.

Slope angles in the Project Area have been assessed based on the LiDAR digital terrain data and are presented in **Figure 7-5** and **Figure 7-6**. The terrain within a 3 km wide corridor of the main trunk pipeline is generally of low relief, with slope gradients of typically less than 5 degrees (°). Such areas are not considered to present a slope instability or landslide risk to the pipeline.

Locally, there are areas where slope angles between 20° and 30° are present within 300 m of the pipeline alignment. These areas are also not considered to present a slope instability or landslide risk to the pipeline, given the low slope height and the distance between the slopes and pipeline.

A 65° slope lies within 150 m of the main transfer pipeline between KP 276.8 and KP 277.8. As the slope height is approximately 4 m, it is not considered to pose any slope instability or landslide risk to the pipeline.

Linear parallel sand dunes were observed to have slope angles of between 10° and 15° between KP 0 and KP 30.5 and less than 10° between KP 221.7 and KP 358.6. Slopes associated with sand dunes are not considered to pose a slope instability or landslide risk to the pipeline.

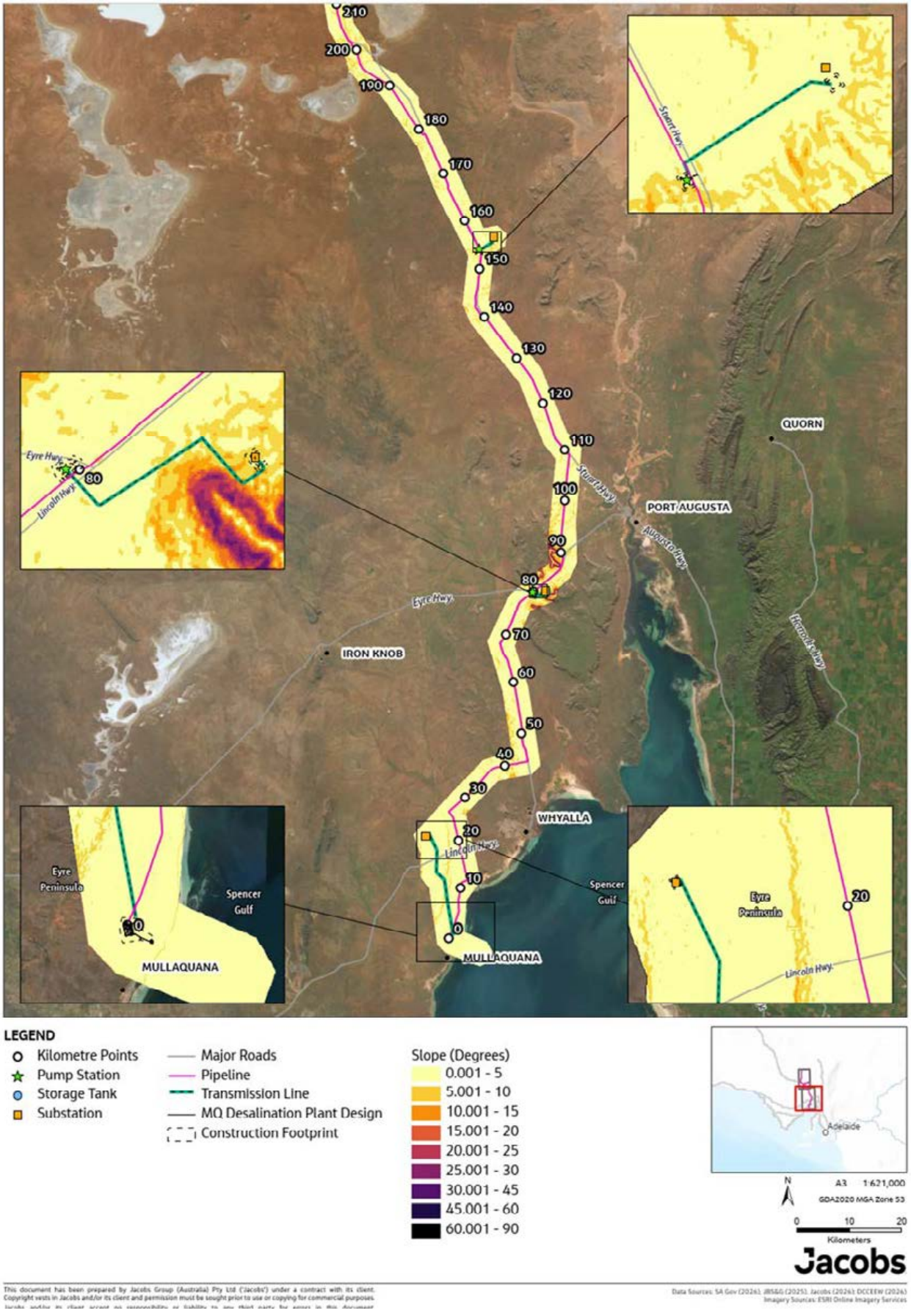
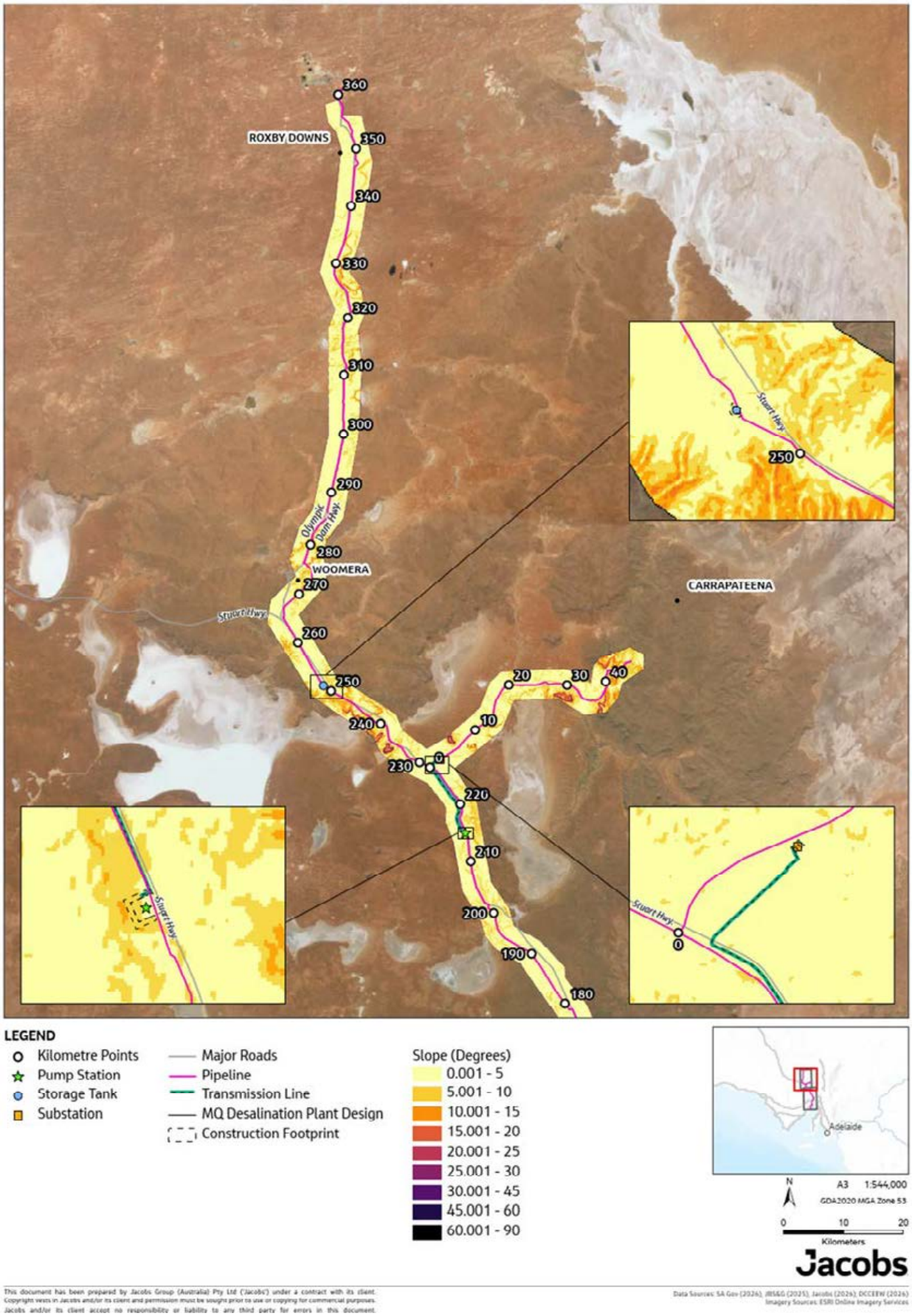


Figure 7-5. Slope angle – southern Project Area



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Data Sources: SA Gov (2026), JBS&G (2025), Jacobs (2026), DCCEEW (2026)
Imagery Sources: ESRI Online Imagery Services

Figure 7-6. Slope angle – northern Project Area

7.1.7 Erosion

Soil erosion can occur as a result of rainfall, surface water run-off and strong winds. Where ground disturbance removes vegetation cover or the existing soil crust, the risk of erosion increases. The extent of erosion is influenced by the erosion potential of the soil type to wind, rain and overland flow, as well as the vegetation cover and the slope of the terrain.

An assessment of the potential for wind erosion of the various soil types and landforms that occur along the alignment and mitigation strategies are presented in Section **7.2**. The erosion risk from rainfall and stormwater is discussed in detail along with proposed mitigation measures in Jacobs (2026).

7.1.8 Aggressive soils

Aggressive soils may cause damage to buried steel structures through corrosion. Moisture within the soils or groundwater acts as an agent for steel corrosion. The potential for such corrosion to occur can be estimated by assessing the pH, electrical resistivity and chloride levels in the soil or groundwater.

Based on the pH and electrical resistivity levels presented in URS (2006), a steel exposure classification was carried out in accordance with AS 2159-2009. 18 No. relevant test results out of the total 324 No. available indicate a severe steel exposure classification, which are related to high permeability soils at locations where shallow groundwater tables are expected (as discussed in Section **5.6.2**), including:

- Approximately between KP 147.1 and KP 153.0, which is characterised by Quaternary aeolian deposits (Qe1) and the DD1 soil landscape. 3 No. samples from the URS test pits URS-TP16 and URS-TP63 indicate severe steel exposure classification.
- Approximately between KP 194.3 and KP 200.3, which is characterised by Quaternary aeolian deposits (Qe1) or Pandurra Formation (M-p) and the Nb42 soil landscape, adjacent to the Pernatty Lagoon salt lake. 14 No. samples from the URS test pits URS-TP25, URS-TP26, URS-TP27, URS-TP28 and URS-TP58 indicate severe steel exposure classification.
- Approximately between KP 276.8 and KP 277.7, which is characterised by Quaternary aeolian deposits (Qe1) or Corraberra Sandstone Member (Nstc) and the DD1/Nb41 soil landscape. 1 No. sample from the URS test pit URS-TP41 indicate severe steel exposure classification.

The URS (2006) investigation does not report sulfate or chloride levels within soil or groundwater, and therefore a concrete exposure classification could not be carried out.

7.1.9 Shallow groundwater

Groundwater conditions for the Project are being assessed and will be documented in a dedicated EIS Groundwater Impact Assessment report (EIS Appendix H-4).

7.1.10 Seismicity

Earthquakes can damage pipelines and infrastructure by the impacts of ground accelerations (including liquefaction) and their amplitudes and/or if resultant displacements/movements/ruptures occur along defined geological structural features, such as faults.

The effects of seismicity are also related to distance from the epicentre and the depth of the earthquake event. For example, the further the distance from the centre of the quake and the deeper the quake is, typically the less the effects are. In general, seismic events which are centred more than 200 km from a site and/or an event greater than 10 km below ground surface will not have significant detrimental effects. In addition, if geological structures do not traverse or lie in close proximity to pipeline or structures, the impacts of possible ground ruptures caused by earthquake events would not apply.

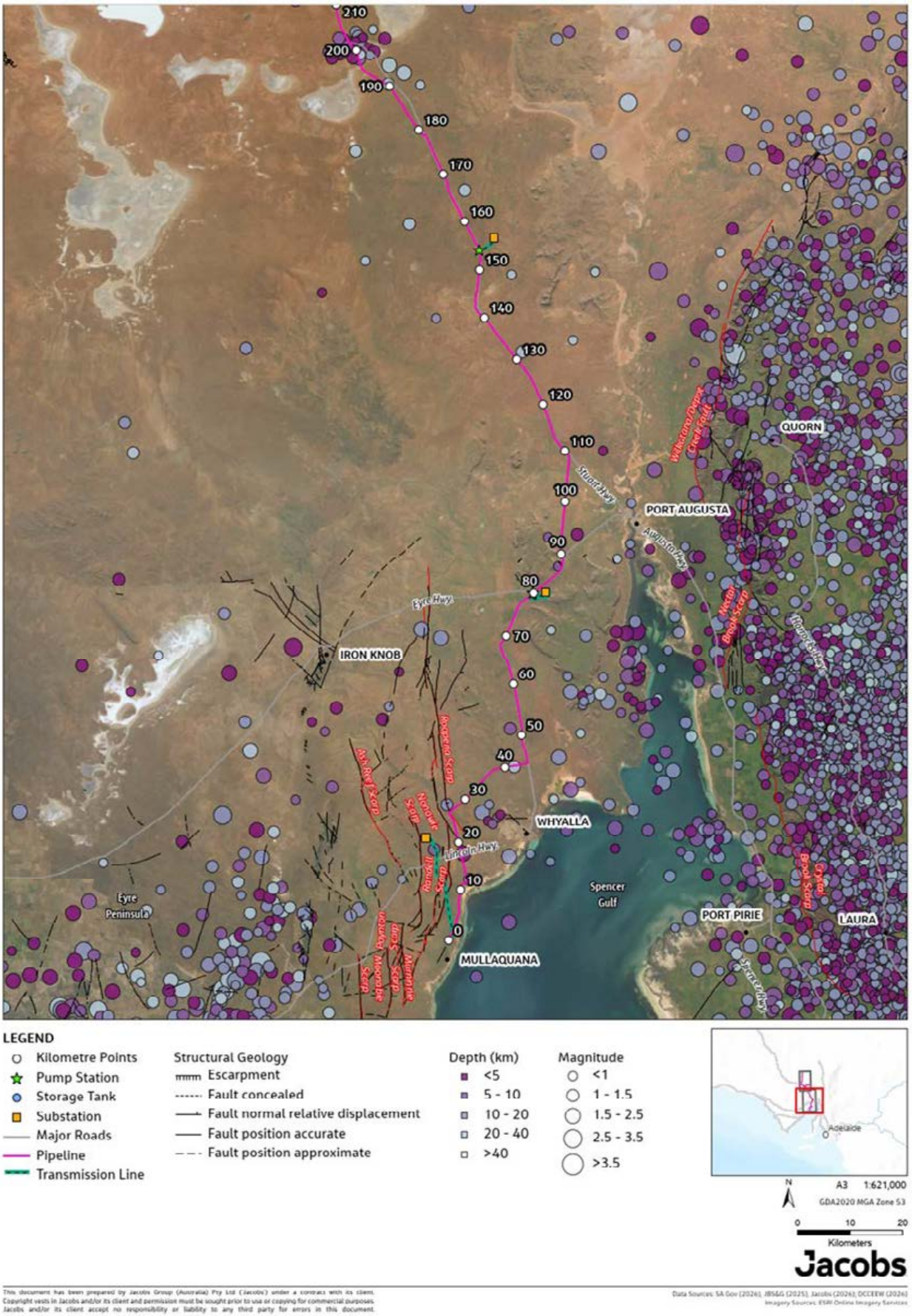
Based on the data from 1840 to 2017, as presented in the Geoscience Australia Earthquake Catalogue, there have been 1,598 No. earthquakes within 200 km of the Project, 18 No. of which had a (moment) magnitude, M_w, of greater than 4.5.

Figure 7-7 and **Figure 7-8** show the location of historical earthquake epicentres, with the size of the circles representing their magnitude and the colour of the circles representing their depth. It can be observed that the majority of the high (moment) magnitude events coincide with the known fault and neotectonic feature locations.

Details of the earthquakes with magnitudes greater than 4.5 within 200 km of the Project Area are summarised in **Table 7-2**.

Table 7-2. Summary of earthquakes with M_w > 4.5 within 200 km of the Project

Date	Magnitude	Longitude	Latitude	Depth (km)	Approximate Distance from the Project (km)
8 January 1887	4.78	138.000	-32.450	10.0	35
16 April 1887	5.26	135.800	-34.300	14.0	28
19 September 1902	5.55	138.000	-35.000	10.0	179
26 October 1911	5.06	136.417	-33.667	<1	105
23 April 1921	4.69	138.833	-33.267	<1	104
1 May 1939	4.76	138.000	-31.400	<1	52
5 June 1939	4.76	138.500	-31.500	<1	100
26 March 1939	5.82	138.300	-31.100	<1	80
2 November 1959	4.69	135.980	-33.360	10.0	75
25 January 1965	4.51	138.495	-31.928	<1	100
14 March 1965	4.59	138.540	-31.950	26.0	104
2 March 1965	4.60	138.380	-30.570	33.0	140
26 July 1971	4.54	138.756	-31.375	18.6	123
18 April 1972	5.05	138.619	-31.578	11.9	114
5 March 1997	4.82	138.979	-33.817	21.7	159
26 December 2007	4.55	138.363	-32.077	15.6	75
5 June 2010	4.84	136.719	-33.589	22.4	15
4 June 2014	4.55	137.615	-29.902	8.6	93



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Data Sources: SA Gov (2026); JBS&G (2025); Jacobs (2026); DCCEEW (2026)
Imagery Sources: ESRI Online Imagery Services

Figure 7-7. Historical seismic events around the southern Project Area

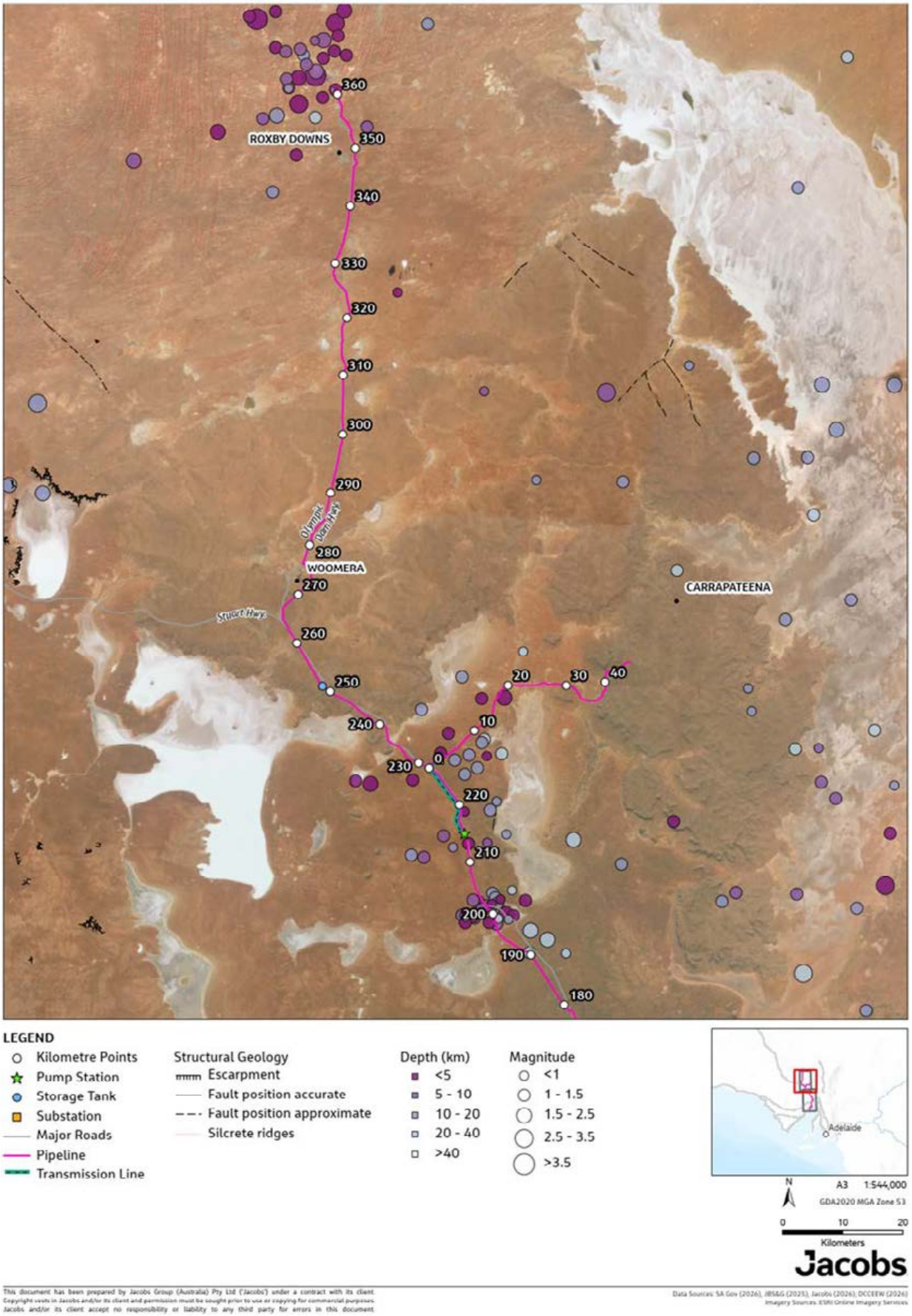


Figure 7-8. Historical seismic events around the northern Project Area

In terms of recent seismic history, most larger scale seismic events documented in the Earthquake Catalogue are associated with the Northern Flinders Ranges group with epicentres located 100 km to 120 km from the northern half of the Project Area. In addition, the Project Area is located on the footwall side of and sub-parallel to the Northern Flinders Ranges group. This suggests the northern half of the Project Area is not at considerable risk of either high magnitude near-field earthquakes or experiencing amplified effects from far-field earthquakes due to hanging wall or directivity effects. There are no known or inferred fault locations that cross the main trunk pipeline.

The NSHA (Geoscience Australia, 2018) has provided a revised estimation of earthquake peak ground acceleration (PGA) across Australia based on probabilistic analysis, as shown in **Figure 7-9**. This assessment supersedes the equivalent Hazard Factor, Z, stipulated in Australian Standard AS 1170.4-2007. However, a 2018 amendment to AS 1170.4 stipulates a minimum Hazard Factor of 0.08 for structural design purposes, which exceeds the NSHA's estimation of PGA in the Project Area.

Previous experience of large magnitude earthquake damage to water supply pipelines indicates that damage rates are typically higher for smaller diameter pipelines, and that pipe joint separations are common.

Liquefaction is the loss of strength in saturated soils which can happen as the result of an earthquake. This loss of strength can cause damage to infrastructure built on the liquifiable soil due to loss of support and significant differential settlement. Infrastructure buried in liquifiable soils can also be damaged due to uplift forces in an earthquake event.

An area is considered to be at risk of potential liquefaction if the area:

- is within a zone of influence, taken as 200 km in this assessment, of a historical shallow (less than 10 km deep) earthquake.
- has a shallow groundwater level, which is within 1.5 times the pipe diameter below the base of the pipe trench. If the soil in this zone was to liquefy, the pipe support would be lost, and the pipe could be damaged.
- is known to include the presence of uncompacted or loose cohesionless soils, such as uniform fine sand.

The sections of pipeline considered to be vulnerable to liquefaction in an earthquake event include:

- Between KP 74.8 and KP 75.1 and KP 75.5 and KP 78.2 where Pleistocene aeolian unit 4 (Qpe4) is present. The locations of 3 No. historical earthquakes of high magnitude lie within 200 km of this section, the closest of which occurred in 1887 at a distance of 88 km from the pipeline alignment. However, GSSA (2012) indicates material induration in this area, which may reduce the liquefaction risk.
- Between KP 145.1 and KP 150.1 where Quaternary aeolian unit 1 (Qe1) is present. The locations of 2 No. historical earthquakes of high magnitude lie within 200 km of this section, the closest of which occurred in 1887 at a distance of 145 km from the pipeline alignment. GSSA (2012) does not report material induration in this area.

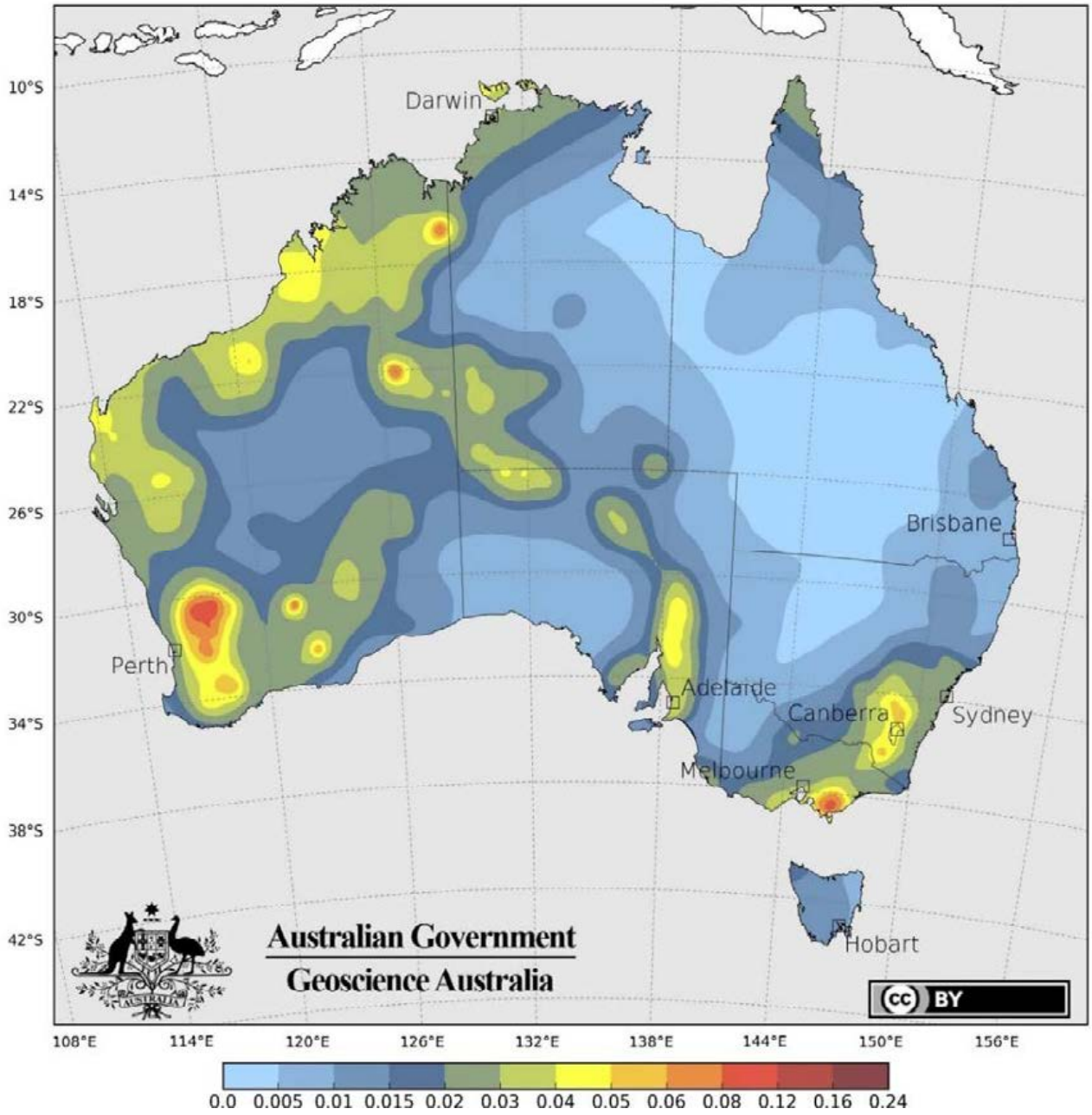


Figure 7-9. Peak Ground Acceleration of 1/500 Annual probability of exceedance seismic events

7.2 Geotechnical residual risk assessment

The geotechnical residual risk assessment of the environmental impact of potential geohazards on the construction and operational phases of the Project is presented in **Table 7-3**. Initial and residual risks following the implementation of proposed mitigation measures have been assessed. Measures to mitigate the impacts of the risks identified are presented in Section **8.1**.

In general, the risks associated with the construction and operation of the Project with regards to landforms, topography, soils and landscape geomorphology are considered manageable with typical construction methodologies and appropriate design.

Table 7-3. Geotechnical risk assessment

Geohazard (and phase)	Environmental risk	Risk likelihood	Risk consequence	Risk rating	Proposed mitigation measure	Final risk likelihood	Final risk consequence	Final risk rating
Shallow bedrock (Construction)	Generation of noise and dust during rock excavation for pipeline and associated infrastructure. Potential effects on sensitive receivers and fauna, if blasting required. Excavated material not suitable for reuse as trench backfill, requiring off-site disposal and importation of suitable backfill material.	Likely	Moderate	High	Selection of appropriate equipment for rock excavation. Construction Environmental Management Plan (CEMP) to address noise and dust mitigation measures. Targeted geotechnical investigation if required to determine extent and strength/excavatability of shallow bedrock. DBOM contractor to consider opportunities and measures required to maximise reuse of excavated rock in the works.	Unlikely	Negligible	Low
Indurated materials (Construction)	Generation of noise and dust during excavation for pipeline and associated infrastructure. Excavated material not suitable for reuse as trench backfill, requiring off-site disposal and importation of suitable backfill material.	Likely	Minor	Medium	CEMP to address noise and dust mitigation measures. Targeted geotechnical investigation if required to determine extent and strength/excavatability of indurated materials. DBOM contractor to consider opportunities and measures required to maximise reuse of excavated rock in the works.	Likely	Negligible	Low
Collapsible soils (Construction and operational)	Formation of concentrated erosion pathway due to collapse/settlement of trench backfill.	Possible	Moderate	Medium	Identification of potential collapsible soils by a targeted geotechnical investigation if required. Backfill to be compacted to an appropriate engineering standard.	Unlikely	Minor	Low

Geohazard (and phase)	Environmental risk	Risk likelihood	Risk consequence	Risk rating	Proposed mitigation measure	Final risk likelihood	Final risk consequence	Final risk rating
Expansive clays (Operational)	Environmental damage due to water leak from damaged pipe. Shrink-swell movements can cause damage to buildings and infrastructure and pipelines, where used as backfill.	Unlikely	Moderate	Medium	Identification of expansive clays by geotechnical investigation. Design of pipeline and infrastructure to consider expansive soil movements. Careful consideration of placement and compaction of expansive clay as trench backfill to minimise strain induced in pipes and joints. Consider use of deadman anchors and holding down straps.	Rare	Minor	Low
Karst (Construction and operational)	Environmental damage due to water leak from pipe caused by collapse of doline/sink hole infill below trench.	Unlikely	Moderate	Medium	Walkover surveys and geotechnical investigation to identify and determine existence of karst features. Realignment of pipeline to avoid identifiable karst features or consider ground treatment if realignment not practicable. Steel pipes and joints designed to span potential loss of support related to karst features. Consider use of clay seals in trench backfill to minimise surface water ingress through trench. Regular inspection as part of maintenance programme.	Rare	Minor	Low
Slope instability and landslides (Construction and operational)	Environmental damage and pipeline damage due to slope instability or landslides.	Rare	Major	Low	Pipeline alignment is located at safe distances from existing slopes.	Rare	Major	Low

Geohazard (and phase)	Environmental risk	Risk likelihood	Risk consequence	Risk rating	Proposed mitigation measure	Final risk likelihood	Final risk consequence	Final risk rating
Soil aggressivity (Operational)	Presence of soils and groundwater that are aggressive to steel pipelines. Risk of corrosion damage to pipes.	Possible	Minor	Medium	Targeted geotechnical investigation if required to determine aggressivity of soils and groundwater (where present) to concrete and steel construction materials. Design to follow relevant standards to achieve durability requirements.	Possible	Low	Low
Shallow groundwater	Risk of flotation causing pipe to breach the ground surface. Groundwater flow in trench leads to scour and loss of backfill materials.	Possible	Moderate	Medium	Increase depth of pipeline, use of straps or anchors, sand filled saddle bags, use of denser backfill materials. Scour protection and rock armouring.	Rare	Moderate	Low
Seismicity (Operational)	Environmental damage resulting in failure of pipeline.	Unlikely	Moderate	Medium	Undertake seismic design in accordance with AS 1170.4 and project-specific requirements. Determine the applicable seismic importance level and ensure potential plastic hinge zones are identified and detailed with consideration of seismic events greater than the design event.	Unlikely	Minor	Low

7.2.1 Lacustrine and trenchless crossings - geotechnical risks

The proposed pipeline construction methodologies consist of:

- Trenchless crossings of selected watercourses.
- Trenched crossing of Playa system south of Lake Windabout.

These crossings have specific geotechnical risks given the nature of the local geological environment and that construction may be impacted by the local fluvial and lacustrine systems, in addition to the local geology.

It is understood that additional information has been and will continue to be collected in relation to these sites, and this information will assist in confirming the proposed construction methodologies. The following geological information should be confirmed to inform the construction risks as part of detailed designs:

- Depth and strength of unconsolidated sediment in the lakes and streams. This will affect the depth of any trenchless construction, the ability to maintain a stable trench without shielding and to use heavy construction machinery.
- The weathering profile of the material below these waterways may differ from the surrounding landscape and, therefore, may impact tunnelling depth and associated shaft size adjacent to the streams.
- The structurally complex nature of the geology in the Project Area and the potential for the waterways to be situated within them will need to be understood prior to construction. The structural complexity and any associated broken ground will add to the risk of any trenchless construction methods. The Constructability report clearly identifies the risks associated with the differing trenchless construction methods.

These sites and risks are documented in **Table 7-4**, operational risks for these crossings, please refer to Jacobs (2026).

Table 7-4. Construction risks for trenchless waterway crossings and construction in ephemeral lakes

Location	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
Trenched crossing to be confirmed as part of detailed design	Trenchless crossing of waterway	Failure of drilling under waterway due to poor geotechnical understanding which requires mechanical recovery through the channel bed resulting in significant earthworks.	Possible	Major	High	Further Geotechnical investigation (if required) and consideration of construction method. Select the trenchless crossing method based on detailed geotechnical information for each site. If risk is considered to great consider trenching or bridging.	Risk to be determined after further geotechnical investigation (if required) and documented in CEMP. CEMP to considered consultation with stakeholders and environmental impacts of support infrastructure to support the trenchless crossing.		
WC28	Trenching in a watercourse located south of Lake Windabout	Watercourse that includes saline material does not allow construction of trench as required - collapse of trench	Likely	Moderate	High	Further Geotechnical investigation (if required) and revision of construction method (i.e. Adoption of safe trench batter slope angles, benching, or temporary support to maintain stability of pipe trench) or relocation of pipeline. Select the waterway crossing method based on detailed geotechnical information for the site. If	Risk to be determined after further geotechnical investigation (if required) and documented in CEMP. CEMP to considered consultation with stakeholders and environmental impacts of support infrastructure to support (track construction) to support the crossing.		

Location	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
						risk/impact is considered to great consider relocating of the alignment.			
		~~Construction of road to support road permanently impacts lake~~	~~Likely~~	~~Moderate~~	~~High~~	~~Further Geotechnical investigation (if required) and revision of construction method or relocation of pipeline.~~	~~Risk to be determined after further geotechnical investigation (if required) and documented in CEMP~~		

Note: WC numbers correspond to the water crossing numbers in **Appendix B**.

7.3 Geomorphological impact pathway identification and risk assessment

The geomorphology impact assessment is based on available information regarding the geomorphology and habitat present in the Project Area, as described in Section **5.3**. The performance objective adopted for the impact assessment is to avoid or minimise impacts on geomorphological processes. The impact assessment involved:

- Identifying pathways through which the geomorphological processes may be impacted by the construction and operation of the Project and then assessing the likelihood and consequence of the risks associated with each effect pathway to determine a risk rating.
- Developing mitigation measures required to manage the identified risk.
- Assessing the likelihood and consequence of residual risks to determine a risk rating following the implementation of mitigation measures.

The effect pathways are described in Section **7.4**, together with initial risk likelihoods, consequences and ratings. The risk assessment of the effect pathways is summarised in **Table 7-5.** for construction risks and **Table 7-6.** for operational risks. Surface water impacts are covered in Jacobs (2026). The ability to completely reinstate the original landforms was considered during the impact assessment. Recommendations have been developed with a focus on minimising the impacts and risk and reinstating the landscape in new infrastructure (principally roads and waterway crossings) in a way that minimises ongoing and future impacts.

It may not be possible to reinstate some landforms following construction of the pipeline. An example of this is the gibber plains, an erosional landform, which are formed by wind or rain washing or blowing away the surface fines component leaving a desert surface consisting of closely packed interlocking gravel and cobble sized rock fragments. The gibber plains also trap the remnant seed from wetter periods.

A further complication of the arid landforms is that some of the soils have a low in-situ density and when compacted as trench backfill will occupy a smaller volume than the in-situ soil. Additional fill may be required to allow the trench surface to be mounded to allow for settlement and avoid future ponding of rainfall and runoff above the trench. Typically, these soils are hydrophobic meaning that the initial rain runs off and pools before being absorbed. Some soils may be dispersive (which may be confirmed by a targeted geotechnical investigation if required) which would exacerbate any runoff related erosion. The rehabilitation of construction areas and the design and construction of access tracks will need to consider these issues.

7.3.1 Erosion and sediment control during construction

The proposed construction works could potentially impact on geomorphological processes via several effect pathways:

- Construction methods lead to increased erosion and sediment mobilisation in the landscape.
- Earthworks expose saline and/or acid sulphate soils (JBS&G, 2026) that impacts on vegetation stabilising the landscape.
- Removal of vegetation leads to increased erosion and sediment deposition as sheetwash.
- Sheetwash sediment runoff from stockpiles of soils that impact receiving waters and vegetation stabilising the landforms.

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway of “Possible”, a risk consequence of “Minor”, and an overall risk rating of “Medium”. This risk can be managed by the DBOM contractor through development and implementation of a CEMP (see **Table 8-2** for specific recommendations).

7.3.2 Erosion and sediment control of saline and ASS soils

The excavation of saline soils has the potential to impact receiving waters and the surrounding vegetation if not appropriately managed. Impacts can occur when wind and stormwater runoff come into contact with exposed areas including stockpiles, dispersing sediment and runoff across the surrounding vegetation.

Areas of highly saline soils include Black Oak Creek, various salt lakes, and unnamed watercourses in the northern extent of the Project Area. The risk of impact to saline surface watercourses is low as the receiving environment has habituated to catchment geology and existing saline impacted surface water flows (see Jacobs (2026)). However, if material is stockpiled outside these areas, runoff could impact receiving waters and the surrounding vegetation.

Areas with the potential for acid sulphate soils (ASS) are:

- Lake Dutto. (KP197) Down Stream of Lake Dutton
- Elizabeth Creek (KP CA209)
- Ironstone Lagoon (KP197) upstream of Lake Dutton
- Yeltacowie Creek (KP CA349) – most likely does not apply to pipeline crossing but further downstream at Pernatty Lagoon
- The Inland Salt Lakes – multiple adjacent to alignment

It should be noted that the field assessment identified potential ASS environment in addition to the JBS&G (2026) report. These areas could present a risk if the ASS is mobilised during construction. The risk of impact of ASS on watercourses is considered to be low (if managed in accordance with Jacobs (2026) recommendations). However, if material is stockpiled outside these areas, runoff could impact the surrounding vegetation.

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway of "Possible", a risk consequence of "Minor", and an overall risk rating of "Medium". This risk can be managed by the DBOM contractor through development and implementation of a CEMP (see **Table 8-2** for specific recommendations).

7.3.3 Sediment erosion from stockpiles and deposition as sheet wash

Removal of vegetation could impact water quality during the construction phase if runoff is allowed to mobilise exposed soils. This can result in erosion and sedimentation across the differing landscapes.

As the pipeline route moves further north, the Project Area the aeolian dunes become the dominant permanently vegetated area as they retain water and promote vegetation growth. Removal of this vegetation could increase the risk of erosion. The soils in the dunal systems are also prone to compaction, therefore, increasing the likelihood of concentrating overland flows and erosion.

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway of "Likely", a risk consequence of "Minor", and an overall risk rating of "Medium". This risk can be managed by the DBOM contractor through development and implementation of a CEMP (see **Table 8-2** for specific recommendations).

7.3.4 Sediment runoff from stockpiles of soils that impact stabilising vegetation

Construction of the Project will require stockpiling of excavated material before it is reused or transported off site. High intensity rainfall events that occur during construction could erode stockpiled materials and disturbed areas with exposed soils by transporting materials via sheet flow.

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway of "Unlikely", a risk consequence of "Low", and an overall risk rating of "Low". This risk can be managed by the DBOM contractor through development and implementation of a CEMP (see **Table 8-2** for specific recommendations).

7.3.5 Channel and bank scour during construction

Construction of the main transfer pipeline and associated access tracks may allow additional scour and sediment mobilisation within the channel; this would only occur during trenching works across the channel. As identified in Jacobs (2026), streams have been classified as either 'sensitive' (with higher potential to scour and impact the channel and associated vegetation (typically for larger watercourses with an active mobile bedload)), and 'standard' (typically for smaller watercourses with no, or limited, bedload).

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway on sensitive watercourses of "Possible", a risk consequence of "Moderate", and an overall risk rating of "Moderate". This risk can be managed by the DBOM contractor through development and implementation of a CEMP (see **Table 8-2** for specific recommendations).

7.3.6 Erosion and sediment control during operation

During the operational phase of the Project, all construction access roads will need to be designed, constructed and maintained to prevent the development of erosion and the transport of sediment. Construction work sites should be progressively decommissioned and rehabilitated following the completion of the works with consideration for the potential for erosion.

7.3.7 Erosion and sediment control associated with access and inspection tracks

For operational purposes, an inspection track along the length of the pipeline and access tracks to pump stations, storages, substations and scour valves will be required. These tracks will typically be unsealed.

To avoid erosion from sheet flows, or flooding from adjacent watercourses during heavy rain events, the tracks will need to be appropriately designed and maintained. Further, the DBOM contractor will consider the potential impact of the roads becoming low points and funnelling runoff to cause erosion if they are set into the surrounding landscape. Inadequate design, relating to track levels and drainage could lead to localised erosion after rain and storm events.

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway of "Possible", a risk consequence of "Minor", and an overall risk rating of "Medium".

7.3.8 Operational discharges

Planned discharges of water (including testing/cleaning of the pipeline) to the receiving environment is expected during maintenance activities. If the works cannot be performed whilst the pipeline is in use, sections of the pipeline will need to be drained. These planned discharges will be undertaken using the scour valves generally located adjacent to rivers, creeks, lakes, and local depressions. Unplanned discharges can occur without warning due to main breaks, valve breaks and faulty air valves that can release water from the pipeline into the environment at any location. Unplanned discharges can also occur from over filling of the storages; however, these are usually of short duration. Emergency discharges may be required if pipeline water quality is unsuitable and requires flushing via the scour valves. Water quality issues are considered in Jacobs (2026).

Discharges, planned and unplanned, can present a risk to the local environment due to release of water that could result in scouring and associated sedimentation. Given most discharges of water will be from the

pipeline into an energy dissipating pit, and where possible at the minimum flow rate according to time available, these risks should be manageable. The location of scour valves will be determined during detailed design, and the design should consider each site and its erodibility (e.g. aeolian dunes may be at risk from discharges).

The initial risk assessment based on the field assessment gave a risk likelihood for this impact pathway of "Possible", a risk consequence of "Moderate", and an overall risk rating of "Medium".

7.4 Geomorphological residual risk assessment

The geomorphological residual risk assessment of the potential impact pathways, resulting from construction and operation of the Project on the various landform types that are present, is presented in **Table 7-5** and **Table 7-6**. Initial and residual risks following the implementation of proposed mitigation measures have been assessed. Measures to mitigate the impacts of the risks identified are presented in **Section 8.2**.

In general, the risks associated with the construction and operation of the Project with regards to landforms, topography, soils and landscape geomorphology are considered manageable with typical construction methodologies and appropriate design.

Table 7-5. Geomorphology landform risk assessment during construction

Landform	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
Alluvial Aeolian landforms	Landform pattern built up or locally excavated, eroded or aggraded by wind	Erosion and sediment control of construction area	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Erosion and sediment control of saline soils	Rare	Minor	Low	CEMP that addresses erosion and runoff	Rare	Minor	Low
		Sediment erosion from stockpiles and deposition as sheet wash	Likely	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Exposure time before reinstatement	Unlikely	Moderate	Medium	Construction period reduced/optimised	Rare	Moderate	Low
		Channel and bank scour during construction (Sensitive)	Possible	Moderate	Medium	CEMP considers site risks, reduced/optimised construction period, time of year and weather forecast	Unlikely	Minor	Low
Aeolian landforms	A complex landform pattern on valley floors with active, inactive or relict erosion and aggradation by channelled and overbank stream flow	Erosion and sediment control of construction area	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Erosion and sediment control of saline soils	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Sediment erosion from stockpiles and deposition as sheet wash	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Exposure time before reinstatement	Unlikely	Moderate	Medium	Reduced construction period/optimised	Rare	Moderate	Low
		Channel and bank scour during construction (Sensitive)	NA – no watercourses exist in Aeolian Landform						

Landform	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
Depositional plain	Level landform pattern with extremely low relief formed by unspecified depositional processes	Erosion and sediment control of construction area	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Erosion and sediment control of saline soils	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Sediment erosion from stockpiles and deposition as sheet wash	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Exposure time before reinstatement	Unlikely	Moderate	Medium	Reduced construction period/optimised	Rare	Moderate	Low
		Channel and bank scour during construction (Sensitive)	Possible	Moderate	Medium	CEMP considers site risks, reduced/optimised construction period, time of year and weather forecast	Unlikely	Minor	Low
Erosional landforms	Landform pattern of very low to high relief and very gentle to steep slopes. The pattern is eroded by continuously active to slightly active or inactive geomorphic processes	Erosion and sediment control of construction area	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Erosion and sediment control of saline soils	NA – Saline soils only occur in depositional environments						
		Sediment erosion from stockpiles and deposition as sheet wash	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Exposure time before reinstatement	Unlikely	Moderate	Medium	Reduced construction period/optimised	Rare	Moderate	Low
		Channel and bank scour during construction (Sensitive)	Possible	Moderate	Medium	CEMP considers site risks, reduced/optimised construction period, time of year and weather forecast	Unlikely	Minor	Low

Landform	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
Lacustrine and playa plains	Sediment deposited from solution and suspension in still water in an inland lake, playa or pan	Erosion and sediment control of construction area	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Erosion and sediment control of saline soils	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Sediment erosion from stockpiles and deposition as sheet wash	Possible	Minor	Medium	CEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Exposure time before reinstatement	Unlikely	Moderate	Medium	Reduced construction period/optimised	Rare	Moderate	Low
		Channel and bank scour during construction (Sensitive)	Possible	Minor	Medium	CEMP considers site risks, reduced/optimised construction period, time of year and weather forecast	Unlikely	Minor	Low

Table 7-6. Geomorphology landform risk assessment during operation

Landform	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
Aeolian landforms	Landform pattern built up or locally excavated, eroded or aggraded by wind.	Erosion and sediment control associated with access and inspection tracks	Possible	Minor	Medium	Appropriate water management incorporated in road design and maintenance	Unlikely	Minor	Low
		Operational discharges	Possible	Moderate	Medium	Appropriate design and maintenance	Unlikely	Minor	Low
Alluvial landforms	A complex landform pattern on valley floors with active, inactive or relict erosion and aggradation by channelled and overbank stream flow	Erosion and sediment control associated with access and inspection tracks	Possible	Minor	Medium	Appropriate water management incorporated in design and maintenance	Unlikely	Minor	Low
		Operational discharges	Possible	Moderate	Medium	Appropriate design and maintenance	Unlikely	Minor	Low
Depositional plain	Level landform pattern with extremely low relief formed by unspecified depositional processes	Erosion and sediment control associated with access and inspection tracks	Possible	Minor	Medium	Appropriate water management incorporated in road design and maintenance	Unlikely	Minor	Low
		Operational discharges	Possible	Minor	Medium	Appropriate design and maintenance	Unlikely	Minor	Low

Landform	Landform description	Risk pathway	Risk likelihood	Risk consequence	Risk Rating	Proposed Mitigation	Final risk likelihood	Final risk consequence	Final risk rating
Erosional landforms	Landform pattern of very low to high relief and very gentle to steep slopes. The pattern is eroded by continuously active to slightly active or inactive geomorphic processes.	Erosion and sediment control of disturbed area	Possible	Minor	Medium	OEMP that addresses erosion and runoff	Unlikely	Minor	Low
		Channel and bank scour	Possible	Moderate	Medium	OEMP considers site risks	Unlikely	Minor	Low
Lacustrine and playa plains	Sediment deposited from solution and suspension in still water in an inland lake, playa or pan	Erosion and sediment control associated with access and inspection tracks	Possible	Minor	Medium	Appropriate water management incorporated in road design and maintenance	Rare	Minor	Low
		Operational discharges	Not applicable as discharge points are not proposed for active waterways and lakes (including salt lakes/playas)						

8. Mitigation measures

8.1 Geohazard mitigation measures

This section identifies mitigation measures that could be taken to lower the likelihood and/or consequence of the impact of the geohazards presented in **Table 7-3.** on the construction and operation of the Project.

In general, the risks associated with the construction and operation of the Project with regards to geohazards are considered to be manageable with appropriate design and construction methodologies. The Project is considered to be at "Low" overall risk from geohazards if the proposed mitigation measures described in **Table 8-1** are implemented.

Table 8-1. Mitigation measures to address identified geohazards

Geohazard being managed	Proposed mitigation measures
Phase: Construction	
Shallow bedrock	▪ Targeted geotechnical investigation (if required) to determine extent and excavatability of shallow bedrock. ▪ Preparation of a CEMP is proposed to outline the measures required to manage noise and dust impacts associated with excavation of rock in the pipeline trench. ▪ DBOM contractor to consider measures required to maximise reuse of excavated rock in the works. ▪ Consider measures to maximise reuse of excavated bedrock as trench backfill or elsewhere in the Project.
Indurated materials	▪ Targeted geotechnical investigation (if required) to determine extent and excavatability of shallow bedrock. ▪ Preparation of a CEMP is proposed to outline the measures required to manage noise and dust impacts associated with excavation of indurated materials in pipeline trench. ▪ DBOM contractor to consider measures required to maximise reuse of excavated indurated materials in the works. ▪ Consider measures to maximise reuse of indurated materials as trench backfill or elsewhere in the Project.
Collapsible soils	▪ Targeted geotechnical investigation (if required) to identify location of potential collapsible soils and their properties. ▪ Adoption of safe trench batter slope angles, benching, or temporary support to maintain stability of pipe trench.
Karst	▪ Walkover surveys and geotechnical investigation (including geophysical investigations) (if required) to identify and determine the existence and characteristics of karst features. ▪ Realignment of pipeline to avoid identifiable karst features or consideration of ground treatment, such as grouting, if realignment not practicable.
Slope instability and landslides	▪ Project infrastructure to be located at safe distances from existing slopes.

Geohazard being managed	Proposed mitigation measures
Phase: Operation	
Collapsible soils	▪ Reuse of collapsible soils as trench backfill to be compacted to appropriate engineering standard. ▪ Incorporation of appropriate drainage measures for Project infrastructure to prevent ponding of surface water.
Expansive clays	▪ Targeted geotechnical information from construction to confirm location and properties of expansive clays. ▪ Careful consideration of placement and compaction of expansive clays as trench backfill to minimise strains induced in pipes and joints.
Karst	▪ Targeted geotechnical information from construction to confirm location and existence of karst features. ▪ Pipes and joints maintenance to span potential loss of support related to karst features. ▪ Consider use of clay seals in trench backfill to minimise surface water ingress through trench. Mounding of ground surface above pipeline trench to avoid surface water ponding. ▪ Regular inspection as part of maintenance programme.
Slope instability and landslides	▪ Preparation of Operational Environmental Management Plan (OEMP).
Soil aggressivity	▪ Targeted geotechnical investigation, if required, to determine aggressivity of soils and groundwater (where present) to concrete and steel construction materials. ▪ Use of saline and acid sulphate soils as trench backfill will require pipeline protective measures including material durability considerations, use of GRP and other non-metallic pipes, pipe coatings and cathodic protection. ▪ Design of Project infrastructure maintenance to follow relevant standards to achieve durability requirements.
Shallow groundwater	▪ Targeted information from construction to confirm groundwater depths and calculations to assess potential for pipe buoyancy and scour. ▪ Adopt appropriate Project infrastructure maintenance methods and safe trench batter angles. ▪ Increase depth of pipeline, use of straps or anchors, sand filled saddle bags, use of denser backfill materials. Scour protection and rock armouring.
Seismicity	▪ Detailed seismology information including probabilistic seismic hazard analysis to understand risks of damage to pipeline and infrastructure during maintenance. ▪ Design of Project infrastructure maintenance to appropriate standards. ▪ Consider installation of isolation valves at either end of potential shear zones and use of flexible joints in higher risk locations, as required.

8.2 Geomorphological mitigation measures

In general, all risks associated with the construction and operation of the Project can be reduced with the adoption of proposed mitigation measures detailed in **Table 8-2**. The highest risk effects pathways all have an initial risk rating of "Medium" apart from saline soils in the Lacustrine and playa lakes landform which has a "High" risk rating and in the Aeolian landform which has a risk rating of "Low". All effect pathways are reduced to or maintained at a "Low" final risk rating. The Project is considered to be low risk overall with the implementation of proposed mitigation measures.

The management of impacts to the landscape by erosion and associated sedimentation can be achieved by the DBOM contractor during the construction and operational phases. Principally, the DBOM contractor can manage impacts by:

- Preparing a CEMP that describes how activities undertaken during the construction phase will be managed to avoid or mitigate environmental impacts, and how those environmental management requirements will be implemented. Erosion and sediment control measures such as sediment fences and temporary drainage are expected to be installed in construction areas to prevent the mobilisation of runoff and sediment into the surrounding environment.
- Preparing a schedule that limits the amount of exposed construction areas at any particular time and having a plan in place to manage the active construction site, associated roadways and tracks, and stockpiles, should significant rain on a local or a regional scale be forecast.
- Consideration of the location of, and scour protection associated with scour valves, management of runoff along the permanent access tracks, and runoff from buildings and sealed surfaces.
- Management and maintenance of stormwater flow from access tracks and buildings to prevent the initiation of erosion.

Where impacts cannot be avoided, measures to minimise or manage impacts should be implemented. Recommendations for mitigation measures based on the risk assessment presented in Section **7** are detailed in **Table 8-2**.

Table 8-2. Proposed mitigation measures to address the identified effect pathways

Impact being managed	Proposed mitigation measures
Phase: Construction	
MM1 – Erosion and sediment control of construction area	Preparation of a CEMP is proposed to outline the measures required to manage soil and water impacts associated with the construction works. If risks are to be minimised, the CEMP should include, but not be limited to, the following: ▪ Minimise clearance of vegetation and retain existing vegetation as much as possible. ▪ Develop a site erosion and sediment control methodology with consideration of contingencies for moderate to high rainfall events. ▪ Install sediment controls around stockpiles to contain coarse soil and sediment as applicable, to prevent sedimentation impacting surrounding vegetation and watercourses. ▪ Measures to minimise/manage erosion and sediment transport within the disturbance area and off site. ▪ Erosion and sediment controls established prior to commencement of vegetation clearing or earthworks. ▪ Specific methodologies should be developed for each landform with flexibility to adjust for specific conditions (e.g. steep terrain, or proximity to area of significance such as gibber plains).

Impact being managed	Proposed mitigation measures
MM2 - Erosion and sediment control of saline soils	Implement site specific control measures to manage potential erosion or sedimentation impacts including, but not limited to, the following to be documented in the CEMP: ▪ Specific measures to manage stockpiled and exposed saline soils.
MM3 - Stockpiles	Stockpiles, spoil loading and transport managed to minimise the potential for mobilisation and transport of dust, sediment, contamination and leachate in runoff. This will include: ▪ Minimising the number of stockpiles, the areas used for stockpiles and the time that they are left exposed. ▪ Stabilising stockpiles, establishing appropriate sediment controls, and supressing dust and runoff as required. ▪ Separation of non-acid forming and potentially acid forming materials and subsequent treatment of potentially acid forming materials with a neutralising agent.
MM4 - Reinstatement	▪ Minimise the duration of works as far as practicable. ▪ Disturbed areas will be rehabilitated as soon as practical and progressively, principally by: - replacing topsoil and cleared vegetation. - Re-establishing and/or managing surface water flows across the landscape.
MM5 – Watercourses (channel and bed scour)	▪ Minimise the duration of works as far as practicable. ▪ Select timing of works (season). ▪ CEMP to consider monitoring of local weather forecast and site-specific mitigations for construction.
Phase: Operation	
MM6 - Erosion and sediment control	▪ Undertake regular visual assessments after significant rainfall events to identify issues, assess the adequacy of mitigation measures, and make improvements where required. ▪ Preparation of an OEMP is proposed to outline the measures required to manage soil and water impacts associated with the maintenance (including planned and unplanned works). If risks are to be minimised, the OEMP should include, but not be limited to, the following: - Minimise impacts to vegetation and retain existing vegetation as much as possible during operations and maintenance if infrastucture - Develop a site management plan with consideration of contingencies for moderate to high rainfall events. - Maintain measures to minimise/manage erosion and sediment transport within the infrastructure area and minimise and off site impacts - Specific methodologies should be developed for each landform with flexibility to adjust for specific conditions (e.g. steep terrain, or proximity to area of significance such as gibber plains).
MM7 – Operational discharges	▪ Scour protection and flow control measures should be designed, implemented, and monitored at the outlet locations to reduce the risk of erosion and subsequent sedimentation.

9. Conclusion

Construction and operation of the Project have the potential to impact landforms, topography, geology and soils if appropriate management measures are not implemented, monitored and maintained. The Project includes earthworks to support construction of the desalination plant at Mullaquana Station, installation of the transfer system, and associated infrastructure (including transfer pump stations, storages, substations, and transmission towers).

At the time of writing, the main transfer and lateral branch pipelines are proposed to be predominantly buried and constructed using trench and cover methods, with trenchless installation (e.g., auger boring or micro-tunnelling) at rail crossings and some watercourse crossings, where required. Localised above-ground pipeline sections may also be required in discrete locations subject to detailed design outcomes and construction constraints.

The Project Area spans a range of terrain types and geomorphic settings. In broad terms, the southern section (KP 0–195) traverses lower-relief plains with gentle undulations, while the northern section (KP 195–360) transitions into more elevated and variable terrain with pronounced rises and intervening valleys. The lateral branch pipeline (KP CA 0–46.569) shows an overall net rise toward the Carrapateena mine delivery point, with the most pronounced ascent occurring in the final portion of the alignment.

Along the main transfer pipeline, ground surface elevations range from 5.97 m AHD at approximately KP 8.5 to 203.63 m AHD at approximately KP 251.3. Within the southern section, elevations range from 5.97 m AHD (approximately KP 8.5) to 138.12 m AHD (approximately KP 154.0). Within the northern section, elevations range from approximately 66.82 m AHD (approximately KP 196.7) to 203.63 m AHD (approximately KP 251.3). Along the lateral branch pipeline, elevations range from 64.10 m AHD (approximately KP CA 21.3) to 222.46 m AHD (approximately KP CA 46.4).

A series of terrain units were identified based on correlations between the geological regimes, land systems and soil landscapes. The most relevant engineering and environmental constraints assessed for construction and operation of the Project infrastructure relate to:

- shallow bedrock and indurated materials, and their influence on excavation methods and reuse of excavated materials.
- collapsible soils and expansive clays, and their influence on trench stability, backfill suitability and potential ground movements.
- potential karst features and their influence on long-term pipeline support conditions.
- soil erosion and sediment mobilisation, particularly where drainage is concentrated and at watercourse crossings.
- soil aggressivity and implications for material durability and corrosion protection.
- seismicity and the potential for damage to buried infrastructure.

The geohazard risk assessment indicates that initial risk ratings are generally Medium, with shallow bedrock presenting a higher initial risk relative to other hazards. Following implementation of proposed mitigation measures, the residual risk ratings for the identified geohazards are assessed as Low.

From a geomorphological perspective, the key areas requiring consideration during construction and operation are watercourse crossings (including locations where flows may be concentrated by existing drainage infrastructure) and aeolian landforms (dunal systems), where disturbance of surface stability and alteration of natural drainage pathways can increase localised erosion and scouring risk. These risks are considered manageable through appropriate design, construction planning and implementation of environmental management measures.

Proposed mitigation measures to address the identified constraints and risks typically include:

- design measures for corrosion protection in aggressive soils (including appropriate coatings and cathodic protection where required).
- consideration of localised alternative installation methods (including above-ground installation or trenchless methods) where warranted by terrain, shallow bedrock, drainage features, or other constraints.
- measures to maximise reuse of excavated materials while managing and segregating unsuitable materials to minimise environmental impacts.
- pipe and joint design measures (and where appropriate, isolation valves) to mitigate impacts of expansive soils, potential loss of support, buoyancy effects and seismic actions.
- drainage and erosion controls to avoid ponding adjacent to infrastructure and to maintain natural flow paths, particularly at watercourse crossings and within dune/swale systems.
- implementation of CEMP and OEMP to manage soil stripping and reinstatement, erosion and sediment control, stockpiling, dust suppression and rehabilitation, supported by appropriate inspection and maintenance programs.

Overall, the risks associated with construction and operation of the Project in relation to topography, landforms, geology and soils are considered manageable, provided that appropriate design, standard construction methodologies, and implementation of the proposed mitigation and management measures are adopted.

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Appendix A. Field inspection notes

Summary of "Key" Geomorphic Sites – Field Inspection

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
85.4	"Lincoln Gap" Creek	Cobble sized, sub rounded. Fine sand over top, attributed to lower flows. No significant vegetation around channel. Scouring around channel. No corrosion around pillars (no salt). Bed rock (potentially calcrete) out crops in the bank of the channel.	No geomorphic reason not to trench.	The site highly suspectable to flash flows. The active cobble bedload indicates that there is potential of the channel to scour any loose/and our softer material, need to ensure that the pipe is armoured or buried below any potential scour depth. Directional drilling will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock which may be complicated by the presence of calcrete layer, so that there is no blowout from the drilling process, this will be dependent on Geotechnical Investigations.	 Lincon Gap Creek  Calcrete layer – unclear if its is bed rock or how it is acting in the control of the stream

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
					 Mobile coble sized bedload
195	Black Oak Creek 1	Channel connecting two salt lakes. Salt Lake crossing, alluvial clays, silty clays, corrosive. Lacustrine sediment appears to be shallow given the apparent lack of the embankment for the road crossing.	Possibly bridge. No geomorphic reason not to trench. Directional drilling dependent on geotechnical investigation principally regarding the bedrock and the depth of sediment.	Flooding during construction. Potential for Acid Sulphate Soils. Directional drilling will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the channel system, this will be dependent on Geotechnical Investigations. Directional drilling at this location will be complicated due to the length required to cross the channel system.	 Black Oak creek crossing – note the lack of road embankment that tends to indicate shallow sediments (in my view)

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
					 Highly corrosive environment.
198.3	Black Oak Creek 2	Minor channel with silty and sandy bed stringers (not enough to consider a full bedload). Partial vegetated, not a mobile bed. Saline water and further concrete corrosion on pillars.	Possibly bridge. No geomorphic reason not to trench. Directional drilling dependent on geotechnical investigation – sediment.	Flooding during construction. Potential for Acid Sulphate Soils. Directional drilling will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the channel system, this will be dependent on Geotechnical Investigations. Directional drilling at this location will be complicated due to the length required to cross the channel system as it is inset into the surrounding landscape.	

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
					
233.8	Lake Windabout	Watercourse crossing.	Current alignment adjacent to the road considered extremely difficult to trench given the lacustrine sediments. Trenching potentially possible in a watercourse to the west of the lake. Directional drilling maybe possible but will be dependent on the geotechnical investigation.	Flooding during construction. Potential for Acid Sulphate Soils. Directional drilling will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the channel system, this will be dependent on Geotechnical Investigations. Directional drilling at this location will be complicated due to the length required to cross the watercourse area.	 Potential trenching alignment  Current alignment adjacent to the road.

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
CA 30.2	Dunal Material	Dunal material– no discernible channels, just occasional small salt pans associated with small, enclosed catchments.	Trench through vegetation stabilised dunal Sands.	The concentration of flows adjacent to the road is causing erosion withing the dunal system. This erosion of dunal material where flows are concentrated will need to be considered during construction and post construction so that channels do not develop above the pipeline and along the construction and access tracks. Dunal material may be more susceptible to "significant" amounts of compaction with regards to access tracks – this may exacerbate any erosion by concentrating any overland flow after larger rainfall events.	
CA 20.9	Carrapateena Access Road	Saline channel – base level control by Pernatty Lagoon – Salt Lake.	Trenching through channel potentially difficult due to groundwater influence from Pernatty Lagoon. Directional drilling under the river will be dependent on Geotechnical investigation where consideration will need to be given to bed rock and the depth of in-channel alluvial sediments and any requirement for the drilling to interface between.	The management of groundwater/instream flows will be critical for all crossings. The water will most likely have an elevated salinity. Trenching will need to consider the unconsolidated nature of the river alluvial sediments and their saturated state. Directional drilling will need to consider the unconsolidated nature and the depth of the alluvial sediments as well as the basement rock so that there is no blowout from the drilling process into the river channel.	
CA 26.5	Dunal material - Eroding drainage	Example of concentrated flows due to road drainage.	Eroding dunal material – construction issue.	The concentration of flows adjacent to the road is causing erosion withing the dunal system. This erosion of dunal material where flows are concentrated will need to be considered during construction and post construction so that channels do not develop above the pipeline and along the construction and access tracks.	 Incised flow channel adjacent to road.

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
CA 34.5	Large Active Channel Crossing	Large, braided stream with multiple sand bars and multiple channels. Sediment in the channel is graded with the base of the channel consisting of a gravel to cobble bedload covered by a finer sand bedload. This tends to indicate that the more frequent (and smaller) flows activate the sand bedload, while the less frequent ("flood flows") activate the entire bed load. The channel is incised into the surrounding colluvium. This tends to indicate that the channel sediment will not have a large depth estimated to be 2.5 to 3.5 m but this will vary along the channel. The presence of the overstorey eucalypt vegetation indicates the presence of significant flows or water being retained in the channel for longer periods to allow for their survival. The depth of the scour pool. Coupled with the eucalypt overstorey indicates that there is the potential of semi-permanent pools developing in the channel.	No geomorphic reason not to trench. Directional drilling under the river will be dependent on geotechnical investigation where consideration will need to be given to bed rock and depth of in-channel alluvial sediments. There is not expected to be any requirement for the drilling to interface between these differing units.	Given the mobility of the bedload in the channel and trenching will need to ensure that the Pipeline is protected either through depth of installation of protective measures. It is unknown if the frequency of large flow events and development of pools (and if they last long enough) to support an invertebrate or amphibious aquatic fauna. The ability of the weathered colluvium to contain any blowouts into the channel will need to be considered if directional drilling is considered.	 Heavy upstream scouring in channel ~1.70m in depth note the exposed coble bedload.  Braided sand bed channel with islands stabilised by overstorey vegetation.  Channel bank appears to be incised into collvium, not the coble bedload assocaited with the eroding bank.

Km Point	Site Name	Site Description	Waterway Crossing/Area of geomorphic interest	Risks/Impacts	Photos
CA 38.5	Large Active Channel Crossing	Large, braided stream with multiple sand bars and multiple channels. Sediment in the channel is predominantly a gravel to cobble bedload with a finer sand bedload associated the more heavily vegetated islands. The channel is incised into the surrounding colluvium. This tends to indicate that the channel sediment will not have a large depth. The presence of the overstorey eucalypt vegetation indicates the presence of significant flows or water being retained in the channel for longer periods to allow for their survival.	No geomorphic reason not to trench. Directional drilling under the river will be dependent on Geotechnical investigation where consideration will need to be given to bed rock condition and depth of in-channel alluvial sediments. There is not expected to be any requirement for the drilling to interface between these differing units.	Given the mobility of the bedload in the channel and trenching will need to ensure that the pipeline is protected either through depth of installation of protective measures. The ability of the weathered colluvium to contain any blowouts into the channel will need to be considered if directional drilling is considered.	

Appendix B. Watercourse crossings

Table B-1. Summary of hydrology characteristics at major watercourse crossings (GHD, 2025a)

Intercept ID	Approx. km point (km)	Basin	Feature	General hydrology
WC 1	26	**Spencer Gulf**	Unnamed watercourse	*Increased runoff May to October.*
WC 2	55		Unnamed watercourse	*Potential for larger flashy runoff events due to summer storms.*
WC 3	58		Unnamed watercourse	
WC 4	64		Unnamed watercourse	
WC 5	69		Myall Creek	
WC 6	75		Pine Creek	
WC 7	79		Unnamed watercourse	
WC 8	80		Unnamed watercourse	
WC 9	-	**Mambray Coast**	-	*No clear seasonality.*
WC 10	83		Unnamed watercourse	*Runoff should be similar across all months.*
WC 11	85		Unnamed watercourse	*Larger runoff events may occur throughout the year resulting from unpredictable storms.*
WC 12	87		Unnamed watercourse	
WC 13	88		Unnamed watercourse	
WC 14	88		Unnamed watercourse	
WC 15	93		Unnamed watercourse	
WC 16	95		Unnamed watercourse	
WC 17	96		Unnamed watercourse	
WC 18	99		Lake Dempsey Creek Crossing	
WC 19	102		Lake Dempsey Creek Crossing	
WC 20	106		Lake Dempsey Creek Crossing	
WC 21	141		Unnamed watercourse	
WC 22	153		Ranges View Creek Crossing	
WC 23	197	**Gairdner**	Unnamed watercourse	*Potential for increased runoff May to July.*
WC 24	198		Unnamed watercourse	*Summer months may experience higher runoff due to occasional storm events.*
WC 25	200		Black Oak Creek Crossing	
WC 26	202		Black Oak Creek Crossing	
WC 27	222		Unnamed watercourse	
WC 28	237		Lake Windabout	
WC 29	238		Unnamed watercourse	
WC 30	238		Unnamed watercourse	
WC 31	239		Unnamed watercourse	
WC 32	240		Unnamed watercourse	
WC 33	240		Unnamed watercourse	
WC 34	241		Unnamed watercourse	
WC 35	241		Unnamed watercourse	
WC 36	243		Unnamed watercourse	
WC 37	244		Unnamed watercourse	
WC 38	256		Unnamed watercourse	
WC 39	265		Unnamed watercourse	

WC 40	270		Unnamed watercourse	
WC 41	277		Wirrawirralu Creek	
WC 42	279		Unnamed watercourse	
WC 43	280		Unnamed watercourse	
WC 44	281		Unnamed watercourse	
WC 45	331		Unnamed watercourse	
WC 46	21		Elizabeth Creek Crossing	
WC 47	27		Unnamed watercourse	
WC 48	29		Carra Creek Crossing	
WC 49	31		Unnamed watercourse	
WC 50	31		Unnamed watercourse	*No clear seasonality. Runoff should be similar across all months. Summer months may experience higher runoff due to occasional storm events.*
WC 51	33		Unnamed watercourse	
WC 52	36		Yeltacowie A Creek Crossing	
WC 53	37		Yeltacowie Creek Unnamed Tributary	
WC 54	35		Yeltacowie Creek Unnamed Tributary	
WC 55	39		Yeltacowie B Creek Crossing	
WC 56	41		Unnamed watercourse	
WC 57	-		-	

* WC = Water Crossing

Appendix H-2:

Preliminary Site Investigation Report

Geosyntec consultants | JBS&G A Geosyntec Company

Northern Water Project – Limited Preliminary Site Investigation

Department for Infrastructure and Transport

Final Report

63753 | 166,975 (Rev 0)

24 November 2025



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Abbreviations

Term	Definition
ANSIS	Australian National Soil Information System
ASC NEPM	*National Environment Protection (Assessment of Site Contamination) Measure 1999*
ASS	Acid sulfate soils
CEMP	Construction Environmental Management Plan
CL	Crown Lease
CSM	Conceptual Site Model
CT	Certificate of Title
CTA	Cultana Training Area
DEW	Department for Environment and Water
DIT	Department for Infrastructure and Transport
EL	Exploration Licence
EOIR	Explosive Ordinance Incident Reports
EP	Environmental Protection
GL/year	Gigalitre per year
JBS&G	JBS&G Australia Pty Ltd
km	Kilometres
lb	Pound
m	Meter
m bgl	Metres below ground level
mg/L	Miligram per litre
NEPM	National Environmental Protection Council
PAH	Polycyclic aromatic hydrocarbons
PASS	Potential acid sulfate soils
PCAs	Potentially contaminating activities
PCB	Polychlorinated biphenyls
PFAS	Per- and poly-fluoroalkyl substances
PSI	Preliminary Site Investigation
SA EPA	South Australian Environmental Protection Authority
SAPPA	South Australian Property and Planning Atlas
SWL	Standing Water Level
TDS	Total Dissolved Solids
UXO	Unexploded ordnance
WPA	Woomera Prohibited Area

Executive Summary

JBS&G Australia Pty Ltd (JBS&G) was engaged by the Department for Infrastructure and Transport (DIT; the client) to undertake a limited Preliminary Site Investigation (PSI) in general accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM) for the proposed Northern Water Project (the Project).

The Project aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the project will involve the construction and operation of a 51 gigalitre per year (GL/year) seawater reverse osmosis desalination plant located on the Upper Spencer Gulf, and associated water transfer system (including pipelines, transfer pump stations and product water storages) and electricity infrastructure.

The primary objective of this PSI was to identify any reasonable likelihood of human health and/or environmental risks which may be encountered during construction of the proposed pipeline and associated infrastructure by identifying potentially contaminating activities (PCAs) within the proposed pipeline construction corridor.

Subject to the limitations presented in **Section 9,** the following key outcomes were noted:

Pump station and desalination plant[1] sites

- The proposed pump station and desalination plant sites appear to have been used for farming purposes at the time of this report, with grazing as the predominant land-use;
- No Class 1 PCAs were identified as potentially being undertaken on the pump stations or desalination plant site, noting that potential Class 2 PCAs relating to general agricultural land use (such as chemical use and animal / waste burial) may have historically occurred at the sites. However, given the absence of these specific PCAs being identified, the overall risk of site contamination being present at the sites is considered to be low; and
- There were generally no current PCAs identified on land areas adjacent the pump stations or desalination plant site (i.e. considering surrounding land use activities), noting that for the purposes of the PSI a limited site inspection was completed as part of the assessment.

Pipeline

Potential for impacts to soil from PCAs were considered at:

- locations where a railway line is in close proximity to the pipeline
- locations in close proximity to the Carrapateena access road electrical transformers
- two locations along / in close proximity to the proposed pipeline where potential acid sulfate soils (PASS) were indicated to be present
- the Olympic Dam, Mount Gunson and Carrapateena Mine sites, all of which have undertaken several PCAs as defined by the *Environment Protection Regulations 2023* and Practice Direction 14 (SPC 2023). In addition, Olympic Dam and a portion of the Carrapateena access road both have Section 83 notifications under the *Environment Protection Act 1993* affecting or threatening groundwater.

[1] Note, some PASS has been identified at the desalination plant location as part of other investigations. This is addressed in other EIS technical studies, and in the EIS itself.

- three locations pertaining to the proposed pipeline alignment where the potential for unexploded ordnance (UXOs) was identified – north of Pernatty Lagoon, west of Port Augusta Airport, and between Port Augusta Airport and Whyalla. Defence training areas are classified as Class 2 PCAs under SPC 2023.

Subject to the limitations presented in **Section 9**, the PSI has concluded the following:

- The potential for historical practices and activities to have caused site contamination at the pump stations and the desalination plant site is considered to be low
- The potential for historical practices and activities to have caused site contamination along the proposed pipeline alignment is generally considered to be low with the exception of railways operations, Carrapateena access road electrical transformers and PASS, which are considered to have moderate potential to have caused site contamination at relevant locations.
- With the exception of the Carrapateena access road electrical transformers, a review of aerial photography along the proposed pipeline route indicates a low probability of interaction with identified PCAs during construction works. Groundwater may be encountered in areas surrounding the desalination plant where the water table is shallow, or where underboring on the pipeline alignment occurs The implementation of a project Construction Environmental Management Plan (CEMP) will assist in management of potential hazards, as well as unexpected finds during construction works.
- A Project specific survey for UXO has been undertaken and concluded that 'no live explosive items were found' and that risk of UXO within 'the surveyed areas are decreased to as low as reasonably practicable'.

Future soil and groundwater testing to establish baseline conditions and whether site contamination is present is proposed by DIT, including an assessment of the potential for ASS.

A project CEMP is recommended to assist in management of these potential hazards and unexpected finds during construction works.

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by the Department for Infrastructure and Transport (DIT; the client) to undertake a limited desktop Preliminary Site Investigation (PSI) in general accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM, as amended 2013) for the proposed Northern Water Project (the Project).

The Project aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the project will involve the construction and operation of a 51 gigalitre per year (GL/year) seawater reverse osmosis desalination plant located on the Upper Spencer Gulf, and associated water transfer system (including pipelines, transfer pump stations and product water storages) and electricity infrastructure.

The project is proposed to consist of a desalination plant at Mullaquana Station, approximately 30 km south-west of Whyalla, three satellite pump stations, and several water storage tanks and pipeline offtakes, connected by a pipeline extending from Mullaquana Station and the Olympic Dam mine site. The locations of the proposed infrastructure incorporating pump stations, desalination plant and the pipeline corridor are shown in **Figure 1**.

For the purposes of this limited PSI, JBS&G has focused on the three pump stations and the desalination plant (herein referred to as the 'sites') as the primary areas of likely future construction. GIS Revision 3 of the current project design plan has been referred to for the alignment of project infrastructure.

1.2 Objectives

The primary objective of this limited PSI was to identify any reasonable likelihood of human health and/or environmental risks related to site contamination which may be encountered during construction of the proposed pipeline and associated infrastructure.

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2. Scope of Work

Due to the nature of the project involving construction over an extensive area (approximately 406 km of pipeline as well as the desalination plant, associated pump stations, storage tanks, electrical cabling and substation connections, laydown yards, etc.), a 'limited desktop PSI' approach was undertaken[2].

The scope of work completed included the following:

- A site inspection of the approximate areas of development for the desalination plant, pump station locations and various locations across the proposed pipeline route;
- Aerial photograph assessment of the entire proposed pipeline length using the most recently published Google Earth imagery (ranging from 2022 to 2025);
- Review of current and oldest available historical aerial photography available for each pump station and the desalination plant site (ranging from 1969 to 1985);
- Review of current and historical ownership of each pump station and the desalination plant site;
- Review of geological maps and acid sulfate soils (ASS) maps for each pump station and the desalination plant site. An assessment of the entire pipeline length was also completed to review potential ASS risk;
- Review of publicly available information from the EPA, local government and state government sources relevant to each pump station and desalination plant site in the context of the potential for site contamination;
- Review of the WaterConnect Groundwater Database within 2 km of each pump station and the desalination plant site;
- Review and summary of surrounding land uses that have the potential to impact on the site; and
- Preparation of a limited PSI report with conclusions that directly relate to the objectives outlined in **Section 1.2**.

Due to the length of the proposed pipeline route, a high-level review of Google Earth imagery was completed to identify the likelihood of any PCAs with the potential to impact on either human health or the environment during the construction or operation of the pipeline and associated infrastructure. No other site history searches were completed for the proposed pipeline route.

[2] Note that proposed electricity transmission and distribution lines, substations and the Bimba storage were not within the scope of the PSI.

3. Site Identification

3.1 Site Details

The details of each pump station and the desalination plant site are presented in **Tables 3.1 to 3.4**. The current Certificates of Title (CTs) for each site are included in **Appendix A.** The locations of the sites relative to CT boundaries are also displayed on **Figure 2 to Figure 5.**

Table 3.1: Site Details – Mangata (Oakden Hills) Pump Station

Category	Details
CT Reference and Property Description	Portion of Crown Lease (CL) Volume 6178, Folio 725, DP 47746, Q 8, Hundred of Torrens, Area named Oakden Hills; and
Address	Lot 9 Stuart Highway, Oakden Hills, SA, 5713
Site Area	Approx. 2.8 hectares
Registered Proprietors	Coondambo Nominees Pty Ltd
Municipality	Pastoral Unincorporated Area
Zoning	Remote Areas
Current Land Use	Livestock
Future Land Use	Pump Station

Table 3.2: Site Details – Kalaya (Kootaberra) Pump Station

Category	Details
CT Reference and Property Description	Portion of CL Volume 6204, Folio 748, DP 47682, Q 3, Hundred of Port Augusta, Area named Kootaberra
Address	211 Kootaberra Rd, Kootaberra, SA 5713
Site Area	Approx. 3.6 hectares
Registered Proprietor	Kootaberra Pty Ltd
Municipality	Pastoral Unincorporated Area
Zoning	Remote Areas
Current Land Use	Livestock
Future Land Use	Pump Station

Table 3.3: Site Details - Lincoln Gap Pump Station

Category	Details
CT Reference and Property Description	CT Volume 6306 Folio 522, Section 8, Hundred of Handyside in the Area Named Lincoln Gap
Address	2252 Eyre Highway, Lincoln Gap, SA 5715
Site Area	Approx. 313 hectares
Registered Proprietor	Nutt Bros Nominees Pty Ltd
Municipality	Pastoral Unincorporated Area
Zoning	Remote Areas
Current Land Use	Livestock
Future Land Use	Pump Station

Table 3.4: Site Details - Mullaquana Station Desalination Plant

Category	Details
CT Reference and Property Description	CL 6186 Folio 2, Sections 53 and 54 Hundred of Poynton in the Area Named Middleback Range Unallocated Crown Reserve abutting coastline
Address	22448 Lincoln Highway, Middleback Range, SA, 5609
Site Area	Approx. 200 hectares
Registered Proprietor	Joyce Pastoral Pty. Ltd.
Municipality	The Corporation of the City of Whyalla
Zoning	Remote Areas / Conservation
Current Land Use	Livestock
Future Land Use	Desalination Plant

3.2 Review of South Australian Property and Planning Atlas

A review of information in the South Australian Property and Planning Atlas (SAPPA)[3] was completed to determine the current planning zones under the Planning and Design Code of each site, with information summarised in **Table 3.5** below.

[3] http://sappa.plan.sa.gov.au/ (accessed online 14 April 2025)

Table 3.5 Summary of Current Zoning of the Sites

Location	Zoning	Description of Zoning and Acceptable Land Uses
Mangata Pump Station and surrounding Kalaya Pump Station and surrounding Lincoln Gap Pump Station and surrounding Mullaquana Station and surrounding[4]	Remote Areas	Diverse range of uses including: • Pasture growing, grazing, farming, agricultural processing and transportation • Mining and petroleum • Energy generation and storage • Pipeline infrastructure • Aerospace and defence related activities • Aboriginal lands and related activities • Tourist development • Worker's accommodation and settlements
Mullaquana Station[5]	Conservation	The conservation and enhancement of the natural environment and natural ecological processes for: • Their ability to reduce the effects of climate change • Their historic, scientific, landscape, habitat, biodiversity, carbon storage and cultural values • Provision of opportunities for the public to experience these through low-impact recreational and tourism development.

[4] The desalination plant is located within the Remote Areas zone. The Conservation Zone is present at the eastern edge of the CT which the underground intake/outfall tunnel passes beneath.
[5] The Conservation Zone relates to the CT associated with the coastal fringe adjacent the desalination plant site. It is understood that the footprint of the desalination plant will not be constructed within the coastal fringe. The site will be constructed on land in the Remote Areas zone.

4. PSI – Site History

4.1 Overview

A summary of the content of this section is presented in **Table 4.1**.

Table 4.1: PSI Overview

Scope of PSI	Report Section
Methodology	**Section 4.2**
Site Inspection	**Section 4.3, Appendix B**
Review of land ownership history	**Section 4.4, Appendix A and Appendix C**
Review of aerial photographs	**Section 4.5 and Figure 6 to Figure 9**
Assessment of surrounding land uses	**Section 4.6 and Figure 2 to Figure 5[6].**
Review of SA EPA Site Contamination Index	**Section 4.7**
Defence UXO Database Search	**Section 4.8**
Review of historical site uses	**Section 4.9**
Summary of PCAs	**Section 4.10, Figure 10, Appendix C and Appendix E**
Review of regional geology	**Section 4.11**
Review of hydrogeology and groundwater bore search	**Section 4.124.12 and Appendix F**
Review of hydrology	**Section 4.13**
Review of acid sulfate soils mapping	**Section 4.14 and Figure 11 and Figure 12**

4.2 Methodology

The site history assessment was undertaken in general accordance with the procedures presented within the ASC NEPM, with particular reference to Schedule B(2) 'Site Characterisation'.

In addition, the following South Australian guidance was referenced in relation to PCAs:

- *Environment Protection Regulations 2023* (the EP Regulations)[7];
- Practice Direction 14 – Site Contamination Assessment 2021[8]; and
- Guidelines for the Assessment and Remediation of Site Contamination 2018[9].

4.3 Site Inspection

A limited site inspection was undertaken by experienced JBS&G personnel on the 5th and 6th of August 2025. Site inspection included observations at the proposed locations of the pump stations and desalination plant. Observations were also made at various points along the pipeline route. Relevant photos from the site

[6] High level generalised uses of land are depicted spatially through the Land Use Generalised 2024 layer in the South Australian Planning and Property Atlas (SAPPA).
[7] South Australian *Environment Protection Regulations 2023*
[8] State Planning Commission 2021, Practice Direction 14 – Site Contamination Assessment, dated October 2023
[9] Environment Protection Authority (EPA) 2018, Guidelines for the Assessment and Remediation of Site Contamination, updated in 2019

inspection are included in **Appendix C**. The key findings from the site inspection are presented in **Section 4.3.1** to **4.3.5.**

4.3.1 Mangata Pump Station

The approximate area surrounding the proposed development footprint of the Mangata pump station was observed to be in an undeveloped land, under pastoral (livestock grazing) land use. The area was flat, covered by gibber and sparse, low growing shrubs.

A pipeline and power cables were observed to run adjacent to Stuart Highway, to the east of the site.

4.3.2 Kalaya Pump Station

The approximate area surrounding the proposed development footprint of the Kalaya pump station was observed to be undeveloped, with the exception of a radio tower to the northwest of the pump station site. The area was under a pastoral (livestock grazing) land use. The approximate area of development was relatively flat, gently sloping up towards the west, with sparse to moderate density low shrub cover.

Stuart Highway was observed to be present to the east of the site.

4.3.3 Lincoln Gap Pump Station

The approximate area surrounding the proposed development footprint of the Lincoln Gap pump station was observed to consist of undeveloped land with pastoral (livestock grazing) land use. The area was relatively flat, with sparse groundcover.

Two roadways were observed adjoining the pump station site; Lincoln Highway to the southeast, and Eyre Highway to the south of the pump station site. Various powerlines were present running parallel to these adjacent roadways.

An electrical substation was observed to be present to the east of the pump station. Additionally, five large above ground concrete storage tanks were observed northeast of the pump station.

4.3.4 Mullaquana Station Desalination Plant

The approximate area surrounding the proposed development footprint of the Mullaquana Station desalination plant was observed to consist of largely undeveloped land, used for livestock grazing. The proposed desalination site is located near the coast and avoids sensitive areas such as dunes, mangroves and a threatened ecological community. Rural residential and associated agricultural structures were present surrounding the site. The nearest residence to the desalination plant at Mullaquana Station is the Mullaquana Station homestead, located approximately 4.4 km inland (east) of the desalination plant site and outside the Project Area.

Notably, there were groundwater wells present on site.

The area was relatively flat, covered by moderately dense chenopod scrubland vegetation. Various small (generally tidal) waterbodies and coastal shrubs were present along the coastal fringe surrounding the desalination plant's tunnel location. There were no areas of substantial development surrounding the proposed footprint of development, however at the time of inspection there were minor geotechnical survey excavation and drilling activities taking place.

4.3.5 Pipeline

The areas along the proposed pipeline route generally present as areas of undeveloped land, not including surrounding transport infrastructure such as nearby roadways. Surrounding environments varied from sparse to dense shrublands, with the majority of areas observed to consist of undeveloped land, or pastoral (livestock grazing) land uses. Key observations noted along the pipeline route included the following:

- Pipeline running along Stuart Highway, southwest to southeast;

- Railway running adjacent to the proposed pipeline route, noting several portions where the proposed route intersects the rail;
- The Lincoln gap windfarm;
- The Myall Creek bridge, with nearby fencing and signage indicating a nearby prohibited military area;
- A railway line running south to southeast, adjacent to Lincoln Highway; and
- Phillips Ponds ruins.

4.4 Land Ownership

A review of the proprietors referenced on current and historical CTs to assess historical site ownership was undertaken on the 30th of October 2025 for each of the pump station sites and the desalination plant. The details of the searches are summarised below and provided in **Appendix C.**

4.4.1 Mangata Pump Station

The site was first registered in 1904 to sheep farmers John Beviss and Walter and Charles Ives. The Ives family retained the property until 1920 when the Kidman family took ownership. The property was held under company names including Oakden Hills Ltd (1926-1937) and Nonning Pastoral Company Ltd (1937-1988), after which it was transferred to grazier Andrew and Penelope McTaggart, before it was transferred to Nutt Bros Nominees P/L in 2002 and Coondambo Nominees P/L in 2022.

4.4.2 Kalaya Pump Station

The site was first registered in 1904 to sheep farmer William Mortlock. After his death, it was transferred to pastoralist Richard Hawker and in trust, before it was transferred to sheep farmer John Mortlock in 1918. The Yudnapinna pastoral Company P/L took and retained ownership from 1922 to 1964 when various other parties (including Lloyd Pollard, the Wilkinson family, and Sword Nominees P/L) leased portions of the site. Kootaberra Pty Ltd took full ownership in 2013 and is the current proprietor.

4.4.3 Lincoln Gap Pump Station

The site was first registered in 1892 to a farmer Johann Fredrich Wilhelm Herde until 1906 when it was transferred to Esther Ann Mould (married woman). The site was retained within the Mould family until 1978 when it was transferred to Cooyerdoo Nominees P/L. Ownership was transferred to the current proprietors Nutt Bros Nominees P/L in 1997.

4.4.4 Mullaquana Station (Desalination Plant)

The land on which the desalination plant site is proposed to be located was first registered in 1908 to a Railway Officer, John Terry. The land was then transferred to various holders from the Jenkins family between 1963 and 1974. Ownership was briefly held by Askham P/L from 1980, before being transferred to Rex Luckraft and his wife in 1984. In 1991, a portion of the site was leased to The Electricity Trust of South Australia for an easement. The site was passed down in the Luckraft family in 2001, then transferred to the Jones family in 2006. Joyce Pastoral Pty. Ltd is the current proprietor, has had ownership of the site since 2021.

4.5 Current and Historical Aerial Photograph Review

Tables 4.2 to 4.5 present a summary of the review of current and historical aerial photographs for each pump station and the desalination plant site. The first available historical aerial photograph, and the most recent available aerial photograph were reviewed. Copies of the aerial photographs obtained from the Department for Environment and Water (DEW) Mapland and Google Earth or Nearmap are presented in **Figure 6 to Figure 9**.

Table 4.2: Aerial Photograph Review – Mangata Pump Station

Date	Comments
1980	The aerial photograph is in black and white. This is the first available photograph for the site. **Onsite:** • The site appears as undeveloped arid shrubland. • There is no visible activity on the proposed development site. **Offsite:** • An on-ground water pipe and access track appear to run parallel to site, approximately 10 m east from the site boundary. Stuart highway is visible approximately 20 m east from the site, running northwest to southeast. • The broader offsite area is largely undeveloped, except for the water pipe and access track, Stuart Highway and several access tracks and laydown areas in the vicinity of the site.
14/04/2024 Google Earth (Current)	The aerial photograph is in colour. **Onsite:** • The site area appears largely unchanged from the previous photograph. **Offsite:** • A reservoir (Jrp Dam) appears to have been constructed approximately 1.7km northwest of the site. • There are no other obvious changes to the offsite areas in the vicinity of the site.

Table 4.3: Aerial Photograph Review – Kalaya Pump Station

Date	Comments
1973	The aerial photograph is in black and white. This is the first available photograph for the site. **Onsite:** • The site appears as undeveloped arid shrubland. **Offsite:** • The Stuart Highway and another track are visible to the east of the site, and a radio tower with its associated access track is visible to the north / north-west. • The site and surrounds within an approximate 500 m radius of the site appear to be much less vegetated than other areas. • The Ranges View Rest Area is located approximately 300 m south of the site
6/04/2024 Google Earth (Current)	The aerial photograph is in colour. **Onsite:** • There are no visible changes to the site. **Offsite:** • A second radio tower is visible to the north of the tower visible in 1973. • There are no obvious changes to the offsite areas in the vicinity of the site.

Table 4.4: Aerial Photograph Review - Lincoln Gap Pump Station

Date	Comments
1981	The aerial photograph is in black and white. This is the first available photograph for the site. **Onsite:** • The site appears as undeveloped arid shrubland with some tracks on and around the site. There appears to be a potential ephemeral stream along the northeastern corner of the site. **Offsite:** • The Eyre Highway is visible to the north of the site, with what appears to be a public rest area along the road to the northeast of the site. • To the south and east of the site lies Lincoln Highway and a rail line running from south-west to north-east, approximately 900 m from the site. • Five water tanks approximately 1.5 km northeast of the site lie between Eyre Highway and the rail line and appear to be in use. • Undeveloped land that is sparsely vegetated lies to the west.
19/1/2024 Google Earth (Current)	The aerial photograph is in colour. **Onsite:** • There are no visible changes to the site. **Offsite:** • There are no other obvious changes to the offsite areas in the vicinity of the site.

Table 4.5: Aerial Photograph Review – Mullaquana Station

Date	Comments
1985	The aerial photograph is in colour. This is the earliest available photograph for the site. **Onsite:** • The majority of the site appears to consist of undeveloped land. • There are vehicle tracks crossing the site at various locations, with the main track/road extending north-south, with a secondary track leading to the coast (east) from the approximate centre of the site. **Offsite:** • There are a number of tracks on and in the vicinity of the site. However, the broader region appears to remain undeveloped. • A farm dam and adjacent square-shaped unvegetated area is located approximately 1.5 km to the south-west of the site – this may be a fenced holding area. • The ocean (Spencer Gulf) is located east of the site.
4/4/2022 Google Earth (Current)	The aerial photograph is in colour. **Onsite:** • The site area appears largely unchanged from the previous photograph. **Offsite:** • The remaining surrounds of the site remain relatively similar to the previous aerial image.

4.6 Assessment of Surrounding Land Use

Each pump station and the desalination plant site were assessed during site inspection and by review of aerial photography for current surrounding land uses. Results are displayed in the tables below and on **Figure 2 to Figure 5.**

Table 4.6: Mangata Pump Station Surrounding Land Uses

Direction From Site	Land Use
North	Livestock grazing, Stuart Highway, water pipeline, access track
East	Livestock grazing, Stuart Highway, water pipeline, access track
South	Livestock grazing, former track
West	Livestock grazing

Table 4.7: Kalaya Pump Station Surrounding Land Uses

Direction From Site	Land Use
North	Livestock grazing, gravel track, radio towers, Stuart Highway, gravel laydown (800 m)
East	Stuart Highway, livestock grazing
South	Livestock grazing, rest area (350m)
West	Livestock grazing

Table 4.8: Lincoln Gap Pump Station Surrounding Land Uses

Direction From Site	Land Use
North	Eyre Highway, rest areas, farming (grazing).
East	Lincoln Highway / Eyre Highway intersection leading to former water storage tanks (used for tyre storage, and location of large fire in 2023) (approximately 1 km northeast), rail line (Port Augusta to Whyalla) (approximately 0.5 km east), farming (grazing)
South	Livestock grazing, Lincoln Highway (approximately 150 m east), rail line (approximately 300 m south)
West	Livestock grazing

Table 4.9: Mullaquana Station Surrounding Land Uses

Direction From Site	Land Use
North	Livestock grazing, mineral exploration (approximately 1.5 km northwest)
East	Coastal fringe, ocean (approximately 800 m east)
South	Livestock grazing
West	Livestock grazing

4.7 EPA Records

4.7.1 SA EPA Site Contamination Index

A search of the Public Register Directory: Site Contamination Index[10] for Section 83A notifications (relating to site contamination that affects or threatens underground water) which have been received by the EPA since 1 July 2009 was undertaken on 14 April 2025. It is noted the Public Register is not an exhaustive record of identified contamination in South Australia as the Section 83A notification system relies on landowners and assessing consultants to notify the EPA when they identify contamination and has only been in force since 1 July 2009.

Locations pertaining to these records are displayed on **Figure 10.**

Table 4.10: SA EPA Site Contamination Index Search Results

Site	SA EPA Records Displayed	Notification Number	Approximate Distance from Project Area
Pipeline – Olympic Dam	1. Section 83A notification pertaining to Lot 1516 Olympic Dam Highway OLYMPIC DAM SA 5725 • Fire training areas (Class 2 Activity, SPC 2021); • Listed substances (storage) (Class 1 Activity, SPC 2021); • Metal processing, smelting, refining or metallurgical works (Class 1 Activity, SPC 2021)	12087	Bordering pipeline terminus
	2. Section 83 notification pertaining to Olympic Dam Operations Lot 1516 Olympic Dam Highway OLYMPIC DAM SA 5725 • No further detail provided	62196 - 01	
	3. Section 83A notification pertaining to OH Andamooka Block 1266, Sections 461, 1499, 1500, 1504 and 1505 OLYMPIC DAM SA 5725 (• Mineral processing, metallurgical laboratories or mining or extractive industries (Class 2 Activity, SPC 2021)	60876 - 01	Approximately 2.35 km east
Mangata pump station	1. Section 83A notification pertaining to Allotment Piece 2 OUT OF HUNDREDS Torrens OAKDEN HILLS SA 5713 • Electrical substations The map associated with the EPA notification refers to a triangular-shaped area, extending from an open mine pit associated with the Mount Gunson Mine site to beyond the Carrapateena access road to the west, covering an area of approximately 5,000 ha. It does not cover the proposed pump station location; however, it does cross the pipeline offtake alignment to Carrapateena.	61224 – 01	Approximately 4.18 km northeast
Kalaya pump station	No records		
Lincoln Gap pump station	No records		

[10] https://www.epa.sa.gov.au/public_register/site_contamination_index (accessed online 13 May 2025)

Site	SA EPA Records Displayed	Notification Number	Approximate Distance from Project Area
Mullaquana Station	No records		

4.7.2 Lincoln Gap – Waste Tyre Treatment Business and Fire

The Lincoln Gap Waste Tyre Treatment Business site (Section 9 Hundred of Handyside Eyre Highway, Lincoln Gap SA 5715), which is approximately 1 km north-east of the Lincoln Gap site, was licensed in 2010 as a waste tyre treatment operation and transport business from 2010 to 2024[11].

Following a period of stockpiling of tyres and no significant processing, EPA issued a clean-up order (record number 40094) in April 2020 which required removal of the tyres by January 2021. The conditions were not met.

Two large concrete tanks containing tyres were set alight in February 2024, with the CFS extinguishing the fires. Two other large concrete tanks were observed to be full of tyres following the fire.

A channel runs south / south-west of the tyre treatment facility, with conduits under the road to assist with drainage.

4.8 Defence UXO Database Search

The Defence online unexploded ordnance (UXO) maps database[12] was accessed on 14 April 2025 to assess the pump station and desalination plant sites for the potential presence of UXO. This was compared against a UXO risk assessment report prepared by GHD[13], however it is noted that this report was prepared for a previous pipeline alignment. None of the pump station or desalination plant sites recorded potential UXO on the Defence UXO map.

In addition, the length of the proposed pipeline was assessed. Three key areas recorded instances of potential UXOs:

- East side of the Stuart Highway north of approximately Pernatty Lagoon to and including Roxby Downs and Olympic Dam – Former Woomera Prohibited Area.
- Woomera Village and west of Woomera Village – Woomera Prohibited Area (WPA). GHD reported slight to moderate explosive potential in this area, noting the existence of two previous Explosive Ordinance Incident Reports (EOIR). GHD reported that intrusive surveys did not identify any live explosive item or evidence of UXO producing activities, such as fragmentation, weapon parts or impact craters.
- Lincon Gap (previously known as Lincoln Park) – was gazetted for Defence use in the 1960s. GHD reports[13] classify this area as having a slight explosive potential. Anecdotal evidence from the report suggests that four 25 pound (lb) artillery projectiles were previously identified during the Lincoln Gap Windfarm Project. Intrusive investigations conducted by GHD indicated no evidence of any live explosive items or UXO producing activities.
- Cultana Training Area (CTA) – GHD reports[13] identify this area as a mix of no/slight/moderate explosive potential. This report suggests 300+ EOIR exist for this area, however locations of these were not provided. GHD intrusive surveys did not identify any live explosive item or evidence of UXO producing activities in this area.

[11] https://www.epa.sa.gov.au/public_register/search-public-register#/record/136850#skip
[12] https://uxo-map.defence.gov.au/ (accessed online 13 May 2025)
[13] GHDa 2025, Northern Water Project – UXO Report

These areas are displayed on **Figure 10**.

4.9 Summary of Historical Site Information

Each pump station and the desalination plant site have been assessed for historical site uses based on the available information. A summary is provided below.

4.9.1 Mangata Pump Station

The site has been owned by families or companies associated with farming since 1904. It is likely from the appearance of the aerial imagery that the land has only been used for grazing.

The site is adjacent the Stuart Highway, which was originally developed in the mid-1800s, and also adjacent a water pipeline which runs between Port Augusta and Woomera. A former track is visible in the space between the highway and water pipeline, which could be a previous road, rail line or telegraph line. A reservoir (Jrp Dam) is present approximately 1.7 km to the northwest of the site.

4.9.2 Kalaya Pump Station

The site has been owned by families or companies associated with farming since 1904. It is likely from the appearance of the aerial imagery that the land has only been used for grazing.

The aerial imagery shows a darker area towards the centre of the proposed pump station location, which could be a denser area of vegetation. An ephemeral stream is apparent on the eastern side of the Stuart Highway.

4.9.3 Lincoln Gap Pump Station

The site has been owned by families or companies associated with farming since 1892. It is likely from the appearance of the aerial imagery that the land has only been used for grazing. An ephemeral stream was present running along the northeastern corner of the site.

The following surrounding land uses were noted:

- A public rest area lies along Eyre highway, approximately 300 m northeast of the site.
- A railway line linking Whyalla and Port Augusta is located approximately 900 m from the site, running southwest to southeast.
- Five large concrete tanks are situated approximately 1 km to the northeast to the site, which had been used for storage of used vehicle tyres since 2010[9]. A cleanup order (40094) was issued for the site in 2020 which was not actioned. Following this, a fire occurred within two of these tanks in 2023.

4.9.4 Mullaquana Station Desalination Plant Site

The site was initially owned by families associated with farming since 1908. Askham Pty Ltd briefly owned the property from 1980 to 1984, at which time it was returned to family ownership. An electrical easement was established by ETSA 1991. The land is currently owned by Joyce Pastoral Pty Ltd.

From a review of the available aerial imagery, observations during site inspection and historical ownership appear to suggest that to the site has mainly been utilised for stock grazing. The majority of the site appears to have remained largely undeveloped, with the exception of small rural residential dwellings and related agricultural structures. Drilling and excavation activities were noted at the time of site inspection.

4.10 Summary of Potentially Contaminating Activities

4.10.1 Pump Station and Desalination Plant Sites

A review of the ownership records and aerial imagery has identified all of the sites (pump stations and desalination plant) are pastoral (livestock grazing) land uses and part of broader pastoral properties / stations.

The northern most sites (Mangata and Kalaya) are more arid and sparsely vegetated sites, while the Lincoln Gap and Mullaquana Station sites appear to be smaller pastoral livestock grazing properties.

There was no evidence to suggest Class 1 PCAs associated with current or historical agricultural land uses at each of the sites on the basis of the limited review completed. There is potential for Class 2 agricultural activities (including historical chemical application, waste burial or animal burial at or in the vicinity of the sites) to have occurred on the basis of their historical agricultural land use, however, there was no direct evidence of this identified during the desktop review.

The potential for site contamination to be present at these sites is considered to be low. Nevertheless, preparation of a construction environment management plan (CEMP) is recommended to address any unexpected finds that may be associated with historical land uses.

4.10.2 Mine Sites

The only sites where PCAs were identified, albeit the majority of activities appear to be away from the proposed pipeline route, were the Olympic Dam mine site (the pipeline ends at the Olympic Dam Special Mining Lease boundary), Mount Gunson mine site (approx. 800m from the pipeline at its closest point) and the Carrapateena mine site (with the mine site being over 8km away from the pipeline delivery point). The activities identified as being undertaken at these sites (with respect to the information reviewed herein) are summarised in **Table 4.11** below:

Table 4.11: PCAs Identified for Olympic Dam, Carrapateena, and Mount Gunson Mine Sites

Site	PCAs
Olympic Dam[14]	• Fire training areas[15] • Listed substances (storage)[13] • Metal processing, smelting, refining or metallurgical works[13] • Mineral processing, metallurgical laboratories or mining or extractive industries[13] • Landfill sites[16] • Electrical substations[14] • Transport depots or loading sites[14] • Desalination plants[14]
Carrapateena[13]	• Transport depots or loading sites[14] • Listed substances (storage)[14] • Mineral processing, metallurgical laboratories or mining or extractive industries[14] • Electrical substations[14] • Airports, aerodromes or aerospace industry[14]
Mount Gunson[17]	• Electrical substations[14] • Mineral processing, metallurgical laboratories or mining or extractive industries[16]

[14] It is noted that mining activities may incorporate additional PCAs which are not listed in this table. The PCAs in this table are based on the review of information accessed for the preparation of this report (aerial imagery, government records etc)
[15] Information sourced from SA EPA Site Contamination Index
[16] Visible on aerial photography
[17] It is noted that Mount Gunson is not currently operational. Anecdotal evidence and assessment of aerial imagery indicate the potential failure of the tailing dam with what appears to be material runoff.

4.10.3 Pipeline

The proposed pipeline alignment passes through several areas identified on either the EPA Site Contamination Index database (detailed in **Section 4.7.1**) or the Defence UXO database (detailed in **Section 4.8**).

A review of the Site Contamination Index identified two Section 83A notifications for affecting or threatening groundwater at Olympic Dam pertaining to Fire training areas (Class 2 Activity), listed substances (storage) (Class 1 Activity), metal processing, smelting, refining or metallurgical works (Class 1 Activity), and mineral processing, metallurgical laboratories or mining or extractive industries (Class 2 Activity). In addition, a Section 83 notification relating to serious or material environmental harm was also recorded for the Olympic Dam mine site. Based on the proposed alignment of the pipeline, and an aerial review of surface activities (which are approximately 2 km away from the area of the proposed pipeline), it is unlikely that the above notifications would impact on the construction of the pipeline.

A Section 83A notification for affecting or threatening groundwater was recorded for electrical substations (Class 2 Activity) in the vicinity of (and intersecting) the Carrapateena access road. Based on the proposed alignment of the pipeline (less than 200 m from the nearest substation) and that there may be soil impacts associated with the substations (given the S83A notification of groundwater), there is potential for this to impact on the construction of the pipeline. Furthermore, although the assessment of transmission lines connecting the pipeline to the substations is outside of the scope of this investigation, further consideration would also be required should this be proposed.

Defence activities have been undertaken in three sections of the proposed pipeline alignment. As identified on the Defence UXO database, these areas include a large portion of the northern end of the pipeline, as well as an area between Port Augusta and Whyalla. These areas are described as “Former Woomera Prohibited Area (WPA)”, “Lincon Park” and “Cultana Training Area (CTA)”. Defence training areas are categorised as Class 2 Activities. A review of GHD’s UXO report[13] indicates that the CTA has a no/slight/moderate explosive potential and the WPA has a slight to moderate explosive potential with various EOIRs being associated with these areas. The intrusive surveys of the proposed pipeline at the time of reporting did not identify any live explosives or evidence of UXO producing activities. However, it may be possible that remnants of defence activities may be identified in the course of excavation for the pipeline.

The locations of these PCAs are shown on **Figure 10**.

4.11 Regional Geology

Regional geology was assessed for each pump station and desalination plant site using relevant 1:250k geological map sheets[18]. A summary of the geological settings is provided below.

Table 4.12: Regional Geology Summary

Site	Map Reference[19]	Geological Description
Mangata Pump Station	Torrens Mapsheet SH 53-16 1981	PANDURRA FORMATION: Cross bedded grits, red-purple quartzites, sandstones, pebbly grits. Deeply weathered near unconformity surfaces.
Kalaya Pump Station	Port Augusta Mapsheet SI 53-04 1968	WHYALLA SANDSTONE MEMBER: Poorly outcropping basal grits and sandstones with abundant cobbles of Pandurra Formation.
Lincoln Gap Pump Station	Port Augusta Mapsheet SI 53-04 1968	QUATERNARY REGOLITH/COLLUVIAL: Sands along flat plains. Presence of mulga-vegetated dendritic or tiger bush drainage patterns.

[18] https://map.sarig.sa.gov.au/ (accessed online 11 April 2025).
[19] Coordinate System: Geocentric Datum of Australia (GDA) 2020

Mullaquana Station	Whyalla Mapsheet SI 53 08 1983	The desalination plant footprint is underlain by several geological stratigraphy's, as summarised below: • PLEISTOCENE REGOLITH/COLLUVIAL: Pleistocene gravel, clay, silt and sand with soft carbonate and overlying nodular or tabular calcrete. • HOLOCENE ALLUVIAL/FLUVIAL SEDIMENTS: Undifferentiated Holocene alluvial and fluvial sediments. • SAINT KILDA FORMATION: a combination of calcareous, fossiliferous sand and mud of intertidal sand flats, beaches and tidal marches and gypseous clay of supertidal flats. • SEMAPHORE SAND MEMBER: transgressive dune fields and unconsolidated white bioclistic quartz-carbonate sand of modern beaches.

4.12 Hydrogeology and Registered Groundwater Bore Search

Information gathered from the WaterConnect database[20] identified very limited information relating to groundwater levels, with only two wells reporting a standing water level (located at Lincoln Gap with a measured water level of 7-12 metres below ground level [m bgl] and Mullaquana Station with a measured water level of 7-10 m bgl).

Where recorded, wells were drilled to depths between 16 and 85 m bgl. Salinity, where recorded, measured was between 3,480 and 52,500 mg/L Total Dissolved Solids (TDS), which may be potentially suitable for livestock and aquaculture (where TDS ranges are < 13,000 mg/L). The sections below provide a summary of the WaterConnect search which was undertaken on 28 October 2025 to assess whether operational bores were present within a 2 km radius of each site and what groundwater in the vicinity of the site may be used for.

4.12.1 Mangata Pump Station

Two registered groundwater bores were located within 2 km of the proposed development site, with no registered bores present onsite.

One bore (permit 6334-48) was drilled in 1978 to 85 m for industrial purposes and is now listed as abandoned. Associated water parameters suggested brackish water (TDS of 3,482 mg/L) and neutral pH. The second bore was drilled in 1947, however was lacking any further information.

Groundwater in the broader region predominantly consists of perched groundwater, which tends to have a lower salinity. Historically, these aquifers were commonly used for domestic, or stock watering uses[21].

4.12.2 Kalaya Pump Station

There were no registered groundwater bores identified onsite or within 2 km of the proposed development site.

Groundwater in the broader region predominantly consists of perched groundwater, which tends to have a lower salinity. Historically, these aquifers were commonly used for domestic, or stock watering uses[21].

[20] https://www.waterconnect.sa.gov.au/Systems/GD/Pages/Default.aspx (accessed online 28 October 2025)
[21] JBS&G, 2026. *Northern Water – Hydrological Conceptual Model and Groundwater Impact Assessment Report*, Ref: 171,552 (Rev A), JBS&G Australia Pty Ltd, 19 June 2026.

4.12.3 Lincoln Gap Pump Station

Three registered groundwater bores were located within 2 km of the proposed development site, with no registered bores present onsite.

All three bores (permits 6432-988 to 990, inclusive) were drilled in 2003 to depths between 24 and 60 m bgl. Two bores were operational, one of which (permit 6432-988) was used for stock water and had a recorded depth to water (DTW) of 12 metres below ground level (m bgl) and a TDS of 9,556 mg/L. No further information was provided for the remaining two bores.

Groundwater quality in the broader region is generally more saline, influenced by the emergence of deeper aquifer systems[21].

4.12.4 Mullaquana Station Desalination Plant Site

There were two registered groundwater wells located within 2 km of the proposed development site, with no registered bores onsite.

The two bores (permit 6331-561 and 6331-617) were drilled to dept between 13 m bgl and 16 m bgl, and were utilised for investigation purposes. The measured water levels were recorded between 7 m bgl and 10 m bgl, with one well (6331-617) recording a TDS of 52,500 mg/L.

A hydrogeological assessment across the desalination plant footprint was conducted by Kleinfelder in August to October 2025. Thirteen groundwater wells were assessed across the site and indicated that underlying water was hypersaline (with a TDS range of 53,000 to 100,000 mg/L) and depth to groundwater ranged between 2.813 – 9.534 m bgl[22].

Water quality within the broader region is relatively lower in salinity when compared against regions throughout the rest of the pipeline, with some areas potentially suitable for domestic and stock water supply[21].

4.12.5 Pipeline

There was limited data relating to the water quality of shallow groundwater throughout the pipeline alignment. However, broader regional characterisation of hydrology suggests that total dissolved solid (TDS) concentrations range between less than 500 mg/L to over 50,000 mg/L[20].

4.13 Hydrology

Surface water bodies within 2 km of the sites were assessed in the PSI process for the potential that site activities may impact surface water. This may include construction-related activities such as sediment runoff, production of excessive dust or drag-out of soil onto roadways, or ongoing operations including potential chemical storage and use, sediment runoff and stormwater management.

An aerial photography review was undertaken to assess the pump station and desalination plant sites for proximity to surface water bodies (including but not limited to dams, ephemeral streams, and lakes). Surface water bodies within 2 km of the sites were noted only for the Lincoln Gap site (where the pump station site is in close proximity to an ephemeral stream which may be linked to Spencer Gulf), and Mullaquana Station (where the desalination plant site is immediately adjacent the ocean to the east, and approximately 1.5 km from a dam to the south-west).

An assessment of surface water bodies within 2km lateral distance of the pipeline alignment identified a number of surface water bodies within 2 km of the proposed alignment.

[22] Kleinfelder, 2026. Northern Water Project (Package 5) Groundwater Model Update – June 2026, Ref: NWP-KLF-ONG-3000-GEO-RPT-0014_002, Kleinfelder 25 June 2026.

It is recommended that issues surrounding potential interactions with surface water bodies during construction are addressed in a project CEMP.

4.14 Potential for Acid Sulfate Soils

A search of the Australian National Soil Information System (ANSIS)[23] was undertaken on 15 April 2025 to assess the potential presence of actual or potential acid sulfate soils (ASS or PASS). Results for each site are outlined in the table below.

Table 4.13: Potential Acid Sulfate Soils Rating for Pump Station and Desalination Plant Sites

Location Name	Acid Sulfate Soils Rating
Mangata Pump Station	B4 (Low probability, Very low confidence)
Kalaya Pump Station	C4 (Extremely low probability, Very low Confidence)
Lincoln Gap Pump Station	C4 (Extremely low probability, Very low Confidence)
Mullaquana Station Desalination Plant Site	C4 (Extremely low probability, Very low Confidence)

In addition to the sites listed above, the proposed pipeline alignment was assessed using the ANSIS portal for the potential presence of ASS or PASS. Where PASS was indicated on the Northern Water portal, further details pertaining to the likelihood were obtained from ANSIS. These locations are displayed on **Figure 11 and Figure 12.**

Table 4.14: Potential Acid Sulfate Soils Rating for Additional Areas of Concern

Approximate Location Details (Easting, Northing - GDA 2020 Zone 53)	Source	Acid Sulfate Soils Rating[10]
6488192.141, 708167.12 (15km south of Mangata PS, between Monalena Lagoon and Lake Dutton)	ANSIS portal	A4 (High probability, very low confidence)
6105648.121, 752647.403 (20km North of Lincoln Gap pump station, approximately 4km east to the pipeline)	Northern Water Portal	A4 (High probability, very low confidence)

5. Identified Areas of Interest

Areas of interest have been assessed based on the findings of the desktop site history review and assessment of PCAs that may have occurred at, or in close proximity to, the pump station and desalination plant sites, as well as the pipeline alignment. A summary is provided below and presented on **Figure 10**.

Table 5.1: Identified Areas of Interest

Location Name	Areas of Interest and Chemical Substances of Potential Concern
Potential Impact on Pipeline	
Railway operations	The proposed pipeline is in close proximity to the existing railway line at several locations. Weed treatments along the railway line, and asbestos in train brakes have the potential to impact soils in these areas.

[23] https://portal.ansis.net/ (accessed online 15 April 2025)

Location Name	Areas of Interest and Chemical Substances of Potential Concern
PASS	PASS has been identified in close proximity to the proposed pipeline at two locations. Should PASS be present, excavation works have the potential to create ASS which can mobilise metals and cause acid runoff.
Olympic Dam Mine Site	Section 83A notifications pertaining to Fire training areas; listed substances (storage); metal processing, smelting, refining or metallurgical works; and mineral processing, metallurgical laboratories or mining or extractive industries. Additionally, a Section 83 notification for site contamination. A review of aerial photography indicates a low probability of interaction with these identified PCAs during pipeline construction works.
Carrapateena Access Road	Section 83A notification pertaining to electrical substations. Based on the proposed alignment of the pipeline (less than 200 m from the nearest substation) and that there may be soil impacts associated with the substations (given the S83A notification of groundwater), there is potential for this to impact on the construction of the pipeline. Furthermore, although the assessment of transmission lines connecting the pipeline to the substations is outside of the scope of this investigation, further consideration would also be required should this be proposed.
Mount Gunson Mine	Anecdotal evidence and assessment of aerial imagery indicate the potential failure the tailing dam with what appears to be material runoff (noting that Mount Gunson is not currently operational). A review of aerial photography indicates that this mine site lies greater than 2 km from the proposed pipeline. Therefore, it is unlikely any impacts at the Mount Gunson mine would affect the construction of the pipeline.
Pipeline Alignment north of Pernatty Lagoon	Interaction with land identified on UXO database as “Former Woomera Prohibited Area”. Reports indicate no evidence of any live explosive items or UXO producing activities, however EOIRs exist for the area. A project CEMP should be developed to assist in management of these potential hazards, as well as unexpected finds during construction works.
Pipeline Alignment west of Port Augusta Airport	Interaction with land identified on UXO database as “Lincon Park”, an area gazetted for Defence use in the 1960s. Reports indicate no evidence of any live explosive items or UXO producing activities, however anecdotal evidence suggests the previous discovery of artillery projectiles within the surrounding area. A project CEMP should be developed to assist in management of these potential hazards, as well as unexpected finds during construction works.
Pipeline Alignment south-west of Port Augusta to Whyalla	Interaction with land identified on UXO database as “Cultana Training Area”. Reports indicate no evidence of any live explosive items or UXO producing activities, however EOIRs exist for the area. A project CEMP should be developed to assist in management of these potential hazards, as well as unexpected finds during construction works.
Potential Impact to Mullaquana Station Site	
Agricultural activities	Potential Class 2 PCAs relating to general agricultural land use (such as chemical use and animal / waste burial) may have historically occurred at the sites. However, given the absence of these specific PCAs being identified, the overall risk of site contamination being present at the sites is considered to be low. A project CEMP should be developed to assist in management of unexpected finds during construction works.
Potential Impact to Lincoln Gap Pump Station	
Lincoln Gap Waste Tyre Treatment	Historical activity from a Waste Tyre Treatment Business, holding an EPO and has previously been associated with a fire in 2024. This is considered to be of low risk given the distance between the location and Lincoln Gap Pimp Station.

Location Name	Areas of Interest and Chemical Substances of Potential Concern
Potential Impact to Mangata, Kalaya and Lincoln Gap Sites	
Agricultural activities	Potential Class 2 PCAs relating to general agricultural land use (such as chemical use and animal / waste burial) may have historically occurred at the sites. However, given the absence of these specific PCAs being identified, the overall risk of site contamination being present at the sites is considered to be low. A project CEMP should be developed to assist in management of unexpected finds during construction works.

6. Preliminary Conceptual Site Model

The ASC NEPM (NEPC 2013) identifies a conceptual site model (CSM) as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments.

The essential elements of a CSM (as outlined in the ASC NEPM) include:

- Known and potential sources of contamination and contaminants of concern;
- Potentially affected media (soil, sediment, groundwater, surface water, indoor or ambient air);
- Preferential pathways for vapour intrusion (where volatile chemicals are contaminants of concern);
- Human and ecological receptors; and
- Potential and complete exposure pathways.

A CSM has been developed based on the available information pertaining to the pump stations and the desalination plant site as well as the proposed pipeline alignment. The project preliminary CSM is presented in the table below.

Table 6.1: Project Preliminary Conceptual Site Model

Element of CSM	Discussion
Potential sources of contamination	• **Pump station sites:** agricultural activities (potential chemical application, waste burial/disposal, animal disposal); • **Desalination plant site:** agricultural activities (potential chemical application, waste burial/disposal, animal disposal); • **Pipeline route** o Railway Operations o Defence training areas: firing of ordnances, waste disposal, fire training o Olympic Dam mine: EPA Section 83A notification pertaining to fire training areas, listed substances (storage), metal processing, smelting, refining or metallurgical works, mineral processing, metallurgical laboratories or mining or extractive industries. Landfill, desalination plant, transport depot or loading sites, electrical substations o Carrapateena mine access road**:** EPA Section 83A notification pertaining to electrical substations o Mount Gunson Mine: Potential failure of tailings dam with material runoff o ASS risk areas

Element of CSM	Discussion
Chemicals of potential concern associated with PCAs	• **Agricultural activities:** broad range including pesticides, herbicides, heavy metals, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), nutrients; • **Railway operations:** herbicides, pesticides, heavy metals, hydrocarbons, asbestos; • **Defence training areas:** broad range including explosive residues, heavy metals, petroleum hydrocarbons, PFAS; • **ASS risk areas:** heavy metals, pH; • **Olympic Dam and Carrapateena mines:** broad range including heavy metals, petroleum hydrocarbons, acids and alkalis, PFAS, listed substances, polychlorinated biphenyls (PCBs); • **Carrapateena access road (substation sites):** heavy metals, PCBs and petroleum hydrocarbons; • **Mount Gunson mine**: broad range, including heavy metals, PCBs and petroleum hydrocarbons.
Potentially affected media	• Soil is the most likely media to be affected by the identified PCAs. • Groundwater is less likely to be impacted. It is noted there were several S83A notifications in vicinity of the pipeline associated with offsite sources, however, these notifications were considered unlikely to impact the assessed areas. • Soil vapour is less likely to be impacted, given the majority of the COPCs identified were not volatile.
Land use and building design	The project comprises construction of a number of different components which are outlined in the project engineering reference designs[24]. The desalination plant has an approximate footprint of 360 x 600 m (roughly 21.6 ha), with infrastructure (i.e. intake pump station) down to an estimated depth of 13.7 m (relative to the building footprint). The pipeline alignment infrastructure covers approximately 406 km, with infrastructure at approximate depths up to 2700 mm (unless deeper installation is required e.g. at rail or road crossings). The assumed depth of infrastructure for each pump station is not expected to exceed the maximum depth of the pipeline, however have not been specified within the reference design. It is noted that some of the exposure pathways outlined below may have an impact on the project infrastructure (e.g. ASS, UXO, etc)
Geology	Geological descriptions for the pump station sites and the desalination plant site are presented in **Section 4.11**. The proposed pipeline route passes through various geographical areas and future geotechnical assessment will provide further information regarding the geological setting.

[24] GHDb, 2025. *Reference Design Report Northern Water Project,* Ref: 12601676 (Rev 0), GHD, 3 October 2025.

Element of CSM	Discussion
Hydrogeology	Hydrogeology information has been sourced for each pump station site and the desalination plant site from the WaterConnect12 database. Limited information regarding standing water level (SWL) and water quality was available at the sites. One well at Lincoln Gap (permit 6432-988) listed for stock use recorded a SWL of 12 m bgl and a TDS measure of 9556 mg/L/. One well in the vicinity of the pipeline along Carrapateena access road suggests SWL may be at least 30 m bgl in that area. Water quality data for shallow groundwater was had limited data throughout the pipeline. Broader classification of hydrology suggests a wide range salinity (less than 500 mg/L to over 50,000 mg/L). However, regions of lower salinity (where TDS ranges are < 13,000 mg/L) may potentially be suitable for domestic and/or stock uses appear to surround Mullaquana Station, Kalaya and Mangata pump stations.
Human and ecological receptors	The following human receptors were identified under the proposed land uses: • Construction workers (during construction works only) • Operational staff (e.g. at the desalination plant site) • Subsurface maintenance workers The following ecological receptors were identified: • Native flora and fauna • Introduced flora and fauna • Transitory wildlife • Biota supporting ecological processes.
Potential exposure pathways	The following potential exposure pathways have been identified: • Dermal contact with soil • Incidental ingestion of soil • Inhalation of dust • Inhalation of vapours • Acid generation and runoff (if ASS encountered and not management appropriately) • Dermal contact with groundwater • Incidental ingestion of groundwater.

7. Data Gaps

The following data gaps have been identified following the desktop review of historical information documented herein:

- Contamination status of pipeline soils where the railway line is in close proximity (within 80 m);
- Contamination status of pipeline soils in close proximity (within 80 m) to the Carrapateena access road electrical substations; and
- The extent to which ASS may be present within the proposed pipeline alignment.

It is noted that the above is based off a limited PSI assessment, as outlined in the scope provided in **Section 2**, and did not include a full assessment of the project pipeline.

8. Conclusions

Subject to the limitations presented in **Section 9,** the following key outcomes were noted:

Pump station and desalination plant sites

- The proposed pump station and desalination plant sites appear to have been used for farming purposes at the time of this report, with grazing appearing to be the predominant land-use;
- No Class 1 PCAs were identified as potentially being undertaken on the pump station or desalination plant sites, noting that potential Class 2 PCAs relating to general agricultural land use (such as chemical use and animal / waste burial) may have historically occurred at the sites. However, given the absence of these specific PCAs being identified, the overall risk of site contamination being present at the sites is considered to be low; and
- There were generally no current PCAs identified on land areas adjacent the pump stations or desalination plant site (i.e. considering surrounding land use activities), noting that for the purposes of the PSI a limited site inspection was completed as part of the assessment.

Pipeline

Potential for impacts to soil from PCAs were considered at:

- locations where the railway line is in close proximity to the pipeline
- locations in close proximity to the Carrapateena access road electrical transformers
- two locations along / in close proximity to the proposed pipeline where potential acid sulfate soils (PASS) were indicated to be present
- the Olympic Dam, Mount Gunson and Carrapateena Mine sites, all of which have undertaken several PCAs as defined by the EP Regulations (2023) and Practice Direction 14 (SPC 2023). In addition, Olympic Dam and a portion of the Carrapateena access road both have Section 83 notifications affecting or threatening groundwater.
- three locations pertaining to the proposed pipeline alignment where the potential for UXOs was identified – north of Pernatty Lagoon, west of Port Augusta Airport, and between Port Augusta Airport and Whyalla. Defence training areas are classified as Class 2 PCAs under SPC 2023.

Subject to the limitations presented in **Section 9**, the following was concluded:

- The potential for historical practices and activities to have caused site contamination at the pump stations and the desalination plant site is considered to be low
- The potential for historical practices and activities to have caused site contamination along the proposed pipeline alignment is generally considered to be low with the exception of railways operations, Carrapateena access road electrical transformers and PASS, which are considered to have moderate potential to have caused site contamination at relevant locations.
- With the exception of the Carrapateena access road electrical transformers, a review of aerial photography along the proposed pipeline route indicates a low probability of interaction with identified PCAs during construction works. Groundwater may be encountered in areas surrounding the desalination plant where the water table is shallow, or where under boring occurs is proposed. The preparation of a project Construction Environmental Management Plan (CEMP) will assist in management of potential hazards, as well as unexpected finds during construction works.

- A Project specific survey for UXO has been undertaken and concluded that 'no live explosive items were found' and that risk of UXO within 'the surveyed areas are decreased to as low as reasonably practicable'.

Future soil and groundwater testing to establish baseline conditions and whether site contamination is present is proposed by DIT, including an assessment of the potential for ASS. Further classification testing may be required for areas of surplus soils.

A project CEMP is recommended to assist in management of these potential hazards and unexpected finds during construction works.

9. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only and has been based in part on information obtained from the client and other parties. The report has been prepared specifically for the client for the purposes of the commission, and no warranties, express or implied, are offered to any third parties and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. This report should not be amended in any way without prior approval by JBS&G, or reproduced other than in full including all attachments as originally provided to the client by JBS&G.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements or agreed scope of work.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

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Figures

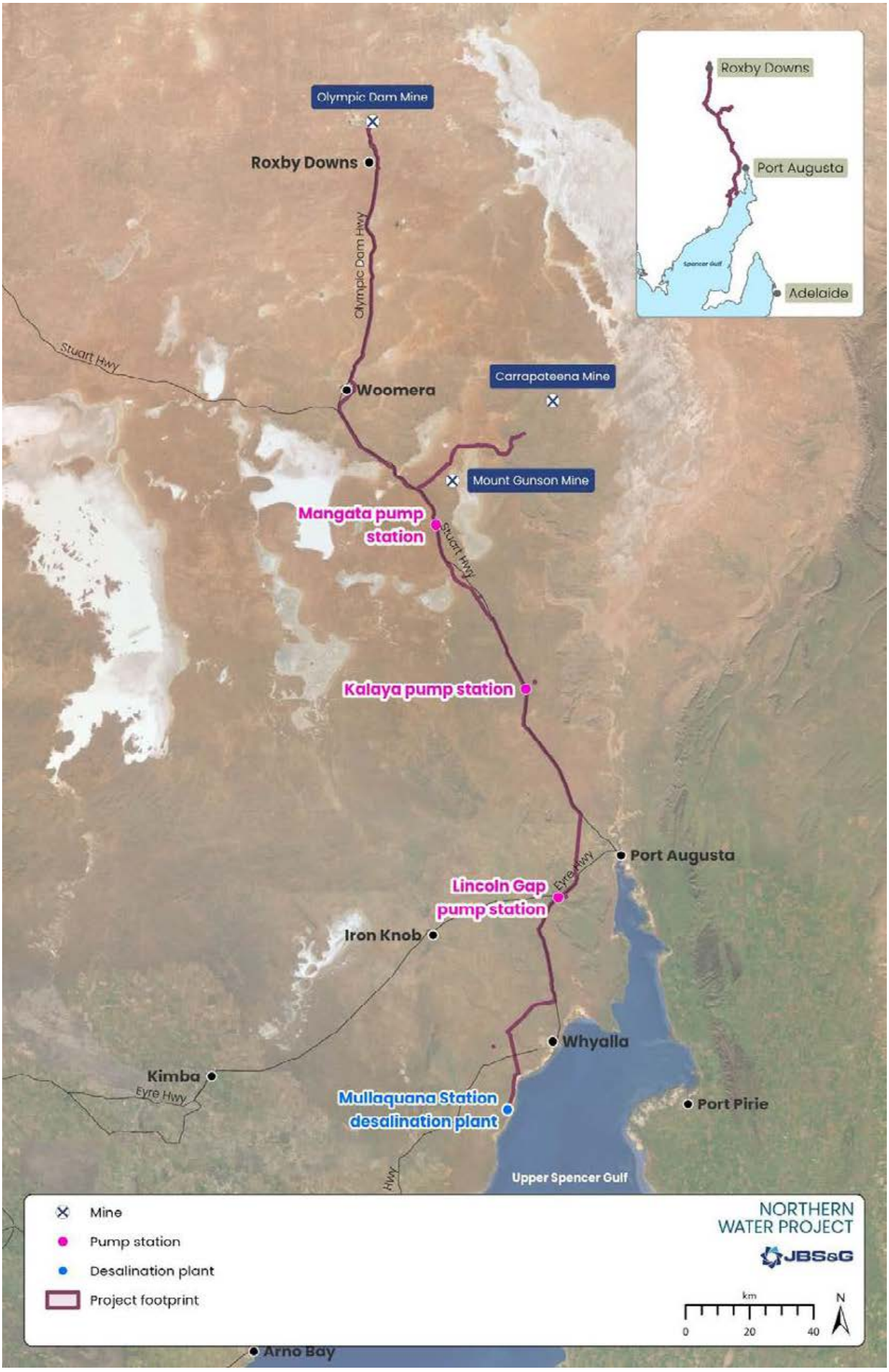


Figure 1: Site Location and Layout



Figure 2: Surrounding Land Uses - Mangata Pump Station



Figure 3: Surrounding Land Uses - Kalaya Pump Station

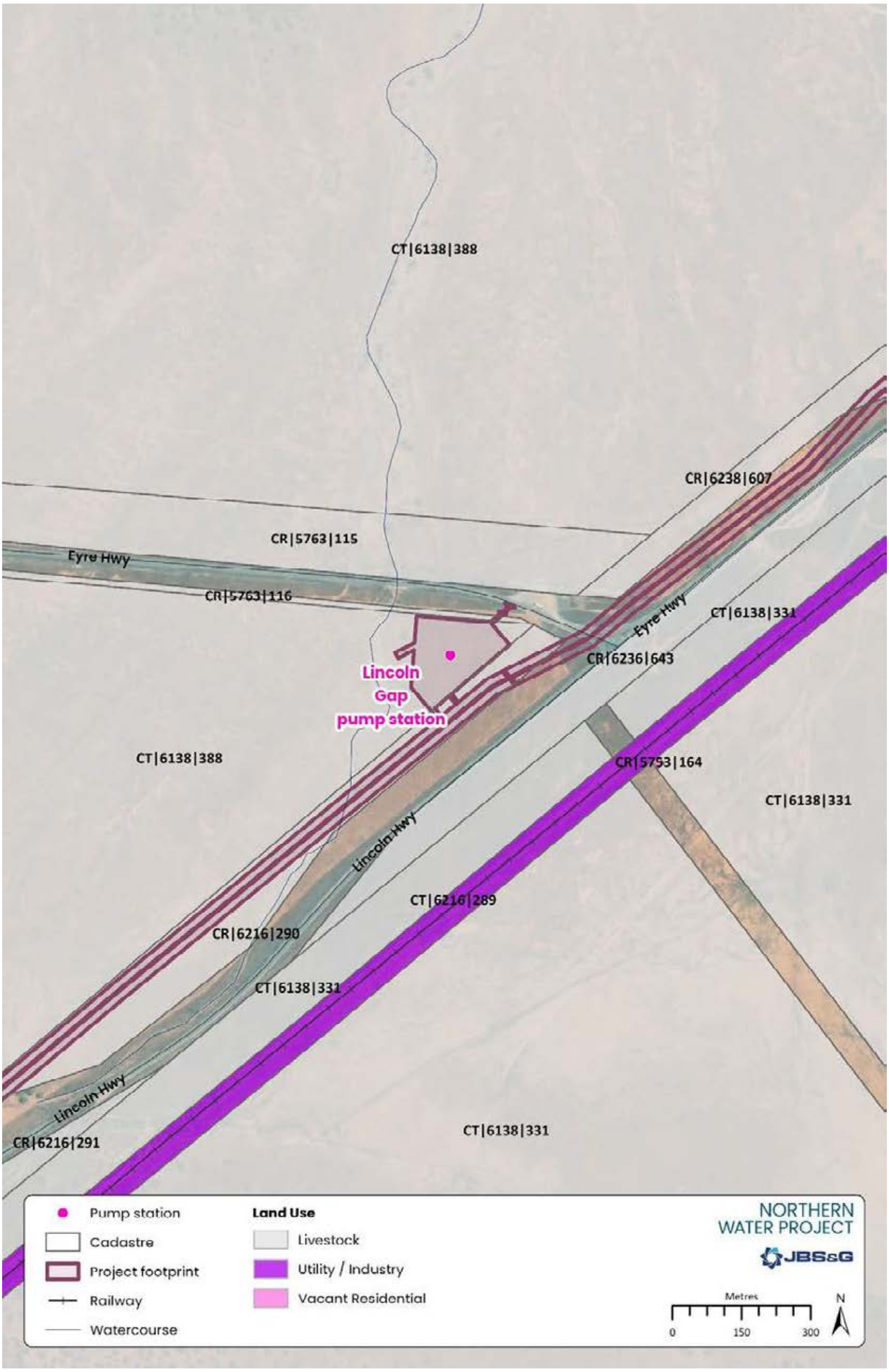


Figure 4: Surrounding Land Uses – Lincoln Gap Pump Station

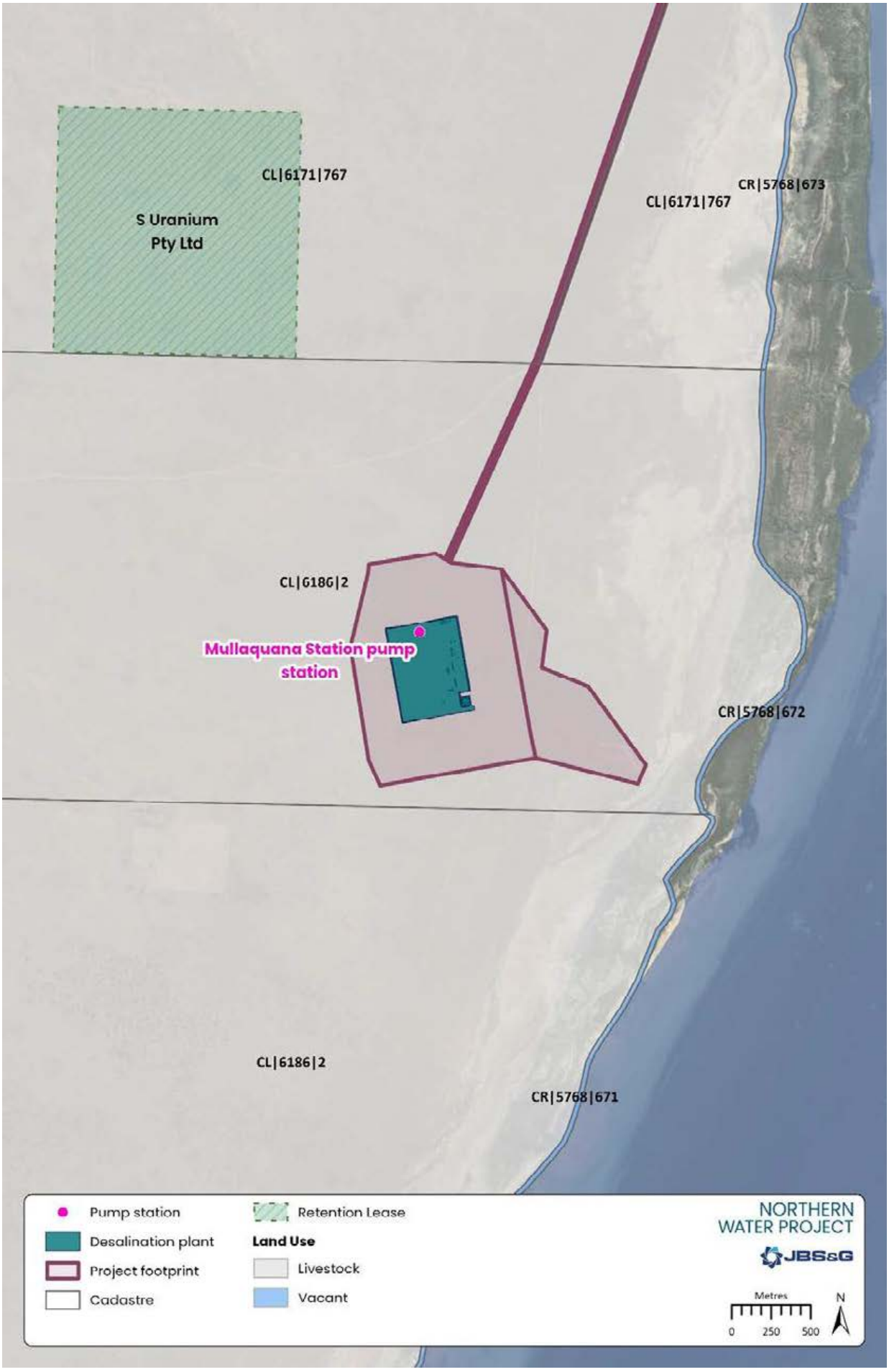


Figure 5: Surrounding Land Uses – Mullaquana Station Desalination Plant Site

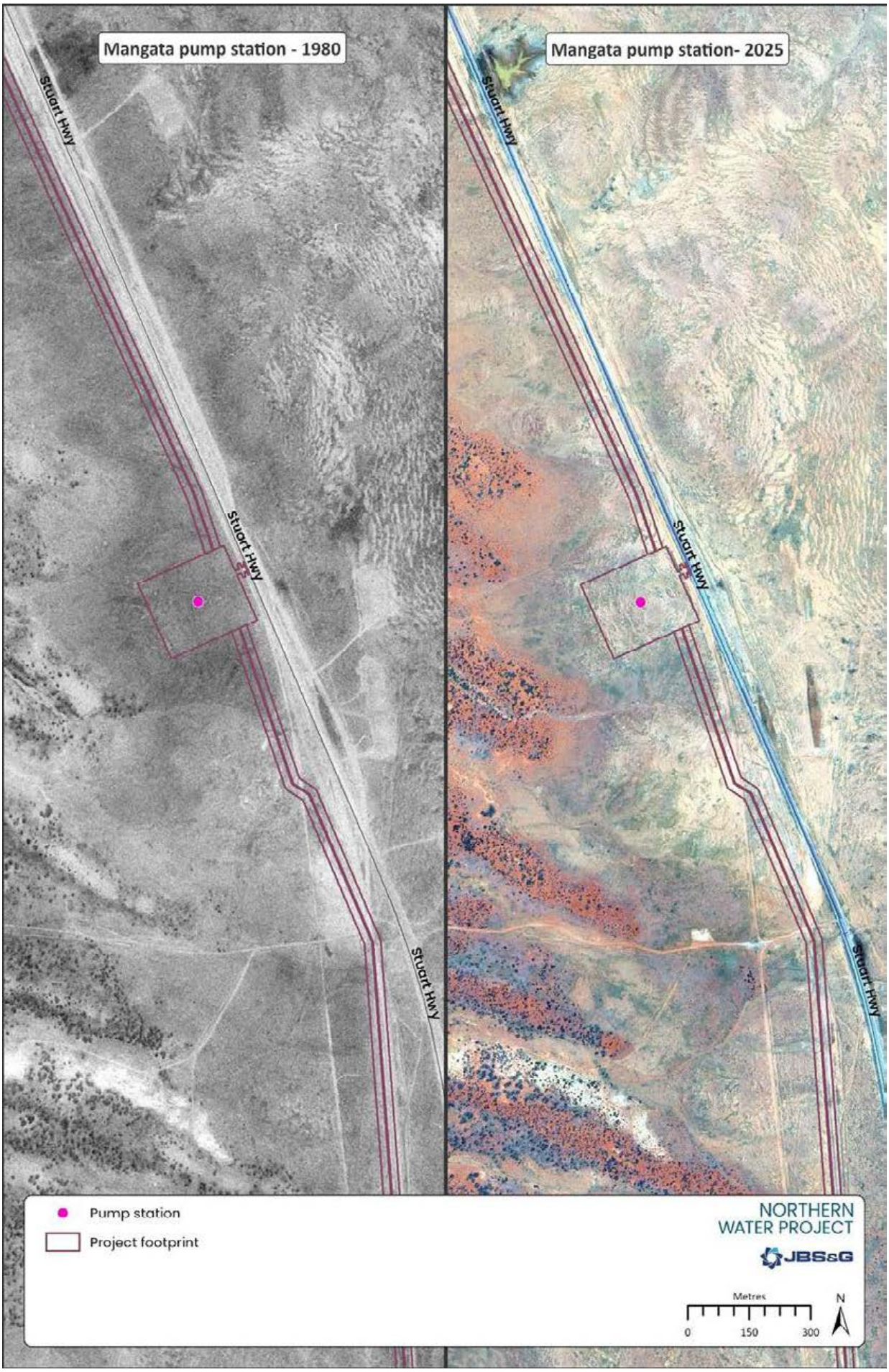


Figure 6: Aerial Photograph Review - Mangata Pump Station

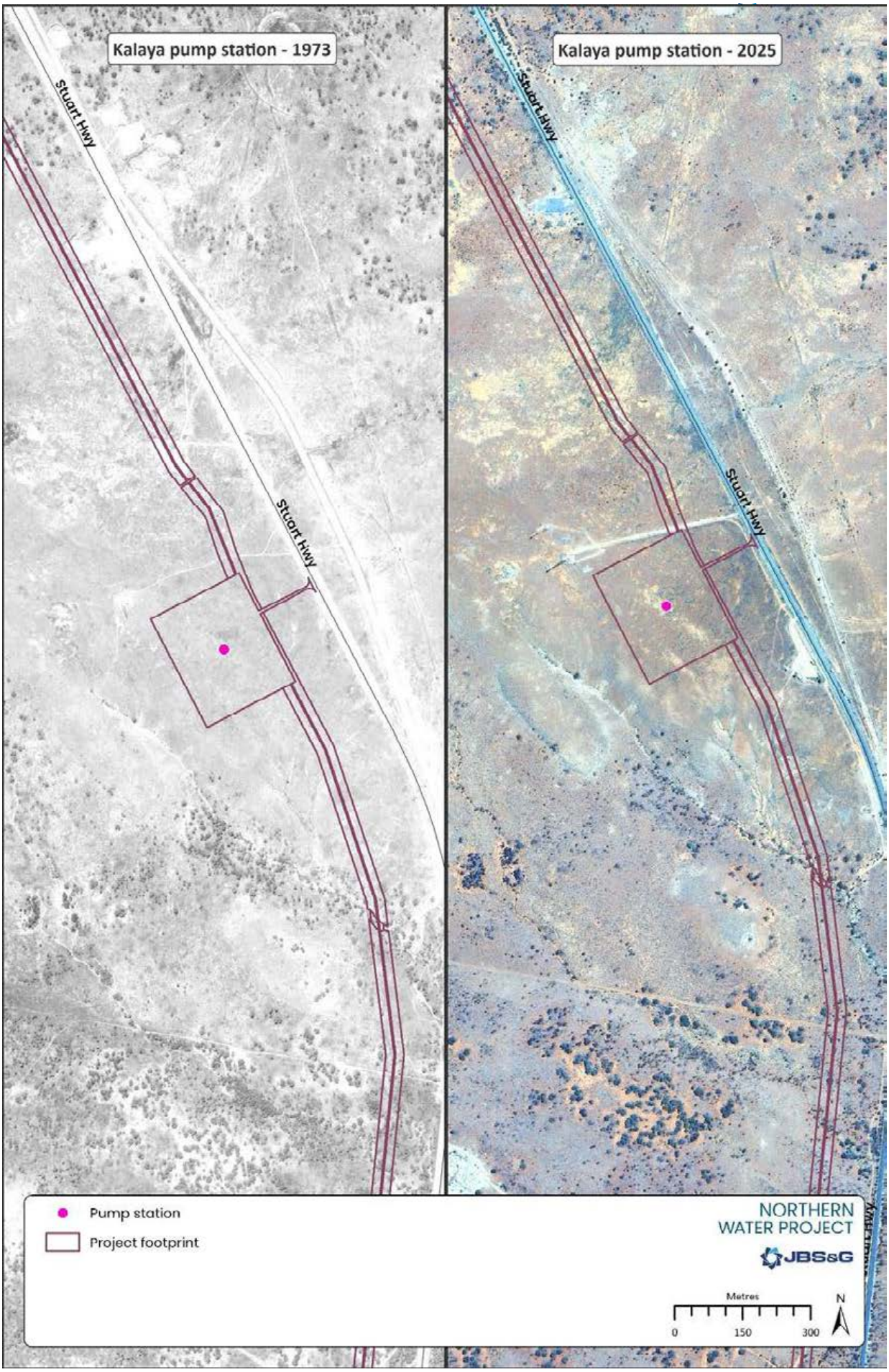


Figure 7: Aerial Photograph Review – Kalaya Pump Station

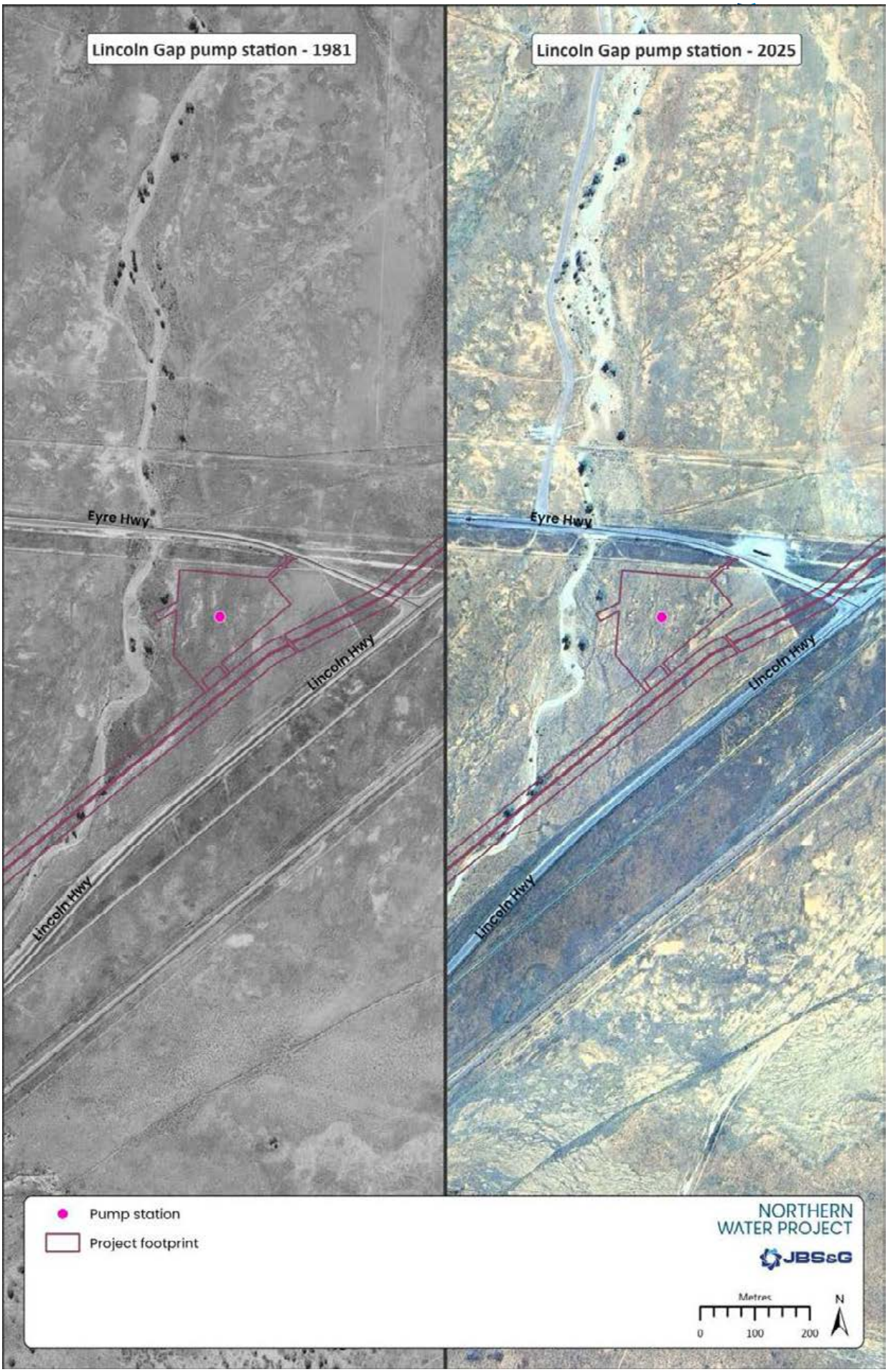


Figure 8: Aerial Photograph Review – Lincoln Gap Pump Station

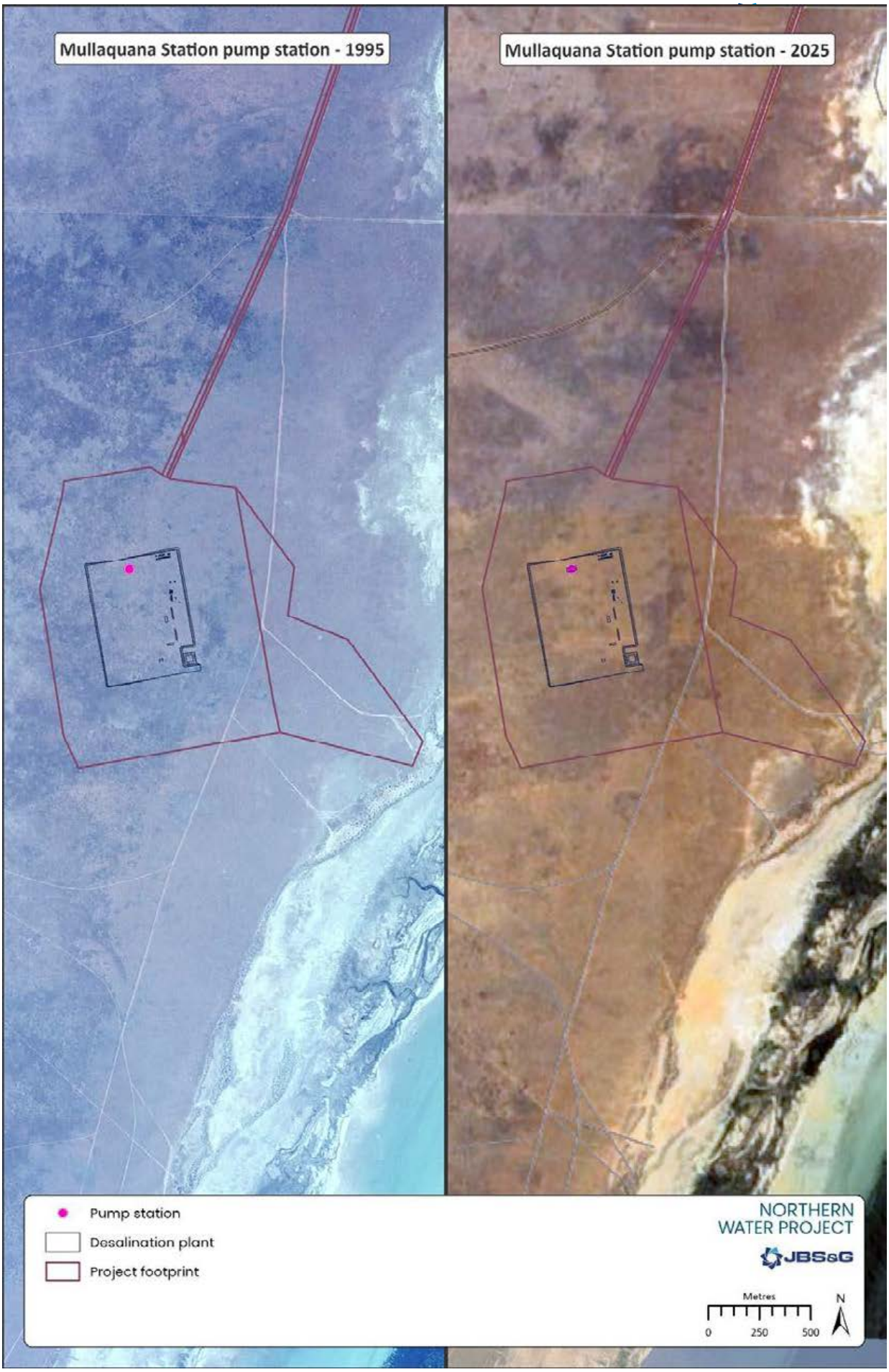


Figure 9: Aerial Photograph Review – Mullaquana Station Desalination Plant Site

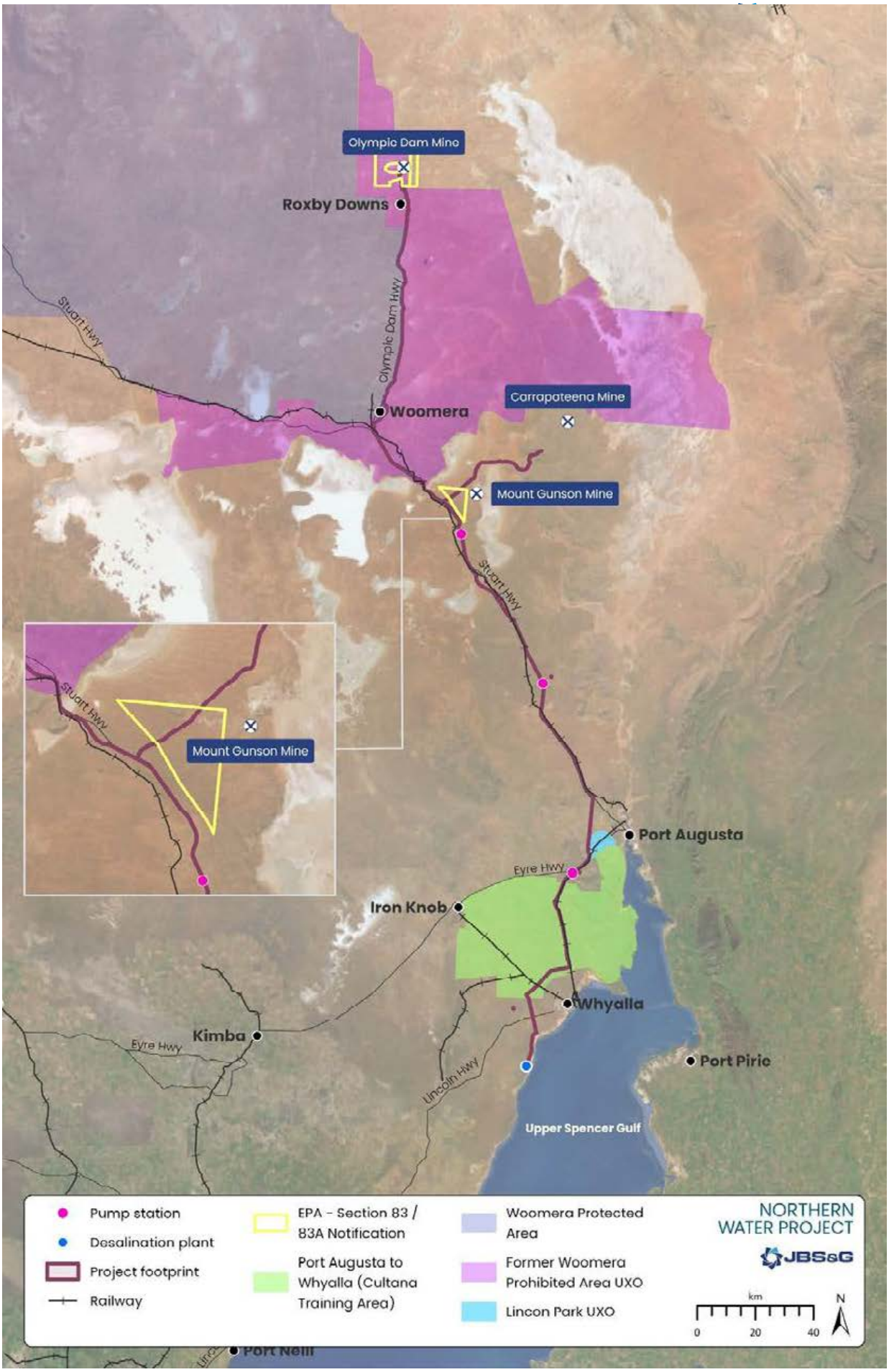


Figure 10: Potentially Contaminating Activities

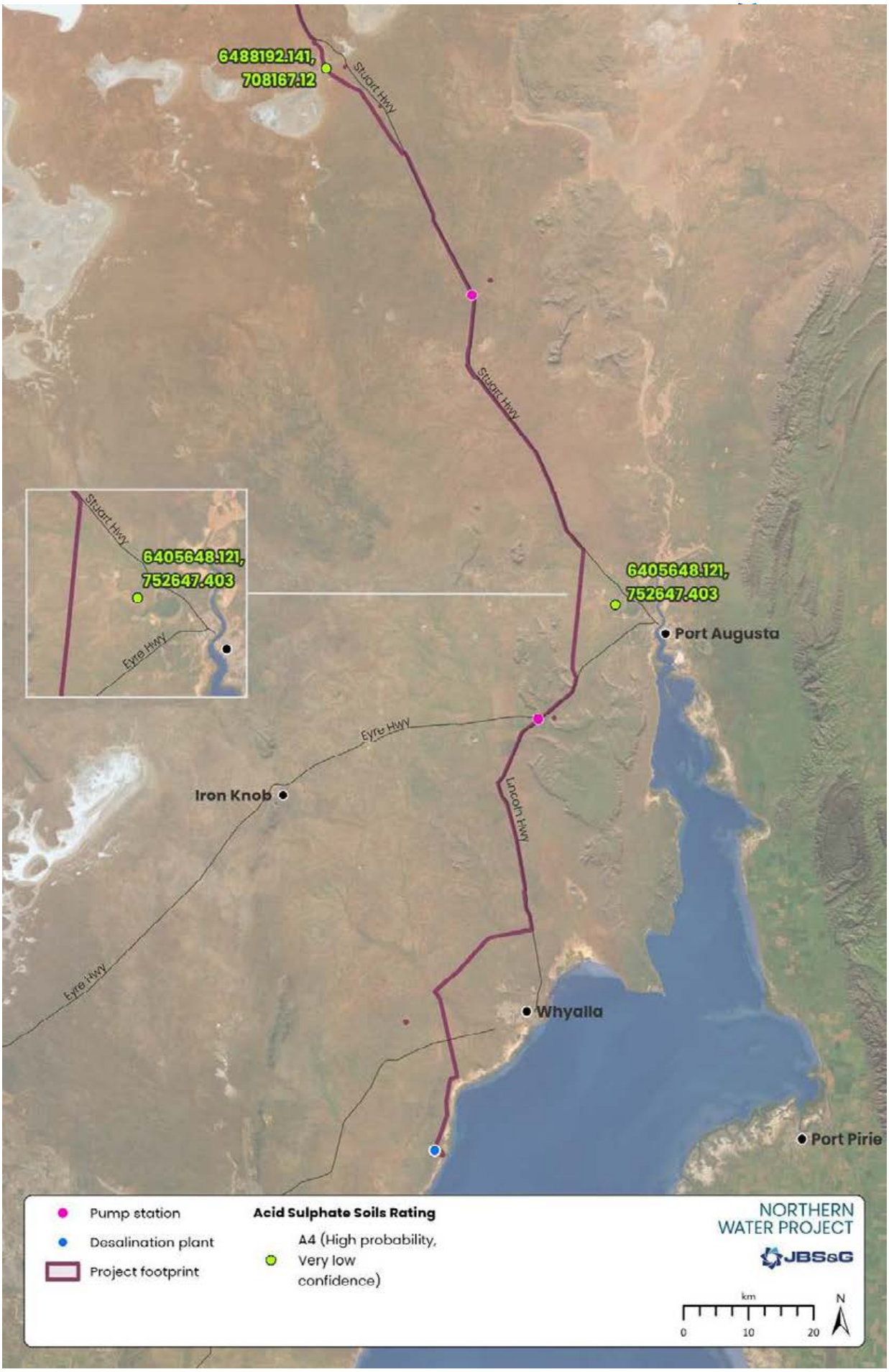


Figure 11: Potential Acid Sulfate Soils Risk Areas – southern section



Figure 12: Potential Acid Sulfate Soils Risk Areas – northern section

Appendix A Current Certificates of Title

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Product	Register Search (CL 6178/725)
Date/Time	02/04/2024 01:05PM
Customer Reference	63753 AJ
Order ID	20240402006137

This Crown Lease Register Search is a true and correct extract of the Register of Crown Leases maintained by the Registrar-General.

Pastoral Leases are granted and administered pursuant to the Pastoral Land Management and Conservation Act 1989 by the Department for Environment and Water.

Crown Lease - Volume 6178 Folio 725

Parent Title(s) CL 1298/7

Creating Dealing(s) RT 12566182

Title Issued 12/08/2016 **Edition** 4 **Edition Issued** 09/03/2022

Estate Type

CROWN LESSEE

Owner

THE CROWN

Crown Lessee

COONDAMBO NOMINEES PTY. LTD. (ACN: 169 615 749)
OF PRIVATE BAG 15 PORT AUGUSTA SA 5700

Description of Land

ALLOTMENT COMPRISING PIECES 1, 2, 3, 4, 5, 6, 7, 8, 9 AND 10 DEPOSITED PLAN 47746
IN THE AREA NAMED OAKDEN HILLS
OUT OF HUNDREDS (TORRENS)

TOTAL AREA: 1600KM² (APPROXIMATE)

Lease Details

Lease Number	PE002377
Lease Type	PASTORAL
Commencing On	07/03/1990
Expiring On	01/10/2056

Conditions

CROWN LEASE CONDITIONS VIDE CL 1298/7

Easements

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED A ON D47746 TO THE COMMONWEALTH OF AUSTRALIA (TT 8252760)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED W ON D47746 TO THE COMMONWEALTH OF AUSTRALIA (TT 8252760)

SUBJECT TO EASEMENT(S) WITH LIMITATIONS OVER THE LAND MARKED E AND P ON D47746 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) EXPIRING ON 21/07/2035 (GU 7656514)

Schedule of Dealings

Dealing Number	Description

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13222608	CAVEAT BY TELSTRA CORPORATION LTD. (ACN: 051 775 556) OVER PORTION (AREA A IN F254902)
13728686	MORTGAGE TO BENDIGO & ADELAIDE BANK LTD. (ACN: 068 049 178)

Notations

Dealings Affecting Title NIL

Priority Notices NIL

Registrar-General's Notes

UNAPPROVED FILED PLAN FOR LEASE PURPOSES FX251888
APPROVED FILED PLAN FOR LEASE PURPOSES FX252599
APPROVED FILED PLAN FOR LEASE PURPOSES FX254040
APPROVED FILED PLAN FOR LEASE PURPOSES FX254902
APPROVED D121088
APPROVED FX257924
APPROVED FX33297
APPROVED FX39695

Administrative Interests NIL

Additional Information

This additional information is provided by the Department for Environment and Water and does not constitute part of the Crown Leases Register maintained by the Registrar-General. Contact the Department for Environment and Water to verify the currency of this information and to obtain further details.

Related Leases

Related Leases:

Maximum Stocking Rate: 14,000 Sheep Equivalents

Annual Rent

Annual Rent: $7600

Rent Review: Rent to be review no later than 01/12/2016

Schedule of Interests

Licence Number	Description
OL055861	ANNUAL LICENCE TO OZ MINERALS SERVICES PTY. LTD. (ACN: 629 461 481) FOR INFRASTRUCTURE PURPOSES COMMENCING ON 01/11/2019 AND EXPIRING ON 31/10/2029
OL055955	ANNUAL LICENCE TO ELECTRANET PTY. LTD (ACN: 094 482 416) FOR INFRASTRUCTURE PURPOSES COMMENCING ON 08/04/2019 AND EXPIRING ON 07/04/2029

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Product	Historical Search
Date/Time	02/04/2024 01:05PM
Customer Reference	63753 AJ
Order ID	20240402006137

Crown Lease

Title Reference: CL 6239/126

Status: CURRENT

Parent Title(s): CL 6213/672

Dealing(s) Creating Title: RTD 13306930

Title Issued: 26/06/2020

Edition: 1

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
14/02/2011	20/05/2011	11536766	MORTGAGE	REGISTERED	AUSTRALIA & NEW ZEALAND BANKING GROUP LTD.

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Product	Historical Search
Date/Time	02/04/2024 01:05PM
Customer Reference	63753 AJ
Order ID	20240402006137

Crown Record

Title Reference: CR 5564/915

Status: CURRENT

Parent Title(s):

Dealing(s) Creating Title: RT 8534359

Title Issued: 13/08/1998

Edition: 4

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
28/05/2020	09/06/2020	13307589	VESTING (GLOBAL PROPRIETORSHIP UPDATE)	REGISTERED	MINISTER FOR ENVIRONMENT AND WATER
26/06/2012	11/05/2013	11780169	VESTING	REGISTERED	MINISTER FOR SUSTAINABILITY, ENVIRONMENT AND CONSERVATION

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Product	Historical Search
Date/Time	02/04/2024 01:05PM
Customer Reference	63753 AJ
Order ID	20240402006137

Crown Lease

Title Reference: CL 6204/748

Status: CURRENT

Parent Title(s): CL 1296/32

Dealing(s) Creating Title: RT 12842628

Title Issued: 09/03/2018

Edition: 2

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
26/02/2024	13/03/2024	14226192	TRANSFER OF LEASE	REGISTERED	AUSTRALIA TOWER NETWORK PTY. LTD. (ACN: 643 875 165) 12876884
14/02/2018	28/03/2018	12876884	LEASE	REGISTERED	OPTUS MOBILE PTY. LTD. (ACN: 054 365 696)

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REAL PROPERTY ACT, 1886 South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

REGISTRAR-GENERAL SOUTH AUSTRALIA

Certificate of Title - Volume 6306 Folio 522

Parent Title(s) CT 6138/388

Creating Dealing(s) RT 14357843

Title Issued 17/10/2024 **Edition** 1 **Edition Issued** 17/10/2024

Estate Type

FEE SIMPLE

Registered Proprietor

NUTT BROS NOMINEES PTY. LTD. (ACN: 079 738 659)
OF PRIVATE BAG 15 PORT AUGUSTA SA 5700

Description of Land

SECTION 8
HUNDRED OF HANDYSIDE
IN THE AREA NAMED LINCOLN GAP

Easements

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED D FOR WATER SUPPLY PURPOSES TO SOUTH AUSTRALIAN WATER CORPORATION (TG 11439438)

Schedule of Dealings

Dealing Number	Description
9404306	MORTGAGE TO BENDIGO & ADELAIDE BANK LTD. (ACN: 068 049 178)
12841089	LEASE TO LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595) COMMENCING ON 07/11/2017 AND EXPIRING ON 06/11/2037
12841090	MORTGAGE OF LEASE 12841089 TO NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937)

Notations

Dealings Affecting Title	NIL
Priority Notices	NIL
Notations on Plan	NIL
Registrar-General's Notes	NIL
Administrative Interests	NIL

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Product	Historical Search
Date/Time	13/05/2025 08:35AM
Customer Reference	63753 PY
Order ID	20250513000624

Certificate of Title

Title Reference: CT 6306/522

Status: CURRENT

Parent Title(s): CT 6138/388

Dealing(s) Creating Title: RT 14357843

Title Issued: 17/10/2024

Edition: 1

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
06/12/2017	19/12/2017	12841090	MORTGAGE OF LEASE	REGISTERED	NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937) 12841089
06/12/2017	19/12/2017	12841089	LEASE	REGISTERED	LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595)
13/08/2002	02/09/2002	9404306	MORTGAGE	REGISTERED	RURAL BANK LTD.

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Crown Lease

Title Reference: CL 6186/2

Status: CURRENT

Parent Title(s): CL 547/97

Dealing(s) Creating Title: RT 12635739

Title Issued: 18/01/2017

Edition: 3

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
08/06/2022	01/07/2022	13805465	DISCHARGE OF MORTGAGE	REGISTERED	13486137
18/03/2021	01/04/2021	13486137	MORTGAGE	REGISTERED	NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937)
18/03/2021	01/04/2021	13486136	TRANSFER	REGISTERED	JOYCE PASTORAL PTY. LTD. (ACN: 645 913 435)
18/03/2021	01/04/2021	13486135	DISCHARGE OF MORTGAGE	REGISTERED	10446893
26/04/2006	16/05/2006	10446893	MORTGAGE	REGISTERED	ELDERS RURAL BANK LTD.

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Appendix B Site inspection Photolog

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LANDSCAPE SURROUNDING PROPOSED DESALINATION STATION LOCATION



LANDSCAPE SURROUNDING PROPOSED DESALINATION STATION LOCATION



COASTAL ENVIRONMENT SURROUNDING TUNNEL OUTLET



COASTAL ENVIRONMENT SURROUNDING TUNNEL OUTLET

JBS&G



COASTAL ENVIRONMENT SURROUNDING TUNNEL OUTLET



COASTAL ENVIRONMENT SURROUNDING TUNNEL OUTLET



MULLAQUANA STATION - GEOTECH DRILLING



MULLAQUANA STATION - EXCAVATION



MULLAQUANA STATION RESIDENTIAL AND AGRICULTURAL STRUCTURES



MULLAQUANA STATION - GROUNDWATER WELL



LANDSCAPE SURROUNDING PROPOSED LINCOLN GAP PUMP STATION



LANDSCAPE SURROUNDING PROPOSED LINCOLN GAP PUMP STATION



WATER TANKS IN VICINITY OF LINCOLN GAP PUMP STATION



SUBSTATION NEARBY LINCOLN GAP PUMP STATION



LANDSCAPE SURROUNDING PROPOSED KALAYA PUMP STATION



LANDSCAPE SURROUNDING PROPOSED KALAYA PUMP STATION



LANDSCAPE SURROUNDING PROPOSED KALAYA PUMP STATION



RECEPTION TOWER NORTHWEST TO THE PROPOSED KALAYA PUMP STATION

JBS&G



LANDSCAPE SURROUNDING PROPOSED MANGATA PUMP STATION



LANDSCAPE SURROUNDING PROPOSED MANGATA PUMP STATION



NORTHERN MULLAQUANA PIPELINE SECTION - SURROUNDING LANDSCAPE



NORTHERN MULLAQUANA PIPELINE SECTION - SURROUNDING LANDSCAPE



COWLEDS LANDING PIPELINE SECTION - SURROUNDING LANDSCAPE



MYALL CREEK PIPELINE SECTION - SURROUNDING LANDSCAPE

JBS&G



MYALL CREEK PIPELINE SECTION - SURROUNDING LANDSCAPE & DEFENCE PROHIBITED AREA



LINCOLN GAP PIPELINE SECTION – SURROUNDING LANDSCAPE



STUART HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



STUART HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



STUART HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



STUART HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



CARAPATEENA ENTRY PIPELINE SECTION – SURROUNDING LANDSCAPE



CARAPATEENA ENTRY PIPELINE SECTION – SURROUNDING LANDSCAPE



STUART HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



STUART HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



PHILLIPS PONDS RUINS PIPELINE SECTION – SURROUNDING LANDSCAPE



PHILLIPS PONDS RUINS PIPELINE SECTION – SURROUNDING LANDSCAPE

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PHILLIPS PONDS RUINS PIPELINE SECTION – SURROUNDING LANDSCAPE



ARCAROONA STATION ROAD PIPELINE SECTION - SURROUNDING LANDSCAPE



ARCAROONA STATION ROAD PIPELINE SECTION - SURROUNDING LANDSCAPE



OLYMPIC DAM HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



OLYMPIC DAM HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



OLYMPIC DAM HIGHWAY PIPELINE SECTION – SURROUNDING LANDSCAPE



ANDAMOOKA ROAD PIPELINE SECTION – SURROUNDING LANDSCAPE



ANDAMOOKA ROAD PIPELINE SECTION – SURROUNDING LANDSCAPE



BOREFIELD ROAD PIPELINE SECTION – SURROUNDING LANDSCAPE



BOREFIELD ROAD PIPELINE SECTION – SURROUNDING LANDSCAPE



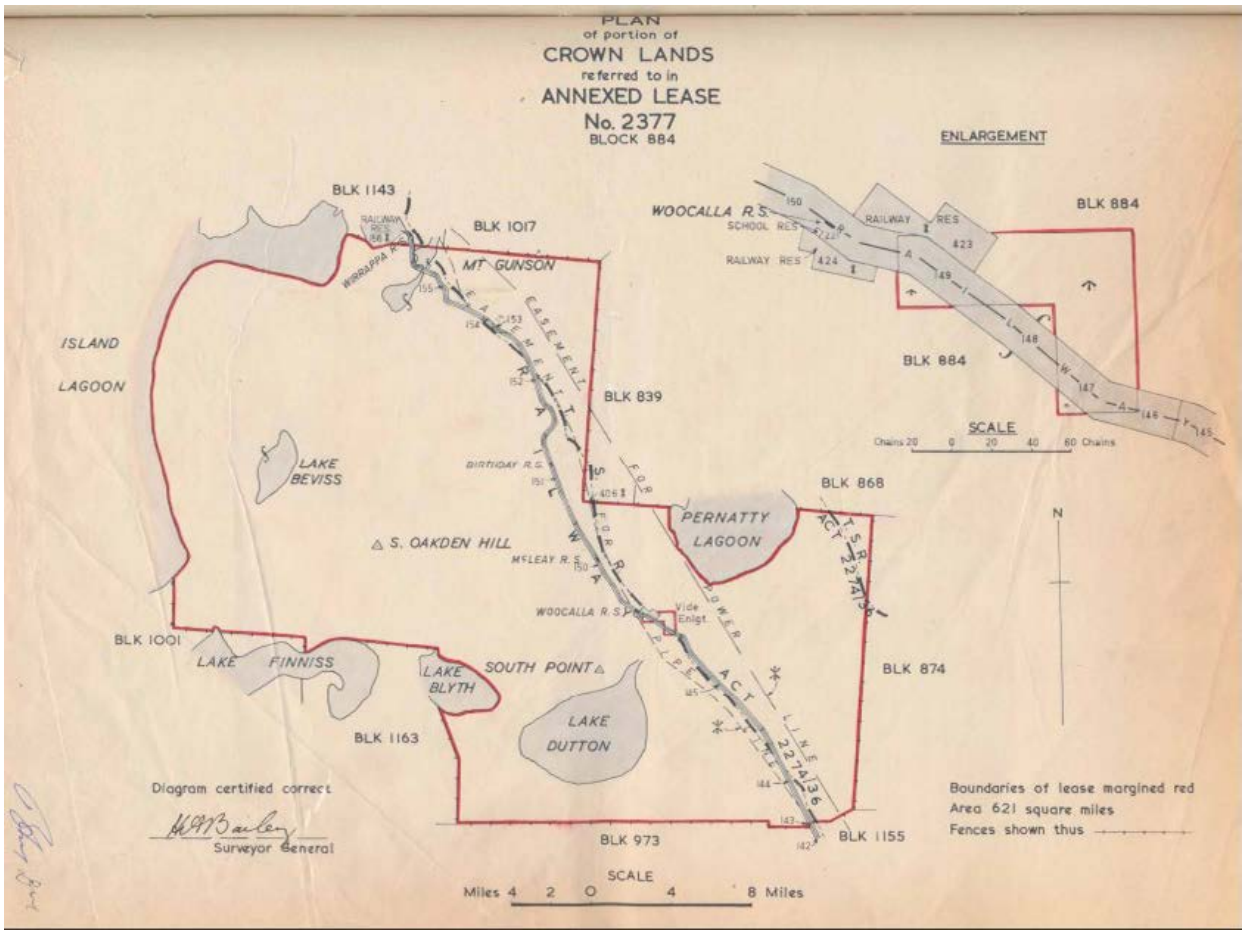
BOREFIELD ROAD PIPELINE SECTION – SURROUNDING LANDSCAPE

Appendix C Historical Ownership Summary

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CT History - CL Vol 6178 Folio 725

Property Description	Certificate of Title	Parent Title	Date	Details
Deposited Plan 47746, Queens Parcel 8, Hundred of Torrens, Area named Oakden Hills	CL Vol 487, Folio 115	-	23/1/1904	John Beviss, Walter Ives & Charles Marsh Ives (sheep farmers)
			24/3/1904	Transfer to Walter Ives & Charles Marsh Ives
			23/1/1912	Transfer to Walter Ives & James George Mosely of part
			29/10/1914	Transfer to Walter Ives & Charles Marsh Ives
			30/6/1920	Transfer to Hurtle Nunn Kidman (grazier) & George Jackville Kidman
			22/12/1926	Transfer to Oakden Hills Limited
	CL Vol 821, Folio 42	CL Vol 487, Folio 115	21/11/1934	Oakden Hill Limited
			24/6/1937	Transfer to Nonning Pastoral Company Ltd
	CL Vol 1105 Folio 6	CL Vol 821, Folio 42	11/10/1951	Nonning Pastoral Company Ltd
	CL Vol 1298 Folio 7	CL Vol 1105 Folio 6	27/3/1964	Nonning Pastoral Company P/L
			15/9/1988	Transfer to Andrew Donald McTaggart (Grazier) & Penelope Anne McTaggart
			13/8/2002	Transfer to Nutt Bros Nominees P/L
	CL Vol 6178 Folio 725	CL Vol 1298 Folio 7	12/8/2016	Nutt Bros Nominees P/L
			9/3/2022	Transfer to Bruce Graeme Nutt & Lloyd Wilton Nutt
			9/3/2022	Transfer to Coondambo Nominees Pty Ltd Annual license to OZ Minerals Services Pty Ltd for infrastructure purposes 1/11/2019 to 31/10/2029 Annual license to Electranet Pty Ltd for infrastructure purposes 8/4/2019 to 7/4/2029


PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
No. 2377
BLOCK 884
ENLARGEMENT
BLK 1143
BLK 1017
MT GUNSON
WOOCALLA R.S.
BLK 884
RAILWAY RES
SCHOOL RES
ISLAND
LAGOON
EASEMENT
BLK 839
LAKE BEVISS
BIRTHDAY R.S.
S. OAKDEN HILL
McLEAY R.S.
PERNATTY LAGOON
BLK 868
WOOCALLA R.S.
BLK 1001
LAKE FINNISS
LAKE BLYTH
SOUTH POINT
LAKE DUTTON
BLK 874
BLK 1163
BLK 973
BLK 1155
SCALE
Chains 20 0 20 40 60 Chains
N
Diagram certified correct
W.A.T. Bailey
Surveyor General
Boundaries of lease margined red
Area 621 square miles
Fences shown thus
SCALE
Miles 4 2 0 4 8 Miles

Product	Register Search (CL 6178/725)
Date/Time	02/04/2024 01:05PM
Customer Reference	63753 AJ
Order ID	20240402006137

This Crown Lease Register Search is a true and correct extract of the Register of Crown Leases maintained by the Registrar-General.

Pastoral Leases are granted and administered pursuant to the Pastoral Land Management and Conservation Act 1989 by the Department for Environment and Water.

Crown Lease - Volume 6178 Folio 725

Parent Title(s) CL 1298/7

Creating Dealing(s) RT 12566182

Title Issued 12/08/2016 **Edition** 4 **Edition Issued** 09/03/2022

Estate Type

CROWN LESSEE

Owner

THE CROWN

Crown Lessee

COONDAMBO NOMINEES PTY. LTD. (ACN: 169 615 749)
OF PRIVATE BAG 15 PORT AUGUSTA SA 5700

Description of Land

ALLOTMENT COMPRISING PIECES 1, 2, 3, 4, 5, 6, 7, 8, 9 AND 10 DEPOSITED PLAN 47746
IN THE AREA NAMED OAKDEN HILLS
OUT OF HUNDREDS (TORRENS)

TOTAL AREA: 1600KM² (APPROXIMATE)

Lease Details

Lease Number	PE002377
Lease Type	PASTORAL
Commencing On	07/03/1990
Expiring On	01/10/2056

Conditions

CROWN LEASE CONDITIONS VIDE CL 1298/7

Easements

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED A ON D47746 TO THE COMMONWEALTH OF AUSTRALIA (TT 8252760)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED W ON D47746 TO THE COMMONWEALTH OF AUSTRALIA (TT 8252760)

SUBJECT TO EASEMENT(S) WITH LIMITATIONS OVER THE LAND MARKED E AND P ON D47746 TO DISTRIBUTION LESSOR CORPORATION (SUBJECT TO LEASE 8890000) EXPIRING ON 21/07/2035 (GU 7656514)

Schedule of Dealings

Dealing Number	Description

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13222608	CAVEAT BY TELSTRA CORPORATION LTD. (ACN: 051 775 556) OVER PORTION (AREA A IN F254902)
13728686	MORTGAGE TO BENDIGO & ADELAIDE BANK LTD. (ACN: 068 049 178)

Notations

Dealings Affecting Title NIL

Priority Notices NIL

Registrar-General's Notes

UNAPPROVED FILED PLAN FOR LEASE PURPOSES FX251888
APPROVED FILED PLAN FOR LEASE PURPOSES FX252599
APPROVED FILED PLAN FOR LEASE PURPOSES FX254040
APPROVED FILED PLAN FOR LEASE PURPOSES FX254902
APPROVED D121088
APPROVED FX257924
APPROVED FX33297
APPROVED FX39695

Administrative Interests NIL

Additional Information

This additional information is provided by the Department for Environment and Water and does not constitute part of the Crown Leases Register maintained by the Registrar-General. Contact the Department for Environment and Water to verify the currency of this information and to obtain further details.

Related Leases

Related Leases:

Maximum Stocking Rate: 14,000 Sheep Equivalents

Annual Rent

Annual Rent: $7600

Rent Review: Rent to be review no later than 01/12/2016

Schedule of Interests

Licence Number	Description
OL055861	ANNUAL LICENCE TO OZ MINERALS SERVICES PTY. LTD. (ACN: 629 461 481) FOR INFRASTRUCTURE PURPOSES COMMENCING ON 01/11/2019 AND EXPIRING ON 31/10/2029
OL055955	ANNUAL LICENCE TO ELECTRANET PTY. LTD (ACN: 094 482 416) FOR INFRASTRUCTURE PURPOSES COMMENCING ON 08/04/2019 AND EXPIRING ON 07/04/2029

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South Australia

Register Book, Vol. 1298 Folio 7

B. Nelson Hayter Deputy Registrar-General.

Crown Lease

PASTORAL No. 2377

Pursuant to Section 46A of the Pastoral Act 1936-1960

In lieu of surrendered Lease No. 2119 (Part Of) Register Book Volume 1105 Folio 6

Her Majesty the Queen doth hereby lease to NONNING PASTORAL COMPANY PROPRIETARY LIMITED whose register

is situate C/- Giles Magarey and Lloyd 97 King William Street Adelaide its Successors

~~his Executors Administrators~~ and Assigns (all of whom are hereinafter included in the term "lessee") for pastoral purposes all that land containing six hundred and twenty one (621)

square miles or thereabouts and situate and being Block 884 forty five (45) miles north west of Port Augusta known as "Oakden Hills"

as the same is delineated in the public maps deposited in the Land Office in the City of Adelaide and in the plan annexed hereto (hereinafter called "the land") to be held by the lessee from the twenty seventh day of March

one thousand nine hundred and sixty four until the twenty sixth day of March

two thousand and six at the yearly rent of one thousand six hundred and fifty three pounds and eight shillings (£1653: 8: 0)

for the first period of seven years to be paid in advance on the twenty seventh day of March in each year the rent for the succeeding periods of the term of the lease to be fixed by the Pastoral Board and subject to the reservations covenants and conditions stated below and to such further reservations covenants and conditions as may be implied by law

The Minister of Lands.

By command,

Director of Lands.

Certified correct,

EXD.
D.I., 2705/61.
Term 42 years.
Surrender.
Act 1936-1960.

RESERVATIONS

1. **EXCEPT AND RESERVED** out of this lease all gold silver copper tin and other metals all ores and other substances containing metals all minerals and all gems and precious stones coal and mineral oils live and dead timber stone and sand upon in or under the said land to Her Majesty the Queen Her Heirs and Successors and all persons lawfully claiming under or authorized by her or them **PROVIDED** that the lessee may fell cut down and remove any dead timber stone and sand required for improvements to be constructed or firewood to be used for domestic use upon the land **AND** the Governor and The Minister of Lands (hereinafter called "the Minister") and all persons lawfully claiming under or authorized by them or either of them shall have all necessary rights of access search procuration and removal of all or any of the said excepted and reserved things and all incidental rights and powers and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **AND ALSO** reserved to the Governor and all persons authorized by him or other lawful authority the right at any time or from time to time with all necessary vehicles implements and things to enter upon the land and to come and go for the purpose of laying out and making fit for and devoting to the public use any existing new or additional roads ways and paths **AND ALSO** reserved to Aboriginal Inhabitants of the said State and their descendants full and free right of access into upon over and from the said land except such parts as improvements have been erected upon and in and to the springs and surface waters thereon and to make and erect wurlies and other native dwellings and to take and use for food birds and animals *ferae naturae* as if this lease had not been made **AND ALSO** reserved to all persons the rights of using all and every the roads paths and ways heretofore made and used by them or hereafter to be made and dedicated to the public use **AND ALSO** of crossing the said land with travelling stock subject to the provisions of any Act regulating travelling stock

COVENANTS

2. The Lessee must—

i. Pay the said rent annually in advance **PROVIDED** that a penalty of Ten Pounds per centum per annum may be added to any rent in arrear

ii. Pay any amounts due or becoming due on account of wire-netting vermin rates wild dog rates and dog fence rates

iii. Stock the land with sheep cattle or sheep and cattle combined so that for every square mile leased there shall be five head of sheep or one head of cattle and during the term of the lease keep the land so stocked and when required furnish the Minister and the Pastoral Board with true particulars of the number of such stock **PROVIDED** that the number of stock shall not at any time during the term of the lease without the consent in writing of the Minister exceed 3600 head of cattle or the equivalent number in sheep or sheep and cattle combined

iv. Comply with any notice in writing from the Minister to reduce the number of stock within the time specified in such notice and comply with any other restrictions specified in the notice

v. Forthwith commence to destroy and during the term of the lease use reasonable means to keep the land free from vermin to the satisfaction of the Minister or the Pastoral Board

vi. Make and furnish all such statements and returns as are required by any Act rule or regulation for the time being in force

vii. Comply with and observe the Regulations for the time being in force under the said Pastoral Act or any amendment thereof

viii. Expend such amount as is necessary to ensure that the value of the improvements on the land by the end of the fifth year of the term of the lease will be not less than twenty five pounds per square mile by the end of the thirteenth year not less than forty pounds per square mile and by the end of the twenty-first year not less than sixty pounds per square mile and maintain such improvements ~~(which include those effected pursuant to Covenant 2 ix. hereof)~~ in good order and condition during the term of the lease **PROVIDED** that such amount expended on improvements shall not include any money advanced by any body or person on behalf of the Crown for vermin proof or dog proof fencing and expended for that purpose

COVENANTS—continued

ix. ~~Effect the undermentioned improvements on the land within the time specified:~~

~~**PROVIDED** that the value of the improvements the lessee is obliged to effect pursuant to this covenant shall not together with the value of any other improvements effected in pursuance of Covenant 2 viii exceed in all the value of improvements required to be effected by the end of the fifth thirteenth and twenty-first years pursuant to Covenant 2 viii hereof.~~

x. Permit the Minister the Land Board and the Pastoral Board and his or their agents at all times to enter and view the state and condition of the land and of the improvements thereon and of any defects decays and wants of reparation and within six months next following written notice given by the Minister or left upon the land requiring him to do so repair and amend the same accordingly

xi. Permit the owner of any mining claim situated on the land and the holder of any mining lease or licence of the whole or any portion of the land under any law in force for the time being relating to mining with or without workmen full and free liberty of access ingress egress and regress into upon and from the land comprised in such claim lease or licence using however as far as reasonably can be any public roads paths and ways

xii. If required by the Minister permit the owner of a gold or mineral claim pegged out on the land to take a reasonable quantity of water for mining and domestic purposes from any well or dam on payment of reasonable compensation **PROVIDED** that the quantity of water so taken shall not be such as to deprive the lessee of the quantity of water necessary for stock domestic and general station purposes

xiii. Supply water to stock travelling through the land at the rate of one shilling and three pence for each 100 sheep and ten shillings for each 100 cattle **PROVIDED** that the lessee may determine from what water supply the water is to be taken and such water supply shall not necessarily be that nearest to the most direct route through the land if the water supply is reasonably accessible to such stock

And the Lessee must not—

xiv. Assign or sublet the whole or any part of the land without the consent of the Minister **PROVIDED** that the Minister shall not consent to an assignment or subletting of the whole of the land during the first five years of the term unless it is proved to his satisfaction that a refusal of consent would cause severe hardship. **ALSO** the Minister shall not during the first ten years of the term consent to any assignment or subletting giving effect to a subdivision of the land into two or more parts unless it is proved to his satisfaction that a refusal of consent would cause great hardship **ALSO** the Minister shall not at any time consent to any assignment or subletting giving effect to a subdivision of the land into two or more parts unless plans of the proposed subdivision have first been submitted to and approved by him and he is satisfied that the subdivision is such as would enable the best use to be made of all improvements water and grazing areas Subject to the preceding paragraphs of this proviso the Minister shall not capriciously withhold his consent to any assignment or subletting

xv. At any time during the term of the lease overstock the land or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the Minister or the Pastoral Board would have the effect of depreciating the ordinary capacity of the land for depasturing stock

of portion of
CROWN LANDS
referred to in

PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
No. 2377
BLOCK 884

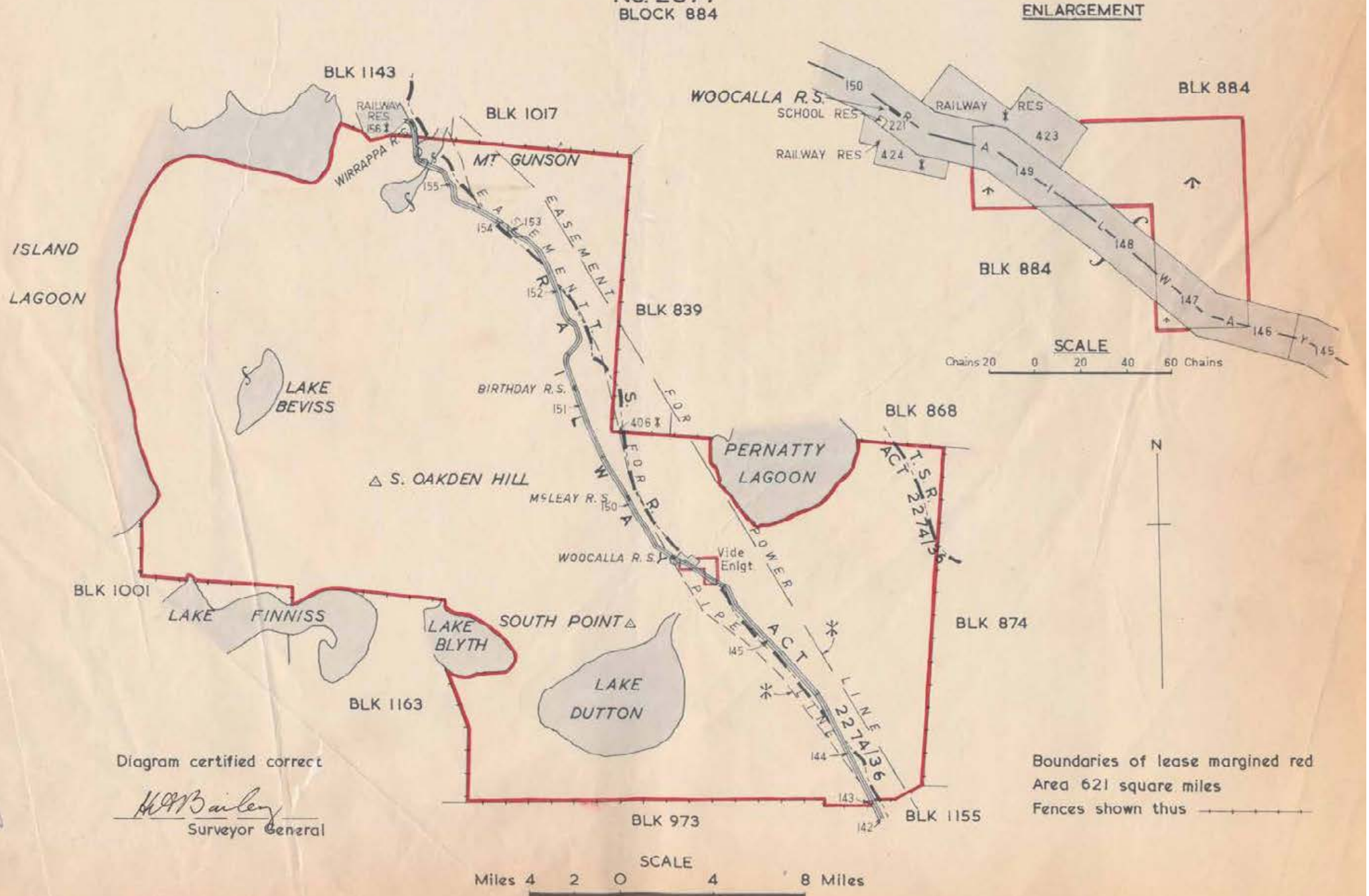


Diagram certified correct

H.W. Bailey
Surveyor General

Boundaries of lease margined red
Area 621 square miles
Fences shown thus

LANDS

COVENANTS—continued

xvi. Erect nor suffer the erection of any brush fence upon the land

xvii. Cut any timber on the land during the term of the lease without the licence in writing of the Minister **PROVIDED** that the lessee may without a licence cut dead timber for making improvements on the land or for firewood for his own domestic use

xviii. Obstruct or interfere with any public roads paths or ways or the use thereof by any person

xix. Use any of the land for agriculture without the consent of the Minister first having been obtained **PROVIDED** that if such consent is given the Minister may revalue the rent of any land so used

xx. Construct maintain enlarge or deepen any artesian bore on the land without licence of the Minister

CONDITIONS

3. The lessee shall not be entitled to possession of the land until he shall have paid the first year's rent and fees and paid or arranged for payment of the price for the improvements (if any)

4. The Minister may cancel this lease in the following cases subject to the provisions of the said Pastoral Act or any amendment thereof—

i. If the rent reserved shall be in arrear for more than three calendar months after the same becomes due

ii. If there has been a breach or non-performance of any of the lessees covenants or conditions 1962

5. If any part of the land is or becomes bounded by a part of the dog fence as defined in the Dog Fence Act 1946-~~1961~~ or any amendment thereof such part of the dog fence shall be maintained by the lessee in dog-proof condition throughout the currency of the lease

6. i. If during the term of the lease any railways water-works reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the land and by reason thereof the value of the land shall in the opinion of the Minister be enhanced the Minister may direct the Pastoral Board to make a re-valuation of the land and the Minister shall thereupon serve notice of any increased rent upon the lessee **PROVIDED** that no such re-valuation shall be retrospective or made within five years after the commencement of the lease

ii. During the first six months of the last year of each seven year period of the term of the lease the Pastoral Board shall make a re-valuation of the land and the Minister shall forthwith serve upon the lessee notice in writing of the rent to be paid during the succeeding period of the said term and such rent shall be paid by the lessee from the date specified in such notice as the date from which such rent is payable **PROVIDED** that the rent so fixed shall be not more than fifty per cent above or below the rent payable during the last year of the period in which the re-valuation is made

7. The lessee may within three months after service upon him of a notice of re-valuation as provided in Condition 6 hereof by notice in writing request that the rent fixed on that re-valuation be reconsidered and thereupon the Pastoral Board shall fix the rent and give notice in writing to the lessee of its decision If the lessee is dissatisfied with the rent as so fixed he may within three months after receiving notice of the Board's decision give the Minister notice that he requires the rent to be fixed by arbitrators and thereupon the matter shall be decided by arbitration

8. It is expressly agreed that the land or any part thereof may be resumed pursuant to and subject to the provisions of the said Pastoral Act or any amendment thereof and on any such resumption the lessee shall be entitled to receive compensation as and subject to the provisions therein contained **PROVIDED** that if any of the land is resumed the rent reserved shall thereafter be reduced by an amount which bears the same proportion thereto as the quantity of land bears to the total area of the land hereby demised **PROVIDED ALSO** that no reduction of rent shall be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced at the rate of one mile no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year

9. Subject to the provisions of the said Pastoral Act or any amendment thereof at the expiration of the term hereby granted the lessee shall be entitled to receive from the incoming lessee the value to be determined as provided by the said Pastoral Act or any amendment thereof of all improvements made or purchased by him existing upon such portions of the land as may be comprised in the new lease **PROVIDED** that no valuation shall be made of any improvements and no payment shall be made in respect of any improvement and no improvements shall be considered unless the lessee prior to their construction has given written notice to the Minister stating the nature and position and probable cost and date of completion thereof and the Minister has consented to the making thereof and the lessee after completion thereof has furnished to the Minister a statement showing the details of the actual cost of such improvements The preceding proviso shall not apply to any improvements under the value of £25 : 0 : 0 nor to any improvements consisting of wells reservoirs tanks or dams of a permanent character available for the use of cattle or sheep and which increase the carrying capacity of the land leased or substantial buildings vermin proof or other fences or huts or sheds erected for residence shearing or other purposes usually required for or in connection with keeping livestock which the board certifies are useful and were made for the purpose of improving the land for pastoral purposes or for increasing the carrying capacity thereof and will have such effect

IN WITNESS whereof the Public Seal of the State of South Australia and the hand and seal of the said lessee were hereunto set the

fifth **day of** November 1964

Signed sealed and delivered by the abovenamed lessee in the presence of—

THE COMMON SEAL of MORNING PASTORAL COMPANY PROPRIETARY LIMITED was hereunto affixed by authority of a resolution of the Board.

L. R. M Gaggart. DIRECTOR L. S.

D. M Lloyd Director L. S.
ALTERNATE TO JOHN McTAGGART

Secretary L. S.

L. S.

Certificate of Alteration No 2611112 of the Minister of Lands whereby in consequence of 1A 0R 33P of the land in the within Lease No 2377 having been acquired by the Commonwealth on 14.11.1963, the area remaining in the within Lease is 621 square miles Produced 17.3.1965 at 2.10 pm

g b Sleeth Dep Reg Gen.

an Easement over portion

THE WITHIN LAND HAS BEEN ACQUIRED BY THE COMMONWEALTH AS APPEARS IN COMMONWEALTH GAZETTE DATED 10/6/1965 AT PAGES 2213/4 VIDE L.T.O. No. 2528 OF 19 64

(Re-entry on trip)

DEP. REG. GEN.

Easements over portions

THE WITHIN LAND HAVE BEEN ACQUIRED BY THE COMMONWEALTH OF AUSTRALIA AS APPEARS IN COMMONWEALTH GAZETTE DATED 14/11/1963 and 4/6/1964 AT PAGES 4039/4042 and 2133/3 respectively VIDE LTO. No. 2528 OF 19 64

(Re-entry on trip)

DEP. REG. GEN.

~~4/ 2880318~~

2880318

Under LEASE No. 2880318 to Linal Travers portion of the land in ~~this~~ 2377 OF THE WITHIN ~~LAND~~ TERM 36 years from and including 1.1.1968 PRODUCED 2.1.1968 AT 3 pm

DEP. REG. GEN.

CERTIFICATE No. 3170330 OF THE MINISTER OF LAND THAT ON REVALUATION OF THE WITHIN LEASE No. 2377 THE RENT HAS BEEN FIXED AT $ 3306 :80 PER ANNUM FROM 27. 3. 1971 PRODUCED 22. 1. 1971 AT 10.45 am

DEP. REG. GEN.

Re-Entry ~~330252~~ 330528 / Underlease 2880318

Re-Entry having been made upon the land comprised in the within ~~Lease No. 2377~~ the estate of the within named Under Lessee has thereupon determined vide 330252 Produced 30.3.1972 at 3.30 pm

Dep Reg Gen

portion of (now Section 702)

THE WITHIN LAND HAS BEEN ACQUIRED BY THE COMMONWEALTH OF AUSTRALIA AS APPEARS IN COMMONWEALTH GAZETTE DATED 20.8.1974 AT PAGE ~~2497~~ 25 VIDE L.T.O. No. Okt 2528 OF 1964

(Re-entry on trip)

DEP. REG. GEN.

23.3.1978 R.O.R.G.

CH 3756416.

Certificate of Alteration 3756416 of The Minister of Lands whereby in consequence of a parcel of land containing 0.3721 hectares situate North and of Hundreds has been acquired by the Commonwealth on the 20.3.1974. The area remaining shall be 621 square miles (1608 km²). Produced 19.6.1975 at 11am

SCH 3845486.

PARTIAL SURRENDER No 3845486 PORTION OF THE WITHIN Lease 2377 IS SURRENDERED AS REGARDS 314.3 ha (approx) AND THE AREA OF THE WITHIN LEASE REDUCED TO 621¾ sq miles (1605 km²) ~~ACRES~~ AND THE ANNUAL RENT REDUCED TO $3301-50 FROM 15-1-1975 PRODUCED 2-2-1976 AT 11.20am

RL 4172131

CERTIFICATE No. 4172131 OF THE MINISTER OF LAND THAT ON REVALUATION OF THE WITHIN LEASE No. 2377 THE RENT HAS BEEN FIXED AT $ 3796 : PER ANNUM FROM 27. 3. 1978 PRODUCED 16.3.1978 AT 3.35 p.m.

PL 5210394

PARTIAL SURRENDER No. 5210394 PORTION OF THE WITHIN land IS SURRENDERED AS REGARDS 42.66 ha. (approx) AND THE AREA OF THE WITHIN LEASE REDUCED TO approx. 1604 square kilometres ~~ACRES AND THE ANNUAL RENT REDUCED TO $~~ FROM 13.3.1984 PRODUCED 3.4.1984 AT 2.30 pm

~~AL 6079223~~ ~~AS 6079224~~

CERTIFICATE No. 6079223 OF THE MINISTER OF LAND THAT ON REVALUATION OF THE WITHIN LEASE No. 2377 THE RENT HAS BEEN FIXED AT $ ~~6944~~ 100 PER ANNUM FROM 27.3.85 PRODUCED 5.9.1985 AT 15:50

PARTIAL SURRENDER No. 6079224 PORTION OF THE WITHIN land IS SURRENDERED AS REGARDS 6279 m2 AND THE AREA OF THE WITHIN LEASE REDUCED TO 1604 square kilometres ~~ACRES AND THE ANNUAL RENT REDUCED TO $~~ FROM 1.8.1985 PRODUCED 5.9.1985 AT 15:50

C.L. 1298 Vol. 7.

TRANSFER No. 6602881 To
Andrew Donald McTaggart Grazier of Oakden Hills Station Via Port Augusta 5700 and Penelope Anne McTaggart his wife
OF THE WITHIN LAND. PRODUCED 15.9.1988 AT 14:45.

LEASE No. 7656514 To The Electricity Trust of South Australia of an easement over portion
OF THE WITHIN LAND. TERM Commencing on 22.7.1993 and expiring on 21.7.2035
PRODUCED 7.2.1994 AT 14:05

PARTIAL SURRENDER No. 6862533 PORTION
OF THE WITHIN Lease
IS SURRENDERED AS REGARDS 854 m² AND THE
AREA OF THE WITHIN LEASE REDUCED TO 1604 square kilometres
~~ACRES AND THE ANNUAL RENT REDUCED TO $~~
FROM 21.12.1989 PRODUCED 31.1.1990 AT 15:45

Certificate 7973053 of Minister For the Environment and Natural Resources whereby a parcel of land being closed Road containing 41.94 HA situate Out of Hundreds (Torrens) is hereby included into the within lease and the area is now 1604 K² approximately
Produced 8.8.1995 at 14.55

CERTIFICATE OF ALTERATION 7046627 of The Minister of Lands whereby pursuant to the provisions of the Pastoral Land Management and Conservation Act 1989 the term of the within lease has been varied so as to commence on 7.3.1990 for a period of 42 years the conditions including covenants and reservations remain unaltered with the following exceptions
1 The rent payable under the lease will be an amount determined annually by the Valuer-General subject to the provisions of Section 23 of the above mentioned Act and payable annually in arrears each year on a date to be fixed by the Pastoral Board
2 No species of animal other than sheep or beef cattle can be pastured in the land contained in the within lease as part of the commercial enterprise under the said lease without the prior approval of the Pastoral Board
3 The reservations relating to aboriginal persons and access to the land are revoked
Produced 22.1.1991 at 10:00
(Dup. C.T. not prod)
PRGS 5.6.1991

Portion of (Lots 108 & 109 in DP 47746)
THE WITHIN LAND IS DISCHARGED FROM MORTGAGE
No. 7424375 VIDE 8305753
PRODUCED 2.6.1997 AT 15:25

PARTIAL SURRENDER No. 8305754 PORTION
OF THE WITHIN land firstly (Lot 108 in DP 47746) secondly (Lot 109 in DP 47746)
IS SURRENDERED AS REGARDS firstly 289.3 HA secondly 164.9 Ha AND THE
AREA OF THE WITHIN LEASE REDUCED TO 1600 km² approximately
~~ACRES AND THE ANNUAL RENT REDUCED TO $~~
FROM PRODUCED 2.6.1997 at 15:25
and the description of the land is now Lot comprising the pieces 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 in DP 47746 ~~and closed road A in DP 33526~~
DMP RG 7.8.1997

PARTIAL SURRENDER No. 7074630 PORTION
OF THE WITHIN land
IS SURRENDERED AS REGARDS 41.58ha AND THE
AREA OF THE WITHIN LEASE REDUCED TO 1604 square kilometres approximately
~~ACRES AND THE ANNUAL RENT REDUCED TO $~~
FROM 14.2.1991 PRODUCED 19.3.1991 AT 14:45

APPLICATION 8889801 The within Lease is vested in DISTRIBUTION LESSOR CORPORATION (Subject to Lease 8890000)
Produced 16.5.2000 at 12:45

Certificate 9085930 of Minister for Primary Industries and Resources whereby the maximum stocking rate is to remain at 2800 cattle or 14000 sheep or the equivalent number of sheep and cattle combined the term of the within lease has been extended for 42 years and expiring on 30.11.2041 Produced 24.4.2001 at 16:00

MORTGAGE No. 7424375 TO
PRIMARY INDUSTRY BANK OF AUSTRALIA LIMITED
PRODUCED 21.12.1992 AT 14:50

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE
No. 7424375 VIDE 9404307
PRODUCED 13.8.2002 AT 12:33

TRANSFER No. 9404305 to Nutt Bros Nominees Pty. Ltd. of Level 1, 187 Wakefield Street Adelaide
OF THE WITHIN land
PRODUCED 13.8.2002 AT 12:33

MORTGAGE No. 9484306 TO
ELDERS Rural Bank Ltd
PRODUCED 13.8.2002

Certificate 12304931 of Minister for Sustainability, Environment and Conservation whereby the maximum stocking rate is to remain at 14,000 sheep equivalents. The term of the within Crown Lease has been extended to the full term of 42 years and the expiry date is now 1 October 2056
Produced 2.4.2015 at 16:03

CANCELLED
CONVERTED TO A COMPUTERISED CROWN LEASE
REGISTRAR-GENERAL SOUTH AUSTRALIA

Clo'Neare.

South Australia.

Register Book.

Vol. 1105 Folio 6

Registrar-General.

Crown Lease.

(PASTORAL, No. 2119 ——.)

(*Pursuant to the Pastoral Act*, 1936~~-1944~~)

1948

(In lieu of Surrendered (Pastoral Lease No. 1767 Register Book Volume 821 Folio 42
(Pastoral Lease No. 1785 Register Book Volume 822 Folio 5

This Indenture made the eleventh day of October in the year of our Lord One Thousand Nine Hundred and fifty one BETWEEN HIS MOST GRACIOUS MAJESTY GEORGE THE SIXTH by the Grace of God of Great Britain, Ireland, and the British Dominions beyond the Seas King Defender of the Faith ~~Emperor of India~~ of the first part His Excellency the Governor in and over the State of South Australia in the Commonwealth of Australia, Etc. Etc. of the second part and NONNING PASTORAL COMPANY LIMITED of Selborne Chambers Pirie Street Adelaide

for itself its Successors ——— ~~Executors Administrators~~ and Assigns herein designated by the term "Lessee" of the third part

Minister of Lands.

Parcels. **WITNESSETH** that the said Governor by virtue of the powers contained in the Pastoral Act 1936-1944 and all other powers enabling him in that behalf **DOTH** lease unto the Lessee for pastoral purposes **ALL THAT** land containing six hundred and sixty five (665) square miles or thereabouts and situate and being Blocks numbered 719 and 884 "Oakden Hills" surrounding Woocalla Railway Station ———

Exceptions and reservations. the abuttals and boundaries whereof are particularly delineated and set forth in the plan thereof to this Indenture annexed and signed by the Surveyor-General together with all ways paths passages waters watercourses advantages and appurtenances thereto belonging or appertaining subject to the exceptions and reservations hereinafter contained that is to say **EXCEPT AND RESERVED** all gold silver copper tin and other metals all ores and other substances containing metals all minerals and all gems and precious stones coal and mineral oils upon in or under the said land to His Majesty the King His Heirs and Successors and all persons lawfully claiming under or authorized by him or them **AND** the Governor and the Minister of Lands for the time being of the said State (hereinafter called the Minister) and all persons lawfully claiming under or authorized by them or either of them shall have full and free liberty of access ingress egress and regress with or without horses cattle carts drays carriages engines machinery and all other necessary implements and things into upon and from the said premises for all public purposes and to cut dig sink for try search procure work remove and dispose of all or any of the hereby excepted and reserved things and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **PROVIDED** that no such bores wells dams reservoirs or embankments shall be sunk or constructed within one mile of any improvement consisting of a well reservoir dam dwelling house factory or building of the value of One Hundred Pounds or upwards the property of the said Lessee **AND** reserving to Aboriginal Inhabitants of the said State and their descendants during the continuance of this lease full and free right of access ingress egress and regress into upon and over the said lands and every part thereof except such parts as improvements have been erected upon and in and to the springs and surface waters thereon and to make and erect such wurlies and other dwellings as the said Aboriginal Natives have been heretofore accustomed to make and erect and to take and use for food birds and animals *ferae naturae* in such manner as they would have been entitled to do if this lease had not been made **AND** reserving to all persons the rights of passing the said lands with travelling stock subject to the provisions of the Stock and Poultry Diseases Act 1934~~-1941~~ the Pastoral Act 1936~~-1944~~ or any other Act for the time being regulating travelling stock **SUBJECT** to the right of His Majesty's subjects to use all and every the roads paths or ways heretofore made and used by them or hereafter to be duly opened and dedicated to the public use for the purpose of passing upon through and over the said lands or any part thereof **SUBJECT ALSO** to the right of the Governor for the time being of the said State and all persons authorized by him or other lawful authority at any time or from time to time as may be deemed requisite with horses carts and carriages or without into upon through and over the said lands to come and go for the purpose of laying out and making fit for and devoting to the public use any existing new or additional roads ways and paths **AND SUBJECT ALSO** to the right of the Minister or any person authorized by him in that behalf to grant licences to enter upon the said lands or any part thereof and to occupy the same for the purpose of cutting obtaining and taking away any live or dead timber stone or sand with full and free liberty of access ingress egress and regress to and for His Majesty His Heirs and Successors and to and for the Governor and the Minister and all other persons authorized by them or either of them with or without horses carts and carriages into over through and upon the said lands for the purpose of cutting obtaining and taking away such timber stone or sand but notwithstanding this last-mentioned provision the Lessee shall be at liberty at any time and from time to time to fell cut down and remove any dead timber stone and sand which may be required by the Lessee for the purpose of improvements to be constructed or made or firewood to be used for domestic use upon the said land **TO HAVE AND TO HOLD** the said lands and premises (subject to the covenants conditions provisos and restrictions herein contained) from the nineteenth day of October One Thousand Nine Hundred and fifty ——— until the thirtieth day of November One Thousand Nine Hundred and seventy three

Director of Lands.

Term.

Rent. **YIELDING AND PAYING** therefor yearly and every year in advance unto His Majesty His Heirs and Successors by payment at his Majesty's Treasury in the City of Adelaide in the said State the rent of two hundred and six pounds and eighteen shillings (£206: 18: 0) until the thirtieth day of November one thousand nine hundred and fifty two (the rent for the following twenty one years being the balance of the term to be fixed by the Pastoral Board) the first of such payments to be made ———

Certified correct,

EXD.

D.L. 3906/1937.

~~Term 42 years~~, with improvements. (Act 1936~~-1944~~)1948 Surrender. Land formerly held under other Acts. Average Lease.

Revaluation of rent by reason of public works. on the nineteenth day of October in the year One Thousand Nine Hundred and fifty ——— and in each succeeding year **PROVIDED** that if during the said term hereby granted any railways waterworks reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the said land hereby demised and by reason thereof the value of the said land hereby demised shall in the opinion of the Minister be enhanced the Minister may direct the Pastoral Board to make a revaluation of the said land hereby demised or any part thereof and thereupon a revaluation shall be made in manner prescribed by Sections 53 and 54 of the Pastoral Act 1936~~-1944~~ and the rent so fixed shall be paid by the Lessee from the date on which it shall be so fixed to be payable but no such revaluation shall be retrospective or made within five years after the commencement of the term ~~of the original lease~~ nor within ten years after any previous revaluation and the Minister shall serve notice of such increased rent upon the Lessee **PROVIDED ALSO** that during the first six months

Revaluation during first six months of twenty-first year.

second

of the ~~twenty-first~~ year of this lease a revaluation of the lands hereby demised shall be made by the Pastoral Board pursuant to the Pastoral Act 1936-1944 and the rent fixed upon such revaluation shall be paid by the Lessee from the ~~date of the expiration of the first twenty-one years of this lease~~ and the Minister shall forthwith serve upon the Lessee notice in writing of such rent **PROVIDED** that in fixing the said rent whether by revaluation or otherwise no regard shall be had to any increase in value of the lands hereby demised caused by improvements thereon which the Lessee shall have made or paid for and which shall not be the property of the Crown **PROVIDED** the rent so fixed on any revaluation pursuant to Sections 55 and 56 of the Pastoral Act 1936-1944 shall not be more than fifty per cent above or below the rent payable during the ~~twenty-first~~ year of the term of this lease **PROVIDED ALWAYS** that the Lessee may within three months after service upon him of a notice of revaluation as provided in Section 53 or 56 of the Pastoral Act 1936-1944 by notice in writing request that the rent fixed on that revaluation be reconsidered and thereupon the Minister and the Pastoral Board shall reconsider the matter and the Pastoral Board subject to the approval of the Minister shall fix the rent and give the Lessee notice in writing of its decision. If the Lessee is dissatisfied with the rent as so fixed he may within three months after receiving notice of the Pastoral Board's decision give the Minister notice that he requires the rent to be fixed by arbitrators and thereupon the matter shall be decided by arbitrators under the Arbitration Act 1891-1934 one arbitrator being appointed by the Minister and one by the Lessee **AND** the Lessee doth hereby covenant with His Majesty His Heirs and Successors and as separate covenants with the said Governor and with the Governor for the time being of the said State that the Lessee will during the continuance of this lease pay the rent hereinbefore reserved in manner aforesaid free and clear of all outgoings and deductions whatsoever **AND** also that the Lessee will pay unto His Majesty at His Majesty's Treasury aforesaid the sum of two thousand one hundred and seventy five pounds fifteen shillings and eleven pence (£2175: 15: 11) being the value of the improvements belonging to the Crown upon the lands hereby demised by instalments with interest, viz. one hundred and forty pounds sixteen shillings and four pence (£140: 16: 4) _____ on the nineteenth day of October yearly and every year during the continuance of the term hereby granted **PROVIDED ALWAYS** that in the event of any instalment being unpaid for three calendar months after any date whereon the same ought to be paid the purchase money and interest then remaining unpaid shall at the option of the Minister become instantly due payable and recoverable and may be recovered by the Minister by action in his own name in any Court of Competent jurisdiction **AND ALSO** the Lessee will pay unto His Majesty at His Majesty's Treasury aforesaid the sum of being due under the former to the day of 19 together with interest thereon at the rate of per centum per annum in equal annual instalments of (being instalments of principal and interest) on the day of in each year the first of such instalments to be paid on the day of 19 such instalments shall be payable and recoverable in the same manner as the rents to become due hereunder **PROVIDED** that in the event of any such instalment being in arrear the Lessee must pay interest thereon at the rate of Five Pounds per centum per annum from the date such instalment became due until the date of payment thereof **PROVIDED ALSO** that the Lessee shall have the right to pay off the whole or any portion of the said arrears together with interest then due at any time **AND ALSO** that the Lessee shall and will stock the land hereby demised with sheep cattle or sheep and cattle combined so that for every square mile leased there shall be five head of sheep or one head of cattle and the Lessee shall keep the land so stocked throughout the term of the lease **AND ALSO** that the Lessee will not without the written consent of the Minister first had and obtained stock the land at any time during the term of the lease with a greater number of sheep cattle or sheep and cattle combined than 2660 head of cattle or the equivalent number in sheep or sheep and cattle combined one head of cattle being computed as equal to five head of sheep **AND ALSO** that the Lessee shall not at any time during the said term hereby granted overstock the land hereby leased or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the Minister or the Pastoral Board would have the effect of depreciating the ordinary capacity of the said land for depasturing stock **AND ALSO** the Lessee will comply with any notice in writing from the Minister requiring the Lessee within the time specified in the notice to reduce the number of stock depasturing on the land included in this lease to a number specified in the notice and to comply with all other restrictions specified in the notice as to the stocking of such land in terms of Section 44a of the Pastoral Act 1936-1944 as enacted by Section 14 of the Soil Conservation Act 1939 ~~1940~~ **AND ALSO** that the Lessee shall at all times upon being thereunto required by the Minister or the Pastoral Board furnish him or them with true particulars of the number of sheep and cattle with which the land hereby demised is stocked **AND ALSO** ~~that the Lessee will expend in improvements on the said land by the end of the fifth year of the lease not less than pounds per square mile by the end of the thirteenth year not less than pounds per square mile and by the end of the twenty-first year of the term not less than pounds per square mile.~~ **AND ALSO** that the Lessee will expend in each of the first five years of the term of this lease ~~approximately one-fifth of the total amount to be spent by the end of the fifth year of the term provided that if in any of the said first five years the Lessee expends more than one-fifth of the total amount to be spent by the end of the fifth year of the term the Lessee shall be entitled to have the amount of the excess treated as money expended in any subsequent year or years of the said period of five years~~ **PROVIDED** ~~that any improvements existing upon the said lands at the time of the granting of this lease shall be deemed to be improvements hereby required to be made and the value thereof shall be taken into account in estimating the amount hereby agreed to be expended~~ **PROVIDED** ~~that such amount expended on improvements shall not include any money advanced by the Minister or by any other body or person on behalf of the Crown to the Lessee for vermin-proof or dog-proof fencing and expended by the Lessee for that purpose~~ **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of the purchase-money of any improvements or any interest thereon keep in proper order repair and condition to the satisfaction of the Minister all such improvements in respect whereof any such money shall remain owing by the Lessee reasonable wear and tear excepted **AND ALSO** that the Lessee so long as any principal money or interest shall remain owing for any improvements will not pull down or remove from the land hereby demised or knowingly suffer to be pulled down or removed or wilfully or knowingly destroy damage or injure or suffer to be destroyed damaged or injured any such improvements without the consent of the Minister in writing first had and obtained **AND ALSO** that it shall be lawful for the Minister and all persons authorized by him at all times unrestrictedly to enter into and upon the said lands hereby demised and view and examine the state and condition thereof and of the improvements belonging to the Crown thereon and of all defects decays and wants of reparation contrary to the provisions herein contained as shall be then and there found to give to the Lessee or leave upon the said lands notice in writing requiring the Lessee to repair and amend the same within six calendar months then next following within which time the Lessee will repair and amend the same accordingly **AND ALSO** that the Lessee will permit all lawfully constituted Land Boards and the Pastoral Board for the time being and the members agents and officers thereof respectively or any of them at all times unrestrictedly to enter upon and examine the land and premises hereby demised **AND ALSO** that the Lessee will subject to the Mining Act 1930-1941 and to regulations for the time being in force thereunder or any other Act authorizing the making of regulations permit the holder of any claim and every gold or mineral lessee or licensee holding a claim lease or licence under the Mining Act 1930-1941 or any other Act for the time being authorizing the granting of claims gold or mineral leases or licences of or respecting any of the land hereby demised and all persons authorized by such claim holder lessee or licensee to have unrestricted access to and egress from the land comprised in such mineral claim lease or licence using however as far as reasonably can be the public roads paths and ways for the time being upon or over the said land or any part thereof **AND ALSO** that the Lessee shall if required by the Minister permit the owner of a gold claim or mineral claim duly registered in terms of the Mining Act 1930-1941 and pegged out on the land hereby demised to take for mining and domestic purposes a reasonable quantity of water from any of the wells or dams on such lands on payment to the Lessee of fair and reasonable compensation to be determined in case of dispute by the Minister PROVIDED that the quantity of water so taken shall not at any time be such as to deprive the Lessee of the quantity of water necessary for stock domestic and general station purposes **AND ALSO** that the Lessee shall supply water to stock travelling through the leased land in terms of Subsection (2) of Section 43 of the Pastoral Act 1936-1944 and that the Lessee shall also have the right to charge for water supplied at the rate of one shilling and threepence for each 100 sheep and ten shillings for each 100 cattle **PROVIDED** that there shall be reserved to the Lessee the right to determine from what water supply the travelling stock are to take water and the water supply so determined shall not necessarily be that nearest to the most direct route through the leased land **AND ALSO** that the Lessee shall not nor will during the said term assign or sublet the whole or any part of the leased land without the consent of the Minister **PROVIDED** that the Minister shall not consent to an assignment or subletting of the whole of the leased land during the first five years of the term unless it is proved to his satisfaction that a refusal of consent would cause severe hardship **ALSO** the Minister shall not during the first ten years of the term consent to any assignment or subletting giving effect to a subdivision of the leased land into two or more parts unless it is proved to his satisfaction that a refusal of consent would cause severe hardship **ALSO** the Minister shall not at any time consent to any assignment or subletting giving effect to a subdivision of the leased land into two or more parts unless plans of the proposed subdivision have first been submitted to and approved by him and he is satisfied that the subdivision is such as would enable the best use to be made of all improvements waters and grazing areas Subject to the preceding paragraphs of this proviso the Minister shall not capriciously withhold his consent to any assignment or subletting **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of any improvements belonging to the Crown and liable to be destroyed or damaged by fire storm and tempest insure and during the term hereby granted keep insured in some Insurance Office in Adelaide to be approved by the Minister against loss and damage by fire storm and tempest all such improvements

Covenants by Lessee to pay rent.

To pay value of improvements belonging to the Crown.

To stock.

Not to overstock.

To furnish returns of stock.

To keep improvements belonging to the Crown in repair.

Power to Minister to enter and view condition of Crown improvements.

Right of ingress etc. to mineral lessee.

To permit owner of gold or mineral claim to take water.

Supply water.

Not to transfer or sublet.

To insure.

It is a condition hereof that the Lessee shall have the right to use the water from water supplies on former Water Reserve No. 64 and J.R.P. Reservoir on the condition that all appliances existing thereon be maintained in good serviceable condition such water supplies and appliances to remain the property of the Crown.

Revised to fit

ANNEXED LEASE

No. 2119.

(Survey Office Plan)

—ENLARGEMENT—

of portion of

CROWN LANDS

referred to in

ANNEXED LEASE

Nº 2119.

(BLOCKS 884 & 719)

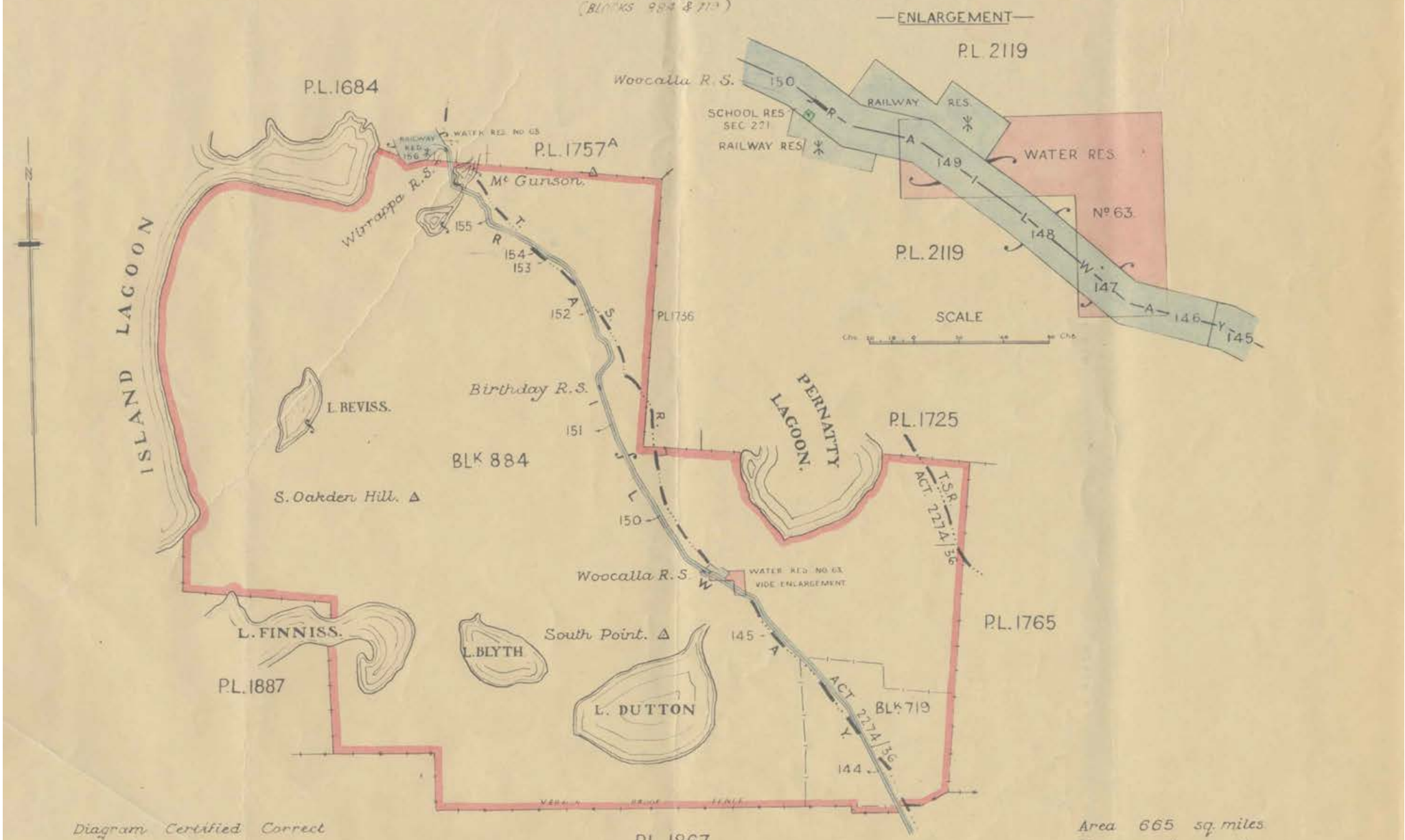


Diagram Certified Correct

N.K.H. Dawson

Deputy Surveyor General.

Area 665 sq. miles

Fences shown thus

Scale

CHAINS 50 40 0 1 2 3 4 5 6 7 8 9 10 MILES

aRC



other than fencing in an amount equal to two-thirds of the amount for the time being owing to the Crown in respect thereof such insurance to be in the joint names of the Lessee and the Minister and will lodge the policy of every such insurance in the office of the Minister within one calendar month after the date thereof and will forward to the Minister the receipts for the premium payable in respect of every such policy within seven days after the same shall become due and that if the foregoing covenent shall not be duly observed then the Minister shall have liberty to insure the said improvements in manner aforesaid and all moneys expended by the Minister in or about such insurance as aforesaid with interest thereon at the rate of Five Pounds per centum per annum computed from the time of expending the same shall be repaid to him on demand and may be recovered in like manner as rent is recoverable and it is declared that all sums of money received by the Lessee or the Minister under any such insurance shall be laid out in reinstating (*pro tanto*) the premises in respect of which the same shall have been received **PROVIDED** that if the Minister and the Lessee shall so agree the moneys so received or such part thereof as may be agreed upon shall in lieu of being laid out as last aforesaid be applied in reduction of the amount for the time being owing by the Lessee to the Crown in respect of such improvements **AND ALSO** that the Lessee will forthwith commence to destroy vermin on the said lands to the satisfaction of the Minister or the Pastoral Board and will at all times during the said term use reasonable means to keep the said land free of vermin to the satisfaction of the Minister or the Pastoral Board **ALSO** that the Lessee will neither erect nor suffer the erection of any brush fence upon the said lands **ALSO** that the Lessee will pay any amounts due or becoming due on account of wire-netting vermin rates and wild dog rates **AND ALSO** that the Lessee will not during the said term without the licence in writing of the Minister for every such purpose fell or cut down any trees or other timber which are now or hereafter shall be growing upon the said lands **PROVIDED** that the Lessee may without a licence cut dead timber for making improvements on the leased land or for firewood for his own domestic use **AND ALSO** that the Lessee will not during the said term without the consent of the Minister first obtained use any of the said lands for Agriculture **PROVIDED** that if such consent of the Minister has been first obtained the Minister may revalue the rent of any land so used for Agriculture **PROVIDED ALSO** that none of the said lands shall be deemed to be used for Agriculture if the produce grown thereon is used solely for consumption on the said land **AND ALSO** that the Lessee will at all times comply with and observe the Regulations that may from time to time be made by the Governor with the advice of the Executive Council under the Pastoral Act 1936-1948 or any other Act him thereunto enabling and for the time being in force **AND ALSO** that the Lessee will make and furnish to the Minister or cause to be so made and furnished all such statements and returns as are required by any Act rule or regulation for the time being in force **AND ALSO** that the Lessee will not obstruct or interfere with any public roads paths or ways or the use thereof by any person **AND ALSO** that the Lessee or any other person will not without licence of the Minister construct or commence to construct any artesian bore on the said land **AND ALSO** that the Lessee will not maintain enlarge or deepen any artesian bore on the said land unless the said Lessee obtains written permission from the Minister given on the recommendation of the Pastoral Board **AND ALSO** that the Lessee will not enlarge or deepen as aforesaid any artesian bore otherwise than in accordance with any requirements imposed by the said written permission of the Minister given on the recommendation of the Pastoral Board **PROVIDED ALWAYS** that if the rent hereby reserved shall be in arrear for more than three calendar months after any of the days hereinbefore appointed for payment thereof or if there shall be a breach or non-performance of any of the Lessees covenants or conditions it shall be lawful for the Minister to cancel this lease subject to the provisions of the Pastoral Act 1936-1948 **PROVIDED** that if the rent hereby reserved be not paid on or before the days whereon the same is hereby made payable then a penalty of Ten Pounds per centum per annum on the amount of the rent unpaid may if the Minister thinks fit be added and any such rent and/or penalty may be recovered by the Minister by action in his own name in any Court of competent jurisdiction **PROVIDED ALSO** and it is hereby expressly agreed and declared that the land hereby demised or any part thereof may be resumed pursuant to and subject to the provisions of the Pastoral Act 1936-1948 and on any such resumption the Lessee shall be entitled to receive compensation as and subject to the provisions therein contained **PROVIDED** that if any of the land hereby demised is at any time resumed out of this lease the rent reserved shall thereafter be reduced by an amount which bears the same proportion thereto as the quantity of land so resumed bears to the total area of the land hereby demised **PROVIDED** that no reduction of rent be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced at the rate for one mile no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year **PROVIDED ALWAYS** that no valuation shall be made of any improvements and no payment shall be made in respect to any improvements and no improvements shall be considered unless the Lessee prior to their construction has given written notice to the Minister stating the nature and position and the probable cost and date of completion thereof and the Minister has on the recommendation of the Pastoral Board consented to the making thereof and the Lessee after the completion thereof has furnished to the Minister a statement showing the details of the actual cost of such improvements **PROVIDED ALSO** that the provisions of the immediately preceding proviso shall not apply to any improvements under the value of twenty-five pounds or to any improvements consisting of wells reservoirs tanks or dams of a permanent character available for the use of cattle or sheep and which increase the carrying capacity of the land leased or substantial buildings vermin-proof or other fences or huts or sheds erected for residence shearing or other purposes usually required for or in connection with keeping livestock which the Pastoral Board certifies are useful and were made for the purpose of improving the land for pastoral purposes or for increasing the carrying capacity thereof and will have such effect **PROVIDED ALSO** that all improvements on the land comprised in this lease which before the granting of this lease were effected by the Lessee or his predecessors in title shall be deemed to be improvements belonging to the Lessee and notwithstanding sections 72 and 73 of the Pastoral Act 1936-1948 upon the expiration of this lease those improvements shall be valued paid for and dealt with in accordance with the other provisions of Part VI. of the said Pastoral Act **PROVIDED ALSO** it is a condition of this lease that the Lessee shall not be entitled to possession of the demised land until he shall have paid the first years rent and fees and paid or arranged pursuant to the Pastoral Act 1936-1948 for payment of the price for the improvements (if any) **IT IS DECLARED** that the notes in the margin of this lease are for the sake of more convenient reference only and shall not in anywise control or affect the interpretation or construction of this lease **AS WITNESS** the Public Seal of the said State and the hand and seal of the said Lessee

To destroy vermin.

To keep scrub brush cleared.

Not to cut down trees, except for improvement, etc.

Land for agricultural purposes.

To comply with regulations.

Not to interfere with public roads.

Lessee not to construct artesian bores.

Power to Minister to forfeit lease on non-payment of rent.

Exemptions.

Reduction of rent where land resumed.

Effect of notes in lease.

Signed sealed and delivered by the said Lessee in the presence of

D.K.W. Taggart

The Common Seal of RONDING PASTORAL COMPANY LIMITED was hereunto affixed by Authority of the Directors,

this 25th day of September 1951

Leland Giles
Alternate for
D.K.W. Taggart } Directors.
Leland Giles Secretary.

CERTIFICATE NO. 1739035 OF MINISTER OF LANDS THAT ON REVALUATION OF THE WITHIN LEASE NO. 2119 THE RENT HAS BEEN FIXED AT £10-7-0 PER ANNUM FROM THE DAY OF December 1957 PRODUCED FOR REGISTRATION THE 28 DAY OF July 1958 AT noon

Perkins
Dep. Reg Gen.

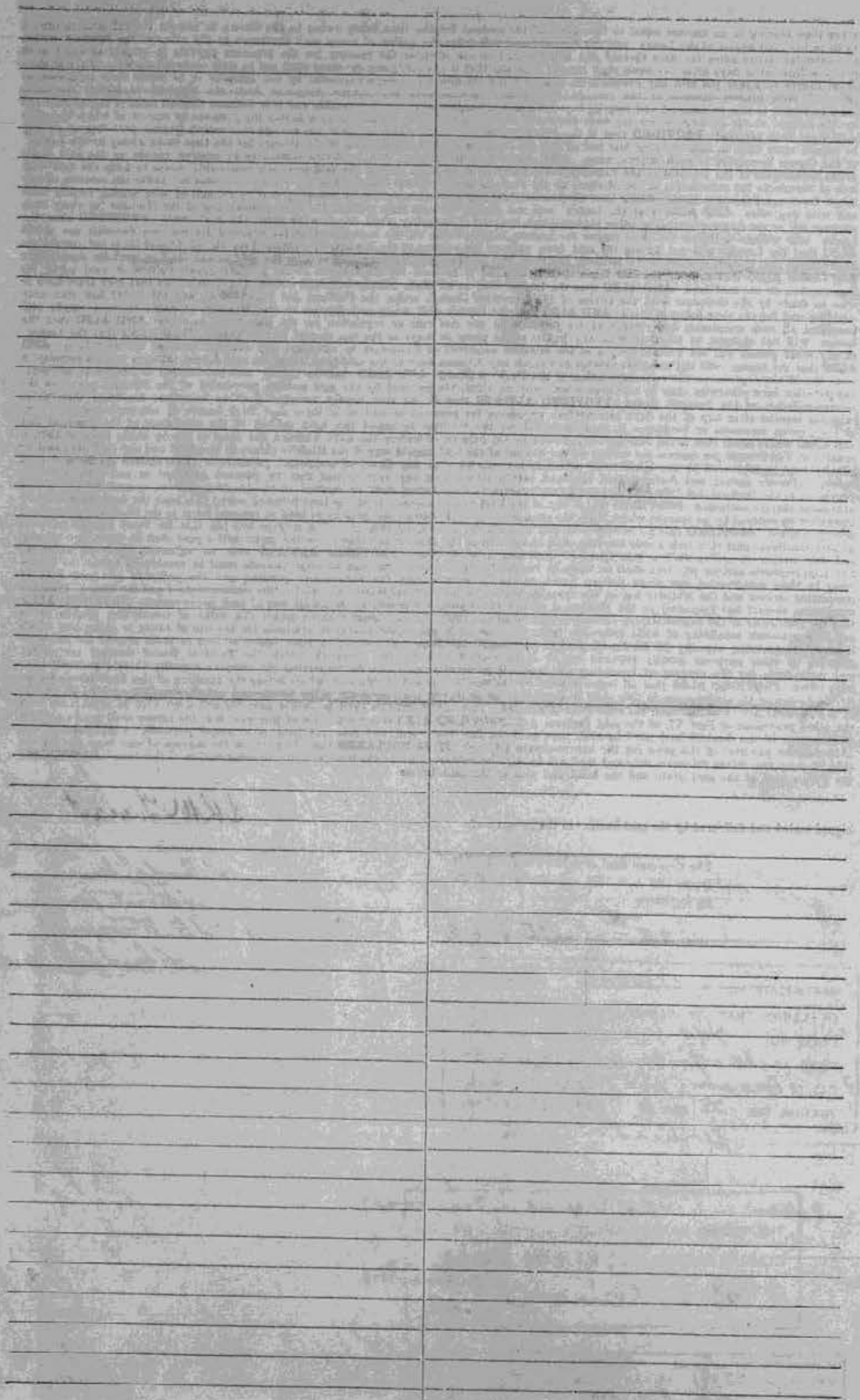
Portion and Easement in Lease No 2119.

THE LAND HAS BEEN ACQUIRED BY THE COMMONWEALTH VIDE L.T.O. NO. 30141 OF 1958

E.A. Nairn (no entry on top)
DEP. REG. GEN'L

SURRENDER OF Lease No. 2119 VIDE No. 2535991 PRODUCED 5/6/1964 AT 2.50 P.M.

Ja Hughes. pro
DEP. REG. GEN.



Winston Dragon

South Australia.

Register Book.

Vol. 821 Folio 42

Registrar-General.

Crown Lease.

(PASTORAL, No. 1767)

(In lieu of Surrendered Leases Nos. 1000 Vol. 487 folio 115- 1001 Vol. 487 folio 116- Mis. Lease 8033 Vol. 656 [illegible] 76)

(Surrendered pursuant to Section 49A of The Pastoral Act, 1904, enacted by Section 4 of The Pastoral Act Amendment Act, 1929.)

This Indenture made the twenty first day of November in the year of our Lord One Thousand Nine Hundred and thirty four **Between** HIS MOST GRACIOUS MAJESTY GEORGE THE FIFTH of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas King Defender of the Faith Emperor of India of the first part His Excellency the Governor in and over the State of South Australia in the Commonwealth of Australia &c. &c. of the second part and OAKDEN HILLS LIMITED whose registered office is situate at Gays Arcade Rundle Street Adelaide

for itself its Successors ~~Executors Administrators~~ and Assigns herein designated by the term "Lessee" of the third part **WITNESSETH** that the said Governor by virtue of the powers contained in "The Pastoral Acts 1904 to 1929" and all other powers enabling him in that behalf **DOTH** lease unto the Lessee for pastoral purposes **ALL THAT** portion of Crown lands containing by estimation six hundred and twenty eight (628)

Parcels. square miles or thereabouts and situate and being Block Nod. 884 "Oakden Hills" Surrounding Woocalla Railway Station

the abuttals and boundaries whereof are particularly delineated and set forth in the plan thereof to this Indenture annexed and signed by the Surveyor-General together with all ways paths passages waters watercourses advantages and appurtenances thereto belonging or appertaining subject to the exceptions and reservations hereinafter contained that is to say **EXCEPT AND RESERVED** all gold silver copper tin and other metals all ores and other substances containing metals all minerals and all gems and precious stones coal and mineral oils upon in or under the said land to His Majesty the King His Heirs and Successors and all persons lawfully claiming under or authorised by Him or them **AND** the Governor and the Commissioner of Crown Lands for the time being of the said State and all persons lawfully claiming under or authorised by them or either of them shall have full and free liberty of access ingress egress and regress with or without horses cattle carts drays carriages engines machinery and all other necessary implements and things into upon and from the said premises for all public purposes and to cut dig sink for try search procure work remove and dispose of all or any of the hereby excepted and reserved things and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **PROVIDED** that no such bores wells dams reservoirs or embankments shall be sunk or constructed within one mile of any improvement consisting of a well reservoir dam dwelling house factory or building of the value of One Hundred Pounds or upwards the property of the said Lessee **AND** reserving to Aboriginal Inhabitants of the said State and their descendants during the continuance of this lease full and free right of egress and regress into upon and over the said lands and every part thereof and in and to the springs and surface waters thereon and to make and erect such wurlies and other dwellings as the said Aboriginal Natives have been heretofore accustomed to make and erect and to take and use for food birds and animals *ferœ naturœ* in such manner as they would have been entitled to do if this lease had not been made **AND** reserving to all persons the rights of crossing the said lands with travelling stock subject to the provisions of "The Stock Diseases Acts 1888 to 1926" "The Pastoral Acts 1904 to 1929" or any other Act for the time being regulating travelling stock **SUBJECT** to the right of His Majesty's subjects to use all and every the roads paths or ways heretofore made and used by them or hereafter to be duly opened and dedicated to the public use for the purpose of passing upon through and over the said lands or any part thereof **SUBJECT ALSO** to the right of the Governor for the time being of the said State and all persons authorised by him or other lawful authority at any time or from time to time as may be deemed requisite with horses carts and carriages or without into upon through and over the said lands to come and go for the purpose of laying out and making fit for and devoting to the public use any new and additional roads ways and paths **AND SUBJECT ALSO** to the right of the said Commissioner or any person authorised by him in that behalf to grant licences to enter upon the said lands or any part thereof and to occupy the same for the purpose of cutting obtaining and taking away any live or dead timber stone and sand with full and free liberty of access ingress egress and regress to and for His Majesty His Heirs and Successors and to and for the Governor and Commissioner of Crown Lands for the time being of the said State and all other persons authorised by them or either of them with or without horses carts and carriages into over through and upon the said lands for the purpose of cutting obtaining and taking away such timber stone and sand but notwithstanding this last-mentioned provision the Lessee shall be at liberty at any time and from time to time to fell cut down and remove any live or dead timber stone and sand which may be required by the Lessee for the purpose of improvements to be constructed or made or firewood to be used upon the said land **TO HAVE AND TO HOLD** the said lands and premises (subject to the covenants conditions provisos and restrictions herein contained)

Term. from the first day of January One Thousand Nine Hundred and thirty two until the thirty first day of December One Thousand Nine Hundred and seventy three **YIELDING AND**

Rent. **PAYING** therefor yearly and every year in advance unto His Majesty His Heirs and Successors by payment at His Majesty's Treasury in the City of Adelaide in the said State the rent or sum of one hundred and eighty eight pounds and eight shillings (£188: 8: 0) for the first term of twenty one years (the rent for the following twenty one years being the balance of the term to be fixed by the Pastoral Board) the first of such payments to be made

Exd. S.G.O., 580 05.

In lieu of Surrendered Lease. Term 42 years, with improvements. (Acts 1904 to 1929.)

Revaluation of rent by reason of public works. on the first day of January in the year One Thousand Nine Hundred and thirty two and in each succeeding year **PROVIDED** that if during the said term hereby granted any railways waterworks reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the said land hereby demised

Commissioner of Crown Lands.

By command,

Director of Lands.

Certified correct.

and by reason thereof the value of the said land hereby demised shall in the opinion of the said Commissioner be enhanced the said Commissioner may direct the Pastoral Board to make a revaluation of the said land hereby demised or any part thereof and thereupon a revaluation shall be made in manner prescribed by Sections 53 and 54 of "The Pastoral Act 1904" and the rent so fixed shall be paid by the Lessee from the date on which it shall be so fixed to be payable but no such revaluation shall be retrospective or made within five years after the commencement of the term of the original lease nor within ten years after any previous revaluation and the said Commissioner shall serve notice of such increased rent upon the Lessee **PROVIDED ALSO** that during the first six months of the twenty-first year of this lease a revaluation of the lands hereby demised shall be made by the Pastoral Board pursuant to "The Pastoral Acts 1904 to 1929" and the rent fixed upon such revaluation shall be paid by the Lessee from the date of the expiration of the first twenty-one years of this lease and the said Commissioner shall forthwith serve upon the Lessee notice in writing of such rent **PROVIDED** that in fixing the said rent whether by revaluation or otherwise no regard shall be had to any increase in value of the lands hereby demised caused by improvements thereon which the Lessee shall have made or paid for and which shall not be the property of the Crown **PROVIDED** the rent so fixed on any revaluation pursuant to "The Pastoral Acts 1904 to 1929" shall not be more than fifty per cent. above or below the rent payable immediately prior to the revaluation **PROVIDED ALWAYS** that the Lessee may at any time within three calendar months from the service of a notice in pursuance of "The Pastoral Acts 1904 to 1929" by the said Commissioner on the said Lessee of any revaluation appeal to the said Commissioner by notice in writing against such revaluation and thereupon the matter shall be determined by arbitrators pursuant to the "Arbitration Acts 1891 and 1921" one arbitrator being appointed by the said Commissioner and the other by the Lessee **AND** the Lessee do hereby covenant with His Majesty His Heirs and Successors and as separate covenants with the said Governor and with the Governor for the time being of the said State and that the Lessee will during the continuance of this lease pay the rent hereinbefore reserved in manner aforesaid free and clear of all outgoings and deductions whatsoever **AND ALSO** that the Lessee will pay unto His Majesty at His Majesty's Treasury aforesaid the sum of two thousand eight hundred and two pounds eight shillings and five pence (£2802: 8: 5)

Revaluation during first six months of twenty-first year.

Covenants by Lessee to pay rent.

To pay value of improvements belonging to the Crown.

being the balance of the value of the improvements belonging to the Crown upon the lands hereby demised by forty two instalments with interest namely one hundred and fifty three pounds three shillings and nine pence(£153: 3: 9)

on the first day of January yearly and every year during the continuance of the term hereby granted **PROVIDED ALWAYS** that in the event of any instalment being unpaid for three calendar months after any date whereon the same ought to be paid the purchase-money then remaining unpaid shall at the option of the said Commissioner become instantly due payable and recoverable and may be recovered by the said Commissioner by action in his own name in any Court of competent jurisdiction **AND ALSO** that the Lessee shall and will stock the land hereby demised with sheep in the proportion of at least five head for every square mile of land included in this lease or with cattle in the proportion of at least one head for every square mile and will keep the same so stocked and before the end of the seventh year of the said term increase the stocking to twenty head of sheep per square mile or four head of cattle per square mile and keep the same so stocked at the least during the remainder of the said term hereby granted **PROVIDED** that the stocking with sheep and cattle combined shall satisfy this present covenant if the requisite number are kept one head of cattle being computed as equal to five head of sheep **AND ALSO** that the Lessee shall not any time during the last three years of the said term hereby granted overstock the land hereby leased or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the said Commissioner or the Pastoral Board would have the effect of depreciating the ordinary capacity of the said land for depasturing stock **AND ALSO** that the Lessee shall at all times upon being thereunto required by the said Commissioner or the Pastoral Board furnish him or them with true particulars of the number of sheep and cattle with which the land hereby demised is stocked **AND ALSO** that the Lessee will expend in improvements on the said land by the end of the fifth year of the lease a sum of not less than ten pounds per square mile by the end of the thirteenth year a sum of not less than fifteen pounds per square mile and by the end of the twenty-first year of the term not less than twenty pounds per square mile **PROVIDED** that any improvements existing upon the said lands at the time of the granting of this lease shall be deemed to be improvements hereby required to be made and the value thereof shall be taken into account in estimating the amount hereby agreed to be expended **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of the purchase-money of any improvements or any interest thereon keep in proper order repair and condition to the satisfaction of the Commissioner all such improvements in respect whereof any such money shall remain owing by the Lessee reasonable wear and tear excepted **AND ALSO** that the Lessee so long as any principal money or interest shall remain owing for any improvements will not pull down or remove from the land hereby demised or knowingly suffer to be pulled down or removed or wilfully or knowingly destroy damage or injure or suffer to be destroyed damaged or injured any such improvements without the consent of the said Commissioner in writing first had and obtained **AND ALSO** that it shall be lawful for the said Commissioner and all persons authorised by him at all times unrestrictedly to enter into and upon the said lands hereby demised and view and examine the state and condition thereof and of the improvements belonging to the Crown thereon and of all defects decays and wants of reparation contrary to the provisions herein contained as shall be then and there found to give to the Lessee or leave upon the said lands notice in writing requiring the Lessee to repair and amend the same within six calendar months then next following within which time the Lessee will repair and amend the same accordingly **AND ALSO** that the Lessee will permit all lawfully constituted Land Boards and the Pastoral Board for the time being and the members agents and officers thereof respectively or any of them at all times unrestrictedly to enter upon and examine the land and premises hereby demised **AND ALSO** that the Lessee will subject to the regulations for the time being in force under "The Mining Acts 1930 and 1931" or any other Act authorising the making of regulations permit every gold or mineral lessee or licencee holding a lease or licence under "The Mining Acts 1930 and 1931" or any other Act for the time being authorising the granting of gold or mineral leases or licences of or respecting any of the land hereby demised and all persons authorised by such lessee or licencee to have unrestricted access to and egress from the land comprised in such mineral lease or licence using however as far as reasonably can be the public roads paths and ways for the time being upon or over the said land or any part thereof **AND ALSO** that the Lessee shall if required by the said Commissioner permit the owner of a gold claim or mineral claim duly registered in terms of "The Mining Acts 1930 and 1931" and pegged out on the land hereby demised to take for mining and domestic purposes a reasonable quantity of water from any of the wells or dams on such lands on payment to the Lessee of fair and reasonable compensation to be determined in case of dispute by the said Commissioner **PROVIDED** that the quantity of water so taken shall not at any time be such as to deprive the Lessee of the quantity of water necessary for stock domestic and general station purposes **AND ALSO** that the Lessee shall if required by the said Commissioner supply water to other lessees of pastoral lands on such terms and conditions as may be determined by the said Commissioner pursuant to Part X. of "The Pastoral Act 1904" as amended by "The Pastoral Act Amendment Act 1929" **AND ALSO** that the Lessee shall supply water to stock travelling through the leased land in terms of Subsection (2) of Section 49E of "The Pastoral Act Amendment Act" 1937 of 1929 and that the Lessee shall also have the right to charge for water supplied at the rate of 1s. 3d. for each 100 sheep and 10s. 0d. for each 100 cattle **AND PROVIDED ALSO** that the lease shall reserve to the Lessee the right to determine from what water supply the travelling stock are to take water and the water supply so determined shall not necessarily be that nearest to the most direct route through the leased land **AND ALSO** that the Lessee shall not nor will during the said term assign or sublet the whole or any part of the leased land without the consent of the Commissioner **PROVIDED** that the Commissioner shall not consent to an assignment or subletting of the whole of the leased land during the first five years of the term unless it is proved to his satisfaction that a refusal of consent would cause severe hardship **ALSO** the Commissioner shall not during the first ten years of the term consent to any assignment or subletting giving effect to a subdivision of the leased land into two or more parts unless it is proved to his satisfaction that a refusal of consent would cause severe hardship **ALSO** the Commissioner shall not at any time consent to any assignment or subletting giving effect to a subdivision of the leased land into two or more parts unless plans of the proposed subdivision have first been submitted to and approved by him and he is satisfied that the subdivision is such as would enable the best use to be made of all improvements waters and grazing areas Subject to the preceding paragraphs of this proviso the Commissioner shall not capriciously withhold his consent to any assignment or subletting **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of any improvements belonging to the Crown and liable to be destroyed or damaged by fire insure and during the term hereby granted keep insured in some Insurance Office in Adelaide to be approved by the said Commissioner against loss or damage by fire all such improvements other than fencing in an amount equal to two-thirds of the amount for the time being owing to the Crown in respect thereof such insurance to be in the joint names of the Lessee and the said Commissioner and will lodge the policy of every such insurance in the office of the said Commissioner within one calendar month after the date thereof and will forward to the said Commissioner the receipts for the premium payable in respect of every such policy within seven days after the same shall become due and that if the foregoing covenant shall not be duly observed then the said Commissioner shall be at liberty to insure the said improvements in manner aforesaid and all moneys expended by the said Commissioner in or about such insurance as aforesaid with interest thereon at the rate of Five Pounds per centum per annum computed from the time of expending the same shall be repaid to him on demand and may be recovered in like manner as rent is recoverable and it is declared that all sums of money received by the Lessee or the said Commissioner under any such insurance shall be laid out in reinstating (*pro tanto*) the premises in respect of which the same shall have been received **PROVIDED** that if the said Commissioner and the Lessee shall so agree the moneys so received or such part thereof as may be agreed upon shall in lieu of being laid out as last aforesaid be applied in reduction of the amount for the time being owing by the Lessee to the Crown in respect of such improvements **AND ALSO** that the Lessee will forthwith commence to destroy vermin on the said lands to the satisfaction of the said Commissioner or the Pastoral Board and will at all times during the said term use reasonable means to keep the said land free of vermin to the satisfaction of the said Commissioner or the Pastoral Board **ALSO** that the Lessee will neither erect nor suffer the erection of any brush fence upon the said lands **AND ALSO** that the Lessee will not during the said term without the licence in writing of the said Commissioner for every such purpose fell or cut down any trees or other timber which are now or hereafter shall be growing upon the said lands except for improvements or firewood **AND ALSO** that the Lessee will not during the said term without the consent of the said Commissioner first obtained use any of the said lands for Agriculture **PROVIDED** that if such consent of the said Commissioner has been first obtained the said Commissioner may revalue the

To stock. Not to overstock.

To furnish returns of stock.

To keep improvements belonging to the Crown in repair.

Power to Commissioner to enter and view condition of Crown improvements.

Right of ingress, &c., to mineral lessees.

To permit owner of gold or mineral claim to take water.

Not to transfer or sublet.

To insure.

Not to erect brush fences.

Not to cut down timber, except for improvements, &c.

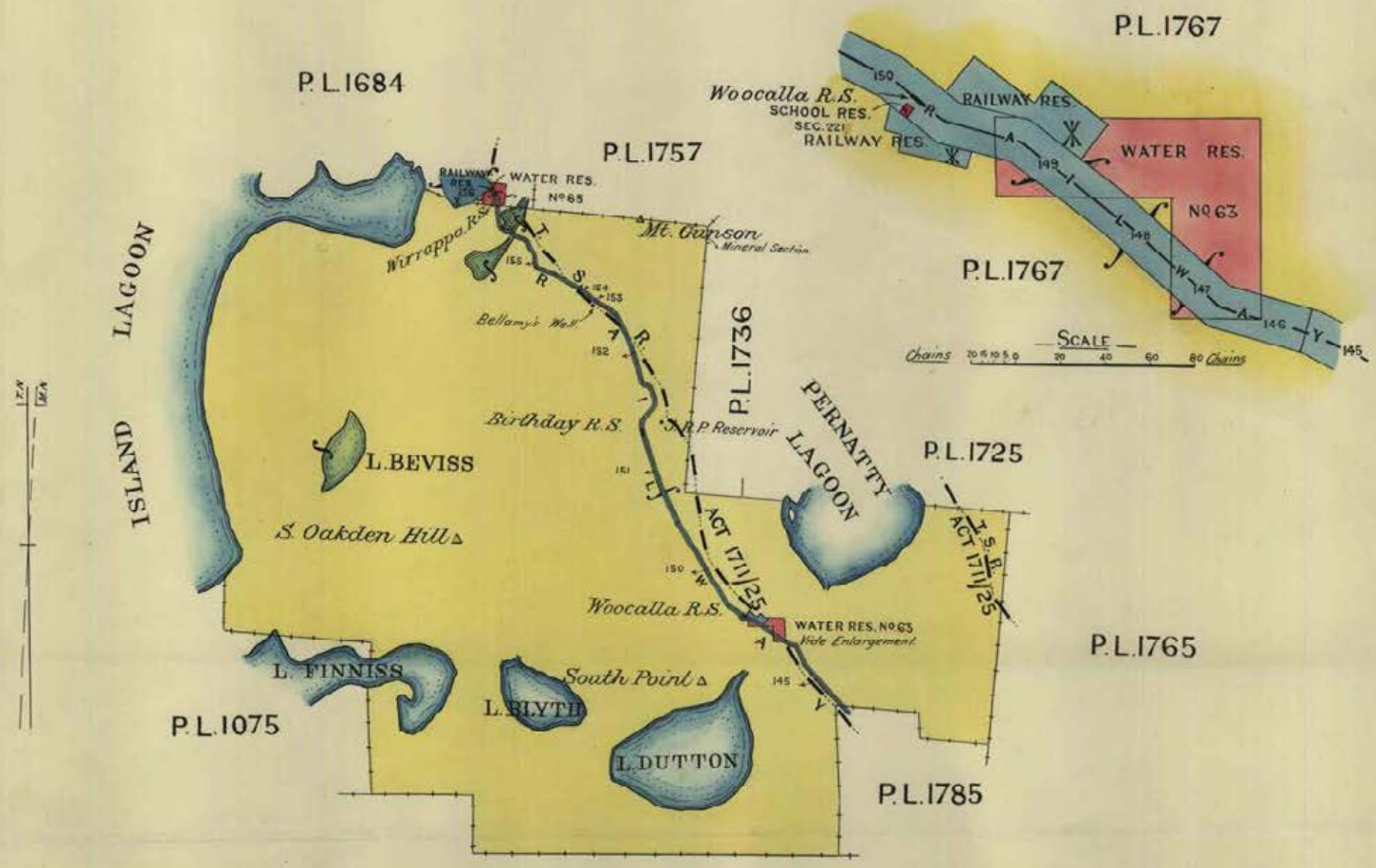
To comply with regulations.

Provided Also the Lessee to have the right to use the water from former Water Reserve No.64 and J. R. P. Reservoir on condition that all appliances existing thereon be maintained in good serviceable condition, such water supplies and appliances to remain the property of the Crown.

PLAN
of portion of
CROWN LANDS

PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
Nº 1767
(BLOCK 884)

— ENLARGEMENT —



P.L.1021

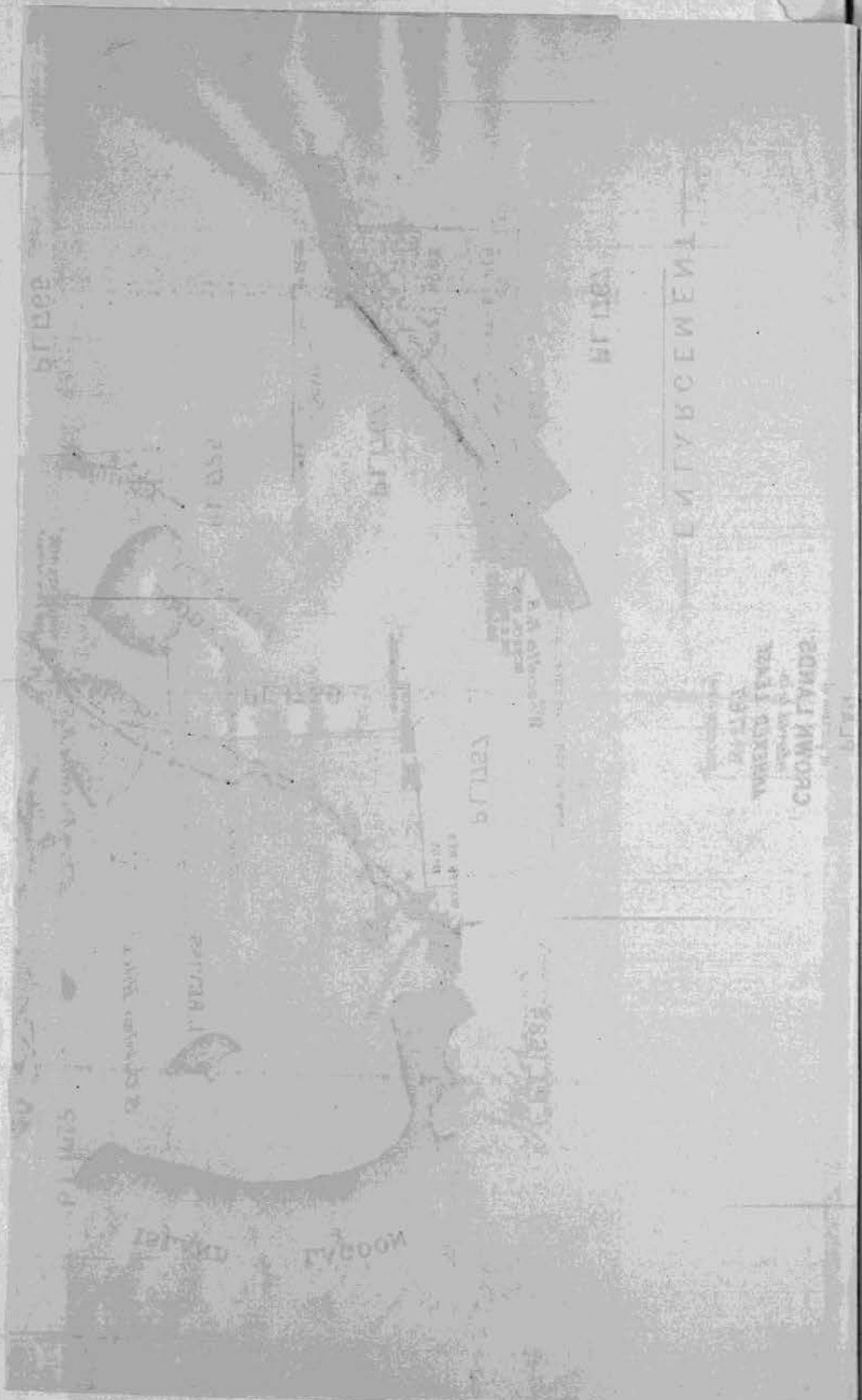
Diagram certified correct.

J.H.M'Shannon
Surveyor General.

Scale

Area 628 sq. miles.

Fences shown thus. ——+——+——



Land for agricultural purposes.

Not to interfere with public roads.

Power to Commissioner to forfeit lease on non payment of rent.

Tenants' Relief Board.

Resumption.

Lessee to have preferential right to occupy resumed land in certain circumstances.

Reduction of rent where land resumed.

Improvements to be valued.

Compensation on resumption.

Improvements to be paid for by incoming Lessee.

Public works not to be taken into account in computing compensation.

Payment of compensation to be made within six months of the Lessee giving up possession.

Compensation to be determined by arbitration.

Marginal notes clause.

rent of any land so used for Agriculture **PROVIDED ALSO** that none of the said lands shall be deemed to be used for Agriculture if the produce grown thereon is used solely for consumption on the said land **AND ALSO** that the Lessee will at all times comply with and observe the Regulations that may from time to time be made by the Governor with the advice of the Executive Council under "The Pastoral Acts 1904 to 1929" or any other Act him thereunto enabling and for the time being in force **AND ALSO** that the Lessee will make and furnish to the Commissioner or cause to be so made and furnished all such statements and returns as are required by any Act rule or regulation for the time being in force **AND ALSO** that the Lessee will not obstruct or interfere with any public roads paths or ways or the use thereof by any person **AND ALSO** that the Lessee or any other person will not without licence of the said Commissioner construct or commence to construct any artesian bore on the said land **AND ALSO** that the Lessee will not maintain enlarge or deepen any artesian bore either existing or under construction on the said land at the time of the passing of the said "Pastoral Act Amendment Act 1929" unless the said Lessee within six months from the commencement of the last-mentioned Act obtains a licence from the said Commissioner pursuant to Part X. of "The Pastoral Act 1904" as amended by "The Pastoral Act Amendment Act 1929" **PROVIDED** that if the rent hereby reserved be not paid on or before the days whereon the same is hereby made payable then a penalty of Ten Pounds per centum per annum on the amount of the rent unpaid may if the said Commissioner think fit be added and if such rent and penalty be not paid within one calendar month after the same shall become due the same shall be recoverable by the said Commissioner by action in his own name in any Court of competent jurisdiction **PROVIDED ALWAYS** that if the rent hereby reserved shall be in arrear for more than three calendar months after any of the days hereinbefore appointed for payment thereof or if there shall be a breach or non-performance of any of the Lessee's covenants or conditions it shall be lawful for the said Commissioner to cancel this lease **PROVIDED ALSO** that this lease shall not be forfeited until after the expiration of three months from the giving of a notice to the Lessee by the said Commissioner of his intention to forfeit the same and unless the said intention to forfeit shall have been previously approved by the Pastoral Board **PROVIDED ALSO** that the Lessee upon receiving notice of the said Commissioner's intention to forfeit this lease for the default in the observance or performance of any covenant or condition herein contained other than the covenant for payment of rent may apply pursuant to "The Pastoral Acts 1904 to 1929" or any other Act for the time being in force to the Tenants' Relief Board for relief **PROVIDED ALSO** and it is hereby expressly agreed and declared that the Governor of the said State shall and may by Proclamation published in the *Government Gazette* and notice in writing forwarded to the Lessee setting out the purpose for which the land is intended to be resumed at any time or from time to time hereafter determine this lease as to and resume possession of all or any part of the said lands if such land shall be required for intense culture or for the purposes of any public work such as railways tramways roads bridges public buildings water conservation works or the like or as a site for a town or cemetery or for mining or for residential sites commonage or other purposes incidental to mining or for park lands in which cases one month's notice of the intention to resume shall be given for all such purposes except for intense culture and where such resumption is for the purpose of intense culture one year's notice shall be given **PROVIDED ALSO** that immediately after notice for resumption for the purposes heretofore specified the said Commissioner may enter upon the lands hereby demised for the purpose of making any necessary surveys **PROVIDED ALSO** that if no portion of the land resumed for intense culture shall be used for intense culture for a period of two years from the date of the expiry of the notice of resumption the Lessee shall have the first right to a lease thereof upon the same terms and conditions as the land was held at the time of such resumption for the balance of the term hereby granted upon repayment by the Lessee of any compensation for such resumption **PROVIDED ALSO** that if a portion of the said lands shall be resumed for intense culture the Lessee may require the said Governor to resume the whole of the lands hereby demised in respect to which notice of such partial resumption shall be given **PROVIDED ALSO** that if any of the lands hereby demised shall be resumed for or in connection with mining and after such resumption be found to be not required for the purposes for which the same were resumed the Lessee shall have a preferential right to occupy during the residue of the term of this lease the lands so resumed and not required on such terms as may be prescribed by Act or regulation in that behalf **PROVIDED ALSO** and it is hereby agreed that for every square mile resumed there shall be deducted from and out of the yearly rental hereinbefore reserved the sum of six shillings (£0: 6: 0) and so in proportion for any quantity of such lands resumed **PROVIDED** that no reduction of rent be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced by the sum of six shillings (£0: 6: 0) no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year **PROVIDED ALSO** that within twelve calendar months before the expiration by effluxion of time of the term hereby granted all improvements (if any) existing upon the land hereby demised shall be valued so far as practicable in detail and the position of such improvements indicated on a plan to be prepared by the said Commissioner and signed by the said Commissioner and the Lessee **PROVIDED ALSO** that if any of the said land hereby demised shall be resumed the Lessee shall be compensated by the Government of the said State for the loss or depreciation in the value of this lease caused by such resumption and also in respect of such improvements as he would have been entitled to payment for from an incoming lessee if this lease had expired and the land had been relet as on the date of notice of resumption **PROVIDED ALWAYS** that no valuation shall be made of any improvements and no payment shall be made in respect of any improvements and no improvements shall be considered unless the Lessee prior to their construction has given written notice to the Commissioner stating the nature and position and the probable cost and date of completion thereof and the Commissioner has on the recommendation of the Board consented to the making thereof and the Lessee after the completion thereof has furnished to the Commissioner a statement showing the details of the actual cost of such improvements **PROVIDED ALSO** that the provisions of the immediately preceding proviso shall not apply to any improvements under the value of twenty-five pounds or to any improvements consisting of wells reservoirs tanks or dams of a permanent character available for the use of cattle or sheep and which increase the carrying capacity of the land leased or substantial buildings vermin-proof or other fences or huts or sheds erected for residence shearing or other purposes usually required for or in connection with keeping livestock which the Board certifies are useful and were made for the purpose of improving the land for pastoral purposes or for increasing the carrying capacity thereof and will have such effect **PROVIDED ALSO** that all machinery or appliances which in the opinion of the Pastoral Board arbitrators or umpire making a valuation shall be necessary for the purpose of raising or distributing after raising the water which may be attached or appurtenant to any well dam tank reservoir or natural water to be valued including all under and over ground tanks and troughs shall when approved by the valuator be included in the valuation of such Board arbitrators or umpire **PROVIDED ALSO** that subject to the provisions of "The Pastoral Acts 1904 to 1929" at the expiration of the said term hereby granted the Lessee shall be entitled to receive from the incoming Lessee the value to be determined as provided by "The Pastoral Acts 1904 to 1929" of all improvements made or purchased by him existing upon such portions of the said lands hereby demised as may be comprised in the new lease **PROVIDED ALSO** that the purchase-money to be paid for improvements by the incoming Lessee whether afterwards payable to the Lessee or not together with interest at the ~~rate of Five pounds~~ fixed rate (within the meaning of "The Pastoral Acts 1904 to 1929") per centum per annum on any amount overdue shall be a debt from the incoming Lessee to the said Commissioner **PROVIDED ALWAYS** that any moneys received by the said Commissioner from the incoming Lessee in respect of improvements made or paid for by the Lessee shall be paid over to the Lessee when he shall give up possession of the said land together with interest at the rate of three per cent. per annum from the time of the receipt of the purchase-money by the said Commissioner less all costs of and incidental to the recovery thereof and less all proper deductions for rent or compensation for loss or depreciation of such improvements or otherwise **PROVIDED ALWAYS** that such costs shall in no case exceed five per centum of the moneys so received by the said Commissioner **PROVIDED ALWAYS** that the Lessee and the incoming Lessee may mutually agree touching the amount to be paid to the Lessee for the improvements and the time and manner of payment thereof pursuant to "The Pastoral Acts 1904 to 1929" **PROVIDED ALSO** that on the determination of this lease all barbed wire and netting by which any boundary fence the property of His Majesty's Government has been or shall during the term of this lease be vermin-proofed by the Lessee at his own cost shall be and be deemed to be on such determination as aforesaid the property of the Lessee and shall at the termination of this lease be valued as provided in "The Pastoral Acts 1904 to 1929" and shall be paid for by any incoming Lessee of the land hereby leased **PROVIDED ALWAYS** that in computing the compensation to be paid for the loss of or depreciation in the value of this lease if the whole or any part of the said lands shall be resumed no increased value given to this lease by reason of any public works executed after the granting hereof shall be included or taken into account **PROVIDED ALSO** that as prescribed by "The Pastoral Acts 1904 to 1929" the amount payable for compensation for loss of or depreciation in value of this lease shall be paid within six calendar months after the expiry of the lease or resumption occasioning such loss or depreciation provided that the Lessee shall then have given up possession of the land resumed **PROVIDED ALSO** that in case the land hereby demised shall not be offered by the said Commissioner for lease within six calendar months after the expiration of this lease the amount determined as provided of all improvements shall be paid by the said Commissioner to the Lessee upon the Lessee giving up possession thereof **PROVIDED ALSO** that all valuations of improvements or in respect of compensation made under these presents shall in case of dispute be determined pursuant to "The Arbitration Acts 1891 and 1921" It is a condition of this lease that the lessee shall not be entitled to possession of the demised land until he shall have paid the first year's rent and paid or arranged pursuant to "The Pastoral Acts 1904 to 1929" for payment of the price for improvements (if any) **IT IS DECLARED** that the notes in the margin of this lease are for the sake of more convenient reference only and shall not in anywise control or affect the interpretation or construction of this lease **AS WITNESS** the Public Seal of the said State and the hand and seal of the said Lessee

Vide L.T.O. No. 1147/38

Dep. Reg. Genl.

The Seal of Oakden Hill Limited was hereunto affixed the 6th day of December 1938

OAKDEN HILL LIMITED

J. Kidman
J. C. Kidman
} Directors

Chas. V. Tassie Secretary

Signed sealed and delivered by the said Lessee in the presence of

~~1135668~~

TRANSFER No. 1238558 FROM
Oakden Wells Limited to
Fanning Pastoral Company
Limited of Albert Chambers Pirie
Street Adelaide
OF THE WITHIN Lease No. 1767
PRODUCED FOR REGISTRATION THIS 24 DAY OF
June 1937 AT 12.35 pm
A. T. Shobbrook DEP. REG. GENL.

SURRENDER OF THE within Lease
No. 1767 BY MEMORANDUM No. 1263670
PRODUCED FOR REGISTRATION THIS 28 DAY OF
February 1951 AT 2.30 pm
L. A. Rogers DEP. REG. GENL.

D/A No. 690064 Copy of Certificate

No. 626519

THIS PIECE OF THE ...written... MORTGAGE

BY RECEIPT ENDORSED THEREON PRODUCED FOR REGISTRATION THE 30 DAY OF June 1920 AT 2.45 p.m.

Registrar-General.

REAL PROP. ACT, GENL.

Vol. 487 Folio 115

Registrar-General.

Transfer No. 754492 from Walter Ives and Charles Marsh Ives to Myrtle Muriel Kidman of Glenelg Grazier and Thora Sackville Kidman of Oakden Hills Grazier of the within lease No. 1000 Produced for registration the 30 day of June 1920 at 2.45 p.m.

Dep. Reg. Genl.

South Australia

Crown Lease.

(PASTORAL, No. 1000)

In lieu of Surrendered Lease No 728

This Indenture made the Twenty Third day of February in the year of our Lord One Thousand Nine Hundred and Four BETWEEN HIS MOST GRACIOUS MAJESTY EDWARD THE SEVENTH of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas King Defender of the Faith Emperor of India of the first part His Excellency the Governor in and over the State of South Australia and the Dependencies thereof in the Commonwealth of Australia &c. &c. of the second part and John Bevis Walker Ives and Charles Marsh Ives all of Oakden Hills Sheepfarmers (See attached sheet)

for themselves their Executors Administrators and Assigns herein designated by the term "Lessee" of the third part **WITNESSETH** that the said Governor by virtue of the powers contained in "The Crown Lands Act 1888" "The Pastoral Act 1893" "The Pastoral Act Amendment Act 1895" "The Pastoral Act Amendment Act 1896" "The Pastoral Amendment Act 1898-9" and "The Pastoral Amendment Act 1901" all other powers enabling him in that behalf **DOTH** lease unto the Lessee for pastoral purposes

Parcels. **ALL THAT** portion of Crown lands containing by estimation three hundred and twenty six (326) square miles or thereabouts situate and being At Oakden Hills the abuttals and boundaries whereof are particularly delineated and set forth in the plan thereof to this Indenture annexed and signed with the initials of the Surveyor-General together with all ways paths passages waters watercourses advantages and appertenances thereto belonging or appertaining subject to the exceptions and reservations hereinafter contained that is to say **EXCEPT AND RESERVED**

Exceptions and reservations. all gold silver copper tin and other metals ores minerals and other substances containing metals and all gems and precious stones and all coal and mineral oils upon in or under the said land to His Majesty the King His Heirs and Successors and all persons lawfully claiming under or authorised by Him or them **AND** the Governor and the Commissioner of Crown Lands for the time being of the said State and all persons lawfully claiming under or authorised by them or either of them shall have full and free liberty of access ingress egress and regress with or without horses cattle carts drays carriages engines machinery and all other necessary implements and things into upon and from the said premises for all public purposes and to cut dig sink for try search procure work remove and dispose of all or any of the hereby excepted and reserved things and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **AND** reserving to Aboriginal Inhabitants of the said State and their descendants during the continuance of this lease full and free right of egress and regress into upon and over the said lands and every part thereof and in and to the springs and surface waters thereon and to make and erect such wurlies and other dwellings as the said Aboriginal Natives have been heretofore accustomed to make and erect and to take and use for food birds and animals *ferae naturae* in such manner as they would have been entitled to do if this lease had not been made **AND** reserving to all persons the rights of crossing the said lands with travelling stock subject to the provisions of Act No. 443 of 1888 or any other Act for the time being regulating travelling stock **SUBJECT** to the right of His Majesty's subjects to use all and every the roads paths or ways heretofore made and used by them or hereafter to be duly opened and dedicated to the public use for the purpose of passing upon through and over the said lands or any part thereof **SUBJECT ALSO** to the right of the Governor for the time being of the said State and all persons authorised by him or other lawful authority at any time or from time to time as may be deemed requisite with horses carts and carriages or without into upon through and over the said lands to come and go for the purpose of laying out and making fit for and devoting to the public use any new and additional roads ways and paths **AND SUBJECT ALSO** to the right of the said Commissioner or any person authorised by him in that behalf to grant licences to enter upon the said lands or any part thereof and to occupy the same for the purpose of cutting obtaining and taking away any live or dead timber stone and sand with full and free liberty of access ingress egress and regress to and for His Majesty His Heirs and Successors and to and for the Governor and Commissioner of Crown Lands for the time being of the said State and all other persons authorised by them or either of them with or without horses carts and carriages into over through and upon the said lands for the purpose of cutting obtaining and taking away such timber stone and sand but notwithstanding this last-mentioned provision the Lessee shall be at liberty at any time and from time to time to fell cut down and remove any live or dead timber stone and sand which may be required by the Lessee for the purpose of any erection fencing firewood or improvements to be constructed or used upon the said land or that may be required in any way upon the said land **TO HAVE AND TO HOLD** the said lands and premises (subject to the covenants conditions provisos and restrictions herein contained) for the full term of FORTY-TWO YEARS from

Term. the First day of January One Thousand Nine Hundred and Four **YIELDING AND**

Rent. **PAYING** therefor yearly and every year in advance unto His Majesty His Heirs and Successors by payment at His Majesty's Treasury in the City of Adelaide in the said State the rent or sum of sixty nine pounds and six shillings (£69 6 0) sterling on the first day of January in the year One Thousand Nine Hundred and Three and in each succeeding year the first year's rent having been heretofore paid **PROVIDED** that if after the first

Revaluation of rent by reason of public works. five years of the said term hereby granted any railways waterworks reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the said land hereby demised and by reason thereof the value of the said land hereby demised shall in the opinion of the said Commissioner be enhanced the said Commissioner may direct the Pastoral Board to make a revaluation of the said land hereby demised or any part thereof and thereupon a revaluation shall be made in manner prescribed by sections 68 and 69 of "The Pastoral Act 1893" and the rent so fixed shall be paid by the Lessee from the date on which it shall be so fixed to be payable and the said Commissioner shall serve notice of such increased rent upon the Lessee **PROVIDED ALSO** that after the expiration of the

Revaluation after first twenty-one years. period of twenty-one years of this lease a revaluation of the lands hereby demised shall be made by the Pastoral Board pursuant to "The Pastoral Act 1893" and the rent fixed upon such revaluation shall be paid by the Lessee from the date of the expiration of the first twenty-one years of this lease **PROVIDED** that in fixing the said rent whether by revaluation or otherwise no regard shall be had to any increase in value of the lands hereby demised caused by improvements thereon which the Lessee shall have made or paid for and which shall not be the property of the Crown **PROVIDED** the rent so fixed shall not be more than fifty per cent. above or below the rent payable during the last year of the first twenty one years of the term of this lease **PROVIDED ALWAYS** that the Lessee may at anytime

CERTIFICATE NO. 22097 OF COMMISSIONER OF CROWN LANDS THAT ON REVALUATION OF THE WITHIN LEASE NO 1000 THE RENT HAS BEEN FIXED AT £ 109 : 13 : 9 PER ANNUM FROM THE 1 DAY OF January 1922 PRODUCED FOR REGISTRATION THE 29 DAY OF June 1922 AT 2 p.m.

Dep. Reg. Genl.

within three calendar months from the service of a notice by the said Commissioner on the said Lessee of such increased rent appeal to the said Commissioner by notice in writing against such revaluation and thereupon the matter shall be determined by arbitrators pursuant to the "Arbitration Act 1891" one arbitrator being appointed by the said Commissioner and the other by the Lessee **AND** the Lessee do

Covenants by Lessee to pay rent.

hereby covenant with His Majesty His Heirs and Successors and as separate covenants with the said Governor and with the Governor for the time being of the said State that the Lessee will during the continuance of this lease pay the rent hereinbefore reserved in manner aforesaid free and clear of all rates and taxes except such as are or may be imposed by or under the authority of any Act and free and clear also of all outgoings and deductions whatsoever **AND ALSO** that the Lessee will pay unto His Majesty at His Majesty's Treasury

To pay value of improvements belonging to the Crown.

aforesaid the sum of *four thousand seven hundred and ninety seven pounds and six shillings* (£4797. 6. 0)
being the value of the improvements belonging to the Crown upon the lands hereby demised by instalments with interest at the rate of
five hundred and twenty eight pounds thirteen shillings and five pence (£528. 13. 5)
on the first day of *January* yearly and

every year during the continuance of the term hereby granted **PROVIDED ALWAYS** that in the event of any instalment being unpaid for three calendar months after any date whereon the same ought to be paid the purchase-money then remaining unpaid shall at the option of the said Commissioner become instantly payable and recoverable and may be recovered by the said Commissioner by action in his own name in

To stock.

any Court of competent jurisdiction **AND ALSO** that the Lessee shall and will before the end of the third year of the said term hereby granted stock the land hereby demised with sheep in the proportion of at least five head for every square mile of land included in this lease or with cattle in the proportion of at least one head for every square mile and will keep the same so stocked and before the end of the seventh year of the said term increase the stocking to twenty head of sheep per square mile or four head of cattle per square mile and

Not to overstock.

keep the same so stocked at the least during the remainder of the said term hereby granted **PROVIDED** that the stocking with sheep and cattle combined shall satisfy this present covenant if the requisite number are kept one head of cattle being computed as equal to five head of sheep **AND ALSO** that the Lessee shall not at any time during the last three years of the said term hereby granted overstock the land hereby leased or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the said

To furnish returns of stock.

Commissioner or the Pastoral Board would have the effect of depreciating the ordinary capacity of the said land for depasturing stock **AND ALSO** that the Lessee shall at all times upon being thereunto required by the said Commissioner or the Pastoral Board furnish him or

If land inferior, stocking clause modified.

them with true particulars of the number of sheep and cattle with which the land hereby demised is stocked **PROVIDED** that if the said Commissioner shall be satisfied that the said land hereby demised is waterless or vermin infested or otherwise specially inferior for pastoral purposes and if the said Commissioner shall be satisfied that during the first six years of the term hereby granted a sum equal to Five Pounds per square mile of the land hereby demised has been expended by the Lessee in destroying vermin upon the said land or has been expended by the Lessee in erecting vermin-proof fencing thereon or in constructing improvements consisting of wells reservoirs tanks or dams of a permanent character and available for the use of cattle or sheep and which increase the carrying capacity of the said land the Lessee shall not be bound to increase the stock to more than ten head of sheep or two head of cattle (or their equivalent) per square mile at any time during the said term hereby granted **PROVIDED** that the value of improvements on the land at the commencement of this lease shall be taken into consideration as fully as if the same had been made during the first six years of the term hereby granted **AND ALSO** that the

Lessee will expend in improvements on the said land a sum of not less than *Nil* per mile per annum until

To keep improvements belonging to the Crown in repair.

three pounds per square mile shall have been expended by the Lessee **PROVIDED** that any improvements existing upon the said lands at the time of the granting of this lease shall be deemed to be improvements hereby required to be made and the value thereof shall be taken into account in estimating the amount hereby agreed to be expended **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of the purchase-money of any improvements or any interest thereon keep in good order repair and condition all such improvements in respect whereof any such money shall remain owing by the Lessee reasonable wear and tear excepted **AND ALSO** that the Lessee so long as any principal money or interest shall remain owing for any improvements will not pull down or remove from the land hereby demised or knowingly suffer to be pulled down or removed or wilfully or knowingly destroy damage or injure or knowingly suffer to be destroyed damaged or injured any such improvements without the consent of the said Commissioner in writing first had and obtained

Power to Commissioner to enter and view condition of Crown improvements.

AND ALSO that it shall be lawful for the said Commissioner and all persons authorised by him at all times unrestrictedly to enter into and upon the said lands hereby demised and view and examine the state and condition thereof and of the improvements belonging to the Crown thereon and of all defects decays and wants of reparation contrary to the provisions herein contained as shall be then and there found to give to the Lessee or leave upon the said lands notice in writing requiring the Lessee to repair and amend the same within six calendar months then next following within which time the Lessee will repair and amend the same accordingly **AND ALSO** that the Lessee will permit all lawfully constituted Land Boards and the Pastoral Board for the time being and the members agents and officers thereof respectively or any

Right of ingress, &c., to mineral lessees.

of them at all times unrestrictedly to enter upon and examine the land and premises hereby demised **AND ALSO** that the Lessee will subject to the regulations for the time being in force under "The Mining Act 1893" or any other Act authorising the making of regulations permit every gold or mineral lessee or licencee holding a lease or licence under "The Mining Act 1893" or any other Act for the time being authorising the granting of gold or mineral leases or licences of or respecting any of the land thereby demised and all persons authorised by such lessee or licencee to have unrestricted access to and egress from the land comprised in such mineral lease or licence using however as far as reasonably can be the public roads paths and ways for the time being upon or over the said land or any part thereof **AND ALSO** that

Not to transfer or sublet.

the Lessee shall not nor will during the said term without the consent in writing of the said Commissioner first had and obtained transfer or sublet the premises hereby demised or any part thereof or assign these presents or do commit or suffer any act matter or thing whereby the said premises or any part thereof shall or may be transferred or sublet to any person or persons provided that such consent shall not be capriciously withheld **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of any improvements

To insure.

belonging to the Crown and liable to be destroyed or damaged by fire insure and during the term hereby granted keep insured in some Insurance Office in Adelaide to be approved by the said Commissioner against loss or damage by fire all such improvements other than fencing in an amount equal to two-thirds of the amount for the time being owing to the Crown in respect thereof such insurance to be in the joint names of the Lessee and the said Commissioner and will lodge the policy of every such insurance in the office of the said Commissioner within one calendar month after the date thereof and will forward to the said Commissioner the receipts for the premium payable in respect of every such policy within seven days after the same shall become due and that if the foregoing covenant shall not be duly observed then the said Commissioner shall be at liberty to insure the said improvements in manner aforesaid and all moneys expended by the said Commissioner in or about such insurance as aforesaid with interest thereon after the rate of Five Pounds per centum per annum computed from the time of expending the same shall be repaid to him on demand and may be recovered in like manner as rent is recoverable and it is declared that all sums of money received by the Lessee or the said Commissioner under any such insurance shall be laid out in reinstating *(pro tanto)* the premises in respect of which the same shall have been received **PROVIDED** that if the said Commissioner and the Lessee shall so agree the moneys so received or such part thereof as may be agreed upon shall in lieu of being laid out as last aforesaid be applied in reduction of the amount for the time being owing by the Lessee to the Crown in respect of such improvements **AND ALSO** that the Lessee will forthwith commence to destroy vermin on the said lands to the satisfaction of the said Commissioner or the Pastoral Board and will at all

Not to erect brush fences. Not to cut down timber except for improvements, &c. To comply with regulations.

times during the said term keep the said land free of vermin to the satisfaction of the said Commissioner or the Pastoral Board **ALSO** that the Lessee will neither erect nor suffer the erection of any brush fence upon the said lands **AND ALSO** that the Lessee will not during the said term without the licence in writing of the said Commissioner for every such purpose fell or cut down any trees or other timber which are now or hereafter shall be growing upon the said lands except for erections fencing or firewood **AND ALSO** that the Lessee will at all times comply with and observe the Regulations that may from time to time be made by the Governor with the advice of the Executive Council under "The Pastoral Act 1893" or any other Act him thereunto enabling and for the time being in force **AND ALSO** that the Lessee will make or cause to be made all such statements and returns as are required by sections 85 and 86 of "The Crown Lands Act 1888" and by any Act or regulation for the time being in force **AND ALSO** that the Lessee will not obstruct or interfere with any public roads

Not to interfere with public roads.

paths or ways or the use thereof by any person **PROVIDED** that if the rent hereby reserved be not paid on or before the days whereon the same is hereby made payable a penalty of Ten Pounds per centum per annum may if the said Commissioner think fit be added and if such rent and penalty be not paid within one calendar month after the same shall become due the same shall be recoverable by the said Commissioner by action in his own name in any Court of competent jurisdiction **PROVIDED ALWAYS** that if the rent hereby reserved shall be in arrear for more than three calendar months after any of the days hereinbefore appointed for payment thereof or if there shall be a breach or non-performance of any of the Lessees covenants it shall be lawful for the said Commissioner to forfeit this lease **PROVIDED ALSO** that

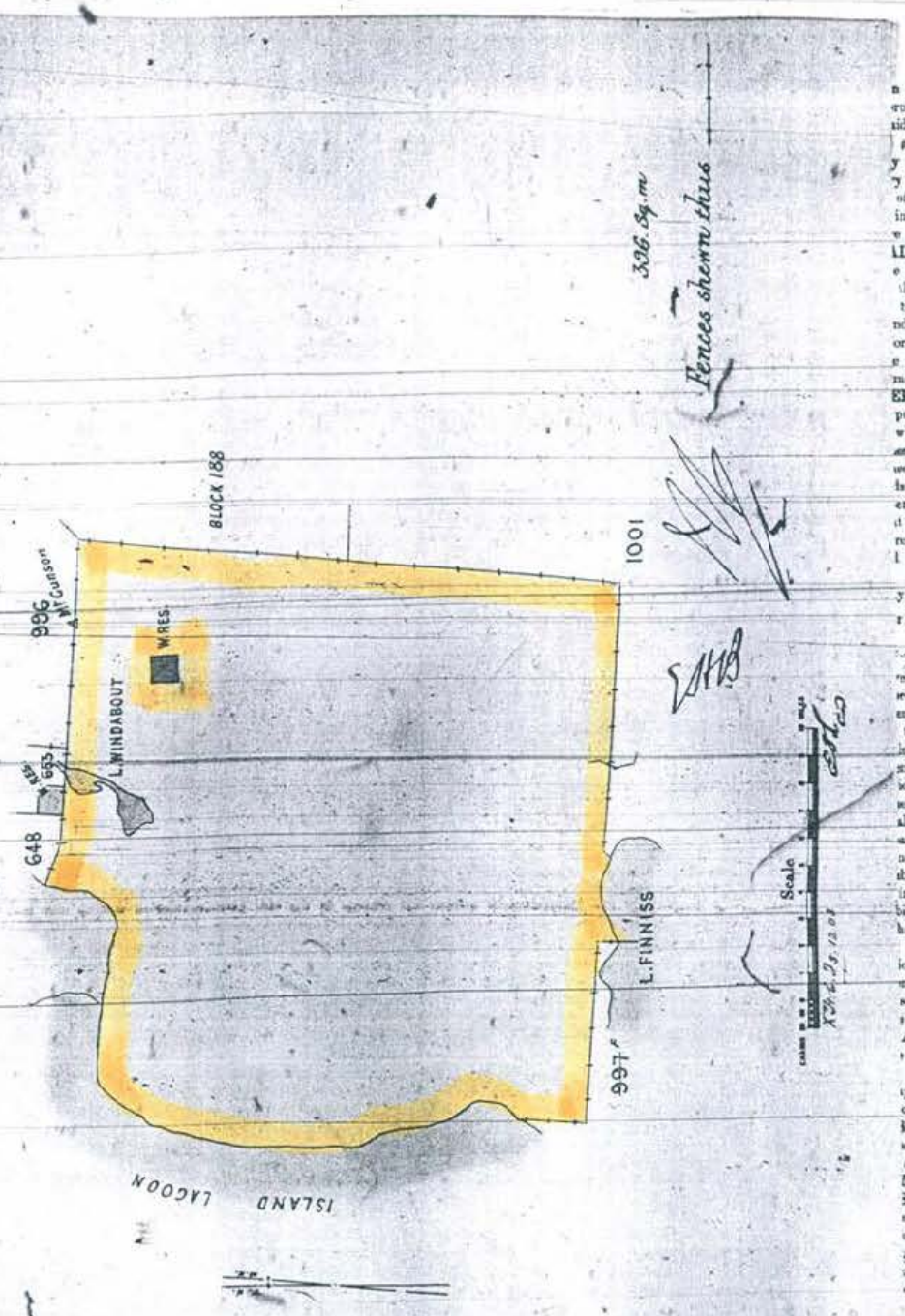
Power to Commissioner to forfeit lease on non-payment of rent.

this lease shall not be forfeited until after the expiration of three months from the giving of a notice to the Lessee by the said Commissioner of his intention to forfeit the same **PROVIDED ALSO** that the Lessee upon receiving notice of the said Commissioner's intention to

Tenants' Relief Board.

CROWN LANDS referred to in ANNEXED LEASE

CROWN LANDS
referred to in
ANNEXED LEASE
No 1000



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forfeit this lease for the default in the observance or performance of any covenant or condition herein contained other than the covenant for payment of rent may apply pursuant to "The Pastoral Act Amendment Act 1895" or any other Act for the time being in force to the Tenants' Relief Board for relief **PROVIDED ALSO** and it is hereby expressly agreed and declared that the Governor of the said State shall and may by Proclamation published in the *Government Gazette* at any time or from time to time hereafter determine this lease as to and resume possession of all or any part of the said lands if such land shall be required for intense culture or for the purposes of any public work such as railways tramways roads bridges public buildings water conservation works or the like or as a site for a town or cemetery or for mining or for residential sites commonage or other purposes incidental to mining or for park lands in which cases one month's notice of the intention to resume shall be given for all such purposes except for intense culture and where such resumption is for the purpose of intense culture one year's notice shall be given **PROVIDED ALSO** that immediately after notice for resumption for the purposes heretofore specified the said Commissioner may enter upon the lands hereby demised for the purpose of making any necessary surveys **PROVIDED ALSO** that nothing herein contained shall prevent the said Commissioner from resuming pastoral lands in hundreds existing at the time of the passing of "The Pastoral Amendment Act 1901" in manner prescribed by Part X. of "The Pastoral Act 1893" **PROVIDED ALSO** that if no portion of the land resumed for intense culture shall be used for intense culture for a period of two years from the date of the expiry of the notice of resumption the Lessee shall have the first right to a lease thereof upon the same terms and conditions as the land was held at the time of such resumption for the balance of the term hereby granted upon repayment by the Lessee of any compensation for such resumption **PROVIDED ALSO** that upon the resumption of the whole or any part of the said land hereby demised the Lessee shall subject to the provisions of "The Pastoral Act 1893" and "The Pastoral Amendment Act 1898-9" or any other Act for the time being in force receive payment of the value not exceeding actual cost of all improvements then on the land so resumed **PROVIDED ALSO** that if notice of resumption shall be given in respect of a portion of the said lands for any purpose other than for any of the purposes for which one calendar month's notice of intention to resume is sufficient the Lessee may require the said Governor to resume the whole of the lands hereby demised in respect to which notice of such partial resumption shall be given **PROVIDED ALWAYS** that the Lessee shall not be entitled to require the said Governor to resume the whole of the lands hereby demised where the lands shall be resumed for commonage residential or other purposes incidental to mining and do not exceed in area one-tenth of the whole area of lands hereby demised **PROVIDED ALSO** that if any of the lands hereby demised shall be resumed for or in connection with mining and after such resumption be found to be not required for the purposes for which the same were resumed the Lessee shall have a preferential right to occupy during the residue of the term of this lease the lands so resumed and not required on such terms as may be prescribed by regulations in that behalf **PROVIDED ALSO** and it is hereby agreed that for every square mile resumed there shall be deducted from and out of the yearly rental hereinbefore reserved the sum of *three shillings and sixpence* (£0-3-6) and so in proportion for any quantity of such lands resumed **PROVIDED** that no reduction of rent be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced by the sum of *three shillings and sixpence* (£0-3-6) no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year **PROVIDED ALSO** that within twelve calendar months before the expiration by effluxion of time of the term hereby granted all improvements (if any) existing upon the land hereby demised shall be valued so far as practicable in detail and the position of such improvements indicated on a plan to be prepared by the said Commissioner and signed by the said Commissioner and the Lessee **PROVIDED ALSO** that if any of the said land hereby demised shall be resumed the Lessee shall be compensated by the Government of the said State for the loss or depreciation in the value of this lease caused by such resumption and also in respect of such improvements as he would have been entitled to payment for from an incoming Lessee if this lease had expired and the land had been relet as on the date of notice of resumption **PROVIDED ALWAYS** that no payment or valuation shall be made in respect of any improvements made nor shall any improvements be considered upon the land hereby demised except those previously sanctioned by the said Commissioner unless the Pastoral Board shall certify that the same are useful and were made *bona fide* for the purpose of improving the said lands for pastoral purposes or for increasing the carrying capacity thereof and will have such effect and unless the same shall consist of wells reservoirs tanks or dams of a permanent character and available for the use of cattle or sheep and shall increase the carrying capacity of the land hereby demised or of substantial buildings vermin-proof or other fences huts or sheds erected for residence shearing or other purposes and usually required for or in connection with keeping livestock **PROVIDED ALSO** that all machinery or appliances which in the opinion of the Pastoral Board arbitrators or umpire making a valuation shall be necessary for the purpose of raising or distributing after raising the water which may be attached or appurtenant to any well dam tank or reservoir to be valued including all under and over ground tanks and troughs shall be deemed part of such well dam tank or reservoir and such Board arbitrators or umpire shall include such machinery or appliances in their valuation **PROVIDED ALWAYS** that the Lessee shall not be entitled to payment in respect of any improvements made after the expiration of the first ten years of the said term unless before making such improvements he shall have given written notice to the said Commissioner stating the nature and position and probable cost and date of completion thereof or if it shall not be conveniently practicable to give such notice prior to the making of such improvements unless such notice shall have been given with all reasonable dispatch **PROVIDED ALSO** that at the expiration of the said term hereby granted the Lessee shall be entitled to receive from the incoming Lessee the value to be determined as provided by "The Pastoral Act 1893" of all improvements made or purchased by him existing upon such portion of the said lands hereby demised as may be comprised in the new lease **PROVIDED ALSO** that the purchase-money to be paid for improvements by the incoming Lessee whether afterwards payable to the Lessee or not together with interest at the rate of Five Pounds per centum per annum on any amount overdue shall be a debt from the incoming Lessee to the said Commissioner **PROVIDED ALWAYS** that any moneys received by the said Commissioner from the incoming Lessee in respect of improvements made or paid for by the Lessee shall be paid over to the Lessee when he shall give up possession of the said land less all costs of and incidental to the recovery thereof and less all proper deductions for rent or compensation for loss or depreciation of such improvements or otherwise **PROVIDED ALWAYS** that such costs shall in no case exceed five per centum of the moneys so received by the said Commissioner **PROVIDED ALWAYS** that the Lessee and the incoming Lessee may mutually agree touching the amount to be paid to the Lessee for the improvements and the time and manner of payment thereof in pursuance of section 52 of "The Pastoral Act 1893" **PROVIDED ALSO** that on the determination of this lease all barbed wire and netting by which any boundary fence the property of His Majesty's Government has been or shall during the term of this lease be vermin-proofed by the Lessee at his own cost shall be and be deemed to be on such determination as aforesaid the property of the Lessee and shall at the termination of this lease be valued as provided in Part VI. of Act 585 of 1893 and shall be paid for by any incoming Lessee of the land hereby leased **PROVIDED ALWAYS** that in computing the compensation to be paid for the loss of or depreciation in the value of this lease if the whole or any part of the said lands shall be resumed no increased value given to this lease by reason of any public works executed after the granting hereof shall be included or taken into account **PROVIDED ALSO** that the amount payable for compensation for loss of or depreciation in value of this lease shall be paid within six calendar months after the resumption occasioning such loss or depreciation provided that the Lessee shall then have given up possession of the land resumed **PROVIDED ALSO** that in case the lands hereby demised shall not be offered by the said Commissioner for lease within six calendar months after the expiration of this lease the amount determined as provided of all improvements shall be paid by the said Commissioner to the Lessee upon the Lessee giving up possession thereof **PROVIDED ALSO** that all valuations of improvements or in respect of compensation made under these presents shall in case of dispute be determined pursuant to "The Arbitration Act 1891" **PROVIDED ALSO** that in no case shall the value of any improvement be deemed to exceed or include any matter or thing beyond or except the actual cost of sinking making constructing enlarging deepening and improving the same less a fair deduction for wear and tear and depreciation **IT IS DECLARED** that the notes in the margin of this lease are for the sake of more convenient reference only and shall not in anywise control or affect the interpretation or construction of this lease **AS WITNESS** the Public Seal of the said State and the hand and seal of the said Lessee

Resumption.

Lessee may require the Governor to resume.

Lessee to have preferential right to occupy resumed land in certain circumstances.

Reduction of rent where land resumed.

Improvements to be valued.

Compensation on resumption.

Improvements to be paid for by incoming Lessee.

Public works not to be taken into account in computing compensation.

Payment of compensation to be made within six months of the Lessee giving up possession.

Compensation to be determined by arbitration.

Improvements not to exceed actual cost.

Marginal notes clause.

John Barnes
by his Attorney
E H Bakewell

Walter Jones
by his attorney
E H Bakewell

Alberta Maude Jones
by his Attorney
E H Bakewell

Signed sealed and delivered by the said Lessee ~~in the presence of~~ John Barnes by his attorney Edward Hamilton Bakewell Walter Jones and Alberta Maude Jones by their attorney Edward Hamilton Bakewell in the presence of

J P Morrell
Law Clerk
Adelaide

Mortgage 388125 to Fairmeare R.J. Coombs & Co Limited

DISCHARGE OF THE WITHIN MORTGAGE
No. 388125 BY MEMORANDUM
No. 406921 PRODUCED FOR REGISTRATION THE 24 DAY OF March 1908 AT Noon
DEP. REG. GENL

Mortgage No 406921 including other lands from John Bevis Walter Ives and Charles Marsh Ives to Fairmeare R.J. Coombs & Co Limited Produced for registration the 24 day March 1908 at noon

Transfer No 406922 from John Bevis Walter Ives and Charles Marsh Ives to the said Walter Ives and Charles Marsh Ives of the within Lease No 1000 Produced for registration the 24 day March 1908 at noon

The name of the above Company is changed from Fairmeare R.J. Coombs & Co Limited to Fairmeare Dearing & Jeffrey Limited as appears by the Certificate of the Registrar of Companies and Application No. 436837 Produced for registration the 7 day of May 1906 at 12.10 pm

DISCHARGE OF THE above MORTGAGE
No. 406921 BY RECEIPT ENDORSED THEREON PRODUCED FOR REGISTRATION THE 10 DAY OF July 1906 AT 11.20 am
DEP. REG. GENL

Mortgage No 501319 from Walter Ives and Charles Marsh Ives to Dalgety and Company Limited Produced for registration the 23 day of December 1909 at 2pm (including other land)

Certificate No 5059/10 of the Commissioners of Crown Lands certifying that in consequence of an agreement land has been reserved for Water Conservation purposes the area of the within lease has been reduced to 395 acres and the annual rent to £69/2/6 from the 27 day of February 1910 produced for registration the 9 day of May 1910 at 1.30 pm

Deposited No 420111

DISCHARGE OF THE above MORTGAGE
NO. 501319
BY RECEIPT ENDORSED THEREON PRODUCED FOR REGISTRATION THE 23 DAY OF January 1912 AT 2.45 pm
DEP. REG. GEN.

Transfer No 552677 from Walter Ives and Charles Marsh Ives to the said Walter Ives of one undivided third part and to James George Morley of Tintinara Agriculturist of two undivided third parts in the within Lease No 1000 Produced for registration the 23 day of January 1912 at 2.45 pm

Mortgage No 552677 (including other lands) from Walter Ives and James George Morley to Dalgety and Company Limited Produced for registration the 23 day of January 1912 at 2.45 pm

Notice of Acquisition Node

DISCHARGE OF THE above MORTGAGE
NO. [illegible]
BY RECEIPT ENDORSED THEREON PRODUCED FOR REGISTRATION THE 23 DAY OF October 1914 AT 11.37 am
DEP. REG. GEN.

Deposited No 420111
Node

Crown Lease Volume 487 Folio 115

Transfer No 986861 from Myrtle Nunn Kidman and George Jackville Kidman to Oakden Wills Limited whose registered office is situated at Gays Arcade Rundle Street Adelaide of the within lease No 1000 Produced for registration the 22 day of December 1926 at 12.35 p.m.

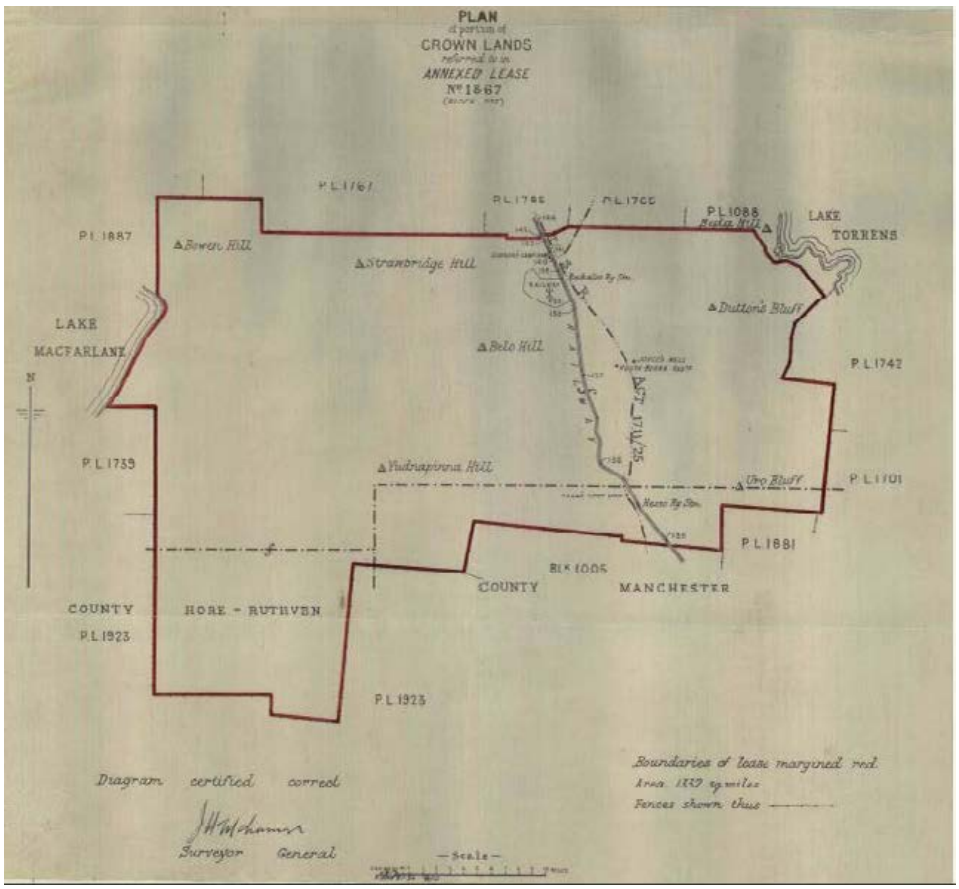
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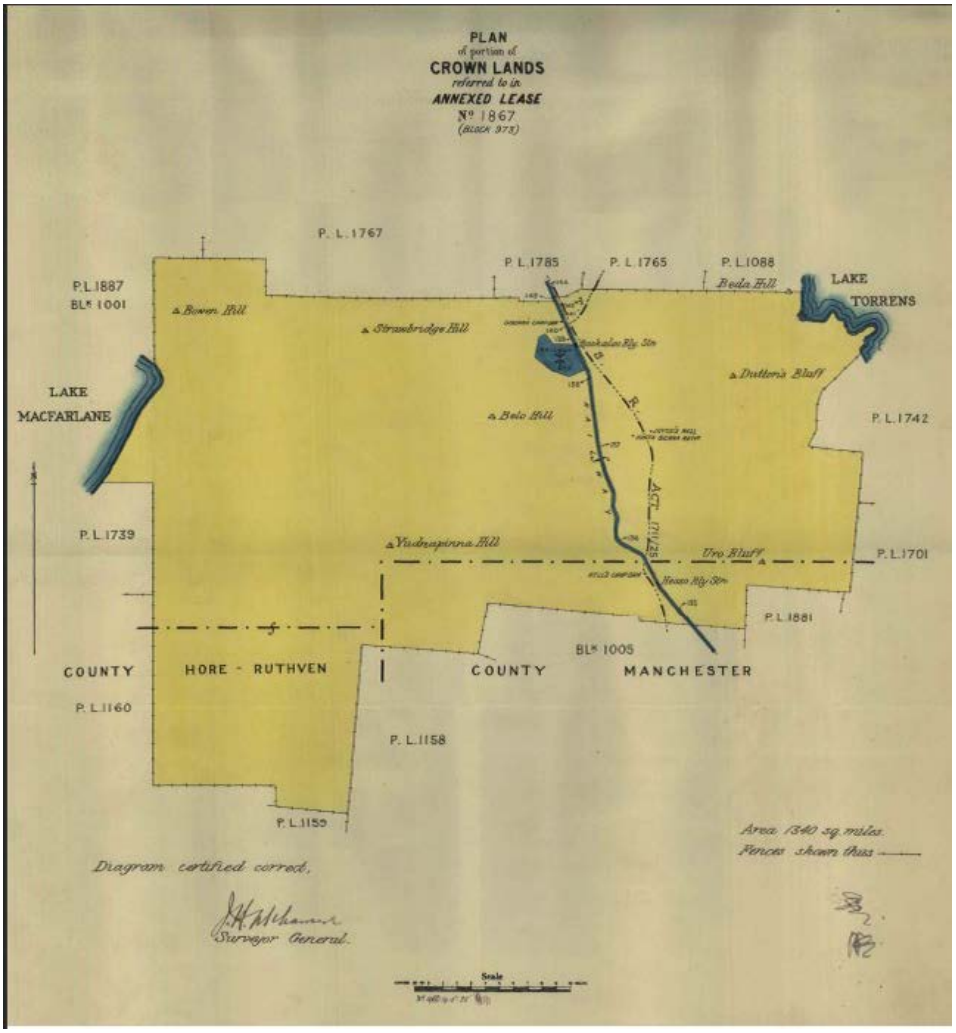
SURRENDER OF THE within Lease No 1000 BY MEMORANDUM No 1166970 PRODUCED FOR REGISTRATION THE 17 DAY OF April 1934 AT 10 o'clock

DEP. REG. GENL.

CT History - CL Vol 6204 Folio 748

Property Description	Certificate of Title	Parent Title	Date	Details
Deposited Plan 47682, Queens Parcel 3, Hundred of Port Augusta, Area named Kootaberra	CL Vol 503 Folio 56	-	29/12/1904	William Tennant Mortlock (sheep farmer)
			3/10/1913	Transfer to Elders Trustee & Executor Company Ltd & Richard MacDonnell Hawker
			12/8/1918	Transfer to John Andrew Tennant Mortlock (sheep farmer)
			22/8/1922	Transfer to The Yudnapinna Pastoral Company P/L
	CL Vol 830 Folio 13	CL Vol 503 Folio 56	26/6/1935	The Yudnapinna Pastoral Company P/L
	CL Vol 1296 Folio 32	CL Vol 830 Folio 13	17/4/1964	The Yudnapinna Pastoral Company P/L
			18/9/1964	Transfer to Lloyd George Pollard (grazier)
			10/3/1966	Transfer to Cyril Lloyd Wilkinson (pastoralist) & Shirley Catherine Wilkinson (wife) of part
			10/3/1966	Transfer to John Lloyd George Wilkinson (pastoralist) of part
			21/7/1970	Transfer to Haydn Bradley Wilkinson (pastoralist) of part
			21/7/1970	Transfer to John Lloyd George Wilkinson & Haydn Bradley Wilkinson of part
			26/9/1988	Transfer to Sword Nominees P/L of part
			20/8/2009	Transfer to John Lloyd George Wilkinson, Haydn Bradley Wilkinson & Anna May Brown of part
			20/8/2009	Transfer to Sword Nominees P/L of part
			20/8/2009	Transfer to Sword Nominees P/L of part
			30/5/2013	Transfer to John Lloyd George Wilkinson
			30/5/2013	Transfer to Kootaberra Pty Ltd
	CL Vol 6204 Folio 748	CL Vol 1296 Folio 32	9/3/2018	Kootaberra Pty Ltd (ACN: 137 388 491) Annual license to OZ Minerals Services Pty Ltd for infrastructure purposes 4/2/2019 to 3/2/2029 Annual license to Electranet Pty Ltd for infrastructure purposes 5/3/2019 to 4/3/2029
			28/3/2018	Lease to Optus Mobile Pty Ltd (ACN: 054 365 696)
			13/3/2024	Lease Transfer to Australia Tower Network Pty Ltd (ACN: 643 875 165)


PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
No 1867
P.L.1767
P.L.1785
P.L.1765
P.L.1088
Beda Hill
LAKE
TORRENS
P.L.1887
Bowen Hill
Strawbridge Hill
Duttons Bluff
LAKE
MACFARLANE
Belo Hill
P.L.1742
N
P.L.1739
Vudnapinna Hill
Uro Bluff
P.L.1701
P.L.1881
Blk 1005
COUNTY
MANCHESTER
COUNTY
HORE - RUTHVEN
P.L.1923
P.L.1923
Diagram certified correct
Surveyor General
Boundaries of lease margined red.
Area 1339 sq miles
Fences shown thus
Scale


PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
No 1867
P. L. 1767
P. L. 1785
P. L. 1765
P. L. 1088
Beda Hill
LAKE
TORRENS
P.L.1887
Blk 1001
Bowen Hill
Strawbridge Hill
Duttons Bluff
LAKE
MACFARLANE
Belo Hill
P. L. 1742
P. L. 1739
Vudnapinna Hill
Uro Bluff
P. L. 1701
P. L. 1881
Blk 1005
COUNTY
MANCHESTER
COUNTY
HORE - RUTHVEN
P. L. 1160
P. L. 1158
P. L. 1159
Area 1340 sq. miles.
Fences shown thus
Diagram certified correct.
Surveyor General.
Scale

South Australia.

Register Book.

Vol. 503 Folio 56

Registrar-General.

Crown Lease.

(PASTORAL, No. 1022.)

(In lieu of Surrendered Leases Nos. 736, 765, 771, 270 Mt Eyre)

This Indenture made the Twenty ninth day of December in the year of our Lord One Thousand Nine Hundred and Two BETWEEN HIS MOST GRACIOUS MAJESTY EDWARD THE SEVENTH of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas King Defender of the Faith Emperor of India of the first part His Excellency the Governor in and over the State of South Australia and the Dependencies thereof in the Commonwealth of Australia &c. &c. of the second part and William Tennant Marlock of Mintaro Shepherd

for himself his ——— Executors Administrators and Assigns herein designated by the term "Lessee" of the third part **WITNESSETH** that the said Governor by virtue of the powers contained in "The Crown Lands Act 1888" "The Pastoral Act 1893" "The Pastoral Act Amendment Act 1895" "The Pastoral Act Amendment Act 1896" "The Pastoral Amendment Act 1898-9" and "The Pastoral Amendment Act 1901" all other powers enabling him in that behalf **DOTH** lease unto the Lessee for pastoral purposes

Parcels. **ALL THAT** portion of Crown lands containing by estimation four hundred and fifty eight (458) square miles or thereabouts situate and being Mt Bluff and Manchowie Park Hd of Port Augusta the abuttals and boundaries whereof are particularly delineated and set forth in the plan thereof to this Indenture annexed and signed with the initials of the Surveyor-General together with all ways paths passages waters watercourses advantages and appurtenances thereto belonging or appertaining subject to the exceptions and reservations hereinafter contained that is to say **EXCEPT AND RESERVED** all gold silver copper tin and other metals ores minerals and other substances containing metals and all gems and precious stones and all coal and mineral oils upon in or under the said land to His Majesty the King His Heirs and Successors and all persons lawfully claiming under or authorised by Him or them **AND** the Governor and the Commissioner of Crown Lands for the time being of the said State and all persons lawfully claiming under or authorised by them or either of them shall have full and free liberty of access ingress egress and regress with or without horses cattle carts drays carriages engines machinery and all other necessary implements and things into upon and from the said premises for all public purposes and to cut dig sink for try search procure work remove and dispose of all or any of the hereby excepted and reserved things and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **AND** reserving to Aboriginal Inhabitants of the said State and their descendants during the continuance of this lease full and free right of egress and regress into upon and over the said lands and every part thereof and in and to the springs and surface waters thereon and to make and erect such wurlies and other dwellings as the said Aboriginal Natives have been heretofore accustomed to make and erect and to take and use for food birds and animals *ferae naturae* in such manner as they would have been entitled to do if this lease had not been made **AND** reserving to all persons the rights of crossing the said lands with travelling stock subject to the provisions of Act No. 443 of 1888 or any other Act for the time being regulating travelling stock **SUBJECT** to the right of His Majesty's subjects to use all and every the roads paths or ways heretofore made and used by them or hereafter to be duly opened and dedicated to the public use for the purpose of passing upon through and over the said lands or any part thereof **SUBJECT ALSO** to the right of the Governor for the time being of the said State and all persons authorised by him or other lawful authority at any time or from time to time as may be deemed requisite with horses carts and carriages or without into upon through and over the said lands to come and go for the purpose of laying out and making fit for and devoting to the public use any new and additional roads ways and paths **AND SUBJECT ALSO** to the right of the said Commissioner or any person authorised by him in that behalf to grant licences to enter upon the said lands or any part thereof and to occupy the same for the purpose of cutting obtaining and taking away any live or dead timber stone and sand with full and free liberty of access ingress egress and regress to and for His Majesty His Heirs and Successors and to and for the Governor and Commissioner of Crown Lands for the time being of the said State and all other persons authorised by them or either of them with or without horses carts and carriages into over through and upon the said lands for the purpose of cutting obtaining and taking away such timber stone and sand but notwithstanding this last-mentioned provision the Lessee shall be at liberty at any time and from time to time to fell cut down and remove any live or dead timber stone and sand which may be required by the Lessee for the purpose of any erection fencing firewood or improvements to be constructed or used upon the said land or that may be required in any way upon the said land **TO HAVE AND TO HOLD** the said lands and premises (subject to the covenants conditions provisos and restrictions herein contained) for the full term of FORTY-TWO YEARS from

Term. the First day of January One Thousand Nine Hundred and Two **YIELDING AND**

Rent. **PAYING** therefor yearly and every year in advance unto His Majesty His Heirs and Successors by payment at His Majesty's Treasury in the City of Adelaide in the said State the rent or sum of one hundred and thirty seven Pounds and eight shillings (£137 : 8 : 0) sterling on the first day of January in the year One Thousand Nine Hundred and Three and in each succeeding year the first year's rent having been heretofore paid **PROVIDED** that if after the first five years of the said term hereby granted any railways waterworks reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the said land hereby demised and by reason thereof the value of the said land hereby demised shall in the opinion of the said Commissioner be enhanced the said Commissioner may direct the Pastoral Board to make a revaluation of the said land hereby demised or any part thereof and thereupon a revaluation shall be made in manner prescribed by sections 68 and 69 of "The Pastoral Act 1893" and the rent so fixed shall be paid by the Lessee from the date on which it shall be so fixed to be payable and the said Commissioner shall serve notice of such increased rent upon the Lessee **PROVIDED ALSO** that after the expiration of the period of twenty-one years of this lease a revaluation of the lands hereby demised shall be made by the Pastoral Board pursuant to "The Pastoral Act 1893" and the rent fixed upon such revaluation shall be paid by the Lessee from the date of the expiration of the first twenty-one years of this lease **PROVIDED** that in fixing the said rent whether by revaluation or otherwise no regard shall be had to any increase in value of the lands hereby demised caused by improvements thereon which the Lessee shall have made or paid for and which shall not be the property of the Crown **PROVIDED** the rent so fixed shall not be more than fifty per cent. above or below the rent payable during the last year of the first twenty-one years of the term of this lease **PROVIDED ALWAYS** that the Lessee may at any time

Revaluation of rent by reason of public works.

Revaluation after first twenty-one years.

Commissioner of Crown Lands.

Surveyor-General.

within three calendar months from the service of a notice by the said Commissioner on the said Lessee of such increased rent appeal to the said Commissioner by notice in writing against such revaluation and thereupon the matter shall be determined by arbitrators pursuant to the "Arbitration Act 1891" one arbitrator being appointed by the said Commissioner and the other by the Lessee **AND** the Lessee do hereby covenant with His Majesty His Heirs and Successors and as separate covenants with the said Governor and with the Governor for the time being of the said State that the Lessee will during the continuance of this lease pay the rent hereinbefore reserved in manner aforesaid free and clear of all rates and taxes except such as are or may be imposed by or under the authority of any Act and free and clear also of all outgoings and deductions whatsoever **AND ALSO** that the Lessee will pay unto His Majesty at His Majesty's Treasury aforesaid the sum of two thousand five hundred and one pounds and five shillings (£2501 : 5 : 0) being the value of the improvements belonging to the Crown upon the lands hereby demised by instalments with interest at the rate of one hundred and nineteen pounds four shillings and six pence (£119 : 4 : 6) — on the first day of — January — yearly and every year during the continuance of the term hereby granted **PROVIDED ALWAYS** that in the event of any instalment being unpaid for three calendar months after any date whereon the same ought to be paid the purchase-money then remaining unpaid shall at the option of the said Commissioner become instantly payable and recoverable and may be recovered by the said Commissioner by action in his own name in any Court of competent jurisdiction **AND ALSO** that the Lessee shall and will before the end of the third year of the said term hereby granted stock the land hereby demised with sheep in the proportion of at least five head for every square mile of land included in this lease or with cattle in the proportion of at least one head for every square mile and will keep the same so stocked and before the end of the seventh year of the said term increase the stocking to twenty head of sheep per square mile or four head of cattle per square mile and keep the same so stocked at the least during the remainder of the said term hereby granted **PROVIDED** that the stocking with sheep and cattle combined shall satisfy this present covenant if the requisite number are kept one head of cattle being computed as equal to five head of sheep **AND ALSO** that the Lessee shall not at any time during the last three years of the said term hereby granted overstock the land hereby leased or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the said Commissioner or the Pastoral Board would have the effect of depreciating the ordinary capacity of the said land for depasturing stock **AND ALSO** that the Lessee shall at all times upon being thereunto required by the said Commissioner or the Pastoral Board furnish him or them with true particulars of the number of sheep and cattle with which the land hereby demised is stocked **PROVIDED** that if the said Commissioner shall be satisfied that the said land hereby demised is waterless or vermin infested or otherwise specially inferior for pastoral purposes and if the said Commissioner shall be satisfied that during the first six years of the term hereby granted a sum equal to Five Pounds per square mile of the land hereby demised has been expended by the Lessee in destroying vermin upon the said land or has been expended by the Lessee in erecting vermin-proof fencing thereon or in constructing improvements consisting of wells reservoirs tanks or dams of a permanent character and available for the use of cattle or sheep and which increase the carrying capacity of the said land the Lessee shall not be bound to increase the stock to more than ten head of sheep or two head of cattle (or their equivalent) per square mile at any time during the said term hereby granted **PROVIDED** that the value of improvements on the land at the commencement of this lease shall be taken into consideration as fully as if the same had been made during the first six years of the term hereby granted **AND ALSO** that the Lessee will expend in improvements on the said land a sum of not less than ——— nil ——— per mile per annum until three pounds per square mile shall have been expended by the Lessee **PROVIDED** that any improvements existing upon the said lands at the time of the granting of this lease shall be deemed to be improvements hereby required to be made and the value thereof shall be taken into account in estimating the amount hereby agreed to be expended **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of the purchase-money of any improvements or any interest thereon keep in good order repair and condition all such improvements in respect whereof any such money shall remain owing by the Lessee reasonable wear and tear excepted **AND ALSO** that the Lessee so long as any principal money or interest shall remain owing for any improvements will not pull down or remove from the land hereby demised or knowingly suffer to be pulled down or removed or wilfully or knowingly destroy damage or injure or knowingly suffer to be destroyed damaged or injured any such improvements without the consent of the said Commissioner in writing first had and obtained **AND ALSO** that it shall be lawful for the said Commissioner and all persons authorised by him at all times unrestrictedly to enter into and upon the said lands hereby demised and view and examine the state and condition thereof and of the improvements belonging to the Crown thereon and of all defects decays and wants of reparation contrary to the provisions herein contained as shall be then and there found to give to the Lessee or leave upon the said lands notice in writing requiring the Lessee to repair and amend the same within six calendar months then next following within which time the Lessee will repair and amend the same accordingly **AND ALSO** that the Lessee will permit all lawfully constituted Land Boards and the Pastoral Board for the time being and the members agents and officers thereof respectively or any of them at all times unrestrictedly to enter upon and examine the land and premises hereby demised **AND ALSO** that the Lessee will subject to the regulations for the time being in force under "The Mining Act 1893" or any other Act authorising the making of regulations permit every gold or mineral lessee or licencee holding a lease or licence under "The Mining Act 1893" or any other Act for the time being authorising the granting of gold or mineral leases or licences of or respecting any of the land thereby demised and all persons authorised by such lessee or licencee to have unrestricted access to and egress from the land comprised in such mineral lease or licence using however as far as reasonably can be the public roads paths and ways for the time being upon or over the said land or any part thereof **AND ALSO** that the Lessee shall not nor will during the said term without the consent in writing of the said Commissioner first had and obtained transfer or sublet the premises hereby demised or any part thereof or assign these presents or do commit or suffer any act matter or thing whereby the said premises or any part thereof shall or may be transferred or sublet to any person or persons provided that such consent shall not be capriciously withheld **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of any improvements belonging to the Crown and liable to be destroyed or damaged by fire insure and during the term hereby granted keep insured in some Insurance Office in Adelaide to be approved by the said Commissioner against loss or damage by fire all such improvements other than fencing in an amount equal to two-thirds of the amount for the time being owing to the Crown in respect thereof such insurance to be in the joint names of the Lessee and the said Commissioner and will lodge the policy of every such insurance in the office of the said Commissioner within one calendar month after the date thereof and will forward to the said Commissioner the receipts for the premium payable in respect of every such policy within seven days after the same shall become due and that if the foregoing covenant shall not be duly observed then the said Commissioner shall be at liberty to insure the said improvements in manner aforesaid and all moneys expended by the said Commissioner in or about such insurance as aforesaid with interest thereon after the rate of Five Pounds per centum per annum computed from the time of expending the same shall be repaid to him on demand and may be recovered in like manner as rent is recoverable and it is declared that all sums of money received by the Lessee or the said Commissioner under any such insurance shall be laid out in reinstating *(pro tanto)* the premises in respect of which the same shall have been received **PROVIDED** that if the said Commissioner and the Lessee shall so agree the moneys so received or such part thereof as may be agreed upon shall in lieu of being laid out as last aforesaid be applied in reduction of the amount for the time being owing by the Lessee to the Crown in respect of such improvements **AND ALSO** that the Lessee will forthwith commence to destroy vermin on the said lands to the satisfaction of the said Commissioner or the Pastoral Board and will at all times during the said term keep the said land free of vermin to the satisfaction of the said Commissioner or the Pastoral Board **ALSO** that the Lessee will neither erect nor suffer the erection of any brush fence upon the said lands **AND ALSO** that the Lessee will not during the said term without the licence in writing of the said Commissioner for every such purpose fell or cut down any trees or other timber which are now or hereafter shall be growing upon the said lands except for erections fencing or firewood **AND ALSO** that the Lessee will at all times comply with and observe the Regulations that may from time to time be made by the Governor with the advice of the Executive Council under "The Pastoral Act 1893" or any other Act him thereunto enabling and for the time being in force **AND ALSO** that the Lessee will make or cause to be made all such statements and returns as are required by sections 85 and 86 of "The Crown Lands Act 1888" and by any Act or regulation for the time being in force **AND ALSO** that the Lessee will not obstruct or interfere with any public roads paths or ways or the use thereof by any person **PROVIDED** that if the rent hereby reserved be not paid on or before the days whereon the same is hereby made payable a penalty of Ten Pounds per centum per annum may if the said Commissioner think fit be added and if such rent and penalty be not paid within one calendar month after the same shall become due the same shall be recoverable by the said Commissioner by action in his own name in any Court of competent jurisdiction **PROVIDED ALWAYS** that if the rent hereby reserved shall be in arrear for more than three calendar months after any of the days hereinbefore appointed for payment thereof or if there shall be a breach or non-performance of any of the Lessees covenants it shall be lawful for the said Commissioner to forfeit this lease **PROVIDED ALSO** that this lease shall not be forfeited until after the expiration of three months from the giving of a notice to the Lessee by the said Commissioner of his intention to forfeit the same **PROVIDED ALSO** that the Lessee upon receiving notice of the said Commissioner's intention to

Covenants by Lessee to pay rent.

To pay value of improvements belonging to the Crown.

To stock.

Not to overstock.

To furnish returns of stock.

If land inferior, stocking clause modified.

To keep improvements belonging to the Crown in repair.

Power to Commissioner to enter and view condition of Crown improvements.

Right of ingress, &c., to mineral lessee.

Not to transfer or sublet.

To insure.

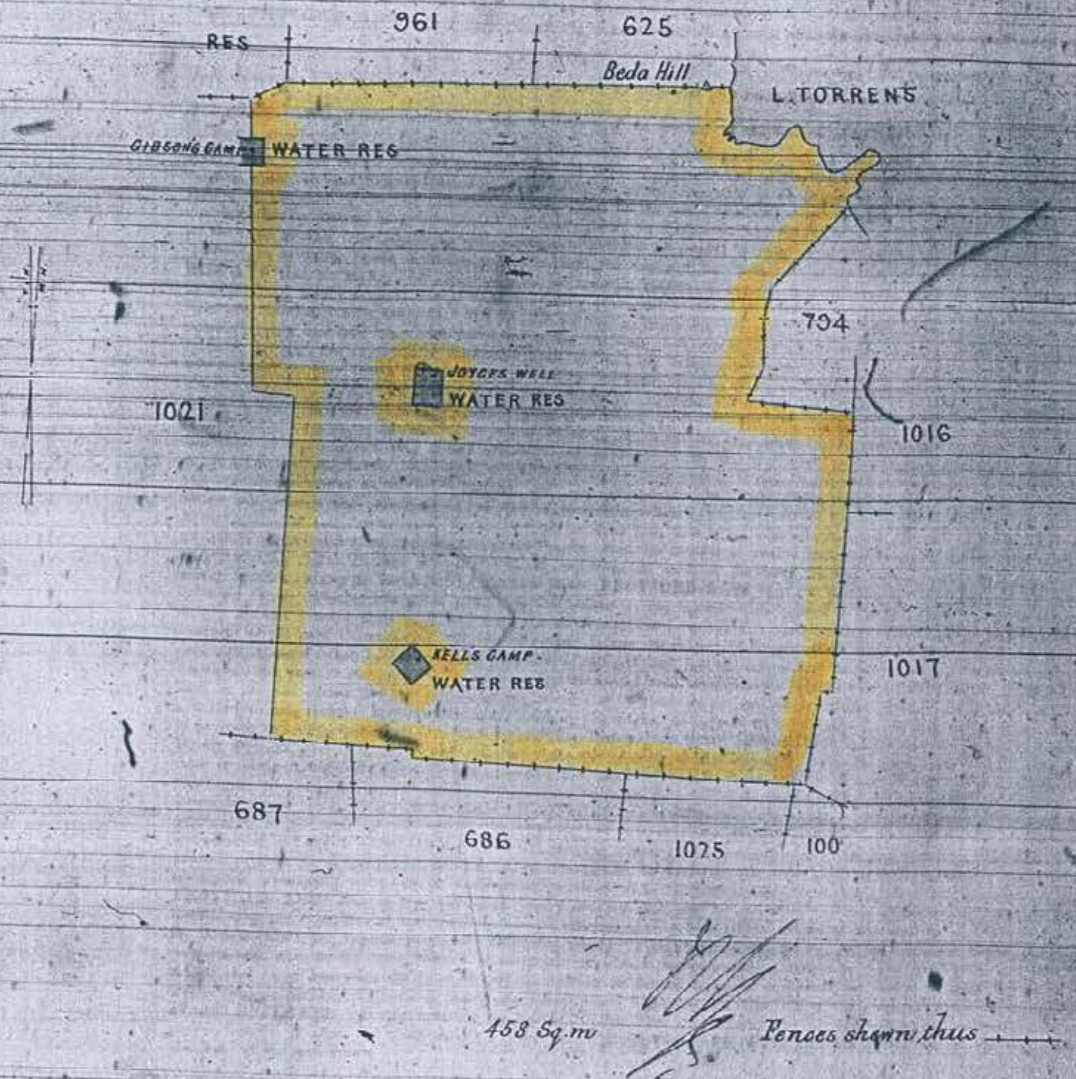
Not to erect brush fences.
Not to cut down timber except for improvements, &c.
To comply with regulations.

Not to interfere with public roads.

Power to Commissioner to forfeit lease on non-payment of rent.

Tenants' Relief — Board.

PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
No. 1022



458 Sq.m

Fences shown thus

Scale

forfeit this lease for the default in the observance or performance of any covenant or condition herein contained other than the covenant for payment of rent may apply pursuant to "The Pastoral Act Amendment Act 1895" or any other Act for the time being in force to the Tenants' Relief Board for relief **PROVIDED ALSO** and it is hereby expressly agreed and declared that the Governor of the said State shall and may by Proclamation published in the *Government Gazette* at any time or from time to time hereafter determine this lease as to and resume possession of all or any part of the said lands if such land shall be required for intense culture or for the purposes of any public work such as railways tramways roads bridges public buildings water conservation works or the like or as a site for a town or cemetery or for mining or for residential sites commonage or other purposes incidental to mining or for park lands in which cases one month's notice of the intention to resume shall be given for all such purposes except for intense culture and where such resumption is for the purpose of intense culture one year's notice shall be given **PROVIDED ALSO** that immediately after notice for resumption for the purposes heretofore specified the said Commissioner may enter upon the lands hereby demised for the purpose of making any necessary surveys **PROVIDED ALSO** that nothing herein contained shall prevent the said Commissioner from resuming pastoral lands in hundreds existing at the time of the passing of "The Pastoral Amendment Act 1901" in manner prescribed by Part X. of "The Pastoral Act 1893" **PROVIDED ALSO** that if no portion of the land resumed for intense culture shall be used for intense culture for a period of two years from the date of the expiry of the notice of resumption the Lessee shall have the first right to a lease thereof upon the same terms and conditions as the land was held at the time of such resumption for the balance of the term hereby granted upon repayment by the Lessee of any compensation for such resumption **PROVIDED ALSO** that upon the resumption of the whole or any part of the said land hereby demised the Lessee shall subject to the provisions of "The Pastoral Act 1893" and "The Pastoral Amendment Act 1898-9" or any other Act for the time being in force receive payment of the value not exceeding actual cost of all improvements then on the land so resumed **PROVIDED ALSO** that if notice of resumption shall be given in respect of a portion of the said lands for any purpose other than for any of the purposes for which one calendar month's notice of intention to resume is sufficient the Lessee may require the said Governor to resume the whole of the lands hereby demised in respect to which notice of such partial resumption shall be given **PROVIDED ALWAYS** that the Lessee shall not be entitled to require the said Governor to resume the whole of the lands hereby demised where the lands shall be resumed for commonage residential or other purposes incidental to mining and do not exceed in area one-tenth of the whole area of lands hereby demised **PROVIDED ALSO** that if any of the lands hereby demised shall be resumed for or in connection with mining and after such resumption be found to be not required for the purposes for which the same were resumed the Lessee shall have a preferential right to occupy during the residue of the term of this lease the lands so resumed and not required on such terms as may be prescribed by regulations in that behalf **PROVIDED ALSO** and it is hereby agreed that for every square mile resumed there shall be deducted from and out of the yearly rental hereinbefore reserved the sum of six shillings (£0.6.0) and so in proportion for any quantity of such lands resumed **PROVIDED** that no reduction of rent be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced by the sum of six shillings (£0.6.0) no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year **PROVIDED ALSO** that within twelve calendar months before the expiration by effluxion of time of the term hereby granted all improvements (if any) existing upon the land hereby demised shall be valued as far as practicable in detail and the position of such improvements indicated on a plan to be prepared by the said Commissioner and signed by the said Commissioner and the Lessee **PROVIDED ALSO** that if any of the said land hereby demised shall be resumed the Lessee shall be compensated by the Government of the said State for the loss or depreciation in the value of this lease caused by such resumption and also in respect of such improvements as he would have been entitled to payment for from an incoming Lessee if this lease had expired and the land had been relet as on the date of notice of resumption **PROVIDED ALWAYS** that no payment or valuation shall be made in respect of any improvements made nor shall any improvements be considered upon the land hereby demised except those previously sanctioned by the said Commissioner unless the Pastoral Board shall certify that the same are useful and were made *bona fide* for the purpose of improving the said lands for pastoral purposes or for increasing the carrying capacity thereof and will have such effect and unless the same shall consist of wells reservoirs tanks or dams of a permanent character and available for the use of cattle or sheep and shall increase the carrying capacity of the land hereby demised or of substantial buildings vermin-proof or other fences huts or sheds erected for residence shearing or other purposes and usually required for or in connection with keeping livestock **PROVIDED ALSO** that all machinery or appliances which in the opinion of the Pastoral Board arbitrators or umpire making a valuation shall be necessary for the purpose of raising or distributing after raising the water which may be attached or appurtenant to any well dam tank or reservoir to be valued including all under and over ground tanks and troughs shall be deemed part of such well dam tank or reservoir and such Board arbitrators or umpire shall include such machinery or appliances in their valuation **PROVIDED ALWAYS** that the Lessee shall not be entitled to payment in respect of any improvements made after the expiration of the first ten years of the said term unless before making such improvements he shall have given written notice to the said Commissioner stating the nature and position and probable cost and date of completion thereof or if it shall not be conveniently practicable to give such notice prior to the making of such improvements unless such notice shall have been given with all reasonable dispatch **PROVIDED ALSO** that at the expiration of the said term hereby granted the Lessee shall be entitled to receive from the incoming Lessee the value to be determined as provided by "The Pastoral Act 1893" of all improvements made or purchased by him existing upon such portion of the said lands hereby demised as may be comprised in the new lease **PROVIDED ALSO** that the purchase-money to be paid for improvements by the incoming Lessee whether afterwards payable to the Lessee or not together with interest at the rate of Five Pounds per centum per annum on any amount overdue shall be a debt from the incoming Lessee to the said Commissioner **PROVIDED ALWAYS** that any moneys received by the said Commissioner from the incoming Lessee in respect of improvements made or paid for by the Lessee shall be paid over to the Lessee when he shall give up possession of the said land less all costs of and incidental to the recovery thereof and less all proper deductions for rent or compensation for loss or depreciation of such improvements or otherwise **PROVIDED ALWAYS** that such costs shall in no case exceed five per centum of the moneys so received by the said Commissioner **PROVIDED ALWAYS** that the Lessee and the incoming Lessee may mutually agree touching the amount to be paid to the Lessee for the improvements and the time and manner of payment thereof in pursuance of section 82 of "The Pastoral Act 1893" **PROVIDED ALSO** that on the determination of this lease all barbed wire and netting by which any boundary fence the property of His Majesty's Government has been or shall during the term of this lease be vermin-proofed by the Lessee at his own cost shall be and be deemed to be on such determination as aforesaid the property of the Lessee and shall at the termination of this lease be valued as provided in Part VI. of Act 585 of 1895 and shall be paid for by any incoming Lessee of the land hereby leased **PROVIDED ALWAYS** that in computing the compensation to be paid for the loss of or depreciation in the value of this lease if the whole or any part of the said lands shall be resumed no increased value given to this lease by reason of any public works executed after the granting hereof shall be included or taken into account **PROVIDED ALSO** that the amount payable for compensation for loss of or depreciation in value of this lease shall be paid within six calendar months after the resumption occasioning such loss or depreciation provided that the Lessee shall then have given up possession of the land resumed **PROVIDED ALSO** that in case the lands hereby demised shall not be offered by the said Commissioner for lease within six calendar months after the expiration of this lease the amount determined as provided of all improvements shall be paid by the said Commissioner to the Lessee upon the Lessee giving up possession thereof **PROVIDED ALSO** that all valuations of improvements or in respect of compensation made under these presents shall in case of dispute be determined pursuant to "The Arbitration Act 1891" **PROVIDED ALSO** that in no case shall the value of any improvement be deemed to exceed or include any matter or thing beyond or except the actual cost of sinking making constructing enlarging deepening and improving the same less a fair deduction for wear and tear and depreciation **IT IS DECLARED** that the notes in the margin of this lease are for the sake of more convenient reference only and shall not in anywise control or affect the interpretation or construction of this lease **AS WITNESS** the Public Seal of the said State and the hand and seal of the said Lessee

Resumption.

Lessee may require the Governor to resume.

Lessee to have preferential right to occupy resumed land in certain circumstances.

Reduction of rent where land resumed.

Improvements to be valued.

Compensation on resumption.

Improvements to be paid for by incoming Lessee.

Public works not to be taken into account in computing compensation.

Payment of compensation to be made within six months of the Lessee giving up possession.

Compensation to be determined by arbitration.

Improvements not to exceed actual cost.

Marginal notes clause.

A. Murdoch

Signed sealed and delivered by the said Lessee in the presence of

L. M. Love

Certificate No 505411 of the Commissioner of Crown Lands authorising that in consequence of one square mile having been reserved for water conservation purposes the area of the within lease No 1022 has been reduced to 6457 square miles and the annual rent £6137/2/0 from the 27 day of February 1910 produced for registration the 9 day of May 1910 at 1.30 pm

F. Wilfred Hethering Dep Registrar

MEMORANDUM of ACQUISITION No 6W570

WHEREBY [illegible] Coulanning 1787½ acres

[illegible] PRODUCED FOR REGISTRATION THE 29

day of November 1917 at 11.50 a.m.

[illegible]

DEP. REG. GEN'L

THE William Leg. 2d NO 1022 WAS TRANSMITTED TO [illegible] whose registered Office is situate at the Mount Hamer Street Fremantle and Richard Macdonnell Hawker of Bungarra near Perenjori (Many 1913 as the Executors NAMED IN THE WILL DATED THE 9th day of Nov 15 DAY OF December 1913 BY THE NAMED William Leonard Westlock WHO DIED ON THE 14 DAY OF August 1913 AS APPEARS BY PROBATE DATED THE 8 DAY OF October 1917 PRODUCED FOR REGISTRATION THE 18 DAY OF October 1917 AT 3 p.m. No 5 5 4 4

[illegible]

DEP. REG. GEN.

Transfer No 695955 from Peters Trustee and Executor Company Limited and Richard MacDonnell Hawker to John Andrew Tennant Westlock of Mintara Sheepfarmer of the within lease no 1022 produced for registration the 12 day of August 1918 at 2.50 p.m.

H. W. Jeakes Dep. Reg. Genl

921,603 COMMISSIONER OF CROWN LANDS THAT ON REVALUATION OF THE WITHIN LEASE NO 1022 THE RENT HAS BEEN FIXED AT £ 201 : 6 : 0 PER ANNUM FROM THE 1 DAY OF January 1923 PRODUCED FOR REGISTRATION THE 4 DAY OF August 1923, AT 3 p.m.

[illegible] Dep Reg Genl

Transfer No 821124 from John Andrew Tennant Westlock to The Yudnapinna Pastoral Company Limited of Guppie Street Adelaide of the within lease No 1022 Produced for registration the 22 day of August 1922 at 2.40 pm

[illegible]

Dep Reg Genl

SH80977

SURRENDER OF THE within lease No 1022 BY MEMORANDUM No 1180971 PRODUCED FOR REGISTRATION THE 26 DAY OF December 1934 AT 11 a.m.

[illegible]

DEP. REG. GEN'L

SH80477

Certificate No 505411 of Commissioner of Crown Lands certifying that in consequence of one square mile having been reserved for water conservation purposes the area of the within lease No 1022 has been reduced by 4.57 square miles and the annual rent is £137/2/0 from the 27 day of February 1910 produced for registration the 9 day of May 1910 at 3.30 pm

Registered Certificate No. 505411 of Commissioner of Crown Lands certifying that in consequence of one square mile having been reserved for water conservation purposes the area of the within lease No 1022 has been reduced by 4.57 square miles and the annual rent is £137/2/0 from the 27 day of February 1910 produced for registration the 9 day of May 1910 at 3.30 pm

[illegible] Dep Reg Genl

SURRENDER OF THE within lease No. 1022 BY MEMORANDUM No. 1180971 PRODUCED FOR REGISTRATION THE 26 DAY OF December 1934 AT 11 a.m.

H. L. Conrad
DEP. REG. GEN.

MEMORANDUM of ACQUISITION No. 6U570

Portion of Containing 1705 acres

PRODUCED FOR REGISTRATION THE 29 DAY OF November 1917 AT 11.30 a.m.

DEP. REG. GEN'L

THE within Lease No. 1022 WAS TRANSMITTED TO Executors Trustee and Agency Company Limited and Richard MacDonnell Hawker of Beltana Station whose registered office is situated at No. 31 Leigh Street Adelaide AS THE EXECUTORS NAMED IN THE WILL DATED THE 15th day of May 1903 of the late Robert Thomas Baker of Beltana Station deceased who died on the 11th day of January 1918 and proved in the Supreme Court on the 15 DAY OF December 1917 NAMED William Lennon Murdoch WHO DIED ON THE 17 DAY OF December 1917 AS APPEARS BY PROBATE DATED THE 3 DAY OF October 1918 PRODUCED FOR REGISTRATION THE 10 DAY OF December 1917 AT 3 p.m. NO. [illegible]

DEP. REG. GEN.

Transfer No. 69995 from Executors Trustee and Executor Company Limited and Richard MacDonnell Hawker to John Andrew Tennant Murdoch of Minnipa Sheepfarmer of the within lease No. 1022. Produced for registration the 12 day of August 1918 at 2.50 p.m.

H. L. Conrad Dep. Reg. Genl

69995 CANCELLED

OF CROWN LANDS THAT ON REVALUATION OF THE WITHIN LEASE NO 1022 THE RENT HAS BEEN FIXED AT £ 200 : 6 : 0 PER ANNUM FROM THE 1 DAY OF January 1923 PRODUCED FOR REGISTRATION THE 4 DAY OF August 1923 AT 3 p.m.

H. L. Conrad Dep Reg Genl

Transfer No 821124 from John Andrew Tennant Murdoch to The Yardea Pastoral Company Limited of Currie Street Adelaide of the within lease No 1022 Produced for registration the 22 day of August 1922 at 2.40 pm

J. J. Hoffy
Dep Reg Genl

Winston Dugan

South Australia.

Register Book.

Vol. 830 Folio 13

Registrar-General.

Crown Lease.

(PASTORAL, No. 1867)

(*In lieu of Surrendered Lease*s No*s*. 1021 Vol.503 folio 55 Part 1022 Vol.503 folio 56 Water Leases 378 Vol.632 folio 33 379 Vol.632 folio 34 and 401 Vol.667 folio 90

(*Surrendered pursuant to Section 49a of The Pastoral Act, 1904, enacted by Section 4 of The Pastoral Act Amendment Act, 1929.*)

This Indenture made the twenty sixth day of June in the year of our Lord One Thousand Nine Hundred and thirty five **Between** HIS MOST GRACIOUS MAJESTY GEORGE THE FIFTH of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas King Defender of the Faith Emperor of India of the first part His Excellency the Governor in and over the State of South Australia in the Commonwealth of Australia &c. &c. of the second part and THE YUDNAPINNA PASTORAL COMPANY LIMITED of Currie Street Adelaide

for itself its Successors Executors Administrators and Assigns herein designated by the term "Lessee" of the third part **WITNESSETH** that the said Governor by virtue of the powers contained in "The Pastoral Acts 1904 to 1929" and all other powers enabling him in that behalf **DOTH** lease unto the Lessee for pastoral purposes **ALL THAT** portion of Crown lands containing by estimation

Parcels. one thousand three hundred and forty (1340)

square miles or thereabouts and situate and being Block 973 "Yudnapinna" North West of Port Auguste

the abuttals and boundaries whereof are particularly delineated and set forth in the plan thereof to this Indenture annexed and signed by the Surveyor-General together with all ways paths passages waters watercourses advantages and appurtenances thereto belonging or appertaining subject to the exceptions and reservations hereinafter contained that is to say **EXCEPT AND RESERVED** all gold silver copper tin and other metals all ores and other substances containing metals all minerals and all gems and precious stones coal and mineral oils upon in or under the said land to His Majesty the King His Heirs and Successors and all persons lawfully claiming under or authorised by Him or them **AND** the Governor and the Commissioner of Crown Lands for the time being of the said State and all persons lawfully claiming under or authorised by them or either of them shall have full and free liberty of access ingress egress and regress with or without horses cattle carts drays carriages engines machinery and all other necessary implements and things into upon and from the said premises for all public purposes and to cut dig sink for try search procure work remove and dispose of all or any of the hereby excepted and reserved things and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **PROVIDED** that no such bores wells dams reservoirs or embankments shall be sunk or constructed within one mile of any improvement consisting of a well reservoir dam dwelling house factory or building of the value of One Hundred Pounds or upwards the property of the said Lessee **AND** reserving to Aboriginal Inhabitants of the said State and their descendants during the continuance of this lease full and free right of egress and regress into upon and over the said lands and every part thereof and in and to the springs and surface waters thereon and to make and erect such wurlies and other dwellings as the said Aboriginal Natives have been heretofore accustomed to make and erect and to take and use for food birds and animals *ferœ naturæ* in such manner as they would have been entitled to do if this lease had not been made **AND** reserving to all persons the rights of crossing the said lands with travelling stock subject to the provisions of "The Stock Diseases Acts 1888 to 1926" "The Pastoral Acts 1904 to 1929" or any other Act for the time being regulating travelling stock **SUBJECT** to the right of His Majesty's subjects to use all and every the roads paths or ways heretofore made and used by them or hereafter to be duly opened and dedicated to the public use for the purpose of passing upon through and over the said lands or any part thereof **SUBJECT ALSO** to the right of the Governor for the time being of the said State and all persons authorised by him or other lawful authority at any time or from time to time as may be deemed requisite with horses carts and carriages or without into upon through and over the said lands to come and go for the purpose of laying out and making fit for and devoting to the public use any new and additional roads ways and paths **AND SUBJECT ALSO** to the right of the said Commissioner or any person authorised by him in that behalf to grant licences to enter upon the said lands or any part thereof and to occupy the same for the purpose of cutting obtaining and taking away any live or dead timber stone and sand with full and free liberty of access ingress egress and regress to and for His Majesty His Heirs and Successors and to and for the Governor and Commissioner of Crown Lands for the time being of the said State and all other persons authorised by them or either of them with or without horses carts and carriages into over through and upon the said lands for the purpose of cutting obtaining and taking away such timber stone and sand but notwithstanding this last-mentioned provision the Lessee shall be at liberty at any time and from time to time to fell cut down and remove any live or dead timber stone and sand which may be required by the Lessee for the purpose of improvements to be constructed or made or firewood to be used upon the said land **TO HAVE AND TO HOLD** the said lands and premises (subject to the covenants conditions provisos and restrictions herein contained)

Term. from the first day of January One Thousand Nine Hundred and thirty four until the thirty first day of December One Thousand Nine Hundred and seventy five **YIELDING AND PAYING** therefor yearly and every year in advance unto His Majesty His Heirs and Successors by payment at His Majesty's Treasury in the City of Adelaide in the said State the rent or sum of

Rent. eight hundred and thirty seven pounds and ten shillings (£837: 10: 0) for the first term of twenty one years (the rent for the following twenty one years being the balance of the term to be fixed by the Pastoral Board) the first of such payments to be made

Exd. S.G.O. 880 05.

In lieu of Surrendered Lease. Term 42 years, with improvements. (Acts 1904 to 1929.)

Revaluation of rent by reason of public works.

on the first day of January in the year One Thousand Nine Hundred and thirty four and in each succeeding year **PROVIDED** that if during the said term hereby granted any railways waterworks reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the said land hereby demised

Commissioner of Crown Lands.

By command,

Director of Lands.

Certified correct.

and by reason thereof the value of the said land hereby demised shall in the opinion of the said Commissioner be enhanced the said Commissioner may direct the Pastoral Board to make a revaluation of the said land hereby demised or any part thereof and thereupon a revaluation shall be made in manner prescribed by Sections 53 and 54 of "The Pastoral Act 1904" and the rent so fixed shall be paid by the Lessee from the date on which it shall be so fixed to be payable but no such revaluation shall be retrospective or made within five years after the commencement of the term of the original lease nor within ten years after any previous revaluation and the said Commissioner shall serve notice of such increased rent upon the Lessee **PROVIDED ALSO** that during the first six months of the twenty-first year of this lease a revaluation of the lands hereby demised shall be made by the Pastoral Board pursuant to "The Pastoral Acts 1904 to 1929" and the rent fixed upon such revaluation shall be paid by the Lessee from the date of the expiration of the first twenty-one years of this lease and the said Commissioner shall forthwith serve upon the Lessee notice in writing of such rent **PROVIDED** that in fixing the said rent whether by revaluation or otherwise no regard shall be had to any increase in value of the lands hereby demised caused by improvements thereon which the Lessee shall have made or paid for and which shall not be the property of the Crown **PROVIDED** the rent so fixed on any revaluation pursuant to "The Pastoral Acts 1904 to 1929" shall not be more than fifty per cent. above or below the rent payable immediately prior to the revaluation **PROVIDED ALWAYS** that the Lessee may at any time within three calendar months from the service of a notice in pursuance of "The Pastoral Acts 1904 to 1929" by the said Commissioner on the said Lessee of any revaluation appeal to the said Commissioner by notice in writing against such revaluation and thereupon the matter shall be determined by arbitrators pursuant to the "Arbitration Acts 1891 and 1921" one arbitrator being appointed by the said Commissioner and the other by the Lessee **AND** the Lessee do hereby covenant with His Majesty His Heirs and Successors and as separate covenants with the said Governor and with the Governor for the time being of the said State and that the Lessee will during the continuance of this lease pay the rent hereinbefore reserved in manner aforesaid free and clear of all outgoings and deductions whatsoever **AND ALSO** that the Lessee will pay unto His Majesty at His Majesty's Treasury aforesaid the sum of three thousand six hundred and thirty pounds nine shillings and five pence (£3630: 9: 5)

being the balance of the value of the improvements belonging to the Crown upon the lands hereby demised by ten instalments with interest namely four hundred and forty seven pounds and twelve shillings (£447: 12: 0)

on the first day of January yearly and every year during the continuance of the term hereby granted **PROVIDED ALWAYS** that in the event of any instalment being unpaid for three calendar months after any date whereon the same ought to be paid the purchase-money then remaining unpaid shall at the option of the said Commissioner become instantly due payable and recoverable and may be recovered by the said Commissioner by action in his own name in any Court of competent jurisdiction **AND ALSO** that the Lessee shall and will stock the land hereby demised with sheep in the proportion of at least five head for every square mile of land included in this lease or with cattle in the proportion of at least one head for every square mile and will keep the same so stocked and before the end of the seventh year of the said term increase the stocking to twenty head of sheep per square mile or four head of cattle per square mile and keep the same so stocked at the least during the remainder of the said term hereby granted **PROVIDED** that the stocking with sheep and cattle combined shall satisfy this present covenant if the requisite number are kept one head of cattle being computed as equal to five head of sheep **AND ALSO** that the Lessee shall not any time during the last three years of the said term hereby granted overstock the land hereby leased or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the said Commissioner or the Pastoral Board would have the effect of depreciating the ordinary capacity of the said land for depasturing stock **AND ALSO** that the Lessee shall at all times upon being thereunto required by the said Commissioner or the Pastoral Board furnish him or them with true particulars of the number of sheep and cattle with which the land hereby demised is stocked **AND ALSO** that the Lessee will expend in improvements on the said land by the end of the fifth year of the lease a sum of not less than ten pounds per square mile by the end of the thirteenth year a sum of not less than fifteen pounds per square mile and by the end of the twenty-first year of the term not less than twenty pounds per square mile **PROVIDED** that any improvements existing upon the said lands at the time of the granting of this lease shall be deemed to be improvements hereby required to be made and the value thereof shall be taken into account in estimating the amount hereby agreed to be expended **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of the purchase-money of any improvements or any interest thereon keep in proper order repair and condition to the satisfaction of the Commissioner all such improvements in respect whereof any such money shall remain owing by the Lessee reasonable wear and tear excepted **AND ALSO** that the Lessee so long as any principal money or interest shall remain owing for any improvements will not pull down or remove from the land hereby demised or knowingly suffer to be pulled down or removed or wilfully or knowingly destroy damage or injure or suffer to be destroyed damaged or injured any such improvements without the consent of the said Commissioner in writing first had and obtained **AND ALSO** that it shall be lawful for the said Commissioner and all persons authorised by him at all times unrestrictedly to enter into and upon the said lands hereby demised and view and examine the state and condition thereof and of the improvements belonging to the Crown thereon and of all defects decays and wants of reparation contrary to the provisions herein contained as shall be then and there found to give to the Lessee or leave upon the said lands notice in writing requiring the Lessee to repair and amend the same within six calendar months then next following within which time the Lessee will repair and amend the same accordingly **AND ALSO** that the Lessee will permit all lawfully constituted Land Boards and the Pastoral Board for the time being and the members agents and officers thereof respectively or any of them at all times unrestrictedly to enter upon and examine the land and premises hereby demised **AND ALSO** that the Lessee will subject to the regulations for the time being in force under "The Mining Acts 1930 and 1931" or any other Act authorising the making of regulations permit every gold or mineral lessee or licencee holding a lease or licence under "The Mining Acts 1930 and 1931" or any other Act for the time being authorising the granting of gold or mineral leases or licences of or respecting any of the land hereby demised and all persons authorised by such lessee or licencee to have unrestricted access to and egress from the land comprised in such mineral lease or licence using however as far as reasonably can be the public roads paths and ways for the time being upon or over the said land or any part thereof **AND ALSO** that the Lessee shall if required by the said Commissioner permit the owner of a gold claim or mineral claim duly registered in terms of "The Mining Acts 1930 and 1931" and pegged out on the land hereby demised to take for mining and domestic purposes a reasonable quantity of water from any of the wells or dams on such lands on payment to the Lessee of fair and reasonable compensation to be determined in case of dispute by the said Commissioner **PROVIDED** that the quantity of water so taken shall not at any time be such as to deprive the Lessee of the quantity of water necessary for stock domestic and general station purposes **AND ALSO** that the Lessee shall if required by the said Commissioner supply water to other lessees of pastoral lands on such terms and conditions as may be determined by the said Commissioner pursuant to Part X. of "The Pastoral Act 1904" as amended by "The Pastoral Act Amendment Act 1929" **AND ALSO** that the Lessee shall supply water to stock travelling through the leased land in terms of Subsection (2) of Section 49B of "The Pastoral Act Amendment Act" 1937 of 1929 and that the Lessee shall also have the right to charge for water supplied at the rate of 1s. 3d. for each 100 sheep and 10s. 0d. for each 100 cattle **AND PROVIDED ALSO** that the lease shall reserve to the Lessee the right to determine from what water supply the travelling stock are to take water and the water supply so determined shall not necessarily be that nearest to the most direct route through the leased land **AND ALSO** that the Lessee shall not nor will during the said term assign or sublet the whole or any part of the leased land without the consent of the Commissioner **PROVIDED** that the Commissioner shall not consent to an assignment or subletting of the whole of the leased land during the first five years of the term unless it is proved to his satisfaction that a refusal of consent would cause severe hardship **ALSO** the Commissioner shall not during the first ten years of the term consent to any assignment or subletting giving effect to a subdivision of the leased land into two or more parts unless it is proved to his satisfaction that a refusal of consent would cause severe hardship **ALSO** the Commissioner shall not at any time consent to any assignment or subletting giving effect to a subdivision of the leased land into two or more parts unless plans of the proposed subdivision have first been submitted to and approved by him and he is satisfied that the subdivision is such as would enable the best use to be made of all improvements waters and grazing areas Subject to the preceding paragraphs of this proviso the Commissioner shall not capriciously withhold his consent to any assignment or subletting **AND ALSO** that the Lessee will so long as any money shall remain owing by the Lessee in respect of any improvements belonging to the Crown and liable to be destroyed or damaged by fire insure and during the term hereby granted keep insured in some Insurance Office in Adelaide to be approved by the said Commissioner against loss or damage by fire all such improvements other than fencing in an amount equal to two-thirds of the amount for the time being owing to the Crown in respect thereof such insurance to be in the joint names of the Lessee and the said Commissioner and will lodge the policy of every such insurance in the office of the said Commissioner within one calendar month after the date thereof and will forward to the said Commissioner the receipts for the premium payable in respect of every such policy within seven days after the same shall become due and that if the foregoing covenant shall not be duly observed then the said Commissioner shall be at liberty to insure the said improvements in manner aforesaid and all moneys expended by the said Commissioner in or about such insurance as aforesaid with interest thereon at the rate of Five Pounds per centum per annum computed from the time of expending the same shall be repaid to him on demand and may be recovered in like manner as rent is recoverable and it is declared that all sums of money received by the Lessee or the said Commissioner under any such insurance shall be laid out in reinstating (*pro tanto*) the premises in respect of which the same shall have been received **PROVIDED** that if the said Commissioner and the Lessee shall so agree the moneys so received or such part thereof as may be agreed upon shall in lieu of being laid out as last aforesaid be applied in reduction of the amount for the time being owing by the Lessee to the Crown in respect of such improvements **AND ALSO** that the Lessee will forthwith commence to destroy vermin on the said lands to the satisfaction of the said Commissioner or the Pastoral Board and will at all times during the said term use reasonable means to keep the said land free of vermin to the satisfaction of the said Commissioner or the Pastoral Board **ALSO** that the Lessee will neither erect nor suffer the erection of any brush fence upon the said lands **AND ALSO** that the Lessee will not during the said term without the licence in writing of the said Commissioner for every such purpose fell or cut down any trees or other timber which are now or hereafter shall be growing upon the said lands except for improvements or firewood **AND ALSO** that the Lessee will not during the said term without the consent of the said Commissioner first obtained use any of the said lands for Agriculture **PROVIDED** that if such consent of the said Commissioner has been first obtained the said Commissioner may revalue the

Revaluation during first six months of twenty-first year.

Covenants by Lessee to pay rent.

To pay value of improvements belonging to the Crown.

To stock. Not to overstock.

To furnish returns of stock.

To keep improvements belonging to the Crown in repair.

Power to Commissioner to enter and view condition of Crown improvements.

Right of ingress, &c., to mineral lessees.

To permit owner of gold or mineral claim to take water.

Not to transfer or sublet.

To insure.

Not to erect brush fences.

Not to cut down timber, except for improvements, &c.

To comply with regulations.

The Lessee to have the right to use the water from Water Supplies on former Water Reserves Nos. 58, 61, 186 and Koota Berra Reservoir on the condition that all appliances existing thereon be maintained in good serviceable condition, such water supplies and appliances effected by the Crown to remain the property of the Crown and those effected by the Lessee to remain the property of the Lessee

PLAN

PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
Nº 1867
(BLOCK 973)

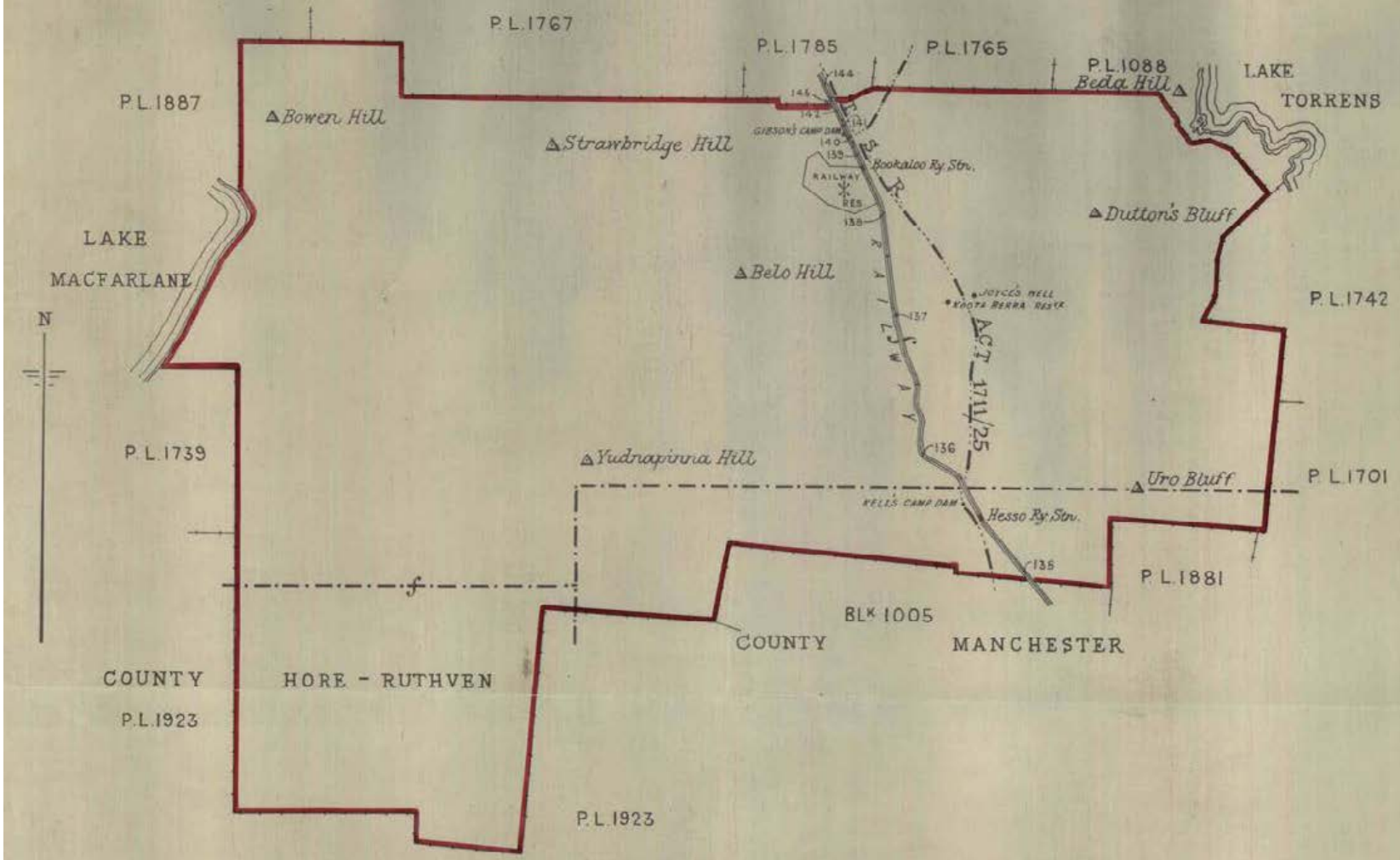


Diagram certified correct

J H McInnes

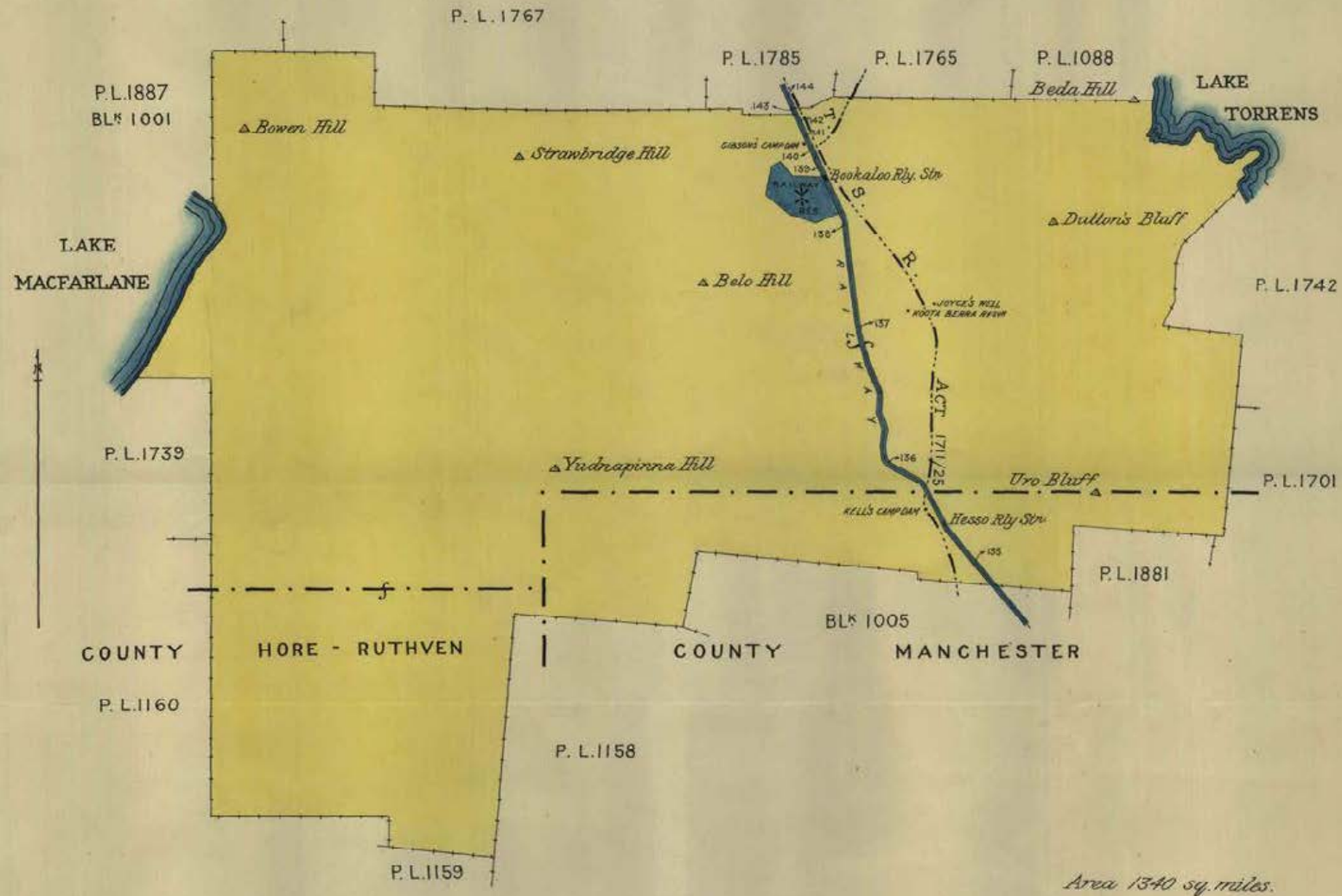
Surveyor General

— Scale —

Boundaries of lease margined red
Area 1332 sq miles
Fences shown thus ——·——·——



PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
№ 1867
(BLOCK 973)



Area 1340 sq. miles.
Fences shown thus ——

Diagram certified correct,

J. H. McKenzie
Surveyor General.

Scale

rent of any land so used for Agriculture **PROVIDED ALSO** that none of the said lands shall be deemed to be used for Agriculture if the produce grown thereon is used solely for consumption on the said land **AND ALSO** that the Lessee will at all times comply with and observe the Regulations that may from time to time be made by the Governor with the advice of the Executive Council under "The Pastoral Acts 1904 to 1929" or any other Act him thereunto enabling and for the time being in force **AND ALSO** that the Lessee will make and furnish to the Commissioner or cause to be so made and furnished all such statements and returns as are required by any Act rule or regulation for the time being in force **AND ALSO** that the Lessee will not obstruct or interfere with any public roads paths or ways or the use thereof by any person **AND ALSO** that the Lessee or any other person will not without licence of the said Commissioner construct or commence to construct any artesian bore on the said land **AND ALSO** that the Lessee will not maintain enlarge or deepen any artesian bore either existing or under construction on the said land at the time of the passing of the said "Pastoral Act Amendment Act 1929" unless the said Lessee within six months from the commencement of the last-mentioned Act obtains a licence from the said Commissioner pursuant to Part X. of "The Pastoral Act 1904" as amended by "The Pastoral Act Amendment Act 1929" **PROVIDED** that if the rent hereby reserved be not paid on or before the days whereon the same is hereby made payable then a penalty of Ten Pounds per centum per annum on the amount of the rent unpaid may if the said Commissioner think fit be added and if such rent and penalty be not paid within one calendar month after the same shall become due the same shall be recoverable by the said Commissioner by action in his own name in any Court of competent jurisdiction **PROVIDED ALWAYS** that if the rent hereby reserved shall be in arrear for more than three calendar months after any of the days hereinbefore appointed for payment thereof or if there shall be a breach or non performance of any of the Lessee's covenants or conditions it shall be lawful for the said Commissioner to cancel this lease **PROVIDED ALSO** that this lease shall not be forfeited until after the expiration of three months from the giving of a notice to the Lessee by the said Commissioner of his intention to forfeit the same and unless the said intention to forfeit shall have been previously approved by the Pastoral Board **PROVIDED ALSO** that the Lessee upon receiving notice of the said Commissioner's intention to forfeit this lease for the default in the observance or performance of any covenant or condition herein contained other than the covenant for payment of rent may apply pursuant to "The Pastoral Acts 1904 to 1929" or any other Act for the time being in force to the Tenants' Relief Board for relief **PROVIDED ALSO** and it is hereby expressly agreed and declared that the Governor of the said State shall and may by Proclamation published in the *Government Gazette* and notice in writing forwarded to the Lessee setting out the purpose for which the land is intended to be resumed at any time or from time to time hereafter determine this lease as to and resume possession of all or any part of the said lands if such land shall be required for intense culture or for the purposes of any public work such as railways tramways roads bridges public buildings water conservation works or the like or as a site for a town or cemetery or for mining or for residential sites commonage or other purposes incidental to mining or for park lands in which cases one month's notice of the intention to resume shall be given for all such purposes except for intense culture and where such resumption is for the purpose of intense culture one year's notice shall be given **PROVIDED ALSO** that immediately after notice for resumption for the purposes heretofore specified the said Commissioner may enter upon the lands hereby demised for the purpose of making any necessary surveys **PROVIDED ALSO** that if no portion of the land resumed for intense culture shall be used for intense culture for a period of two years from the date of the expiry of the notice of resumption the Lessee shall have the first right to a lease thereof upon the same terms and conditions as the land was held at the time of such resumption for the balance of the term hereby granted upon repayment by the Lessee of any compensation for such resumption **PROVIDED ALSO** that if a portion of the said lands shall be resumed for intense culture the Lessee may require the said Governor to resume the whole of the lands hereby demised in respect to which notice of such partial resumption shall be given **PROVIDED ALSO** that if any of the lands hereby demised shall be resumed for or in connection with mining and after such resumption be found to be not required for the purposes for which the same were resumed the Lessee shall have a preferential right to occupy during the residue of the term of this lease the lands so resumed and not required on such terms as may be prescribed by Act or regulation in that behalf **PROVIDED ALSO** and it is hereby agreed that for every square mile resumed there shall be deducted from and out of the yearly rental hereinbefore reserved the sum of twelve shillings and six pence (£0: 12: 6) and so in proportion for any quantity of such lands resumed **PROVIDED** that no reduction of rent be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced by the sum of twelve shillings and six pence (£0: 12: 6) no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year **PROVIDED ALSO** that within twelve calendar months before the expiration by effluxion of time of the term hereby granted all improvements (if any) existing upon the land hereby demised shall be valued so far as practicable in detail and the position of such improvements indicated on a plan to be prepared by the said Commissioner and signed by the said Commissioner and the Lessee **PROVIDED ALSO** that if any of the said land hereby demised shall be resumed the Lessee shall be compensated by the Government of the said State for the loss or depreciation in the value of this lease caused by such resumption and also in respect of such improvements as he would have been entitled to payment for from an incoming lessee if this lease had expired and the land had been relet as on the date of notice of resumption **PROVIDED ALWAYS** that no valuation shall be made of any improvements and no payment shall be made in respect of any improvements and no improvements shall be considered unless the Lessee prior to their construction has given written notice to the Commissioner stating the nature and position and the probable cost and date of completion thereof and the Commissioner has on the recommendation of the Board consented to the making thereof and the Lessee after the completion thereof has furnished to the Commissioner a statement showing the details of the actual cost of such improvements **PROVIDED ALSO** that the provisions of the immediately preceding proviso shall not apply to any improvements under the value of twenty-five pounds or to any improvements consisting of wells reservoirs tanks or dams of a permanent character available for the use of cattle or sheep and which increase the carrying capacity of the land leased or substantial buildings vermin-proof or other fences or huts or sheds erected for residence shearing or other purposes usually required for or in connection with keeping livestock which the Board certifies are useful and were made for the purpose of improving the land for pastoral purposes or for increasing the carrying capacity thereof and will have such effect **PROVIDED ALSO** that all machinery or appliances which in the opinion of the Pastoral Board arbitrators or umpire making a valuation shall be necessary for the purpose of raising or distributing after raising the water which may be attached or appurtenant to any well dam tank reservoir or natural water to be valued including all under and over ground tanks and troughs shall when approved by the valuator be included in the valuation of such Board arbitrators or umpire **PROVIDED ALSO** that subject to the provisions of "The Pastoral Acts 1904 to 1929" at the expiration of the said term hereby granted the Lessee shall be entitled to receive from the incoming Lessee the value to be determined as provided by "The Pastoral Acts 1904 to 1929" of all improvements made or purchased by him existing upon such portions of the said lands hereby demised as may be comprised in the new lease **PROVIDED ALSO** that the purchase-money to be paid for improvements by the incoming Lessee whether afterwards payable to the Lessee or not together with interest at the ~~rate of five pounds per centum~~ fixed rate (within the meaning of "The Pastoral Acts 1904 to 1929") per annum on any amount overdue shall be a debt from the incoming Lessee to the said Commissioner **PROVIDED ALWAYS** that any moneys received by the said Commissioner from the incoming Lessee in respect of improvements made or paid for by the Lessee shall be paid over to the Lessee when he shall give up possession of the said land together with interest at the rate of three per cent. per annum from the time of the receipt of the purchase money by the said Commissioner less all costs of and incidental to the recovery thereof and less all proper deductions for rent or compensation for loss or depreciation of such improvements or otherwise **PROVIDED ALWAYS** that such costs shall in no case exceed five per centum of the moneys so received by the said Commissioner **PROVIDED ALWAYS** that the Lessee and the incoming Lessee may mutually agree touching the amount to be paid to the Lessee for the improvements and the time and manner of payment thereof pursuant to "The Pastoral Acts 1904 to 1929" **PROVIDED ALSO** that on the determination of this lease all barbed wire and netting by which any boundary fence the property of His Majesty's Government has been or shall during the term of this lease be vermin-proofed by the Lessee at his own cost shall be and be deemed to be on such determination as aforesaid the property of the Lessee and shall at the termination of this lease be valued as provided in "The Pastoral Acts 1904 to 1929" and shall be paid for by any incoming Lessee of the land hereby leased **PROVIDED ALWAYS** that in computing the compensation to be paid for the loss of or depreciation in the value of this lease if the whole or any part of the said lands shall be resumed no increased value given to this lease by reason of any public works executed after the granting hereof shall be included or taken into account **PROVIDED ALSO** that as prescribed by "The Pastoral Acts 1904 to 1929" the amount payable for compensation for loss of or depreciation in value of this lease shall be paid within six calendar months after the expiry of the lease or resumption occasioning such loss or depreciation provided that the Lessee shall then have given up possession of the land resumed **PROVIDED ALSO** that in case the land hereby demised shall not be offered by the said Commissioner for lease within six calendar months after the expiration of this lease the amount determined as provided of all improvements shall be paid by the said Commissioner to the Lessee upon the Lessee giving up possession thereof **PROVIDED ALSO** that all valuations of improvements or in respect of compensation made under these presents shall in case of dispute be determined pursuant to "The Arbitration Acts 1891 and 1921" It is a condition of this lease that the lessee shall not be entitled to possession of the demised land until he shall have paid the first year's rent and paid or arranged pursuant to "The Pastoral Acts 1904 to 1929" for payment of the price for improvements (if any) **IT IS DECLARED** that the notes in the margin of this lease are for the sake of more convenient reference only and shall not in anywise control or affect the interpretation or construction of this lease **AS WITNESS** the Public Seal of the said State and the hand and seal of the said Lessee

Land for agricultural purposes.

Not to interfere with public roads.

Power to Commissioner to forfeit lease on non payment of rent.

Tenants' Relief Board.

Resumption.

Lessee to have preferential right to occupy resumed land in certain circumstances.

Reduction of rent where land resumed.

Improvements to be valued.

Compensation on resumption.

Improvements to be paid for by incoming Lessee.

Public works not to be taken into account in computing compensation.

Payment of compensation to be made within six months of the Lessee giving up possession.

Compensation to be determined by arbitration.

Marginal notes clause.

Signed sealed and delivered by the said Lessee in the presence of

(over)

ACA 120/886

Certificate No 120/886 of the Commissioner of Crown Lands hereby in consequence of the alteration in the boundary in the within lease No 1867 the area has been reduced to 1332 square miles and the annual rent payable for the balance of the first term of 21 years £832:10:0 such alterations to date from 1st January 1937 Produced for registration the 6 day of March 1936 at 3pm

T Pentelow, Actg Dep Reg Gen

V.L. 1331186

Underlease No. 1331186 from The Yudnapinna Pastoral Company Limited to The University of Adelaide of portion of the land comprised in the within Lease No. 1867. Term 20 years from the 1 day of September 1940. Produced for registration the 19 day of November 1940 at 3 pm

A Reeves Dep Reg Gen.

V.L. 1354840

Underlease No 1354840 from The Yudnapinna Pastoral Company Limited to The University of Adelaide of portion of the land comprised in the within Lease No 1867 Term 20 years from the 1 day of September 1940 produced for registration the 15 day of October 1941 at 12.40 pm

A.T. Rogers as Dep Reg Genl

CERTIFICATE NO. 1838878 of the MINISTER OF LANDS THAT ON REVALUATION OF THE WITHIN LEASE NO. 1867 for the last 21 years THE RENT HAS BEEN FIXED AT £2.48 : 15 : - PER ANNUM FROM THE 1 DAY OF January 1955 PRODUCED FOR REGISTRATION THE 17 DAY OF June 1954 AT 3 pm

Arthur Dep Reg Genl

Partial Surrender No 2116489 The within lease No 1867 is surrendered as regards 6¼ acres and the area is now 1332 square miles by recalculation as from 5.3.1959 Produced 26.3.1959 at 3 pm

A.T. Rogers Dep Reg Genl.

An easement over portion of the land in the within lease No. 1867

THE WITHIN LAND HAS BEEN ACQUIRED BY THE COMMONWEALTH VIDE L.T.O. No. 3044 OF 1959

[illegible] entry on (Crop 176-1964)

DEP. REG. GEN.

An easement over portion of

THE WITHIN LAND HAS BEEN ACQUIRED BY THE COMMONWEALTH AS APPEARS IN COMMONWEALTH GAZETTE DATED 4/6/1964 AT PAGES 2132 - 2133 VIDE L.T.O. No. 2528 OF 19 64

DEP. REG. GEN.

SURRENDER OF Lease No. 1867 VIDE No. 2559652 PRODUCED 1-7-1964 AT 3.10

DEP. REG. GEN.

Idric Baskyn

South Australia

Register Book,

Vol. 1296 Folio 32

11964

B. Nelson Hayles Deputy Registrar-General

FOUR POUNDS 55.

Crown Lease

PASTORAL No. 2373

Pursuant to Section 46A of the Pastoral Act 1936-1960

In lieu of surrendered Lease No. 1867 (Part of) Register Book Volume 830 Folio 13

Her Majesty the Queen doth hereby lease to THE YUDNAPINNA PASTORAL COMPANY PROPRIETARY LIMITED whose registered office is situate at 172-174 North Terrace Adelaide its Successors ~~his Executors Administrators~~ and Assigns (all of whom are hereinafter included in the term "lessee") for pastoral purposes all that land containing two hundred and forty five (245) square miles or thereabouts and situate and being Block 1155 thirty four (34) miles north west of Port August known as "Kootaberra" as the same is delineated in the public maps deposited in the Land Office in the City of Adelaide and in the plan annexed hereto (hereinafter called "the land") to be held by the lessee from the seventeenth day of April one thousand nine hundred and sixty four until the sixteenth day of April two thousand and six at the yearly rent of eight hundred and twenty seven pounds (£827:0:0) for the first period of seven years to be paid in advance on the seventeenth day of April in each year the rent for the succeeding periods of the term of the lease to be fixed by the Pastoral Board and subject to the reservations covenants and conditions stated below and to such further reservations covenants and conditions as may be implied by law

The Minister of Lands.

By command,

Director of Lands.

Certified correct.

RESERVATIONS

1. **EXCEPT AND RESERVED** out of this lease all gold silver copper tin and other metals all ores and other substances containing metals all minerals and all gems and precious stones coal and mineral oils live and dead timber stone and sand upon in or under the said land to Her Majesty the Queen Her Heirs and Successors and all persons lawfully claiming under or authorized by her or them **PROVIDED** that the lessee may fell cut down and remove any dead timber stone and sand required for improvements to be constructed or firewood to be used for domestic use upon the land **AND** the Governor and The Minister of Lands (hereinafter called "the Minister") and all persons lawfully claiming under or authorized by them or either of them shall have all necessary rights of access search procuration and removal of all or any of the said excepted and reserved things and all incidental rights and powers and may sink bores and wells and construct dams reservoirs and embankments for the purpose of finding or conserving water **AND ALSO** reserved to the Governor and all persons authorized by him or other lawful authority the right at any time or from time to time with all necessary vehicles implements and things to enter upon the land and to come and go for the purpose of laying out and making fit for and devoting to the public use any existing new or additional roads ways and paths **AND ALSO** reserved to Aboriginal Inhabitants of the said State and their descendants full and free right of access into upon over and from the said land except such parts as improvements have been erected upon and in and to the springs and surface waters thereon and to make and erect wurlies and other native dwellings and to take and use for food birds and animals *ferae naturae* as if this lease had not been made **AND ALSO** reserved to all persons the rights of using all and every the roads paths and ways heretofore made and used by them or hereafter to be made and dedicated to the public use **AND ALSO** of crossing the said land with travelling stock subject to the provisions of any Act regulating travelling stock

COVENANTS

2. The Lessee must—

i. Pay the said rent annually in advance **PROVIDED** that a penalty of Ten Pounds per centum per annum may be added to any rent in arrear

ii. Pay any amounts due or becoming due on account of wire-netting vermin rates wild dog rates and dog fence rates

iii. Stock the land with sheep cattle or sheep and cattle combined so that for every square mile leased there shall be five head of sheep or one head of cattle and during the term of the lease keep the land so stocked and when required furnish the Minister and the Pastoral Board with true particulars of the number of such stock **PROVIDED** that the number of stock shall not at any time during the term of the lease without the consent in writing of the Minister exceed 1800 head of cattle or the equivalent number in sheep or sheep and cattle combined

iv. Comply with any notice in writing from the Minister to reduce the number of stock within the time specified in such notice and comply with any other restrictions specified in the notice

v. Forthwith commence to destroy and during the term of the lease use reasonable means to keep the land free from vermin to the satisfaction of the Minister or the Pastoral Board

vi. Make and furnish all such statements and returns as are required by any Act rule or regulation for the time being in force

vii. Comply with and observe the Regulations for the time being in force under the said Pastoral Act or any amendment thereof

viii. Expend such amount as is necessary to ensure that the value of the improvements on the land by the end of the fifth year of the term of the lease will be not less than twenty five pounds per square mile by the end of the thirteenth year not less than forty pounds per square mile and by the end of the twenty-first year not less than sixty pounds per square mile and maintain such improvements ~~(which include those effected pursuant to Covenant 2 ix. hereof)~~ in good order and condition during the term of the lease **PROVIDED** that such amount expended on improvements shall not include any money advanced by any body or person on behalf of the Crown for vermin proof or dog proof fencing and expended for that purpose

EXD.

D.L., 9705/61.
Term 42 years.
Surrender.
Act 1936-1960.

COVENANTS—continued

ix. ~~Effect the undermentioned improvements on the land within the time specified:—~~

~~**PROVIDED** that the value of the improvements the lessee is obliged to effect pursuant to this covenant shall not together with the value of any other improvements effected in pursuance of Covenant 2 viii exceed in all the value of improvements required to be effected by the end of the fifth thirteenth and twenty first years pursuant to Covenant 2 viii hereof~~

x. Permit the Minister the Land Board and the Pastoral Board and his or their agents at all times to enter and view the state and condition of the land and of the improvements thereon and of any defects decays and wants of reparation and within six months next following written notice given by the Minister or left upon the land requiring him to do so repair and amend the same accordingly

xi. Permit the owner of any mining claim situated on the land and the holder of any mining lease or licence of the whole or any portion of the land under any law in force for the time being relating to mining with or without workmen full and free liberty of access ingress egress and regress into upon and from the land comprised in such claim lease or licence using however as far as reasonably can be any public roads paths and ways

xii. If required by the Minister permit the owner of a gold or mineral claim pegged out on the land to take a reasonable quantity of water for mining and domestic purposes from any well or dam on payment of reasonable compensation **PROVIDED** that the quantity of water so taken shall not be such as to deprive the lessee of the quantity of water necessary for stock domestic and general station purposes

xiii. Supply water to stock travelling through the land at the rate of one shilling and three pence for each 100 sheep and ten shillings for each 100 cattle **PROVIDED** that the lessee may determine from what water supply the water is to be taken and such water supply shall not necessarily be that nearest to the most direct route through the land if the water supply is reasonably accessible to such stock

And the Lessee must not—

xiv. Assign or sublet the whole or any part of the land without the consent of the Minister **PROVIDED** that the Minister shall not consent to an assignment or subletting of the whole of the land during the first five years of the term unless it is proved to his satisfaction that a refusal of consent would cause severe hardship. **ALSO** the Minister shall not during the first ten years of the term consent to any assignment or subletting giving effect to a subdivision of the land into two or more parts unless it is proved to his satisfaction that a refusal of consent would cause great hardship **ALSO** the Minister shall not at any time consent to any assignment or subletting giving effect to a subdivision of the land into two or more parts unless plans of the proposed subdivision have first been submitted to and approved by him and he is satisfied that the subdivision is such as would enable the best use to be made of all improvements water and grazing areas Subject to the preceding paragraphs of this proviso the Minister shall not capriciously withhold his consent to any assignment or subletting

xv. At any time during the term of the lease overstock the land or any part thereof or keep thereon any excessive number of sheep cattle horses or other stock which in the opinion of the Minister or the Pastoral Board would have the effect of depreciating the ordinary capacity of the land for depasturing stock

COVENANTS—continued

xvi. Erect nor suffer the erection of any brush fence upon the land

xvii. Cut any timber on the land during the term of the lease without the licence in writing of the Minister **PROVIDED** that the lessee may without a licence cut dead timber for making improvements on the land or for firewood for his own domestic use

xviii. Obstruct or interfere with any public roads paths or ways or the use thereof by any person

xix. Use any of the land for agriculture without the consent of the Minister first having been obtained **PROVIDED** that if such consent is given the Minister may revalue the rent of any land so used

xx. Construct maintain enlarge or deepen any artesian bore on the land without licence of the Minister

CONDITIONS

3. The lessee shall not be entitled to possession of the land until he shall have paid the first year's rent and fees and paid or arranged for payment of the price for the improvements (if any)

4. The Minister may cancel this lease in the following cases subject to the provisions of the said Pastoral Act or any amendment thereof—

i. If the rent reserved shall be in arrear for more than three calendar months after the same becomes due

ii. If there has been a breach or non-performance of any of the lessees covenants or conditions 1962

5. If any part of the land is or becomes bounded by a part of the dog fence as defined in the Dog Fence Act 1946-~~1961~~ or any amendment thereof such part of the dog fence shall be maintained by the lessee in dog-proof condition throughout the currency of the lease

6. i. If during the term of the lease any railways water-works reservoirs or other works of a public nature shall be executed by the Government of the said State on or in the vicinity of the land and by reason thereof the value of the land shall in the opinion of the Minister be enhanced the Minister may direct the Pastoral Board to make a re-valuation of the land and the Minister shall thereupon serve notice of any increased rent upon the lessee **PROVIDED** that no such re-valuation shall be retrospective or made within five years after the commencement of the lease

ii. During the first six months of the last year of each seven year period of the term of the lease the Pastoral Board shall make a re-valuation of the land and the Minister shall forthwith serve upon the lessee notice in writing of the rent to be paid during the succeeding period of the said term and such rent shall be paid by the lessee from the date specified in such notice as the date from which such rent is payable **PROVIDED** that the rent so fixed shall be not more than fifty per cent above or below the rent payable during the last year of the period in which the re-valuation is made

7. The lessee may within three months after service upon him of a notice of re-valuation as provided in Condition 6 hereof by notice in writing request that the rent fixed on that re-valuation be reconsidered and thereupon the Pastoral Board shall fix the rent and give notice in writing to the lessee of its decision If the lessee is dissatisfied with the rent as so fixed he may within three months after receiving notice of the Board's decision give the Minister notice that he requires the rent to be fixed by arbitrators and thereupon the matter shall be decided by arbitration

8. It is expressly agreed that the land or any part thereof may be resumed pursuant to and subject to the provisions of the said Pastoral Act or any amendment thereof and on any such resumption the lessee shall be entitled to receive compensation as and subject to the provisions therein contained **PROVIDED** that if any of the land is resumed the rent reserved shall thereafter be reduced by an amount which bears the same proportion thereto as the quantity of land bears to the total area of the land hereby demised **PROVIDED ALSO** that no reduction of rent shall be made for any resumption of half a mile or less but that for every resumption of a greater fractional part than half a mile the rent shall be reduced at the rate of one mile no period under half a year shall be taken into account and any period exceeding half a year shall be reckoned a whole year

9. Subject to the provisions of the said Pastoral Act or any amendment thereof at the expiration of the term hereby granted the lessee shall be entitled to receive from the incoming lessee the value to be determined as provided by the said Pastoral Act or any amendment thereof of all improvements made or purchased by him existing upon such portions of the land as may be comprised in the new lease **PROVIDED** that no valuation shall be made of any improvements and no payment shall be made in respect of any improvement and no improvements shall be considered unless the lessee prior to their construction has given written notice to the Minister stating the nature and position and probable cost and date of completion thereof and the Minister has consented to the making thereof and the lessee after completion thereof has furnished to the Minister a statement showing the details of the actual cost of such improvements The preceding proviso shall not apply to any improvements under the value of £25 : 0 : 0 nor to any improvements consisting of wells reservoirs tanks or dams of a permanent character available for the use of cattle or sheep and which increase the carrying capacity of the land leased or substantial buildings vermin proof or other fences or huts or sheds erected for residence shearing or other purposes usually required for or in connection with keeping livestock which the board certifies are useful and were made for the purpose of improving the land for pastoral purposes or for increasing the carrying capacity thereof and will have such effect

IN WITNESS whereof the Public Seal of the State of South Australia and the hand and seal of the said lessee were hereunto set the

Fourth **day of** September 19 64

Signed sealed and delivered by the abovenamed lessee in the presence of—

Given under the Common Seal of
The Yudnapinna Pastoral Company
Proprietary Limited by authority
of the Directors in the presence
of

.....Director

.....Secretary

THE YUDNAPINNA PASTORAL COMPANY PROPRIETARY LIMITED

L. S.

L. S.

L. S.

L. S.

over/

This Lease is issued subject to an easement acquired by the Commonwealth over portion of the within land as appears in Commonwealth Gazette dated 4/6/1964 at Pages 2132-2133 vide L.T.O. No. 2528 of 1964.

Director of Lands.

Caveat Lapses 15/9/64 at 2 pm

TRANSFER No. 2564451
John Lloyd George Pollard of Kootaberra via Port Augusta Station Bookaloo Grazier
OF THE WITHIN LAND PRODUCED 18.9.1964 AT 12.40 pm
H. Hudson Quayle DEP. REG. GEN.

MORTGAGE No. 2564452 Dorothy Elizabeth Hamblen and Company Limited to Norlock Richard George Irwin Robert Newenham Irwin Clerk Trustee and Executor
PRODUCED 18.9.1964 AT 12.40 pm
H. Hudson Quayle DEP. REG. GEN.

CAVEAT No. 2564453 LODGED BY The Yudnapinna Pastoral Company Proprietary Limited
OVER THE WITHIN LAND. PRODUCED 18/9/1964 AT 12.40 pm
H. Hudson Quayle DEP. REG. GEN.

T 2707019 T 2707020

TRANSFER No. 2707019 to Cyril Lloyd Wilkinson of 37 Avenue Street, Millswood Pastoralist and Shirley Catherine Wilkinson his wife as to four undivided fifth parts as Tenants in Common (subject to Caveat 2564453)
OF THE WITHIN LAND PRODUCED 10.3.1966 at 11.30 am
K. London DEP. REG. GEN.

TRANSFER No. 2707020 From Cyril Lloyd Wilkinson and Shirley Catherine Wilkinson to John Lloyd George Wilkinson of Kootaberra Station, Bookaloo, via Port Augusta Pastoralist as to one undivided fifth part in
OF THE WITHIN LAND PRODUCED 10.3.1966 at 11.30 am subject to Caveat No 2564453
K. London DEP. REG. GEN.

M 2779061

MORTGAGE No. 2779061
TO: COMMONWEALTH BANK OF AUSTRALIA Development
PRODUCED 29.11.1966 AT 11.25 am Subject to Caveat No. 2564453
J. A. Hughes DEP. REG. GEN.

M 3120797 M 3120797 M 3120797 M 3120797

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE No. 2779061. BY ENDORSEMENT THEREON.
PRODUCED 21.7.1970 AT 11.10 am.
J. A. Hughes DEP. REG. GEN.
J. A. Hughes D.R.G.
PA No. 2676155

TRANSFER No. 3120795. From Lloyd George Pollard to Haydn Bradley Wilkinson of 68 Greenhill Road Wayville 5034 Pastoralist of one undivided fifth part in
OF THE WITHIN LAND PRODUCED 21.7.1970 at 11.10 am. Subject to Caveat No 2564453
J. A. Hughes DEP. REG. GEN.

TRANSFER No. 3120796 From Cyril Lloyd Wilkinson and Shirley Catherine Wilkinson to the within named John Lloyd George Wilkinson and Haydn Bradley Wilkinson of one undivided fifth part as Tenants in Common.
OF THE WITHIN LAND PRODUCED 21.7.1970 at 11.10 am. Subject to Caveat No 2564453
J. A. Hughes DEP. REG. GEN.

MORTGAGE No. 3120797.
Development.
TO COMMONWEALTH BANK OF AUSTRALIA.
PRODUCED 21.7.1970 AT 11.10 am. Subject to Caveat No 2564452
J. A. Hughes DEP. REG. GEN.

MORTGAGE No. 3120798 From John Lloyd George TO Wilkinson and Haydn Bradley Wilkinson to Cyril Lloyd Wilkinson and Shirley Catherine Wilkinson of three undivided fifth parts in the within
PRODUCED 21.7.1970 AT 11.10 am. Land Subject to Caveat No 2564453
J. A. Hughes DEP. REG. GEN.

Revd 3331635 before endorsing please see H. Caveny at front counter

CERTIFICATE No. 3331635 OF THE MINISTER OF LAND THAT ON REVALUATION OF THE WITHIN LEASE No. 2373 THE RENT HAS BEEN FIXED AT for the second period of 7 yrs
$1654-00 PER ANNUM FROM 17/4/1971
PRODUCED 26/6/1972 AT 2.20 pm.
Logbooks pm
DEP. REG. GEN.

A/C 3630280 3630282

DEATH No. 3630280
Robert Newenham Irwin
DIED ON 9.6.1973 PRODUCED 12.6.1974 AT noon
K. London DEP. REG. GEN.

DISCHARGE OF MORTGAGE No. 2564452
VIDE No. 3630282 PRODUCED 12.6.1974 AT noon
K. London DEP. REG. GEN.

(New Section 701)
Portion of THE WITHIN LAND HAS BEEN ACQUIRED BY THE COMMONWEALTH OF AUSTRALIA AS APPEARS IN AUSTRALIAN COMMONWEALTH GAZETTE DATED 1.10.1974 AT PAGE 69 VIDE L.T.O. No. 2528 OF 1964. (See entry on trip) 28.8.1975 D.R.G.
J. A. Hughes DEP. REG. GEN.

A/C 3793927

Certificate of Alteration No. 3793927 of the Minister of Lands whereby a parcel of land now numbered Section 701 containing 0.3781 ha. being portion of Block 1165 having been acquired by Commonwealth of Australia on 1.10.1974 the area of the within lease remains at 245 square miles (634.5 square kilometre)

REGISTRAR-GENERAL SOUTH AUSTRALIA

RV 4151458

CERTIFICATE No. 4151458 OF THE MINISTER OF LAND THAT ON REVALUATION OF THE WITHIN LEASE No. 2373 THE RENT HAS BEEN FIXED AT $1654.00 PER ANNUM FROM 17.4.1978
PRODUCED 6.2.1978 AT 12.05 pm

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as regards portion of the within land

Caveat No2564453 HAS BEEN WITHDRAWN, VIDE No. 4478698 PRODUCED 5.12.1979 AT 11:10 am

PARTIAL SURRENDER No. 4478701 PORTION OF THE WITHIN Lease IS SURRENDERED AS REGARDS 148.1ha approx AND THE AREA OF THE WITHIN LEASE REDUCED TO 633 sq. kilometres ACRES AND THE ANNUAL RENT REDUCED TO $1,647.00 FROM 1.11.1979 PRODUCED 5.12.1979 AT 11:10am

~~AL605340~~

CERTIFICATE No. 6035340 OF THE MINISTER OF LAND THAT ON REVALUATION OF THE WITHIN LEASE No. 2373 THE RENT HAS BEEN FIXED AT $2470 . PER ANNUM FROM 17. 4. 1985 PRODUCED 23.7.1985 AT 15:35

~~RX 6074243~~

NOTICE OF REMOVAL No. 6074243
THE WITHIN CAVEAT No. 2564453
IS DISCHARGED THIS 24.9.1985 AT 11:00 .

~~AS613807~~

PARTIAL SURRENDER No. 6139807 PORTION OF THE WITHIN Land IS SURRENDERED AS REGARDS 6279 square metres AND THE AREA OF THE WITHIN LEASE REDUCED TO 633 square kilometres ~~ACRES AND THE ANNUAL RENT REDUCED TO $~~ FROM 9.9.1985 PRODUCED 14.1.1986 AT 15:40

N.R.G.

~~DM626152~~

P/A 4829982

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE No. 3120797 VIDE 626152 PRODUCED 14.10.1986 AT 11:00

TRANSFER No. 6608074 FROM JOHN LLOYD GEORGE WILKINSON AND HAYDN BRADLEY WILKINSON TO SWORD NOMINEES PROPRIETARY LIMITED OF 68 GREENHILL ROAD WAYVILLE 5034 OF SIX UNDIVIDED TENTH PARTS OF THE WITHIN LAND PRODUCED 26.9.1991 AT 11:35

CERTIFICATE OF ALTERATION 7046627 of The Minister of Lands whereby pursuant to the provisions of the Pastoral Land Management and Conservation Act 1989 the term of the within lease has been varied so as to commence on 7.3.1990 for a period of 42 years the conditions including covenants and reservations remain unaltered with the following exceptions
1 The rent payable under the lease will be an amount determined annually by the Valuer-General subject to the provisions of Section 23 of the above mentioned Act and payable annually in arrears each year on a date to be fixed by the Pastoral Board
2 No species of animal other than sheep or beef cattle can be pastured in the land contained in the within lease as part of the commercial enterprise under the said lease without the prior approval of the Pastoral Board
3 The reservations relating to aboriginal persons and access to the land are revoked
Produced 22.1.1991 at 16:00

PRO AS 20.6.1997
(Dup. C.T. not prod)

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE No. 3120798 VIDE 8305755 PRODUCED 2.6.1997 AT 15:25 (Dup Mortgage Lost)

PARTIAL SURRENDER No. 8305756 PORTION OF THE WITHIN land (Lot 107 in DP 47682) IS SURRENDERED AS REGARDS 273.2HA AND THE AREA OF THE WITHIN LEASE REDUCED TO 630 km² approximately ~~ACRES AND THE ANNUAL RENT REDUCED TO $~~ ~~FROM~~ PRODUCED 26.1997 at 15:25 and the description of the land is now that Lot comprising the Pieces 1, 2, 3 and 4 in DP 47682

Partial Surrender 8767259 as regards an easement over portion (A in D° 47682) of the within land Produced 14.10.1999 at 15:00

Certificate 10882841 of Minister for Environment and Conservation whereby Section 422 out of Hundreds Torrens is hereby included in the within Lease, the annual rent remains unaltered, the area is now increased to approximately 647 square kilometres and the description of the land is now Section 422 out of Hundreds Torrens and Allotment comprising pieces 1, 2, 3, and 4 in DP 47682
Produced 18.1.2008 at 9:52

of 1 undivided fifth part

APPLICATION 11240462 THE WITHIN land IS TRANSMITTED TO John Lloyd George Wilkinson of Kootaberra Station near Port Augusta 5700, Haydn Bradley Wilkinson of 196 Fisher Street Malvern 5061 and Anna May Brown of 29 Avenel Gardens Road Medindie 5081 AS THE EXECUTOR OF Cyril Lloyd Wilkinson WHO DIED 9.6.2008 PRODUCED 20.8.2009 AT 11:13

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TRANSFER No. 11240463 from John Lloyd George Wilkinson, Haydn Bradley Wilkinson and Anna May Brown as Executors to Sword Nominees Pty. Ltd. of Level 6/211 Victoria Square Adelaide 5000

OF THE WITHIN land of 1 undivided ~~fifth~~ part
PRODUCED 20.8.2009 AT 11:13

TRANSFER No. 11240464 from Shirley Catherine Wilkinson to the within Sword Nominees Pty. Ltd.
OF THE WITHIN LAND of 1 undivided fifth part
PRODUCED 20.8.2009 AT 11:13

CANCELLED
CONVERTED TO A COMPUTERISED CROWN LEASE

Certificate 11913104 of Minister for Sustainability, Environment and Conservation whereby the maximum stocking rate is to be reduced to 7,800 sheep. The term of the within Crown Lease has been extended to the full term of 42 years and the expiry date is now 22 October 2054.
Produced 27.3.2013 at 10:35

TRANSFER No. 11945740 to
John Lloyd George Wilkinson of
Kootaberra Station Port Augusta SA 5700
OF THE WITHIN Land
PRODUCED 30.5.2013 AT 11:28

TRANSFER No. 11945741 to
Kootaberra Pty. Ltd. of Level 6/211
Victoria Square Adelaide SA 5000
OF THE WITHIN Land
PRODUCED 30.5.2013 AT 11:28

Certificate 12234210 of Minister for Sustainability, Environment and Conservation whereby Section 492 Out of Hundreds (Port Augusta), Allotment 2 in DP 35235 and Allotment comprising pieces 1, 2, 3, 4 and 5 in DP 47707 are hereby included in the within Crown Lease. The area is increased to approximately 1218km2 and the description of the land is now Section 492 Out of Hundreds (Port Augusta), Section 422 Out of Hundreds (Torrens), Allotment 2 in DP 35235, Allotment comprising pieces 1, 2, 3 and 4 in DP 47682 and Allotment comprising pieces 1, 2, 3, 4 and 5 in DP 47707.
Produced 21.11.2014 at 15:59

PLAN
of portion of
CROWN LANDS
referred to in
ANNEXED LEASE
No 2373
BLOCK 1155

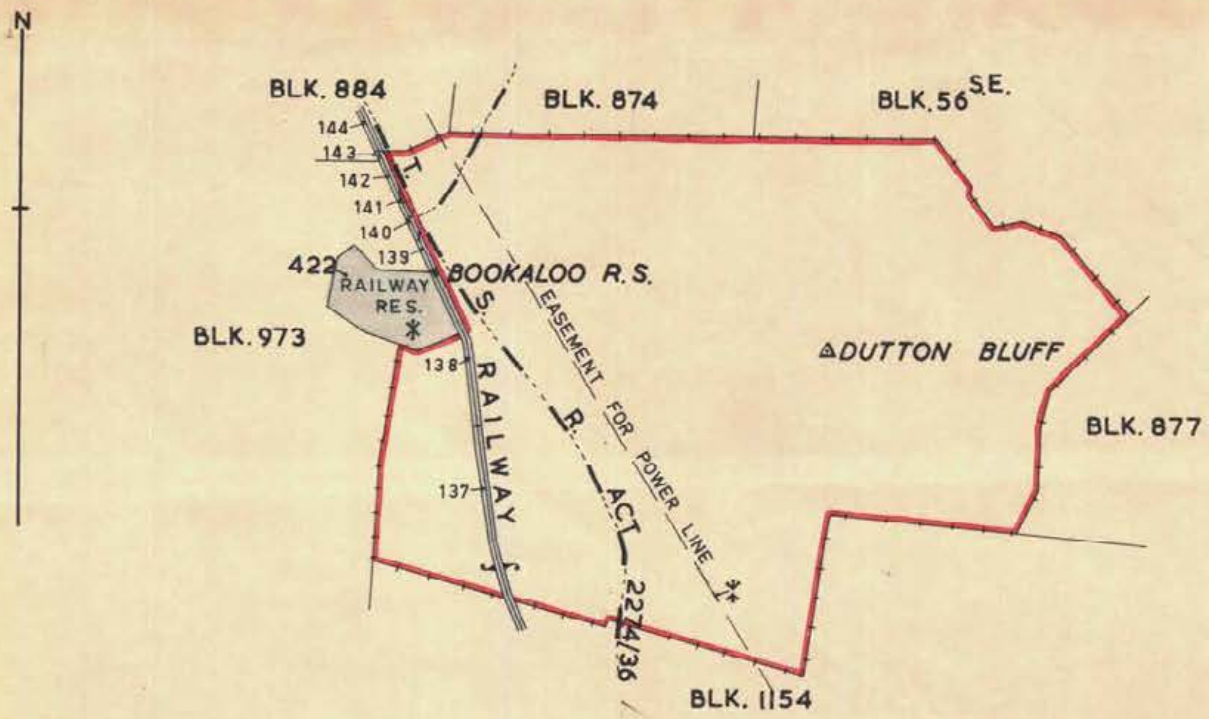


Diagram certified correct

H. W. Bailey

Surveyor General.

Scale

Boundaries of lease margined red.

Area 245 square miles.

Fences shown thus

Product	Historical Search
Date/Time	02/04/2024 01:05PM
Customer Reference	63753 AJ
Order ID	20240402006137

Crown Lease

Title Reference: CL 6204/748

Status: CURRENT

Parent Title(s): CL 1296/32

Dealing(s) Creating Title: RT 12842628

Title Issued: 09/03/2018

Edition: 2

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
26/02/2024	13/03/2024	14226192	TRANSFER OF LEASE	REGISTERED	AUSTRALIA TOWER NETWORK PTY. LTD. (ACN: 643 875 165) 12876884
14/02/2018	28/03/2018	12876884	LEASE	REGISTERED	OPTUS MOBILE PTY. LTD. (ACN: 054 365 696)

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CT History - CT Vol 6306 Folio 522

Property Description	Certificate of Title	Parent Title	Date	Details
Section 2 Hundred of Handyside County of Manchester	CL 249/23	Original	15 October 1892	New title issued to Johann Fredrich Wilhelm Herde (Farmer)
			22 February 1906	Transfer to Esther Ann Mould (Married Woman)
			26 January 1933	Transmission Application to Elders Trustee and Executor Company Ltd.
Sections 2 and 8 Hundred of Handyside, County of Manchester	CL 853/25	Volume 249 Folio 23	12 April 1937	New title issued to Elder's Trustee and Executor Company Ltd.
			26 July 1945	Transfer to Maynard Sydney Mould, Oliver Lincoln Mould and Allen Clifford Mould
			23 May 1947	Transfer to Maynard Sydney Mould (Grazier)
			2 August 1978	Transfer to Cooyerdoo Nominees Pty. Ltd.
Sections 2 and 8 Hundred of Handyside, County of Manchester	CT 4247/280	Volume 853 Folio 25	10 June 1985	New title issued to Cooyerdoo Nominees Pty. Ltd.
Balance of Land in Sections 2 and 8 Hundred of Handyside	CT 4319/753	Volume 4247 Folio 280	4 August 1988	New title issued to Cooyerdoo Nominees Pty. Ltd.
	CT 5270/316	Volume 4319 Folio 753	30 May 1995	New electronic title issued to Cooyerdoo Nominees Pty. Ltd.
			28 October 1997	Transfer to Nutt Bros Nominees Pty. Ltd.
			2 November 2010	Grant of Easement to South Australian Water Corporation
	CT 6066/920	Volume 5270 Folio 316	29 October 2010	New title issued to Nutt Bros Nominees Pty. Ltd.
	CT 6138/388	Volume 6066 Folio 920	27 May 2014	New title issued to Nutt Bros Nominees Pty. Ltd.
			3 June 2016	Caveat to Lincoln Gap Wind Farm Pty. Ltd.
			19 December 2017	Lease to Lincoln Gap Wind Farm Pty. Ltd.
Section 8 Hundred of Handyside in the Area named Lincoln Gap	CT 6306/522	Volume 6138 Folio 388	17 October 2024	New title issued to Nutt Bros Nominees Pty. Ltd.
			19 December 2017	Lease to Lincoln Gap Wind Farm Pty. Ltd.

(C)

South Australia.

(CERTIFICATE OF TITLE.)

Register Book,

Vol CCXLIX Folio 23

Pursuant to Memorandum of Transfer No 73393 from George William Hill to George Collings of Mallala Blacksmith is now seised of an estate in fee simple, subject nevertheless to such incumbrances, liens, and interests, as are notified by memorial underwritten or endorsed hereon in that piece of land situated in the Hundred of Grace County of Gawler being the allotment No 8 containing one rood and twenty one perches or thereabouts of portion of the Section 206 laid out as Mallala

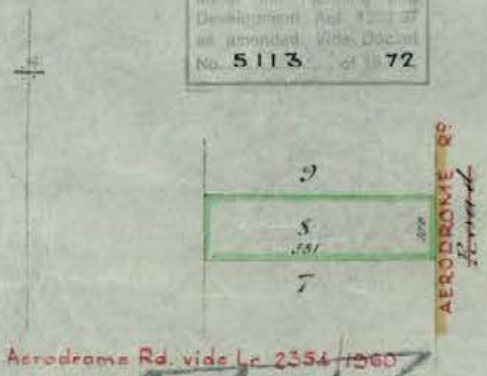
and bounded as appears in the plan in the margin hereof and therein colored green, and in the plan deposited in the Lands Titles Registration Office, No. 375 which said Section 206 delineated in the public map of the said Hundred deposited in the office of the Surveyor-General, and it was originally granted the 13th day of October 1863 under the Seal of Sir Dominick Daly Governor in Chief of the said Province to John Jeffries

In witness whereof, I have hereunto signed my name and affixed my seal this First day of May one thousand eight hundred and seventy seven in presence of

W. H. Leaf

W. Hamilton
Deputy Registrar-General.

Registration APPROVED under the Planning and Development Act, 1966 as amended. Vide Doc. No. 5113 of 72



B. Nelson Dep. Reg. Genl.

A Provisional Certificate was issued the 14 day of January 1880 in consequence declaration by George Collings that the original Certificate was not found

W. Thomas Dep. Reg. Genl.

Mortgage No 209408 from George Collings to William Thomas Manning Produced for registration the 29 day November 1886 at 2 pm

W. Hamilton Dep. Registrar

Discharge of the within Mortgage No 209408 by receipt endorsed thereon produced for registration the 13 day January 1899 at 1.45 pm

E. Heath Dep. Reg. Genl.

Transfer No 336843 from George Collings to Ostain Richard Bridgman of Mallala Saddler of an estate in fee simple in the within land Produced for registration the 13 day January 1899 at 1.45 pm

E. Heath Dep. Reg. Genl.

WB

Transfer No 402356 from Certain Richard Bridgeman to Albert Henry Newstable of Mallala Blacksmith of an Estate in Fee Simple in the within land Produced for registration the 25 day November 1903 at 2pm

J. Heath Reg Prin Asst.

Mortgage No 402357 from Albert Henry Newstable to Patrick James Murphy Produced for registration the 25 day November 1903 at 2pm

J. Heath Reg Prin Asst

DISCHARGE OF THE A&P MORTGAGE No 402357 BY RECEIPT ENDORSED THEREON, PRODUCED FOR REGISTRATION THE 11 DAY OF December 1917 AT 3 35 pm

J. B. Blackwell DEP REG GENL

A 1164074

DEATH No. 328/481
Norman Josiah Good
28/1/72 10.35 AM
DEP. REG. GEN.

TRANSFER No. 3384914 To District Council of Mallala
of C/- Post Office Box 18 Mallala 5502
OF THE WITHIN LAND PRODUCED 17.1.1972 AT 11.30 A.M.
DEP. REG. GEN.

F 440772

TRANSFER No. 3440772 to Glyn Edwards Vaughan Morris and Winnifred Edith Joan Morris
of portion and land
PRODUCED 4.4.1973 AT 2.45 pm
3939 73.
DEP. REG. GEN.

CANCELLED AND ISSUED Balance CERTIFICATE OF TITLE VOL 3939 FOL 74
DEP. REG. GEN

TRANSMISSION APPLICATION No 1684074
Henry Barwick Newstable of Dublin Traveller and Cameron Barron Newstable of Mallala Electrician as
per 6 July 1951
the 17 day of November 1944
Albert Henry Newstable
01 ON 15 Trans
51 2- May 1951 July 51 2-45 pm

T 1746079

TRANSFER No 1746079 FROM
Henry Barwick Newstable and Cameron Barron Newstable to
Percival Thomas Jarmyn of Mallala Farmer
OF AN ESTATE IN FEE SIMPLE IN THE WITHIN LAND
PRODUCED FOR REGISTRATION THE 10 DAY OF
September 1952 AT 3 5m
DEP. REG. GENL

T 1825755

TRANSFER No. 1825755
Percival Thomas Jarmyn to Norman Josiah Good of Mallala Farmer Labourer and Agnes May Good his wife
OF AN ESTATE IN FEE SIMPLE IN THE WITHIN LAND
PRODUCED FOR REGISTRATION THE 24 DAY OF
March 54 2-40 pm
DEP. REG. GENL

A 1032881481

Winston Dugan

South Australia.

Register Book.

Vol. 853 Folio 25

C.H. Crampford

Registrar-General.

Crown Lease.

(PERPETUAL, No. 15629.)

In lieu of Surrendered Right of Purchase Lease No. 6219 Reg. Vol. 249 Folio 23

~~**PERSONAL RESIDENCE.**~~

His Majesty the King doth hereby lease to ELDER'S TRUSTEES AND EXECUTOR COMPANY LIMITED of 142 North Terrace Adelaide as the Executor named in the Will of Esther Ann Mould deceased who died on the sixth day of March One Thousand Nine Hundred and thirty five herein designated by the term "Lessee" all that land containing seven thousand nine hundred and ninety six (7996) acres or thereabouts and being Sections Nos. 2 and 8 in the Hundred of HANDYSIDE County of MANCHESTER as the same is delineated in the public maps deposited in the Land Office in the City of Adelaide to be held **in perpetuity** at the yearly rent of twenty pounds sixteen shillings and six pence (£20: 16: 6) to be paid in advance on the first day of October commencing the first day of October One Thousand Nine Hundred and thirty six and at a further rent of Five Pounds per centum per annum on any rent in arrear subject to the reservations covenants and conditions shortly stated below and which are more fully set out in the "Crown Lands Acts 1929 to 1935."

Commissioner of Crown Lands.

By command,

Director of Lands.

Certified correct,

RESERVATIONS.

1. There are reserved to the Crown all gold silver copper tin and other metals all ores and other substances containing metals all minerals and all gems and precious stones coal and mineral oils with incidental powers of search and mining **AND ALSO** the right to enter upon the land hereby leased to construct drains and/or pipe tracks and/or to lay pipes and/or to conserve water for public use where required without any payment to the Lessee by way of compensation

COVENANTS.

2. The Lessee must—

I. Enclose the land with cattle-proof fence before the end of the fifth year of the lease

II. Keep in good repair all Crown improvements (if any) on the land

III. Pay and discharge all rates taxes assessments impositions and outgoings which shall become payable in respect of the said land and will also pay all amounts due or which may hereafter become due on account of loans repayable under the "Vermin Acts 1931 and 1935" or any Act amending or extending those Acts or substituted therefor

IV. Clear so as to render available for cultivation or so as to improve the grazing capacity thereof Nil acres of the land

V. During the first two years clear so as to render available for cultivation or so as to improve the grazing capacity thereof not less than one-eighth of the area specified in that behalf in the lease and will during the second two years clear as aforesaid not less than one-eighth of the area so specified and will during each succeeding year clear as aforesaid not less than one-eighth of the area so specified until the whole of the area so specified has been cleared and will at all times keep available for cultivation or grazing as the case may be the land so cleared

VI. Insure and keep insured in the full insurable value thereof all buildings the property of the Crown upon the leased land in the joint names of the Commissioner and the Lessee in some Insurance Office in Adelaide to be approved by the Commissioner and forthwith lodge the policy of every such insurance in the office of the Commissioner and forward to the Commissioner the receipts for the premiums payable in respect of such policy within seven days after the same shall become due with a power for the Commissioner to insure on default by the Lessee and to recover the amount paid for such insurance in like manner as the rent is recoverable

EXD. 666
E (d)
(Surrender.)
~~Tr~~
Acts 1929 to 1935.
D.L., 1810/36.

COVENANTS—continued.

VII. ~~Personally reside on the land for nine months in each year~~

VIII. Permit the Crown or the owner of any mining claim situated on the land or the holder of any mining lease of the whole or any portion of the land under any law in force for the time being relating to mining with or without workmen full and free liberty of access ingress egress and regress into upon and from the land comprised in such claim or lease

IX. Forthwith commence to destroy and keep the land and the adjoining half width of all public roads adjacent thereto free from vermin and noxious weeds to the satisfaction of the Commissioner during the lease and fill up all burrows on the land and the said half width of road

X. Pay the balance of arrears of rent and interest thereon due under the former Lease to the_____ day of_____ 19____ viz.: _____

_____

together with interest thereon at the rate of _____ per centum per annum in_____equal annual instalments of _____ _____(being instalments of principal and interest) on the _____day of_____in each year the first of such instalments to be paid on the_____day of_____19____such instalments shall be payable and recoverable in the same manner as the rents to become due hereunder

Provided that in the event of any such instalment being in arrear the Lessee must pay interest thereon at the rate of Five Pounds per centum per annum from the date such instalment became due until the date of payment thereof

Provided also that the Lessee shall have the right to pay off the whole or any portion of the said arrears together with interest then due at any time

And the Lessee must not—

XI. Transfer sublet encumber or mortgage without the written consent of the Commissioner of Crown Lands first had in each case

XII. Erect brush fence or suffer or permit the same to be erected or to remain on the land

CONDITIONS.

3. The lease shall be liable to forfeiture in the following cases:—

I. If default be made in payment of any rent in arrear for six months after the same falls due the Lessee having had at least three months' previous notice in writing demanding its payment or if

II. Default be made in the performance of any covenant or if

III. The land shall be transferred sublet or mortgaged without the written consent of the Commissioner of Crown Lands first had in each case or if

IV. The Lessee shall refuse to permit the Crown by its officers or servants to enter upon the land hereby leased to construct drains and/or pipe tracks and/or to lay pipes and/or to conserve water for public use or if

V. The Lessee shall refuse to permit the Crown or the owner of any mining claim or the holder of any mining lease to exercise the liberty hereinbefore mentioned or if

VI. The Lessee shall erect brush fence or suffer or permit the same to be erected or to remain on the land

4. The land or any portion thereof may be resumed by the Crown for roads railways tramways or for sites for towns or for park lands or for mining purposes or for any public work or purpose upon the Commissioner giving three calendar months' notice to the Lessee by publication in the *Government Gazette* of such intended resumption and that immediately from and after the expiration of three calendar months after such notice shall have been given as aforesaid this lease and the demise hereby made shall cease determine and be void as to all or such parts of the said lands as shall be mentioned and described in such notice anything in this lease to the contrary notwithstanding provided that full compensation shall be made to the Lessee for his loss except where the land shall be resumed for the construction of drains and/or pipe tracks and/or the laying of pipes and/or for the conservation of water for the public use in which case no compensation shall be payable Provided that in case of dispute the amount of such compensation shall be

CONDITIONS—continued.

determined by the Land Board or at the option of the Commissioner or the Lessee in the manner provided by section 289 of the Crown Lands Act, 1929, and provided that immediately upon the giving of a notice to the Lessee by publication in the *Government Gazette* of intended resumption of the whole or any portion of the said land the right of the Lessee to purchase the land comprised in this lease as provided in Condition 5 hereof shall cease and determine and be void as to all or such parts of the said lands as shall be specified in such notice.

5. The Lessee shall have the right subject nevertheless to the provisions lastly hereinbefore contained at any time during the term of this lease to purchase and obtain the fee simple of the land comprised in this lease on payment of the sum of £ 1999: 0: 0 being at the rate of five shillings (5/0d.) per acre in addition to all arrears of rent (if any) and the balance for the time being of the arrears of rent (if any) under the former lease and interest thereon.

6. If and so long as this lease is vested in the Lessee as an Executor or Trustee the Lessee shall become liable under the Covenants hereof so far only as at or after the date of breach it has assets of the Trust under which the lease is vested in it as such Executor or Trustee.

IN WITNESS whereof the Public Seal of the State of South Australia and the hand and seal of the said Lessee were hereunto set the twelfth day of April 1937.

~~Signed sealed and delivered by the above-named Lessee in the presence of~~

THE COMMON SEAL OF ELDER'S TRUSTEE AND EXECUTOR COMPANY LIMITED was hereunto affixed this third day of March 1937 in the presence of FRANCIS COOPER WADE, Secretary of the Company, with the authority of JOSEPH KING SAMUEL and WILLIAM MURRAY FOWLER two of the Directors thereof.

L.S.

Directors

Secretary

T1435529

TRANSFER No. 1435529 FROM

Elders Trustee and Executor Company Limited to Raynard Sydney Mould Oliver Lincoln Mould and Allan Clifford Mould as Tenants in Common of the Estate and Interest in Lease No. 15629 OF THE WITHIN

PRODUCED FOR REGISTRATION THE 26 DAY OF July 1945 AT 2.30 p.m.

DEP. REG. GENL.

T1501507

TRANSFER No. 1501507 FROM

Oliver Lincoln Mould and Allan Clifford Mould to Ivy Mould as Tenant for Life with Remainder to Sydney Mould as Tenant for Life Graziers of THE WITHIN Lease No. 15629

PRODUCED FOR REGISTRATION THE 23 DAY OF May 1947 AT 2.30 p.m.

DEP. REG. GEN.

P/S/L 2982582

Portion of Section 8 in

PARTIAL SURRENDER No. 2982582 OF THE WITHIN LEASE No. 15629 IS SURRENDERED AS REGARDS 0A 0R 27P ~~ACRES~~ AND THE AREA SHALL BE REDUCED TO 7996 ACRES ~~AND THE ANNUAL RENT REDUCED TO £~~ FROM 14.2.1969 PRODUCED 25.2.1969 AT 11.15 a.m.

DEP. REG. GEN.

T 4241045

TRANSFER No. 4241045 To

Cooyerdoo Nominees Pty. Ltd. of 116 Greenhill Road Unley 5061

OF THE WITHIN LAND. PRODUCED 28.1978 AT 11.35am.

SLY743587 SLY743588

PARTIAL SURRENDER No 4743587 PORTION OF THE WITHIN ~~Land~~ Sec. 2 IS SURRENDERED AS REGARDS 929m² AND THE AREA OF THE WITHIN LEASE REDUCED TO 323.6 hectares ~~ACRES~~ AND THE ANNUAL RENT REDUCED TO $ FROM 15.6.1981 PRODUCED 19.6.1981 AT 3.20pm

Partial Surrender 4743588 as regards an easement over portions of the within Section 2.

Produced 19.6.1981 at 3.20pm

D6480/030

SURRENDER OF Lease No. 15629 VIDE No. 4801080 PRODUCED 23.10.1981 AT 3.50pm

ORIGINAL
LAND GRANT

South Australia

REGISTER BOOK
Volume 4247 Folio 280

(Comprising 3 Sheets)

Deputy Registrar-General

(In lieu of surrendered Perpetual Lease No.15629 Reg.Book Vol.853 Fol.25)

HIS EXCELLENCY THE GOVERNOR in consideration of three thousand nine hundred and ninety eight dollars ($3 998-00) heretofore paid to the Treasurer by COOYERDOO NOMINEES PROPRIETARY LIMITED whose registered office is situate at 116 Greenhill Road Unley 5061 hereinafter called the Grantee doth hereby in the name and on behalf of HER MAJESTY GRANT unto the Grantee ALL those Sections of land containing three thousand two hundred and thirty five (3 235) hectares or thereabouts situate in the Hundred of HANDYSIDE County of MANCHESTER and numbered 2 and 8 and delineated in the public maps deposited in the Department of Lands at ADELAIDE and in the plan annexed hereto SUBJECT NEVERTHELESS to the ~~Right of Way and~~ Easement more particularly described and set forth in Memorandum of Partial Surrender No. 4743588 in and over that portion of Section 2 and marked "Easement" in the said plan annexed * TO HOLD unto and to the use of the Grantee its Successors and Assigns for ever.

11.7.88

GIVEN under the hand of the Governor and the Public Seal of South Australia this tenth day of June one thousand nine hundred and eighty five

AMG.
~~Exd.~~ Certified correct,

P.B. Harkin
.....
Acting Registrar, Land Office

BY COMMAND,

.....
The Minister of Lands

* SUBJECT ALSO to a right of way more particularly described and set forth in Memorandum of Partial Surrender No. 4743588 over that portion marked Right of Way on the said plan annexed

2) MORTGAGE 4856607 to COMMONWEALTH DEVELOPMENT BANK OF AUSTRALIA Produced 3.3.1982 at 2 p.m. (Including other land)

1) *REGISTRAR-GENERAL'S CAVEAT 4832131 over portion of the within land Entered 6.1.1982 at 11:00 (Including other land)*

D4632/1681---TG 6328754

Caveat 4832131 is withdrawn this 28.7.1987 at 11:00

Amendment to Easement Description and Diagram Vide Docket 24/88 11/7/88

P/A 4829882
The within land is discharged from Mortgage 4856607 vide 6317681 Produced 25.2.1987 at 11:30

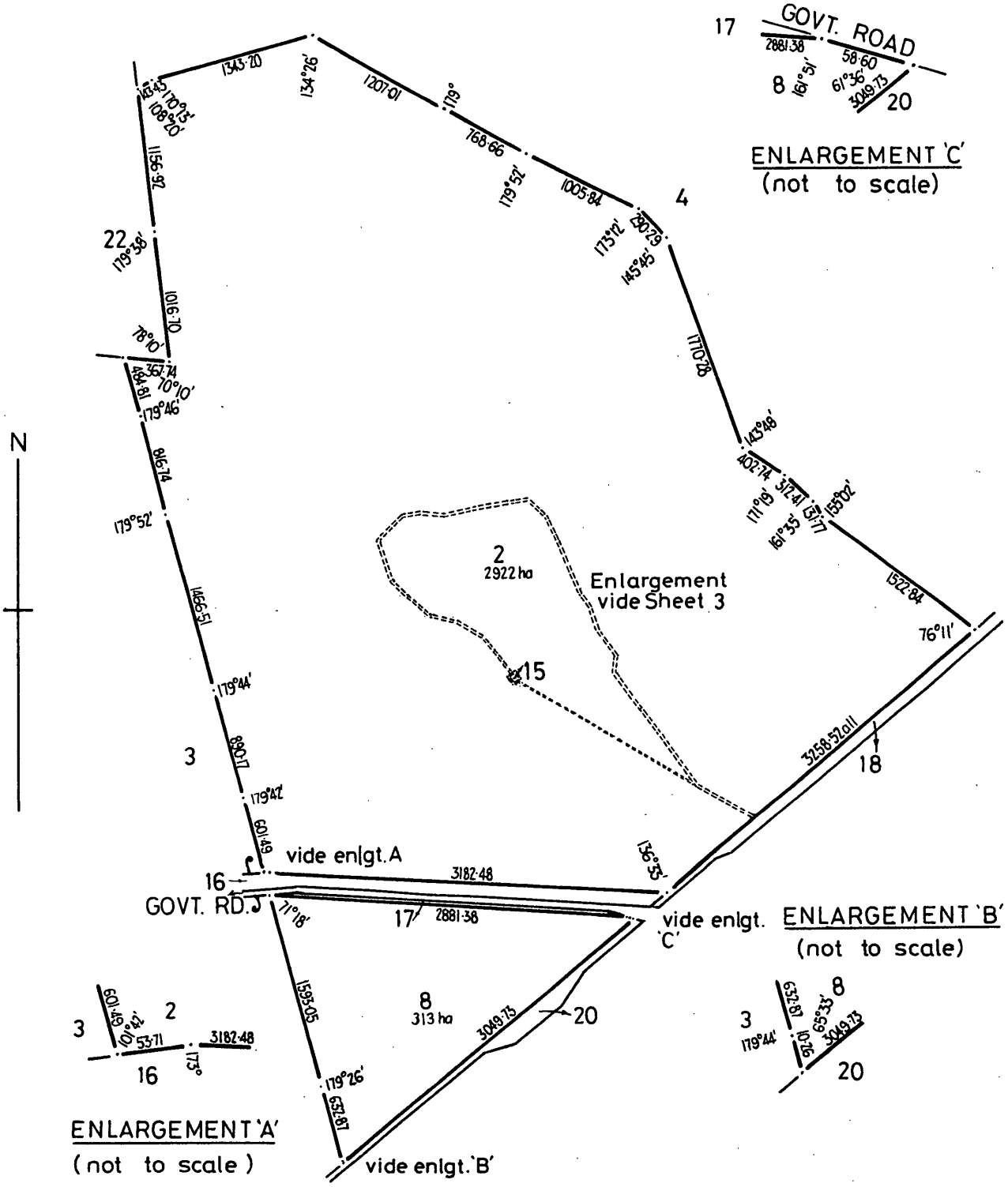
TRANSFER 6328754 to PIPELINES AUTHORITY OF SOUTH AUSTRALIA of an Easement over PORTION of the within land Produced 19.3.1987 at 12:15

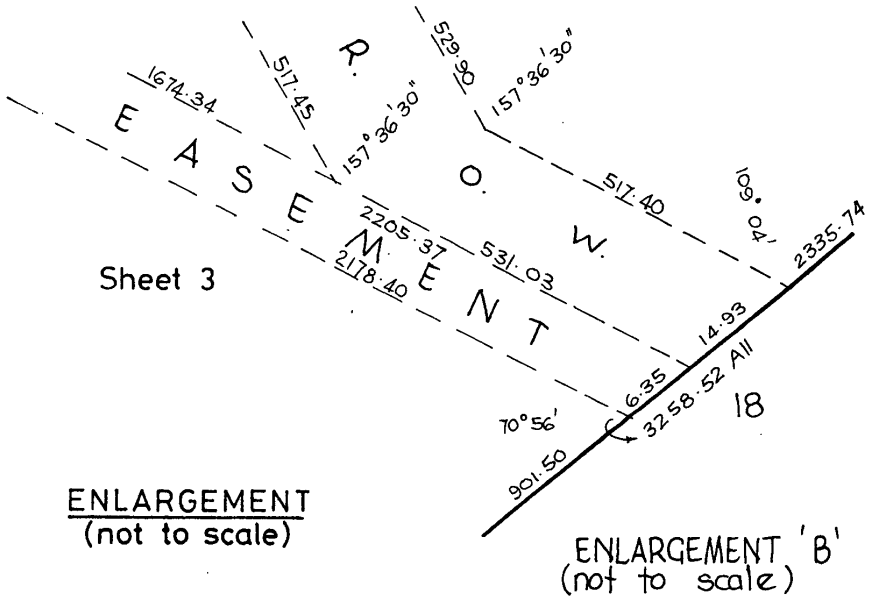
CANCELLED as regards above land and new C.T. issued
VOL. 9319 FOL. 749

CANCELLED
AND Balance CERTIFICATE OF TITLE
ISSUED VIDE 6328754 VOL. 4319 FOL. 753



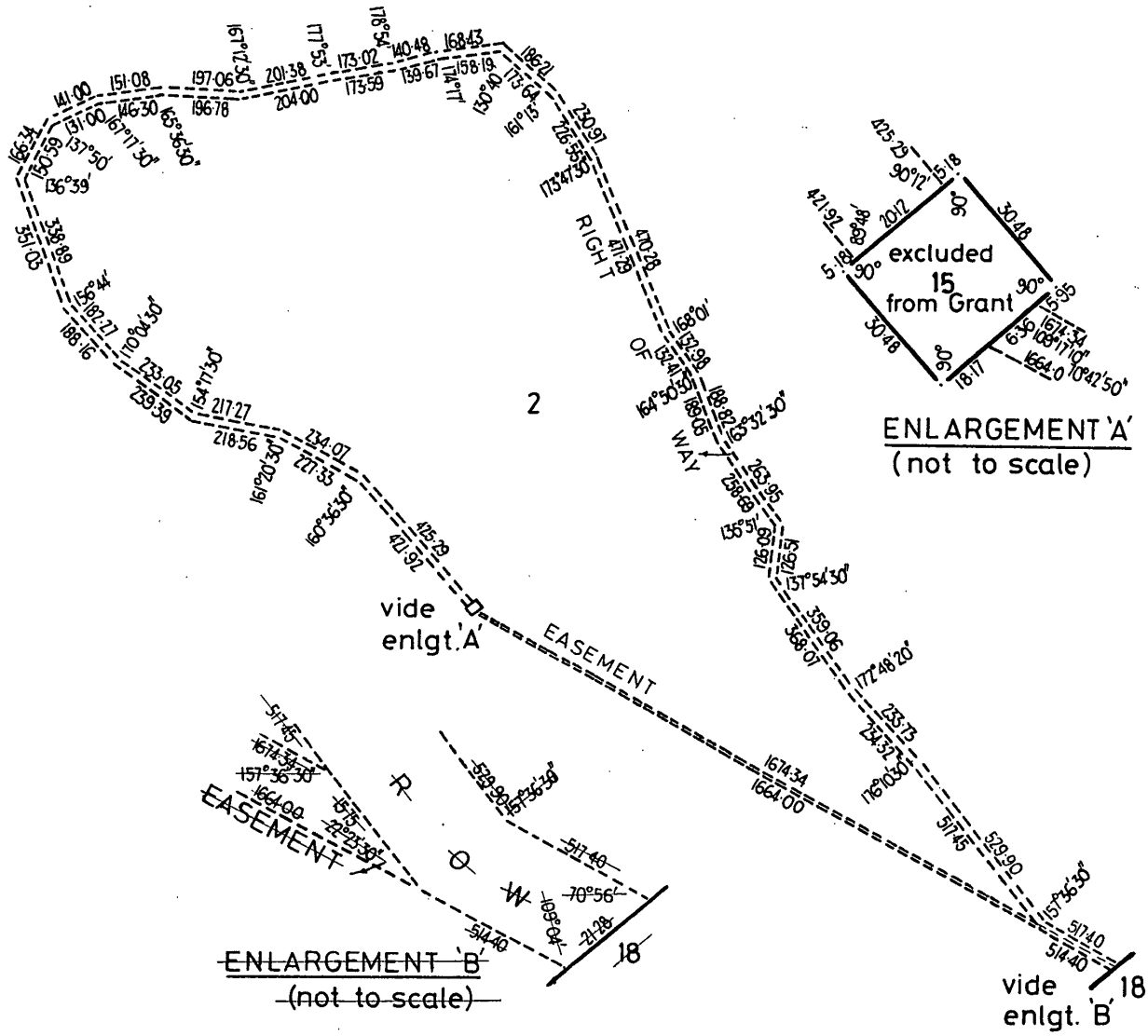
Sheet 2


17
GOVT. ROAD
2881·38
58·60
61°36'
3049·73
8
161°51'
20
ENLARGEMENT 'C'
(not to scale)
4
22
179°38'
1343·20
134°26'
1207·01
179°
168·66
179°51'
1005·84
173°12'
280·73
145°45'
1771·28
143°48'
402·74
171°19'
312·41
161°35'
521·17
155°02'
1522·84
76°11'
3258·52
18
1156·92
1016·10
78°0'
357·74
10°10'
484·81
179°46'
816·74
179°52'
1456·51
179°44'
3
880·17
179°42'
601·49
vide enlgt. A
16
GOVT. RD.
3182·48
71°18'
17
2881·38
136°53'
vide enlgt. 'C'
ENLARGEMENT 'B'
(not to scale)
2
2922 ha
Enlargement
vide Sheet 3
15
8
313 ha
1593·05
179°26'
632·87
3049·73
20
3
601·49
101°49'
53·71
3182·48
173°
16
ENLARGEMENT 'A'
(not to scale)
vide enlgt. 'B'
3
179°44'
632·87
65°33'
3049·73
20
N
0 400 800 1200 1600 Metres



ENLARGEMENT
(not to scale)

ENLARGEMENT 'B'
(not to scale)



ENLARGEMENT 'A'
(not to scale)

ORIGINAL CERTIFICATE OF TITLE

South Australia

Register Book,
Volume 4319 Folio 753

(Comprising 3 Sheets)

New Certificate for the balance of the Land in Vol.4247 Folio 280

COOYERDOO NOMINEES PROPRIETARY LIMITED of 116 Greenhill Road Unley 5061 is the proprietor of an estate in fee simple subject nevertheless to such encumbrances liens and interests as are notified by memorial underwritten or endorsed hereon in SECTIONS 2 and 8 HUNDRED OF HANDYSIDE delineated on the plan hereon by bold black lines SUBJECT to an easement to Australian National Railways Commission created by Partial Surrender of Lease 4743588 in and over those portions marked A hereon SUBJECT ALSO to an easement to the Pipelines Authority of South Australia created by Transfer 6328754 in and over those portions marked B hereon SUBJECT ALSO to a right of way to Australian National Railways Commission created by Partial Surrender of Lease 4743588 in and over those portions marked C hereon

In witness whereof I have signed my name and affixed my seal this 4th day of August 1988

Signed the 4th day of August 1988, in the presence of K Bywaay

I. H. Taylor

Acting Deputy Registrar-General

REGISTRAR-GENERAL SOUTH AUSTRALIA

MORTGAGE 6465526 to ELDER'S TRUSTEE AND EXECUTOR COMPANY LIMITED Produced 6.1.1988 at 11:45 (Including other land)

REGISTRAR-GENERAL SOUTH AUSTRALIA

CHANGE OF NAME 7103714 the name of the within company is changed from Elder's Trustee & Executor Co. Ltd. to AUSTRUST LTD. of 44 Pirie Street Adelaide 5000 Produced 16.5.1991 at 11:15

REGISTRAR-GENERAL SOUTH AUSTRALIA

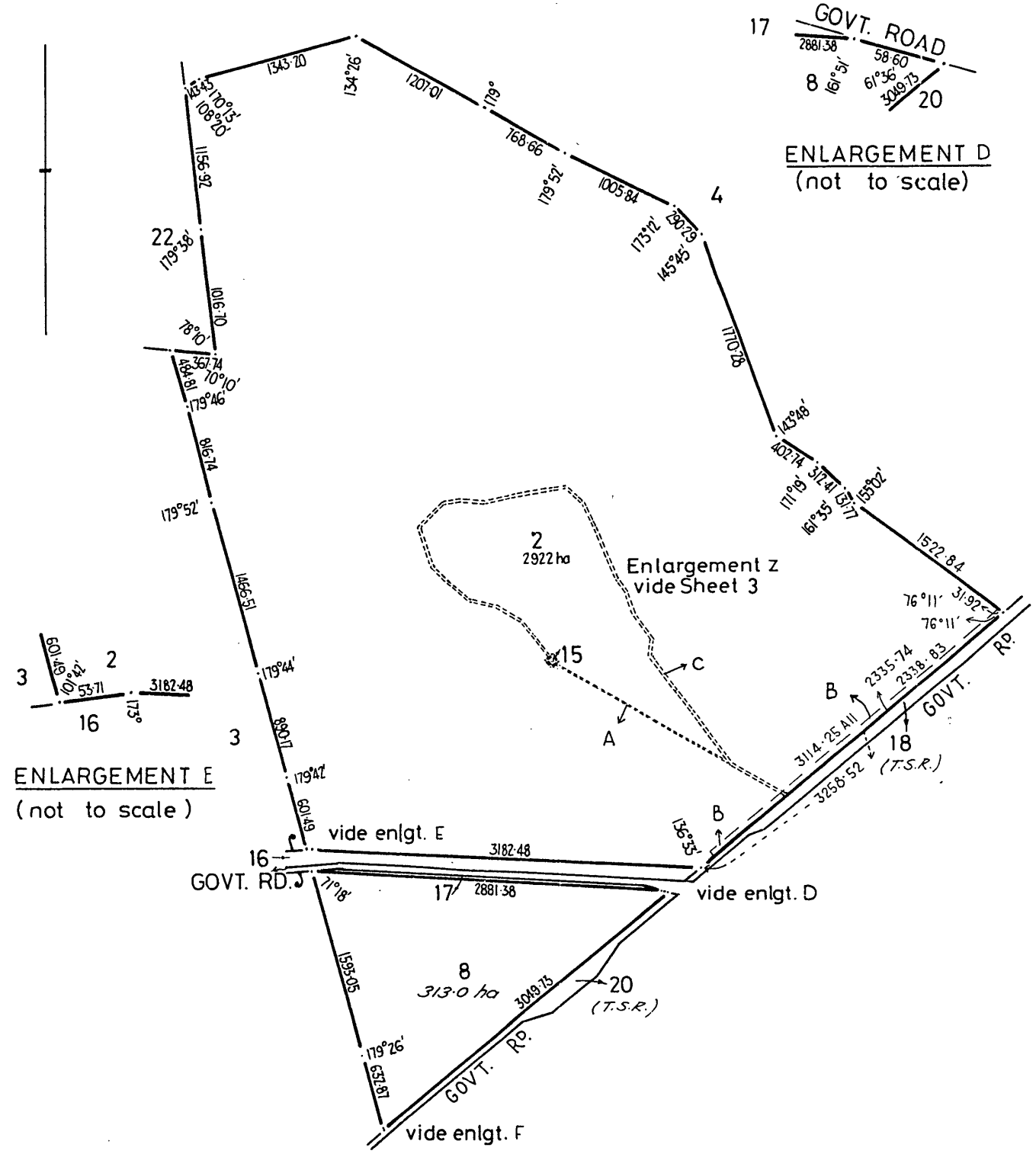
CANCELLED

CONVERTED TO A COMPUTERISED TITLE

REGISTRAR-GENERAL SOUTH AUSTRALIA

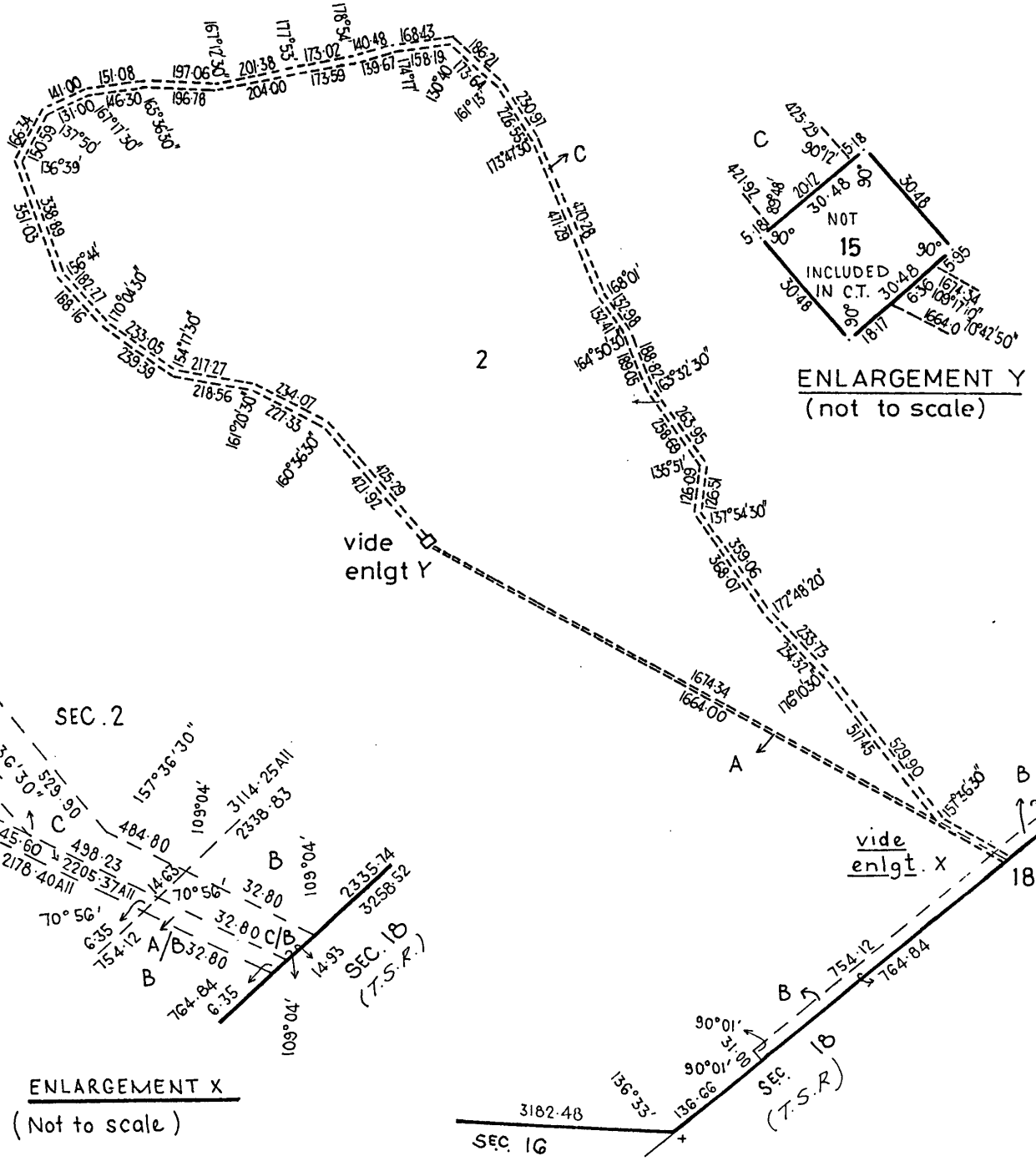
03

Sheet 2


17
GOVT. ROAD
2881·38
58·60
61°36'
3049·73
8
161°51'
20
ENLARGEMENT D
(not to scale)
1343·20
134°26'
1207·01
179°
168·66
179°52'
1005·84
4
173°12'
580·29
145°45'
1710·78
145°48'
402·74
171°19'
317·41
161°35'
131·77
155°02'
1522·84
76°11'
31·92
76°11'
2335·74
2338·83
3114·25 A11
3256·52
GOVT. RD.
18
(T.S.R.)
B
C
A
2
2922 ha
Enlargement z
vide Sheet 3
15
22
179°38'
1156·92
1016·10
78°10'
367·74
484·81
70°10'
179°46'
816·74
179°52'
1466·51
179°44'
890·17
179°42'
601·49
vide enlgt. E
16
GOVT. RD.
3182·48
71°18'
17
2881·38
vide enlgt. D
136°35'
B
1595·05
8
313·0 ha
3049·73
20
(T.S.R.)
179°26'
637·87
GOVT. RD.
vide enlgt. F
3
2
601·49
101°42'
53·71
3182·48
173°
16
ENLARGEMENT E
(not to scale)
3
179°44'
632·87
65°33'
10·26
3049·73
8
20
ENLARGEMENT F
(not to scale)
0 400 800 1200 1600 Metres

Sheet 3

ENLARGEMENT Z
(not to scale)



ENLARGEMENT Y
(not to scale)

ENLARGEMENT X
(Not to scale)

Product	Historical Search (Cancelled Title)
Date/Time	13/05/2025 09:33AM
Customer Reference	63753 PY
Order ID	20250513001533

Certificate of Title

Title Reference: CT 5270/316

Status: CANCELLED

Parent Title(s): CT 4319/753

Dealing(s) Creating Title: CONVERTED TITLE

Title Issued: 30/05/1995

Title Cancelled: 29/10/2010

Child Title(s): CT 6066/919, CT 6066/920

Edition: 5

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
09/09/2010	02/11/2010	11456905	CHANGE OF NAME (SUBSIDIARY INTEREST)	REGISTERED	ELDERS RURAL BANK LTD., RURAL BANK LTD. 9404306
29/07/2010	02/11/2010	11439438	GRANT OF EASEMENT	REGISTERED	SOUTH AUSTRALIAN WATER CORPORATION
13/08/2002	02/09/2002	9404306	MORTGAGE	REGISTERED	RURAL BANK LTD.
13/08/2002	02/09/2002	9404303	DISCHARGE OF MORTGAGE	REGISTERED	8399085
24/11/1997	17/06/1998	8399085	MORTGAGE	REGISTERED	ELDERS LTD. (ACN: 004 045 121)
15/10/1997	28/10/1997	8379404	TRANSFER	REGISTERED	NUTT BROS NOMINEES PTY. LTD. (ACN: 079 738 659)
31/03/1995	07/06/1995	7897713	DISCHARGE OF MORTGAGE	REGISTERED	6465526
06/01/1988	19/08/1988	6465526	MORTGAGE	REGISTERED	

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Certificate of Title

Title Reference: CT 6066/920

Status: CANCELLED

Parent Title(s): CT 5270/316

Dealing(s) Creating Title: TG 11439438

Title Issued: 29/10/2010

Title Cancelled: 27/05/2014

Child Title(s): CT 6138/388

Edition: 1

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
15/04/2014	28/05/2014	12113954	RECTIFICATION OF TITLE	REGISTERED	
21/11/2012	28/11/2012	11855170	VESTING (GLOBAL UPDATE)	REGISTERED	RURAL BANK LTD. 9404306
09/09/2010	02/11/2010	11456905	CHANGE OF NAME (SUBSIDIARY INTEREST)	REGISTERED	ELDERS RURAL BANK LTD., RURAL BANK LTD. 9404306
13/08/2002	02/09/2002	9404306	MORTGAGE	REGISTERED	RURAL BANK LTD.

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Certificate of Title

Title Reference: CT 6138/388

Status: CANCELLED

Parent Title(s): CT 6066/920

Dealing(s) Creating Title: DDA 12113954

Title Issued: 27/05/2014

Title Cancelled: 17/10/2024

Child Title(s): CT 6306/521, CT 6306/522

Edition: 10

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
10/09/2024	17/10/2024	14357843	REQUEST FOR NEW TITLES	REGISTERED	NUTT BROS NOMINEES PTY. LTD. (ACN: 079 738 659)
13/02/2020	28/02/2020	13254482	WITHDRAWAL OF LIEN	REGISTERED	13125708
13/02/2020	26/02/2020	13254454	WITHDRAWAL OF LIEN	REGISTERED	13097603
13/02/2020	26/02/2020	13254453	WITHDRAWAL OF LIEN	REGISTERED	13097600
13/02/2020	26/02/2020	13254912	WITHDRAWAL OF LIEN	REGISTERED	13118383
13/02/2020	26/02/2020	13254851	WITHDRAWAL OF LIEN	REGISTERED	13118373
13/02/2020	26/02/2020	13254470	WITHDRAWAL OF LIEN	REGISTERED	13125707
12/07/2019	17/07/2019	13143352	VESTING (GLOBAL ENDORSEMENT UPDATE)	REGISTERED	BENDIGO & ADELAIDE BANK LTD. (ACN: 068 049 178) 9404306
14/06/2019	18/06/2019	13125708	LIEN (SUBSIDIARY INTEREST)	REGISTERED	CONSOLIDATED POWER PROJECTS AUSTRALIA PTY. LTD. (ACN: 075 411 219), NACAP PTY. LTD. (ACN: 006 306 994) 12841089
14/06/2019	18/06/2019	13125707	LIEN (SUBSIDIARY INTEREST)	REGISTERED	CONSOLIDATED POWER PROJECTS AUSTRALIA PTY. LTD. (ACN: 075 411 219), NACAP PTY. LTD. (ACN: 006 306 994) 12841089
30/05/2019	31/05/2019	13118373	LIEN (SUBSIDIARY	REGISTERED	CONSOLIDATED POWER PROJECTS AUSTRALIA PTY.

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Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
			INTEREST)		LTD. (ACN: 075 411 219), NACAP PTY. LTD. (ACN: 006 306 994) 12841089
30/05/2019	31/05/2019	13118383	LIEN (SUBSIDIARY INTEREST)	REGISTERED	CONSOLIDATED POWER PROJECTS AUSTRALIA PTY. LTD. (ACN: 075 411 219), NACAP PTY. LTD. (ACN: 006 306 994) 12841089
17/04/2019	18/04/2019	13097603	LIEN (SUBSIDIARY INTEREST)	REGISTERED	CONSOLIDATED POWER PROJECTS AUSTRALIA PTY. LTD. (ACN: 075 411 219), NACAP PTY. LTD. (ACN: 006 306 994) 12841089
17/04/2019	18/04/2019	13097600	LIEN (SUBSIDIARY INTEREST)	REGISTERED	CONSOLIDATED POWER PROJECTS AUSTRALIA PTY. LTD. (ACN: 075 411 219), NACAP PTY. LTD. (ACN: 006 306 994) 12841089
06/12/2017	19/12/2017	12841090	MORTGAGE OF LEASE	REGISTERED	NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937) 12841089
06/12/2017	19/12/2017	12841089	LEASE	REGISTERED	LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595)
06/12/2017	19/12/2017	12841087	WITHDRAWAL OF CAVEAT	REGISTERED	12821278
07/11/2017	15/11/2017	12823123	WITHDRAWAL OF CAVEAT	REGISTERED	12534875
06/11/2017	09/11/2017	12821278	CAVEAT	REGISTERED	LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595)
30/05/2016	03/06/2016	12534875	CAVEAT	REGISTERED	LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595)
13/08/2002	02/09/2002	9404306	MORTGAGE	REGISTERED	RURAL BANK LTD.

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REAL PROPERTY ACT, 1886 South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

REGISTRAR-GENERAL SOUTH AUSTRALIA

Certificate of Title - Volume 6306 Folio 522

Parent Title(s) CT 6138/388

Creating Dealing(s) RT 14357843

Title Issued 17/10/2024 **Edition** 1 **Edition Issued** 17/10/2024

Estate Type

FEE SIMPLE

Registered Proprietor

NUTT BROS NOMINEES PTY. LTD. (ACN: 079 738 659)
OF PRIVATE BAG 15 PORT AUGUSTA SA 5700

Description of Land

SECTION 8
HUNDRED OF HANDYSIDE
IN THE AREA NAMED LINCOLN GAP

Easements

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED D FOR WATER SUPPLY PURPOSES TO SOUTH AUSTRALIAN WATER CORPORATION (TG 11439438)

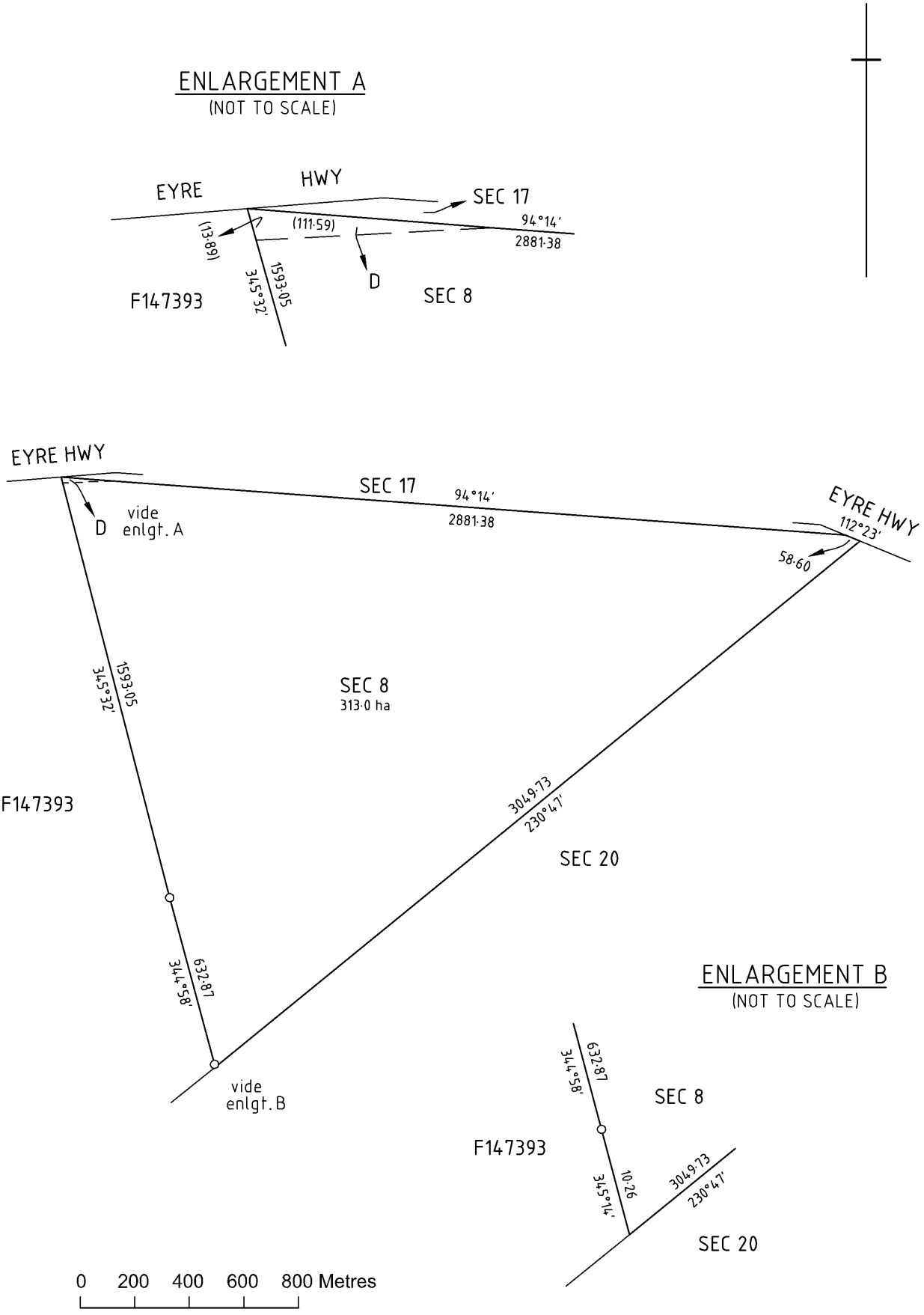
Schedule of Dealings

Dealing Number	Description
9404306	MORTGAGE TO BENDIGO & ADELAIDE BANK LTD. (ACN: 068 049 178)
12841089	LEASE TO LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595) COMMENCING ON 07/11/2017 AND EXPIRING ON 06/11/2037
12841090	MORTGAGE OF LEASE 12841089 TO NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937)

Notations

Dealings Affecting Title	NIL
Priority Notices	NIL
Notations on Plan	NIL
Registrar-General's Notes	NIL
Administrative Interests	NIL

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Product	Historical Search
Date/Time	13/05/2025 08:35AM
Customer Reference	63753 PY
Order ID	20250513000624

Certificate of Title

Title Reference: CT 6306/522

Status: CURRENT

Parent Title(s): CT 6138/388

Dealing(s) Creating Title: RT 14357843

Title Issued: 17/10/2024

Edition: 1

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
06/12/2017	19/12/2017	12841090	MORTGAGE OF LEASE	REGISTERED	NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937) 12841089
06/12/2017	19/12/2017	12841089	LEASE	REGISTERED	LINCOLN GAP WIND FARM PTY. LTD. (ACN: 133 372 595)
13/08/2002	02/09/2002	9404306	MORTGAGE	REGISTERED	RURAL BANK LTD.

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CT History - CL Vol 6486 Folio 2

Property Description	Crown Lease	Parent Title	Date	Details
Sections 53 and 54 in the Hundredth of Ponyton County of York	Volume 547, Folio 97	Original	23 March 1908	John Hogben Terry (Moonta Railway Officer)
			3 September 1926	Transfer to Alexander Jenkins
			19 November 1963	Transfer to William Francis Jenkins (Mullaquana, Grazier) and Joan Mary Jenkins
			22 March 1974	Transfer to Alexander Mark Jenkins (Mullaquana Station Grazier)
			29 February 1980	Transfer to Askham Pty. Ltd.
			13 June 1984	Transfer to Rex Frederick Luckraft (Grazier) and Ruby Marle Luckraft (Grazier)
			25 October 1991	Lease to The Electricity Trust of South Australia (of portion for easement)
			24 June 2001	Transfer to Warren Noel Luckraft and Jane Luckraft
			26 April 2006	Transfer to Maxwell Gordon Jones and Patricia Jones
Sections 53 and 54 Hundred of Ponyton in the Area Named Middleback Range	Volume 6186, Folio 2	Volume 547, Folio 97	1 April 2021	Transfer to Joyce Pastoral Pty. Ltd.

Empl. Lease

South Australia.

Register Book,

Vol. 547 Folio 97

Registrar-General.

Crown Lease.

(PERPETUAL, No. 10327.)

His Majesty the King doth hereby lease to John Hogben Terry of Moonta Railway Officer herein designated by the term "Lessee" all that land containing thirteen thousand six hundred and eighty (13680) acres or thereabouts and being Sections No G 53 and H 54 wide G.R. 38/3435 (are within)

in the Hundred of Poynton County of York as the same is delineated in the public maps deposited in the Land Office in the City of Adelaide to be held **in perpetuity** at the yearly rent of fourteen pounds and five shillings (£14.5.0) to be paid in advance on the fourteenth day of January commencing the fourteenth day of January One Thousand Nine Hundred and eight and at a further rent of Five Pounds per centum per annum on any rent in arrear subject to the reservations covenants and conditions shortly stated below and which are more fully set out in "The Crown Lands Act 1903"

Commissioner of Crown Lands.

By command,

Certified correct, Chief Surveyor-General.

RESERVATIONS.

1. There are reserved to the Crown all gold silver copper tin and other metals ores minerals and other substances containing metals and all gems and precious stones coal and mineral oil with incidental powers of search and mining **AND ALSO** the right to enter upon the land hereby leased to construct drains and pipe tracks and to lay pipes and to conserve water for public use where required

COVENANTS.

2. The Lessee must—

I. Enclose the land with cattle-proof fence before the end of the fifth year of the lease and

II. Keep in good repair all Crown improvements (if any) on the land

III. Forthwith commence to destroy and to keep the land free from vermin to the satisfaction of the Commissioner during the lease

IV. Insure and keep insured in the full insurable value thereof all buildings the property of the Crown upon the leased land in the joint names of the Commissioner and the Lessee in some Insurance Office to be approved by the Commissioner and forthwith lodge the policy of every such insurance in the office of the Commissioner and to forward to the Commissioner the receipts for the premiums payable in respect of such policy within seven days after the same shall become due with a power for the Commissioner to insure on default by the Lessee and to recover the amount paid for such insurance in like manner as the rent is recoverable

And the Lessee must not—

V. Transfer sublet encumber or mortgage without the written consent of the Commissioner of Crown Lands first had in each case

Ex^D
(1)

(Allotted.)

Schedule V.

Act 830/03.

CONDITIONS.

3. The lease shall be liable to forfeiture in the following cases and no others:—

   I. If default be made in payment of any rent in arrear for six months after written notice requiring its payment or if

   II. Default be made in the performance of any covenant for three months after notice of its non-performance requiring its performance or if

   III. The land shall be transferred sublet or mortgaged without the written consent of the Commissioner of Crown Lands first had in such cases or if

   IV. The Lessee shall refuse to permit the Crown by its officers or servants to enter upon the land hereby leased to construct drains and pipe tracks and to lay pipes and to conserve water for public use

4. The land may be resumed by the Crown for mining or for any public work or purpose full compensation being made to the Lessee for loss except where the land shall be resumed for the construction of drains or pipe tracks and the laying of pipes or for the conservation of water for the public use in which cases no compensation whatever shall be made to the Lessee

IN WITNESS whereof the Public Seal of the State of South Australia and the hand and seal of the said Lessee were hereunto set the 23rd day of March 1908.

J. H. Ferris

Signed sealed and delivered by the above-named Lessee in the presence of

W. A. Gage

F.P. 31287
APPROVED

Mortgage No. 507102 (Including other land) from John Hogben Ferry to The Union Bank of Australia Limited Produced for registration the 12 day of April 1910 at 3 pm
Griffiths Anthony Dep Reg Genl

Transfer No. 975183 from John Hogben Ferry to Alexander Jenkins of Yongala Farmer of the within Lease No. 10329 Produced for registration the 3 day of September 1926 at 2.45 pm
Dep Reg Genl

Mortgage No 975183 from Alexander Jenkins to John Hogben Ferry Produced for registration the 3 day of September 1926 at 2.45 pm (Including other land)
Dep Reg Genl

Deposited No 577896
Vernon T. Edwards Dep Reg Genl

DISCHARGE OF THE above MORTGAGE NO. 507102 BY RECEIPT ENDORSED THEREON PRODUCED FOR REGISTRATION THE 16 DAY OF June 1913 AT 3 pm
Vernon T. Edwards DEP. REG. GENL.

MORTGAGE No. 10/6342 FROM Alexander Jenkins to Bennett & Fisher Limited PRODUCED FOR REGISTRATION THE 16 DAY OF August 1929 AT 12.15 pm including other land
DEP. REG GENL.

Mortgage No 590456 (Including other land) from John Hogben Ferry to John Tafen Ferguson Produced for registration the 16 day of June 1913 at 3pm
Vernon T. Edwards Dep Reg Genl

T/A 2088618

APPLICATION No. 2088618 THE WITHIN Mortgage No 975183 IS TRANSMITTED TO Frank Roy Ferry of Kimba Farmer and Mary Franciska Pollock of Dorrilla married woman AS THE EXECUTORS NAMED IN THE WILL DATED 19.2.1948 OF John Hogben Ferry WHO DIED 4.11.1957 VIDE PROBATE DATED 13.2.1958 PRODUCED 20.10.1958 AT 3pm
Bennett
DEP. REG. GEN.

DISCHARGE OF MORTGAGE No. 975183 BY ENDORSEMENT THEREON. PRODUCED 24.10.1958 AT 11.15am
Bennett
DEP. REG. GEN.

DISCHARGE OF THE above MORTGAGE NO. 590456 BY RECEIPT ENDORSED THEREON PRODUCED FOR REGISTRATION THE 3 DAY OF September 1926 AT 2.45 pm
DEP. REG. GENL.

RETURN No 1990-183 m

~~D1076842~~ ~~T248463~~
M248463A M248463B

DISCHARGE OF MORTGAGE No. 1076842 BY ENDORSEMENT THEREON. PRODUCED 19/11/1963 AT 2.25 pm
B.J. Mains
DEP. REG. GEN.

TRANSFER No. 2484633 to William Francis Jenkins of Myllaquana Station via Whyalla Grazier and Joan Mary Jenkins his wife OF THE WITHIN LAND. PRODUCED 19/11/1963 AT 2.25 pm
(Lease 1032)
B.J. Mains
DEP. REG. GEN.

PARTIAL SURRENDER No. 4122594 PORTION OF THE WITHIN Section 9. IS SURRENDERED AS REGARDS 2.249 ha. AND THE AREA OF THE WITHIN LEASE REDUCED TO 5533 ha ~~ACRES AND THE ANNUAL RENT REDUCED TO $~~ FROM 27-10-1977. PRODUCED 23-11-1977 AT 2.30 pm.

AL-4295455

Certificate of alteration No 4295455 of the Minister of Lands whereby the within sections Nos G. and H hundreds have been ~~amended~~ renumbered to sections Nos. 53 and 54 Produced 21.11.1978 at 4 pm

MORTGAGE No. 2484634
to Alexander Jenkins
PRODUCED 19/11/1963 AT 2.25 pm (INCLUDING OTHER LAND)
B.J. Mains
DEP. REG. GEN.

MORTGAGE No. 2484635
to Bennett & Fisher Limited
PRODUCED 19/11/1963 AT 2.25 pm (INCLUDING OTHER LAND)
B.J. Mains
DEP. REG. GEN.

~~D4315992 M4315993~~
PIR 4287699

DISCHARGE OF MORTGAGE NO. 3581317 BY ENDORSEMENT THEREON VIDE NO. 4315992 PRODUCED 8.1.1979 AT 11.15 a.m.

~~TA 2957610~~

APPLICATION No. 2957610 THE WITHIN MORTGAGE No 2484634 IS TRANSMITTED TO Executor Trustee and Agency Company of South Australia Limited of 22 Grenfell Street Adelaide and William Francis Jenkins of Myllaquana Station via Whyalla Farmer and Grazier AS THE EXECUTOR NAMED IN THE WILL DATED 12.8.1963 with 2 codicils OF Alexander Jenkins WHO DIED 4.10.1967 VIDE PROBATE DATED 21.6.1968 PRODUCED 7.11.1968 AT 11.35 a.m.
F.J. Coleman Asst
DEP. REG. GEN.

MORTGAGE No. 4316993
TO THE NATIONAL BANK OF AUSTRALASIA LIMITED
PRODUCED 8.1.1979 AT 11.15 a.m.
(INCLUDING OTHER LAND)

~~T4V516924~~ ~~T4V516925~~ ~~M4V516926~~ ~~M4V516927~~

~~D2X84635~~ (28-8-73)

DISCHARGE OF MORTGAGE No. 2484635 BY ENDORSEMENT THEREON. PRODUCED 28.8.1973 AT 12.10 pm (No entry on trip)
F.J. Coleman Asst
DEP. REG. GEN.
17/10/1973 D.R.G.

DISCHARGE OF MORTGAGE No. 4315993 VIDE 4316924 PRODUCED 29.2.1980 AT NOON

~~D2X84634~~ ~~M3521317~~

DISCHARGE OF MORTGAGE No. 2484634 BY ENDORSEMENT THEREON. PRODUCED 26.9.1978 AT 11.30 am
DEP. REG. GEN.

TRANSFER No. 4516925 To Altham Pty Ltd of "Nanto Springs" North Marola Road Yacka 5470 OF THE WITHIN LAND PRODUCED 29.2.1980 at NOON

MORTGAGE No. 3521317
TO THE NATIONAL BANK OF AUSTRALASIA LIMITED
PRODUCED 26.9.1978 AT 11.30 am (INCLUDING OTHER LAND)
DEP. REG. GEN.

~~T2595647~~

MORTGAGE No. 4516926
TO THE STATE BANK OF SOUTH AUSTRALIA
PRODUCED 29.2.1980 AT NOON
INCLUDING OTHER LAND

MORTGAGE No. 4516927
TO THE STATE BANK OF SOUTH AUSTRALIA
PRODUCED 29.2.1980 AT NOON
INCLUDING OTHER LAND

~~M4528925~~

TRANSFER No. 3595647 To the within named William Francis Jenkins and Joan Mary Jenkins and to Alexander Mark Jenkins of Myllaquana Station via Whyalla as tenants in common OF THE WITHIN LAND PRODUCED 22.3.1974 AT 11.25 am
B.J. Mackin
DEP. REG. GEN.

AL-4122594

OVER

MORTGAGE No. 4528325
TO COMMONWEALTH DEVELOPMENT BANK OF AUSTRALIA
PRODUCED 24.3 1980 AT 10.45 a.m.
INCLUDING OTHER LANDS

~~5248990 5248991 5248992 4528037~~
P/A 5225251

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE
No. 4516926 and 4516927 VIDE 5248990
PRODUCED 13.6.1984 AT 12.15 p.m.

P/A 4629882

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE
No. 4528325 VIDE 5248991
PRODUCED 13.6.1984 AT 12.15pm

TRANSFER No. 5248992 To
REX FREDERICK LUCKRAFT RUBY MERLE LUCKRAFT and WARREN NOEL LUCKRAFT all of Bendleby via Orroroo 5431 Graziers as tenants in common
OF THE WITHIN LAND. PRODUCED 13.6.1984 at 12.15

MORTGAGE No. 5261037 TO
Elders Rural Finance Limited
PRODUCED 3.7.1984 AT 3.50 p.m
INCLUDING OTHER LAND

P/A 6016169

DISCHARGE OF MORTGAGE 5261037
VIDE 6303995 PRODUCED 24-3-1988 AT 15:30

LEASE No. 791070 To
THE ELECTRICITY TRUST OF SOUTH AUSTRALIA
of an easement over portion
OF THE WITHIN LAND. TERM of 99 years
Commencing on 13.8.1991
PRODUCED 25.10. 1991 AT 11:00

MORTGAGE No. 8432069 TO
NATIONAL AUSTRALIA BANK LTD.
PRODUCED 28.1.1998 at 11:50

APPLICATION 8889801 The within Lease is vested in DISTRIBUTION LESSOR CORPORATION (Subject to Lease 8890000)
Produced 16.5.2000 at 12:45

THE WITHIN LAND IS DISCHARGED FROM MORTGAGE
No. 8432069 VIDE 9047351
PRODUCED 20.2.2001 AT 12:30

TRANSFER No. 9127676 to the within named Warren Noel Luckraft and to Jane Luckraft both of Bendleby via Orroroo 5431 OF THE WITHIN land with no Survivorship
PRODUCED ~~29.6.2001~~ AT 10:20

TRANSFER No. 10446892 to Maxwell Gordon Jones and Patricia Jones both of P.M.B. 44 Cleve S.A. 5640
OF THE WITHIN LAND With No Survivorship
PRODUCED 26.4.2006 AT 11:31

MORTGAGE NO. 10446893 TO
ELDERS RURAL BANK LTD.
Produced 26.4.2006 AT 11:31

CANCELLED
CONVERTED TO A COMPUTERISED CROWN LEASE

Crown Lease

Title Reference: CL 6186/2

Status: CURRENT

Parent Title(s): CL 547/97

Dealing(s) Creating Title: RT 12635739

Title Issued: 18/01/2017

Edition: 3

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
08/06/2022	01/07/2022	13805465	DISCHARGE OF MORTGAGE	REGISTERED	13486137
18/03/2021	01/04/2021	13486137	MORTGAGE	REGISTERED	NATIONAL AUSTRALIA BANK LTD. (ACN: 004 044 937)
18/03/2021	01/04/2021	13486136	TRANSFER	REGISTERED	JOYCE PASTORAL PTY. LTD. (ACN: 645 913 435)
18/03/2021	01/04/2021	13486135	DISCHARGE OF MORTGAGE	REGISTERED	10446893
26/04/2006	16/05/2006	10446893	MORTGAGE	REGISTERED	ELDERS RURAL BANK LTD.

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Appendix D Assessment of Potentially Contaminating Activities Relevant to Site (EP Regulations 2023)

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Table D.1: Assessment of Potentially Contaminating Activities Relevant to the Site (EP Regulations 2023)

Activity	Definition	Confirmed or Suspected
Abrasive blasting	Operation of works for abrasive blast cleaning or disposal of abrasive blasting material (including mobile abrasive blasting works and abrasive blast cleaning carried out in fully enclosed booths but excluding abrasive blast cleaning undertaken for residential purposes)	No
Acid sulfate soil generation	Oxidation of iron sulphide in potential acid sulfate soil material (sulfidic material) resulting in formation of actual acid sulfate soil material or sulphuric material	**Plausible (future)**
Agricultural activities	Any of the following activities undertaken in the course of agriculture:	
	(a) burial of animals or parts of animals;	**Plausible, Unlikely**
	(b) burial of other waste;	**Plausible, Unlikely**
	(c) irrigation using wastewater;	No
	(d) intensive application or administration of a listed substance to animals, plants, land or water (excluding routine spraying, in accordance with manufacturers' instructions, of pesticides used in broad-acre farming)	No
Airports, aerodromes or aerospace industry	Operation of premises for commercial or charter aircraft take-off and landing or manufacture, repair or maintenance of commercial or charter aircraft or aircraft equipment	**Yes – Carrapateena Mine, Olympic Dam Village**
Animal burial	Burial of animals or parts of animals other than in the course of agriculture	No
Animal dips or spray race facilities	Operation of animal dips or spray race facilities	No
Animal feedlots	Operation of confined yards or areas for holding of animals and feeding of animals principally by mechanical means or by hand	No
Animal saleyards	Operation of yards at which cattle, sheep or other animals are gathered and confined for the purpose of their sale, auction or exchange (including associated transport loading facilities and associated wastewater disposal)	No
Asbestos disposal	Disposal of asbestos or asbestos products	No
Asphalt or bitumen works	Operation of works for manufacture of asphalt or bitumen	No
Battery manufacture, recycling or disposal	Assembly, disassembly, manufacture or recycling of batteries (excluding storage of batteries for sale)	No
Breweries	Production of beer by infusion, boiling or fermentation	No
Brickworks	Production of bricks (including glazing of bricks)	No
Bulk shipping facilities	Operation of facilities for bulk handling of agricultural crop products, rock, ores, minerals or liquid organic chemical substances to or from wharf or wharf side facility (including sea-port grain terminals)	No
Cement works	Operation of works for production of cement clinker or grinding of cement clinker using argillaceous and calcareous materials	No
Ceramic works	Operation of works for manufacture of tiles, pipes, pottery goods, refractories or other ceramic products	No
Charcoal manufacture	Manufacture of charcoal	No
Coal handling or storage	Handling of coal, coke or carbonaceous material by any means or storage of coal, coke or carbonaceous reject material	No
Coke works	Production, quenching, cutting, crushing or grading of coke	No
Compost or mulch production or storage	Production or storage of compost, mulch or garden soils	No

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Activity	Definition	Confirmed or Suspected
Concrete batching works	Operation of works for production of concrete or concrete products manufactured by inclusion of cement, sand, rock, aggregate or similar materials	No
Curing or drying works	Operation of works for smoking, drying or curing meat, fish or other edible products by application of heat or smoke	No
Defence works	Operation of military defence establishments (including training areas)	**Yes – 3 areas**
Desalination plants	Operation of desalination plants	**Yes – Carrapateena and Olympic Dam Mines**
Dredge spoil disposal or storage	Disposal of dredge spoil onto land or storage of dredge spoil	No
Drum reconditioning or recycling works	Operation of works for reconditioning or recycling of metal or plastic drums	No
Dry cleaning	Operation of premises for dry cleaning	No
Electrical or electronics component manufacture	Manufacture of electrical or electronics components	No
Electrical substations	Operation of electrical substations	No
Electrical transformer or capacitor works	Operation of works for manufacture, repair, storage or disposal of electrical transformers, capacitors or associated equipment or fluids	No
Electricity generation or power plants	Operation of electricity generation or power plants	No
Explosives or pyrotechnics facilities	Operation of facilities for manufacture of explosives or pyrotechnics	No
Fertiliser manufacture	Manufacture of agricultural fertiliser	No
Fibreglass manufacture	Manufacture of fibreglass products	No
Fill or soil importation	Importation, to premises of a business, of soil or other fill originating from a site at which another potentially contaminating activity has taken place	No
Fire extinguisher or retardant manufacture	Manufacture of fire extinguishers or fire retardants	No
Fire stations	Underground storage of fuel at fire stations	No
Fire training areas	Operation of premises for fire training involving the use of liquid fuel, fire accelerants, aqueous film forming foam or similar substances	**Yes – Olympic Dam Mine**
Foundry	Manufacture of metal products by injecting or pouring molten metal into moulds	No
Fuel burning facilities	Burning of solid or liquid fuel (including for generation of power or steam at rate of heat release exceeding 1MW)	No
Furniture restoration	Restoration of furniture	No
Gasworks	Operation of gasworks or gas holders	No
Glass works	Operation of works for manufacture of glass products	No
Glazing	Glazing of ceramics or pottery	No
Hat manufacture or felt processing	Manufacture of hats or processing of felt	No
Incineration	Incineration within the meaning of Schedule 1 Part A clause 3(1) of the Act	No
Iron or steel works	Operation of works for manufacture of iron or steel	No
Laboratories	Operation of laboratories	No
Landfill sites	Operation of sites for disposal of waste onto or into land	**Yes – Olympic Dam Mine**
Lime burner	Manufacture (by means of kiln) of cement or lime from limestone (including associated storage of waste)	No
Metal coating, finishing or spray painting	Finishing, treating or coating of metal (including anodising, galvanising, pickling, electroplating, heat treatment, powder coating, enamelling and spray painting)	No

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Activity	Definition	Confirmed or Suspected
Metal forging	Forging of metal products	No
Metal processing, smelting, refining or metallurgical works	Operation of works for melting (by means of furnace) of ferrous or non-ferrous metal or smelting or reduction of ores to produce metal	**Yes – Olympic Dam Mine**
Mineral processing, metallurgical laboratories or mining or extractive industries	Chemical or physical extraction or processing of metalliferous ores, storage of mining or exploration waste (for example, in tailings dams, overburden or waste rock dumps) mining or processing of minerals or operation of laboratories or pilot facilities for processing or testing of minerals	**Yes – Carrapateena, Mount Gunson and Olympic Dam Mines**
Mirror manufacture	Manufacture of mirrors	No
Motor vehicle manufacture	Manufacture of motor vehicles	No
Motor vehicle racing or testing venues	Operation of facilities designed and used for motor vehicle competitions or motor vehicle speed or performance trials	No
Motor vehicle repair or maintenance	Operation of premises for repair or maintenance of motor vehicles or parts of motor vehicles (including engine reconditioning works)	No
Motor vehicle wrecking yards	Operation of yards for wrecking or dismantling of motor vehicles or parts of motor vehicles	No
Mushroom farming	Farming of mushrooms	No
Oil recycling works	Operation of works for recycling of oil	No
Oil refineries	Operation of works for refining of crude petroleum oil or shale	No
Paint manufacture	Manufacture (including blending, mixing and formulation) of paint	No
Pest control works	Operation of premises for storage of pesticides or filling or washing of tanks used in pest control operations	No
Plastics manufacture works	Operation of works for manufacture (including blending, mixing and formulation) of plastics or plastic components (excluding processing and moulding of plastics manufactured elsewhere)	No
Printing works	Operation of printing works	No
Pulp or paper works	Operation of works for manufacture of timber pulp or paper	No
Railway operations	Railway operations within the meaning of Schedule 1 Part A clause 7(2) of Act	**Yes – where pipeline is within 80 m of the railway**
Rubber manufacture or processing	Manufacture or processing of rubber or rubber products	No
Scrap metal recovery	Recovery (including cleaning) of scrap metal	No
Service stations	Operation of retail fuel outlets	No
Ship breaking	Wrecking or dismantling of ships	No
Spray painting	Spray painting other than spray painting of metal	No
Tannery, fellmongery or hide curing	Operation of works for preservation or treatment of animal skins or hides	No
Textile operations	Manufacture or dyeing of fabrics or materials	No
Transport depots or loading sites	Operation of transport depots or loading sites	**Yes – Carrapateena and Olympic Dam Mines**
	Transport of finished products and, or parts	**Yes – Carrapateena and Olympic Dam Mines**
Tyre manufacture or retreading	Manufacture or retreading of tyres	No

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Activity	Definition	Confirmed or Suspected
Vermiculture	Cultivation of earthworms for production of earthworms or earthworm castings	No
Vessel construction, repair or maintenance	Operation of works or facilities (whether on water or land) for construction, repair or maintenance of vessels	No
Waste depots	Reception, storage or treatment (including recycling) of waste or disposal of waste to land or water	No
Wastewater storage, treatment or disposal	Storage (including in tanks, lagoons and ponds) or treatment (including recycling) of wastewater or disposal of wastewater to land or water	No
Water discharge to underground aquifer	Direct discharge of water from surface of land to underground aquifer	No
Wetlands or detention basins	Operation of bodies of water less than 6 metres deep for collection and management of stormwater or other wastewater for urban amenity, flood mitigation or ecological or other environmental purposes	No
Wineries or distilleries	Operation of works for processing grapes or other produce to make wine or spirits	No
Wood preservation works	Operation of works involving treatment or preservation of timber using chemicals	No
Woolscouring or wool carbonising works	Operation of works involving cleaning or carbonising of wool other than in course of handicraft business where wool is further processed for retail sale	No
Works depots	Operation of works depots by councils or utilities	No
Domestic Activities - Fill or soil importation	Importation, to domestic premises, of soil or other fill originating from a site at which another potentially contaminating activity has taken place	No
Domestic Activities - Liquid organic chemical substances—storage	Storage of more than 500 litres of liquid organic chemical substances in underground or aboveground tanks or vessels at a discrete premises (excluding storage of oil for domestic heating at the premises)	No

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Appendix E Assessment of Class 1, Class 2 and Class 3 Activities Undertaken in the Course of a Business Relevant to Site (SPC 2023)

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Table E.1: Assessment of Class 1, Class 2 and Class 3 Activities Undertaken in the Course of a Business Relevant to the Site (SPC 2023)

Activity	Definition	Confirmed or Suspected
Class 1 Activities		
Asbestos disposal	Disposal of asbestos or asbestos products	No
Defence works	Operation of military defence establishments (including training areas)	**Yes – 3 areas along pipeline**
Drum reconditioning or recycling works	Operation of works for reconditioning or other treatment of metal or plastic drums	No
Dry cleaning	Operation of premises for dry cleaning	No
Electrical or electronics component manufacture	Manufacture of electrical or electronics components	No
Explosives or pyrotechnics facilities	Operation of facilities for manufacture of explosives or pyrotechnics	No
Fertiliser manufacture	Manufacture of agricultural fertiliser	No
Fire extinguisher or retardant manufacture	Manufacture of fire extinguishers or fire retardants	No
Fire stations	Underground storage of fuel at fire stations	No
Foundry	Manufacture of metal products by injecting or pouring molten metal into moulds	No
Gasworks	Operation of gasworks or gas holders	No
Iron or steel works	Operation of works for manufacture of iron or steel	No
Landfill sites	Operation of sites for disposal of waste to land	**Yes – Olympic Dam Mine**
Listed substances—activities involving listed substances	Manufacture, production (including as a by-product or waste) or resource recovery of a listed substance or product containing a listed substance Storage, at discrete business premises, of— (a) 500L or more of a liquid listed substance; or (b) 500kg or more of a listed substance other than a liquid.	**Yes – Carrapateena and Olympic Dam Mines**
Metal coating, finishing or spray painting	Finishing, treating or coating of metal (including anodising, galvanising, pickling, electroplating, heat treatment, powder coating, enamelling and spray painting)	No
Metal processing, smelting, refining or metallurgical works	Operation of works for melting (by means of furnace) of ferrous or non-ferrous metal or smelting or reduction of ores to produce metal	**Yes – Olympic Dam Mine**
Motor vehicle manufacture	Manufacture of motor vehicles	No
Oil recycling works	Operation of works for recycling of oil	No
Oil refineries	Operation of works for refining of crude petroleum oil or shale	No
Paint manufacture	Manufacture (including blending, mixing and formulation) of paint	No
Pest control works	Operation of premises for storage of pesticides or filling or washing of tanks used in pest control operations	No
Plastics manufacture works	Operation of works for manufacture (including blending, mixing and formulation) of plastics or plastic components (excluding processing and moulding of plastics manufactured elsewhere)	No
Printing works	Operation of printing works	No
Railway operations	Railway operations within the meaning of Schedule 1 Part A clause 7(2)(a) of the Environment Protection Act 1993	**Yes**

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Activity	Definition	Confirmed or Suspected
Rubber manufacture or processing	Manufacture or processing of rubber or rubber products	No
Service stations	Operation of retail fuel outlets	No
Tannery, fellmongery or hide curing	Operation of works for preservation or treatment of animal skins or hides	No
Tyre manufacture or retreading	Manufacture or retreading of tyres	No
Waste depots	Reception, storage or treatment (including recycling) of waste or other matter or disposal of waste to land or water	No
Wood preservation works	Operation of works involving treatment or preservation of timber using chemicals	No
Class 2 Activities		
Abrasive blasting	Operation of works for abrasive blast cleaning or disposal of abrasive blasting material (including mobile abrasive blasting works and abrasive blast cleaning carried out in fully enclosed booths but excluding abrasive blast cleaning undertaken for residential purposes)	No
Agricultural activities	Any of the following activities undertaken in the course of agriculture: (a) burial of animals or parts of animals; (b) burial of waste or other matter; (c) irrigation using wastewater; (d) intensive application or administration of a listed substance to animals, plants, land or water (excluding routine spraying, in accordance with manufacturers' instructions, of pesticides used in broad-acre farming)	**Possible – all pump station and desalination plant sites**
Airports, aerodromes or aerospace industry	Operation of premises for commercial or charter aircraft take-off and landing or manufacture, repair or maintenance of commercial or charter aircraft or aircraft equipment	**Yes – Carrapateena Mine and Olympic Dam Village**
Animal dips or spray race facilities	Operation of animal dips or spray race facilities	No
Asphalt or bitumen works	Operation of works for manufacture of asphalt or bitumen	No
Battery manufacture, resource recovery or disposal	Assembly, disassembly, manufacture or resource recovery of batteries (excluding storage of batteries for sale)	No
Breweries	Production of beer by infusion, boiling or fermentation	No
Bulk shipping facilities	Operation of facilities for bulk handling of agricultural crop products, rock, ores, minerals or liquid organic chemical substances to or from wharf or wharfside facility (including sea-port grain terminals)	No
Cement works	Operation of works for production of cement clinker or grinding of cement clinker using argillaceous and calcareous materials	No
Ceramic works	Operation of works for manufacture of tiles, pipes, pottery goods, refractories or other ceramic products	No
Coke works	Production, quenching, cutting, crushing or grading of coke	No
Compost or mulch production or storage	Production or storage of compost, mulch or garden soils	No
Dredge spoil disposal or storage	Disposal of dredge spoil onto land or storage of dredge spoil	No

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Activity	Definition	Confirmed or Suspected
Electrical substations	Operation of electrical substations	**Yes – Carrapateena and Olympic Dam Mines**
Electrical transformer or capacitor works	Operation of works for manufacture, repair, storage or disposal of electrical transformers, capacitors or associated equipment or fluids	No
Fibreglass manufacture	Manufacture of fibreglass products	No
Fire training areas	Operation of premises for fire training involving the use of liquid fuel, fire accelerants, aqueous film forming foam or similar substances	**Yes – Olympic Dam Mine**
Fuel burning facilities	Burning of solid or liquid fuel (including for generation of power or steam at rate of heat release exceeding 1MW)	No
Furniture restoration	Restoration of furniture	No
Glass works	Operation of works for manufacture of glass products	No
Hat manufacture or felt processing	Manufacture of hats or processing of felt	No
Incineration	Incineration within the meaning of Schedule 1 Part A clause 3(1) of the Environment Protection Act 1993	No
Laboratories	Operation of laboratories	No
Metal forging	Forging of metal products	No
Mineral processing, metallurgical laboratories or mining or extractive industries	Chemical or physical extraction or processing of metalliferous ores, storage of mining or exploration waste (for example, in tailings dams, overburden or waste rock dumps) mining or processing of minerals or operation of laboratories or pilot facilities for processing or testing of minerals	**Yes – Carrapateena, Mount Gunson and Olympic Dam Mines**
Mirror manufacture	Manufacture of mirrors	No
Motor vehicle racing or testing venues	Operation of facilities designed and used for motor vehicle competitions or motor vehicle speed or performance trials	No
Motor vehicle repair or maintenance	Operation of premises for repair or maintenance of motor vehicles or parts of motor vehicles (including engine reconditioning works)	No
Motor vehicle wrecking yards	Operation of yards for wrecking or dismantling of motor vehicles or parts of motor vehicles	No
Pulp or paper works	Operation of works for manufacture of timber pulp or paper	No
Railway operations	Railway operations within the meaning of Schedule 1 Part A clause 7(2)(b) and (c) of the Environment Protection Act 1993.	**Yes – where pipeline is within 80 m of railway pipeline route**
Scrap metal recovery	Recovery (including cleaning) of scrap metal	No
Ship breaking	Wrecking or dismantling of ships	No
Spray painting	Spray painting other than spray painting of metal	No
Textile operations	Manufacture or dyeing of fabrics or materials	No
Transport depots or loading sites	Operation of transport depots or loading sites	**Yes – Carrapateena and Olympic Dam Mines**
Vessel construction, repair or maintenance	Operation of works or facilities (whether on water or land) for construction, repair or maintenance of vessels	No
Wastewater storage, treatment or disposal	Storage (including in tanks, lagoons and ponds) or treatment of wastewater or disposal of wastewater to land or water	No

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Activity	Definition	Confirmed or Suspected
Water discharge to underground aquifer	Direct discharge of water from surface of land to underground aquifer	No
Wetlands or detention basins	Operation of bodies of water less than 6 metres deep for collection and management of stormwater or other wastewater for urban amenity, flood mitigation or ecological or other environmental purposes	No
Woolscouring or wool carbonising works	Operation of works involving cleaning or carbonising of wool other than in course of handicraft business where wool is further processed for retail sale	No
Works depots	Operation of works depots by councils or utilities	No
Class 3 Activities		
Acid sulfate soil generation	Oxidation of iron sulphide in potential acid sulfate soil material (sulfidic material) resulting in formation of actual acid sulfate soil material or sulphuric material	**Possible (future)**
Animal burial	Burial of animals or parts of animals other than in the course of agriculture	No
Animal feedlots	Operation of confined yards or areas for holding of animals and feeding of animals principally by mechanical means or by hand	No
Animal saleyards	Operation of yards at which cattle, sheep or other animals are gathered and confined for the purpose of their sale, auction or exchange (including associated transport loading facilities and associated wastewater disposal)	No
Brickworks	Production of bricks (including glazing of bricks)	No
Charcoal manufacture	Manufacture of charcoal	No
Coal handling or storage	Handling of coal, coke or carbonaceous material by any means or storage of coal, coke or carbonaceous reject material	No
Concrete batching works	Operation of works for production of concrete or concrete products manufactured by inclusion of cement, sand, rock, aggregate or similar materials	No
Curing or drying works	Operation of works for smoking, drying or curing meat, fish or other edible products by application of heat or smoke	No
Desalination plants	Operation of desalination plants	**Yes – Carrapateena and Olympic Dam Mines**
Glazing	Glazing of ceramics or pottery	No
Lime burner	Manufacture (by means of kiln) of cement or lime from limestone (including associated storage of waste or other matter)	No
Mushroom farming	Farming of mushrooms	No
Vermiculture	Cultivation of earthworms for production of earthworms or earthworm castings	No
Wineries or distilleries	Operation of works for processing grapes or other produce to make wine or spirits	No

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Appendix F Registered Groundwater Bore Search Results WaterConnect (2024)

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Oakden Hills

Drillhole Number	Unit Number	Class	Aquifer	Depth	Date	Purpose
20552	6334-1	WW				
20599	6334-48	WW	M-p	85	28798	IND

Lincoln Gap

Drillhole Number	Unit Number	Class	Aquifer	Depth	Date	Purpose
196766	6432-988	WW		36	18/03/2003	STK
196771	6432-990	WW		60	17/03/2003	

Mullaquana Station

Drillhole Number	Unit Number	Class	Aquifer	Depth	Date	Purpose
185452	6331-561	WW		16	5/02/2010	INV

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Appendix H-3:

Surface Water Assessment



NORTHERN WATER PROJECT

Department for Infrastructure and Transport

Surface Water Assessment

Jacobs

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Northern Water Project – Surface Water Assessment

Client name:	Department for Infrastructure and Transport		
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Executive summary

Introduction

The Northern Water Project (the Project) aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the Project will involve the construction and operation of a 51 gigalitre per year (GL/year) seawater reverse osmosis desalination plant located at Mullaquana Station on the Upper Spencer Gulf, and associated water transfer system (including pipelines, transfer pump stations, product water storages) and electricity infrastructure aims to deliver up to 260 megalitres per day of desalinated water through construction of a seawater reverse osmosis desalination plant and associated marine structures on Eastern Eyre Peninsula, water delivery infrastructure to Roxby Downs, and required electricity infrastructure.

JBS&G Australia Pty Ltd (JBS&G) and Jacobs Group (Australia) Pty Ltd (Jacobs) were engaged by Department for Infrastructure and Transport (DIT) to prepare and deliver the primary environmental assessments and approvals for all marine and terrestrial works to support the Project.

This Surface Water Assessment Report summarises the findings of a desktop impact assessment of surface water-related constraints and opportunities for the Project. The objective of the desktop surface water impact assessment is to characterise the existing environment and identify potential risks to surface water from the construction and operation of the Project. The assessment reviewed potential impacts to surface water from construction functions such as earthworks, dewatering, construction through watercourses, stockpiling, vegetation removal, leaks and spills from chemicals used in construction, and temporary workforce accommodations. In addition, the assessment considered the commissioning, operations and maintenance of the proposed desalination plant, transfer system, and associated project infrastructure, where these intersect or potentially impact surface water.

Methodology

The assessment used available information from state and national databases, local studies undertaken for other projects in the region and data collected during fieldwork for the Project's terrestrial ecology and topography, geology, and soils assessments. The assessment references findings from the *Northern Water Project – Groundwater Impact Assessment* (JBS&G, 2026); *Northern Water Project – Topography, Geology and Soils Assessment (*Jacobs, 2026a) and *Northern Water Project – Terrestrial Ecology Baseline Report* (Jacobs, 2026b).

Impact assessments were undertaken for two categories of watercourses: "considered to have potential high impact" (those more at risk from construction in or nearby due to landform, hydrological, location or ecological characteristics) and "standard" (those less at risk). Watercourses "considered to have potential high impact" in this assessment were based on their propensity for erosion, presence of Acid Sulfate Soils (ASS) or saline soils, connectivity to groundwater, and/or ecological significance.

Surface water features and associated findings

The assessment identified over 200 separate surface water features that crossed the ~406km of main transfer and lateral branch pipelines, including four drainage basins (Spencer Gulf, Mambray Coast, Gairdner, and Lake Torrens), and ephemeral watercourses, salt lakes and floodplains that only flow or hold surface water intermittently. Of these surface water features, 21 watercourses were rated as "considered to have potential high impact" or "standard" for multiple risks. For example, Ranges View Creek was rated as "considered to have potential high impact" from effects of construction discharge and erosion from creek crossing, but "standard" for other risks such as saline soils and effects from vegetation removal.

The assessment also found no records of aquatic matters of national environmental significance (MNES) within 5 km of the Project alignment, and the predominantly ephemeral watercourses that crossed by or near the Project are unlikely to accommodate fish habitat.

Risks

Risks identified for the construction phase of the pipeline, desalination plant, and associated Project infrastructure included effects from earthworks on erosion and saline/ASS exposure, vegetation removal, discharge or groundwater or unintentional release of chemicals or sediments into downstream receiving environments, and impacts from flood events. Negative impacts of flood events occurring during the construction phase of the Project may be increased if construction equipment and materials, spoil stockpiles, and fuels and chemicals are washed downstream. Implementation of a Construction Environmental Management Plan, staging work to avoid construction activities in or near watercourses during forecasted heavy rain events, storing chemicals in a bunded area away from watercourses, and locating stockpiles away from watercourses reduce the risk to "Medium" for watercourses considered to have potential high impact from flood impacts and "Low" for standard watercourses. All other risks have a residual risk rating of "Low."

Risks associated with operations of the pipelines include effects from the potential interaction with flood flows (for above-ground pipe bridges), testing, commissioning, and maintenance of the pipelines and stormwater runoff from substations and pump stations. During operation of the desalination plant at Mullaquana Station, the primary risk relates to managing post-development flows to avoid erosion, and the pollution of downstream aquatic and marine environments. A treatment train has been developed to achieve Water Sensitive SA (2021) SA MUSIC Guideline requirements (GHD, Reference Design Report, Northern Water Project, 2025a).

Overall, with the implementation of proposed mitigation measures, the Project is considered to be low risk to the quality and flow regime of surface waters, resident aquatic fauna, and cultural and commercial values within and adjacent the Project footprint.

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Appendix A. Environmental Values and Applicable Water Quality Guidelines

Appendix B. Long term rainfall data and CDMP charts

Appendix C. Protected Matters Search Tool results

Appendix D. Biological Database of South Australia Search Results

Acronyms and abbreviations

Acronym	Title
BoM	Bureau of Meteorology
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DBOM	Design, Build, Operate and Maintain
EIS	Environmental Impact Statement
EPA	(South Australian) Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPP	Environment Protection Policy
Water Quality EPP	Environment Protection (Water Quality) Policy 2015
EPLB	Eyre Peninsula Landscape Board
GDE	Groundwater Dependent Ecosystems
LSA Act	*Landscape South Australia Act 2019* (SA)
MNES	Matters of National Environmental Significance
PDI Act	*Planning, Development and Infrastructure Act 2016* (SA)
PMST	Protected Matters Search Tool
SA	South Australia
SAALLB	South Australian Arid Lands Landscape Board
SOE	State of the Environment Reporting
The Project	Northern Water
WAACP	Water Affecting Activity Control Policy
WAAP	Water Affecting Activity Permit

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide an assessment of potential impacts to surface water, in accordance with the scope of services set out in the contract between Jacobs and the Client, JBS&G, and head client, Department for Infrastructure and Transport (DIT).

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1. Introduction

The purpose of this report is to summarise the findings of a desktop impact assessment of surface water-related constraints and opportunities for the Northern Water project (the Project). The desktop surface water impact assessment is to characterise the existing environment and identify potential risks to surface water from the construction and operation of the Project.

The assessment reviewed potential impacts to surface water from construction functions such as earthworks, dewatering, construction through watercourses, stockpiling, vegetation removal, leaks and spills from chemicals used in construction, and temporary workforce accommodations. In addition, the assessment considered the commissioning, operations and maintenance of the proposed desalination plant, transfer system, and associated project infrastructure, where these intersect or potentially impact surface water.

This assessment is based on the Project alignment revision 5, received by Jacobs in November 2025.

The assessment has considered the Assessment Requirements for Environmental Attribute 7: Physical Environment (PE3) Surface Water and Groundwater and Environmental Attribute 2: Biological Environment (BE) - BE 2 Marine Flora and Fauna, and BE3 Terrestrial Flora and Fauna.

This report relates to the surface water assessment of the Project, addressing water quality, hydrology, aquatic ecology, and flooding. It outlines the methodology and results of the desktop assessment, highlights any aquatic ecology constraints associated with the Project and identifies opportunities for mitigation. It also highlights any gaps in the surface water assessment and makes proposals for addressing those gaps.

2. Proposed Project

2.1 Project aim

The Northern Water Project (the Project) aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the Project will involve the construction and operation of a 51 gigalitre per year (GL/year) seawater reverse osmosis desalination plant located at Mullaquana Station and associated marine structures on the Upper Spencer Gulf, transfer system (including pipelines, pump stations, and storages), and electricity infrastructure.

This section outlines the proposed construction methodology and elements of the infrastructure, and transport activities associated with construction and operation of the Project. The information is based on current design information, including the Reference Design Constructability Report (SYSTRA, 2025). This technical report addresses risks and mitigations associated with work near and affecting surface water during the Project.

2.2 Project location

The project location is presented in **Figure 2-1**.

2.2.1 Desalination Plant

The proposed desalination plant is located at Mullaquana Station, approximately 25 km south-west of Whyalla and approximately 14 km east of the Lincoln Highway. The associated marine infrastructure, including intake and outfall structures, pipes and diffusers, is located in the Upper Spencer Gulf.

2.2.2 Transfer system

The transfer system consists of a main transfer pipeline which runs approximately 360 km north from the desalination plant to Olympic Dam via Whyalla, Port Augusta, Woomera and Roxby Downs, with a lateral branch pipeline to Carrapateena, approximately 46 km long.

The alignment of the main transfer and lateral branch pipelines are:

- Desalination plant (Mullaquana Station) to Whyalla – alignment heads generally north following Eight Mile Creek Road and other existing tracks / fencelines on rural land skirting Whyalla to the west. The alignment then veers north-east and heads north following the Lincoln Highway.
- Whyalla to Port Augusta – alignment traverses a section of the Cultana Training Area following the Lincoln Highway heading north before meeting the Stuart Highway alignment via a short section of the Eyre Highway. The alignment may be located within the road reserve of the Lincoln Hwy or immediately adjacent to the west of the road reserve in the Cultana Training Area.
- Port Augusta to Pimba – alignment generally follows the Stuart Highway, with portions following the former Stuart Highway alignment, and paralleling the existing Department of Defence Port Augusta to Woomera water pipeline.
- Pimba to Olympic Dam - generally follows the Olympic Dam Highway with the pipeline diverting to the east to avoid Woomera township.
- Carrapateena mine lateral branch pipeline - heads north-east from the main transfer pipeline, south of Lake Windabout.

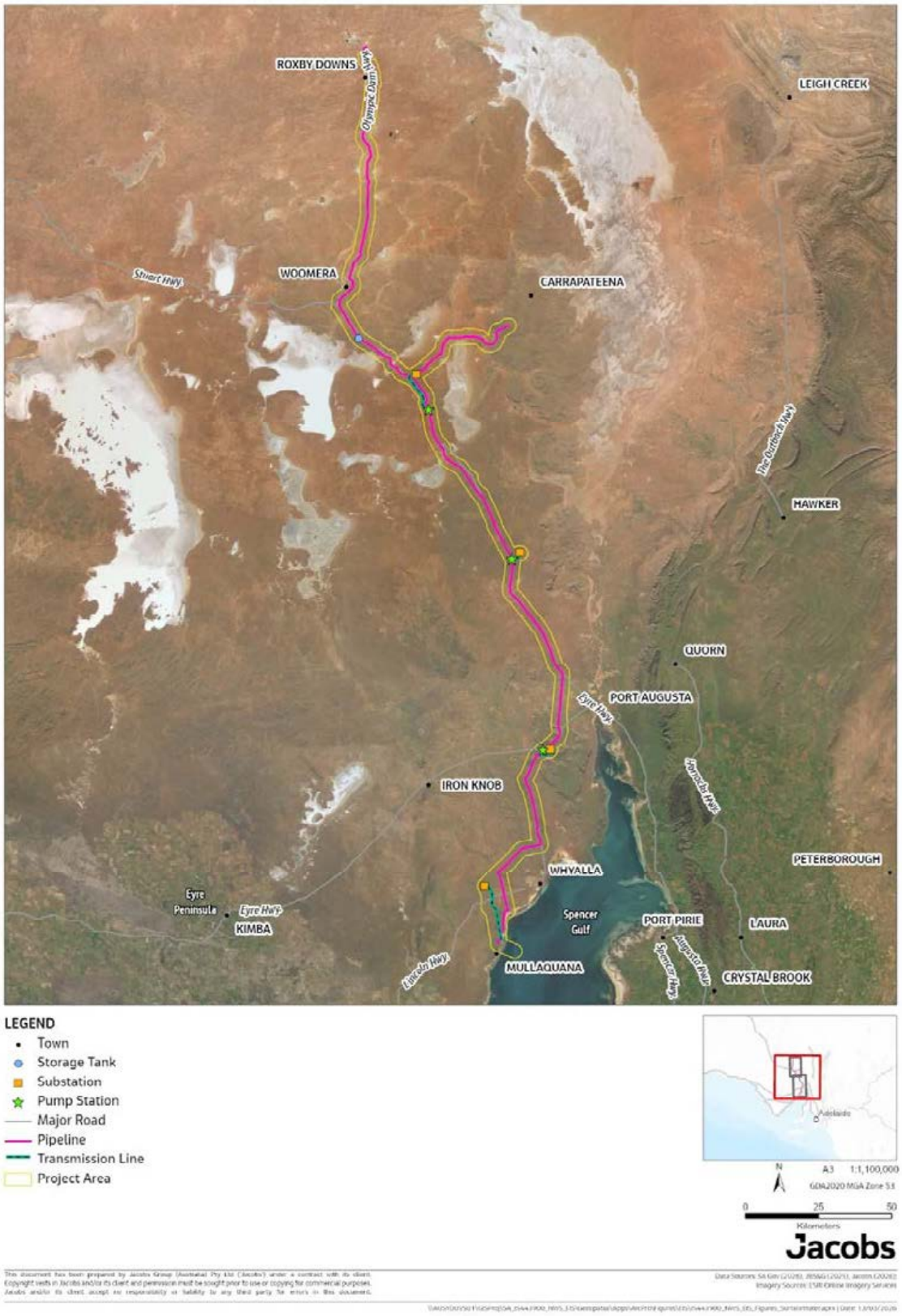


Figure 2-1. Project area and pipeline alignment

2.3 Key Project components

The Project comprises the following key elements:

- A 51 GL/year seawater reverse osmosis desalination plant located at Mullaquana Station approximately 25 km south-west of Whyalla
- Marine intake and outfall tunnels extending underneath the seabed and into Spencer Gulf
- Diffuser structures for discharge of return water into Spencer Gulf
- A transfer system consisting of:
  - a ~360 km main transfer pipeline, largely constructed underground terminating at the delivery point at the Olympic Dam copper-gold mine.
  - a ~46 km lateral branch to a delivery point at the Carrapateena copper-gold mine (which may be constructed above or below ground).
  - Associated transfer pump stations and product water storage
- High voltage electricity supply including new transmission and distribution lines and new network substations to provide power to the desalination plant and transfer pump stations.
- Associated temporary construction-related infrastructure (e.g. construction camps, site offices and amenities, yards, storages and laydown areas)
- Access tracks including establishing new tracks and upgrading existing tracks
- Enabling roadworks and road upgrades.

For the purposes of this report, the main transfer and lateral branch pipelines are collectively referred to as 'the pipeline' and other project components, such as the pump stations, storages, substations, electricity transmission lines and access tracks, but excluding the desalination plant, are collectively referred to as 'associated project infrastructure'. As such, from herein, reference to the Project means the desalination plant, pipeline, and associated project infrastructure.

2.4 Study Area definition

The Project Area is defined as a 2.5 km buffer of the alignment of linear infrastructure (i.e. a 5 km wide corridor). Linear infrastructure includes pipelines, transmission lines and the desalination plant intake and outfall. The buffer effectively incorporates all infrastructure for the purposes of approvals. The Project Area will be used as a guide for the assessment of impacts and final location of the Project is expected to remain inside this corridor.

The construction of the Project has the potential to impact water quality of downstream surface water features near the Project, particularly those within 500 m of the Project which is expected to be the limit of significant water quality impacts. This geographic extent (500 m from the Project) represents the Study Area referred in this report. Therefore, the key impacts assessed in this report are related to:

- Pipeline crossings of surface water features (all surface water disciplines).
- The desalination plant.

The Project Area has been divided into southern and northern sections. The coverage and Project elements relevant to the present risk assessment that are situated within each section are included in **Table 2-1**.

Table 2-1. Project Area sections and descriptions

Section	Coverage	Project elements in the section	Approximate pipeline km point[1]
Southern	North of Munyaroo Conservation Park to Lake Dutton / Pernatty Lagoon. Coverage includes Murninnnie Beach, Cowleds Landing, Whyalla and Port Augusta.	▪ Desalination plant and marine infrastructure ▪ Mullaquana Station 132 kV transmission line ▪ Mullaquana Station substation ▪ Southern section of main transfer pipeline ▪ PS 2 (Lincoln Gap pump station and storage) ▪ Pandurra 275 kV transmission line ▪ Corraberra Hill substation ▪ PS 3 (Kalaya pump station and storage) ▪ Bookaloo 132kV transmission line ▪ Kootaberra substation	0 –195
Northern	Lake Dutton / Pernatty Lagoon to Olympic Dam. Coverage includes Carrapateena mine, Woomera, Pimba, Roxby Downs and Olympic Dam.	▪ Northern section of main transfer pipeline ▪ PS 4 (Mangata pump station and storage) ▪ Oakden Hills transmission line ▪ Mount Gunson substation ▪ Carrapateena lateral branch pipeline ▪ Bimba high point storage tank * Note the pipeline construction footprint and Project Area terminate at the boundary of the BHP Special Mining Lease (SML).	195 –360

[1] km point measured along the main transfer pipeline and does not include lateral branch pipeline sections.

2.5 Construction method

The construction of the pipeline and associated infrastructure is anticipated to last several years, with commissioning to be completed in the final months. Construction will comprise a range of activities, including the establishment of construction compounds and accommodation camps, vegetation and topsoil clearing, earthworks, trenching and backfill, under boring (of railway crossings and including some watercourses), concrete works, ancillary facilities within the construction corridor, and subsequent site rehabilitation.

Land clearing, construction, and rehabilitation will be staged, such that only a limited section of the pipeline alignment would be under construction at any one time. This construction model also enables progressive rehabilitation as construction progresses.

Construction may include environmental discharge of groundwater, hydrostatic test water, and/or disinfection water, but no discharge will occur during commissioning. Hydrostatic test water and disinfection water will require pH adjustment and dechlorination before discharge to the environment. If required to be discharged, Groundwater will be tested and treated as per legislative requirements. Beneficial reuse of water will be prioritised over environmental discharges, subject to detailed design and agreements with potential users. Water used for commissioning may be re-used subject to detailed design and ensuring it is fit for purpose.

The construction approach for the Project will be confirmed during the detailed design phase which will be prepared under the future design, build, operate and maintain (DBOM) contract.

2.5.1 Pipeline Construction

The proposed width for the construction corridor is 40 m, with the width constrained in areas of high sensitivity (generally 25 m). Construction options (trench and cover fill, above ground pipe bridges and trenchless installation) that may be utilised along the alignment are outlined below:

- The pipeline is proposed to be buried using trench and cover fill for the majority of the alignment, including road crossings and some watercourse crossings. It is expected that approximately 500m of pipeline will be laid in a day, depending on the location and complexity of the section. Based on the reference design (GHD, 2025a) and the constructability assessment (SYSTRA, 2025), the locations in **Table 2-2** are proposed to utilise trenched construction.

Table 2-2. Summary of Trenched Crossings (SYSTRA, 2025)

Section of Pipeline	CH	Trenched Major/Minor Road Crossings			Trenched Major/Minor Creek			Trenched Service Crossings		
		No.	Length of Crossing (m)	Methodology	No.	Length of Crossing (m)	Methodology	No.	Length of Crossing (m)	Methodology
510 – Pipeline (Desalination Plant to Whyalla North)	0 to 31.6	1	50	Trenched	0			2	20	Trenched
511 – Pipeline (Whyalla North to Port Bonython)	31.6 to 44.8	0			0					
512 - Pipeline (Port Bonython to Lincoln Gap PS)	44.8 to 80.1	1	50	Trenched	7	50	Trenched	1	20	Trenched
513 – Pipeline (Lincoln Gap PS to Kalaya PS)	80.1 to 154.1	3	50	Trenched	8	50	Trenched	10	20	Trenched
514 – Pipeline (Kalaya PS to Mangata PS PS)	154.1 to 215.2	3	50	Trenched	4	50	Trenched	7	20	Trenched
515 – Pipeline (Mangata PS to Carrapateena Junction)	215.2 to 228.4	0			0			1	20	Trenched
516 – Pipeline (Carrapateena Junction to Bimba storage)	228.4 to 251.9	0			13	50	Trenched	1	20	Trenched
517 – Pipeline (Bimba storage to Woomera)	251.9 to 271.3	1	50	Trenched	2	50	Trenched	11	20	Trenched
518 – Pipeline (Woomera to Oak Dam)	271.3 to 284.8	0			4	50	Trenched			
519 – Pipeline (Oak Dam to Olympic Dam)	284.8 to 361.6	6	50	Trenched	0			9	20	Trenched
520 – Pipeline (Carrapateena Junction to Carrapateena)	0 to 45.6	3	50	Trenched	2	50	Trenched	4	20	Trenched

- Following completion of trench backfilling, a 200 mm high mound (Figure 2-2) will be placed on top of the trench. It is expected that mounding must be graded onsite as not to cause a damming effect on either side for natural water flows.

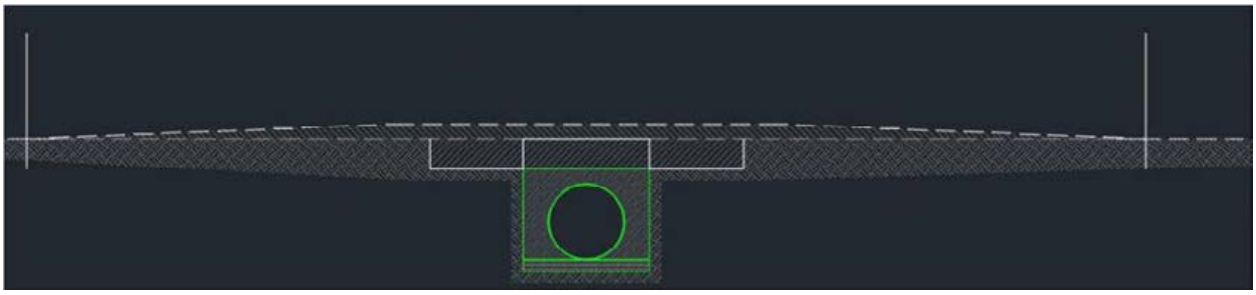


Figure 2-2. Typical Mounding Cross Section (SYSTRA, 2025)

- Trenchless installation (e.g. micro-tunnelling / auger boring) will be used for rail and some watercourse crossings. The sections of the pipeline that will be constructed via trenchless installation will require entry/exit pits (referred to as under bore entry/exit pits in this report) for the launching and receival of the under bored pipe). These under bore entry/exit pits will be open for the duration for the under boring works. Whilst the trenches will not be open for an extended period, groundwater inflow may occur, particularly in areas where the substratum is hydraulically more permeable. The trenches may require dewatering to maintain a safe working environment.
- Above-ground pipe bridges will also be used for some watercourse crossings, predominantly through the Barngarla Determination Aboriginal Corporation (BDAC) area. In the proposed arrangement for the above-ground crossings, the pipeline is supported on driven steel piles and elevated headstocks as per **Figure 2-3** and **Figure 2-4** below. Above-ground crossings generally reduce direct disturbance to the watercourse bed and banks compared to trenching, however they introduce potential interactions with flood flows and require consideration of flood loading. Detailed design should include assessment of potential afflux, debris accumulation, flow diversion and scour around piles and supports, with scour protection and mitigation measures incorporated where required.

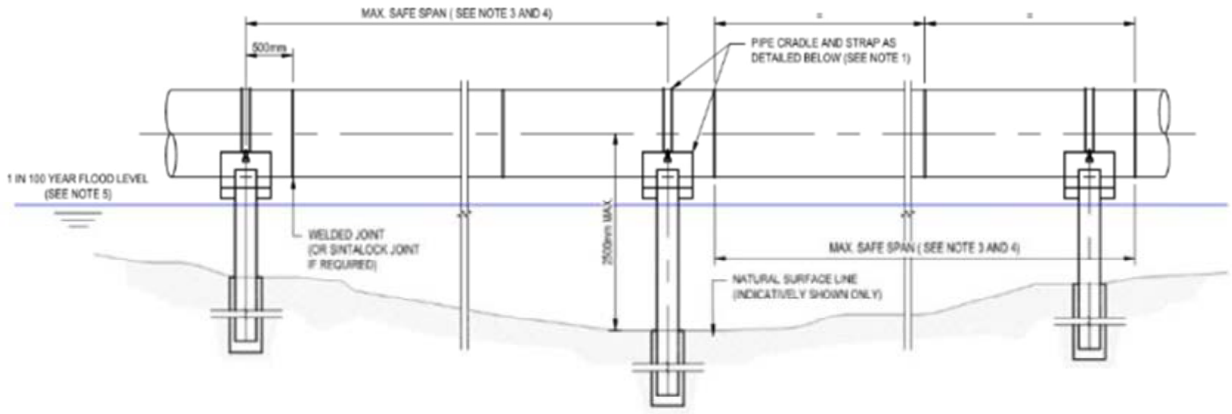


Figure 2-3: Above Ground Crossing Pipe Support Arrangement (GHD, 2025a)

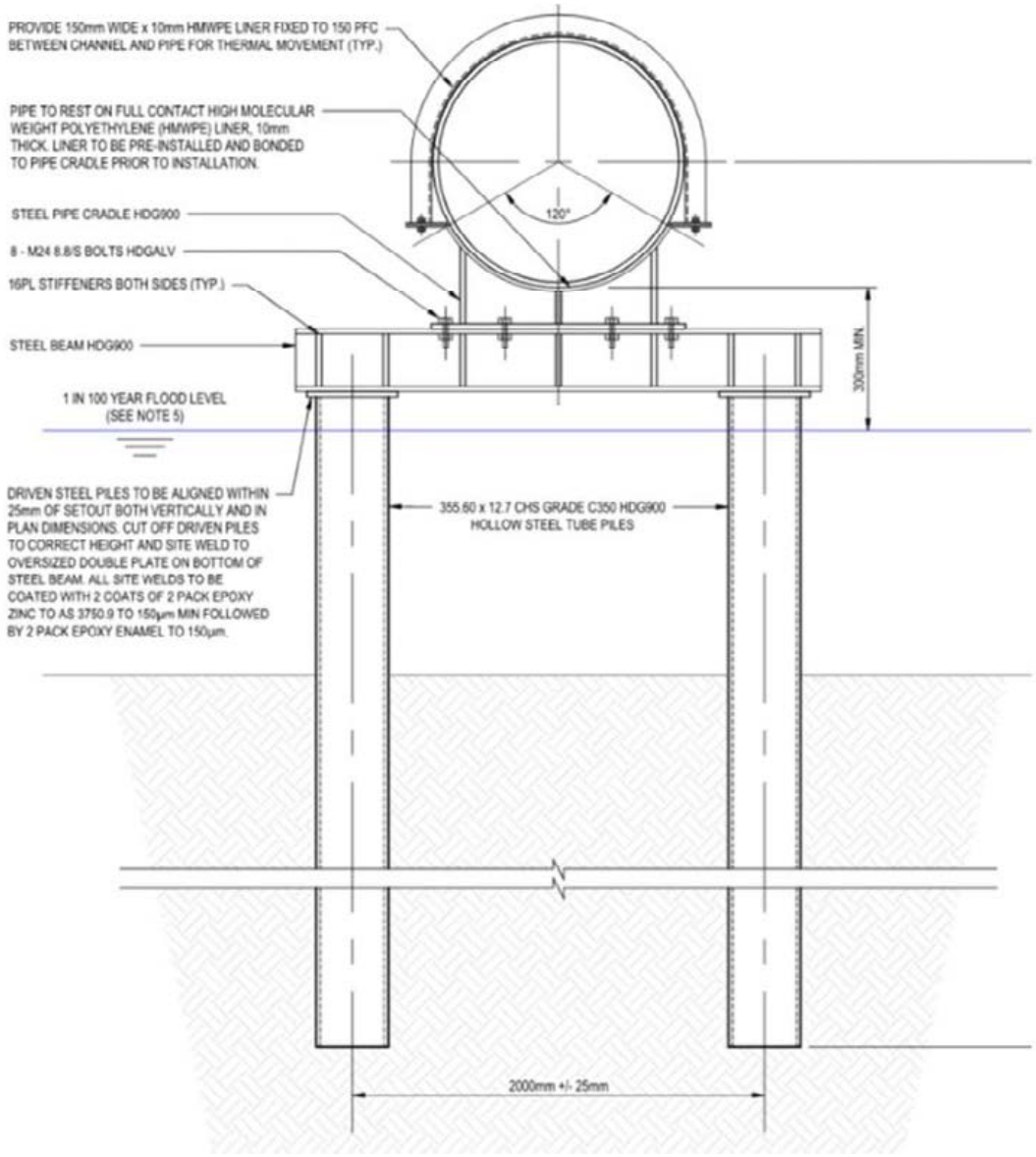


Figure 2-4: Above Ground Crossing Driven Pile Detail (GHD, 2025a)

Locations of trenched, above ground and trenchless crossings will be finalised as part of detailed designs.

Based on the reference design (GHD, 2025a) and the constructability assessment (SYSTRA, 2025), the locations in **Table 2-3** are proposed to utilise above ground and crossings and trenchless construction.

Table 2-3. Identified Above-ground and Trenchless Creek Crossings (SYSTRA, 2025)

Location	Sub Location	CH Location	Crossing Length (m)
Desalination Plant to Whyalla North	Major Creek Above Ground Crossing 1	26.3	150
Lincoln Gap PS to Kalaya PS	Major Creek Above Ground Crossing 2	96.1	300
Lincoln Gap PS to Kalaya PS	Major Creek Above Ground Crossing 3	99.65	200
Lincoln Gap PS to Kalaya PS	Major Creek Above Ground Crossing 4	102.45	100
Lincoln Gap PS to Kalaya PS	Major Creek Above Ground Crossing 5	106.15	50

Lincoln Gap PS to Kalaya PS	Major Creek Trenchless Crossing 1	153.5	50
Mangata PS to Carrapateena Junction	Major Creek Trenchless Crossing 2	221.9	50
Oak Dam to Olympic Dam	Major Creek Trenchless Crossing 3	331.2	50
Carrapateena Lateral	Major Creek Trenchless Crossing 4	34.9	100

2.5.2 Desalination Plant Construction

Construction of the desalination plant is expected to occur progressively over several years, including commissioning, with different elements of the works undertaken concurrently or in stages. The final construction duration and sequencing would be determined by the construction contractor and is expected to include allowances for weather related stoppages. Disturbed areas would be progressively stabilised and rehabilitated following completion of construction activities to minimise erosion and sediment runoff.

2.5.3 Water Required for Construction

Construction water will be required for a range of construction activities. Based on the constructability methodology, construction water demand will be temporary and progressive, moving along the alignment as construction proceeds with the two work fronts.

Indicative construction water requirements vary by activity and location. Daily water demand for pipeline construction is anticipated to be in the order of several hundred kilolitres per day in active work areas, with higher short-term demands associated with trenchless crossing works, which may require up to several megalitres of water over the duration of a single crossing. Tunnelling activities associated with intake and outfall construction at the desalination plant will also require dedicated water supply for soil conditioning, grout production, washdown and ancillary uses.

Construction water will be sourced primarily via existing infrastructure and in particular from SA Water and the Port Augusta to Woomera Pipeline. It will be transported to site by tanker and stored in temporary tank farms co-located at laydown and storage areas. No abstraction from groundwater wells is proposed. Water associated with trenchless crossing and tunnelling works will be managed within contained systems, with treatment, reuse and evaporation undertaken as required to avoid uncontrolled discharge to surface water environments. The construction contractor will be responsible for finalising water supply arrangements in accordance with regulatory requirements.

2.5.4 Construction Wastewater

Construction of the Project would generate wastewater associated with workforce amenities, equipment washdown, commissioning activities and, where relevant, dewatering or treatment processes. As above, wastewater generated through construction will be managed within contained systems, with treatment, reuse and evaporation undertaken as required to avoid uncontrolled discharge to surface water environments. The construction contractor will be responsible for finalising water supply and management arrangements in accordance with regulatory requirements.

2.6 Operation

The pipeline will operate as a closed system during normal operation, with no routine discharge of water to surface water features. Interactions with surface water are expected to be infrequent and primarily limited to commissioning, infrequent maintenance or emergency events (such as pipeline scour or

flushing), operational stormwater runoff from permanent infrastructure, or extreme rainfall or flood events.

Scour and flushing activities may occur during commissioning or infrequent maintenance and will be managed through built-in scour facilities incorporating dechlorination prior to any discharge. Where practicable, water generated during these activities will be captured, reused or managed in accordance with regulatory requirements. Routine operation and maintenance activities are not expected to involve ongoing ground disturbance, erosion or sediment mobilisation.

Stormwater at the desalination plant and other permanent facilities will be managed through permanent drainage infrastructure, including stormwater detention, with stormwater managed separately from process water and wastewater streams.

3. Relevant Legislation

Legislation relevant to the surface water and aquatic ecological aspects of the Project, is summarised below.

3.1 Landscape South Australia Act 2019

The *Landscape South Australia Act 2019* (LSA Act) is the key framework promoting the sustainable and integrated management of the State's natural resources (land, water, biodiversity) and for the management of pest plants and animals.

Under the LSA Act, South Australia is divided into eight regional Landscape South Australia Boards, of which the Project Area falls within the Eyre Peninsula and SA Arid Lands Landscape Boards, managed by the Government of South Australia. Each board develops its own Regional Plan designed to meet the needs of the local regions and contribute to state level planning.

3.1.1 Eyre Peninsula Landscape Board Water Affecting Activity Control Policy

The Eyre Peninsula (EP) Landscape Board's Water Affecting Activity Control Policy sets out the principles for managing water infrastructure and water take and has been developed under the provisions of Section 102 (3) I of the LSA Act. The policy states that water affecting activities "*are activities that may impact the condition of a water resource, water dependent ecosystems or water users. Common examples of water affecting activities include: constructing a dam, road crossing over watercourse, draining water into a watercourse or lake, constructing a drainage channel, or drilling a well. A permit and compliance framework is in place to manage potential impacts associated with these activities*".

It is important to note that the principles for "water take" are specifically for prescribed well areas. In the context of water licensing in South Australia, "water take" refers to the authorised extraction of water from a specific source, such as rivers, streams, groundwater, or other water bodies, as granted by a license issued by the relevant water management authority/authorities. The water take is regulated to ensure sustainable and responsible management of water resources, and helps control the quantity, purpose, and conditions under which water can be taken, promoting efficient water use, protecting ecosystems, and avoiding over-extraction.

The EP Landscape Board's Water Affecting Activities Control Policy (WAACP) sets out the principles that guide the Board and the Minister when considering the granting or refusing of a Water Affecting Activity Permit (WAAP). A WAAP is required to undertake any water affecting activity, to which there are a number of permit exemptions. The relevant water activities are summarised in **Table 3-1**.

It is also noted that a project's approval under the *Planning, Development and Infrastructure Act 2016* (PDI Act) may exempt a contractor from obtaining a WAAP.

Table 3-1. Summary of relevant Eyre Peninsula Landscape Board water affecting activities/exemptions

Activity	Exemption(s)
The construction or modification of a structure or building in a watercourse, lake, or floodplain	▪ Emergency repairs to culvert and causeway provided the activity is consistent with principle 24 (see WAA Control Policy section 2.2.4) ▪ An activity in accordance with an endorsed Best Practice Operating Procedure (BPOP) ▪ Maintaining an existing structure or building in accordance with original permit conditions and or specifications
Draining or discharging water into a watercourse or lake.	▪ An activity in accordance with an endorsed BPOP
Destroying vegetation in a watercourse, lake or floodplain requires a permit.	▪ Vegetation is destroyed in accordance with the LSA Act for the control of pest animals and plants ▪ Vegetation is destroyed with consent granted under the *Native Vegetation Act 1991* ▪ An activity in accordance with an endorsed BPOP
Excavating rock, sand or soil from a watercourse, lake or floodplain.	▪ Repair or maintain an existing drain provided the activity is in accordance with principle 27 (see WAA Control Policy section 2.2.4) ▪ Desilt a spring, soak or water hole provided the activity is in accordance with principle 28 (see WAA Control Policy section 2.2.4) ▪ An activity in accordance with an endorsed BPOP

[1] EP-control-plan-water-2023.pdf (environment.sa.gov.au)

[2] Best Practice Operating Procedure (BPOP) is the process by which a single Water affecting Activity (WAA) permit may be granted allowing a person to undertake a range of specified WAAs at multiple locations using the same operating procedure.

3.1.2 South Australia Arid Lands Landscape Board Water Affecting Activity Control Policy

Similarly, the South Australia Arid Lands Landscape Board (SAALLB) manages and protects water resources through a WAACP. The SAALLB has determined a number of activities require additional controls to protect and better manage the region's water resources by:

- ensuring sustainable use of water resources.
- ensuring equity among existing water users.
- maintaining existing heritage and cultural value; and ensuring long-term integrity of ecological functions and water dependent ecosystems.

The WAACP states that the SAALLB is of the view that it is not necessary or practicable to require a permit for all activities under section 104(4) of the LSA Act and acknowledges that some activities are managed under other legislation (e.g. PDI Act). The water-affecting activities covered by this Policy in the SAAL region are shown in **Table 3-2**.

Furthermore, the SAALLB WAACP outlines requirements to protect the non-prescribed surface water resources of the SAAL Region. The policy aims to manage the risk of water take to water dependent ecosystems (including groundwater dependent ecosystems), species and processes (services) and water quality.

Table 3-2. Summary of relevant SAALLB water affecting activities/exemptions

Activity	Exemption(s)
Managing infrastructure: Building a structure in a watercourse, lake, or floodplain	The building or structure will be erected, constructed or placed no less than 40 metres from the edge of a watercourse and the building or structure does not take water or is not associated with the taking of water
Managing discharge: Drainage or discharge of water into a watercourse or lake	▪ The activity occurs outside of the Port Augusta and Flinders Ranges Management Zone (refer **Figure 3-1**) and where the volume of water drained is less than 1ML per year ▪ The activity is within the Port Augusta and Flinders Management Zone where: - The draining or discharging of water is into a watercourse not delineated as a priority watercourse in the SAAL WAA Control Policy; or - Involves draining or discharging water of better quality than the receiving waters and the volume of the water drained or discharged does not exceed a volume of 0.5 ML
Managing vegetation: Destroying vegetation growing in a watercourse or lake, or growing on the floodplain of a watercourse	▪ The destruction of vegetation growing in a watercourse or lake or growing on the floodplain of a watercourse is undertaken no less than 40 metres from the banks of a watercourse ▪ The proposed vegetation to be destroyed is growing in a watercourse or lake or growing on the floodplain of a watercourse not delineated as a priority watercourse in the SAAL WAA Control Policy, and where the activity is for the purpose of controlling a declared pest plant or in accordance with a consent granted under the Native Vegetation Act 1991; or ▪ Involves either proclaimed plants or other vegetation that does not involve the physical removal of the plants
Using imported water: Using water (including effluent) in the course of carrying on a business in a Landscape region	Nil

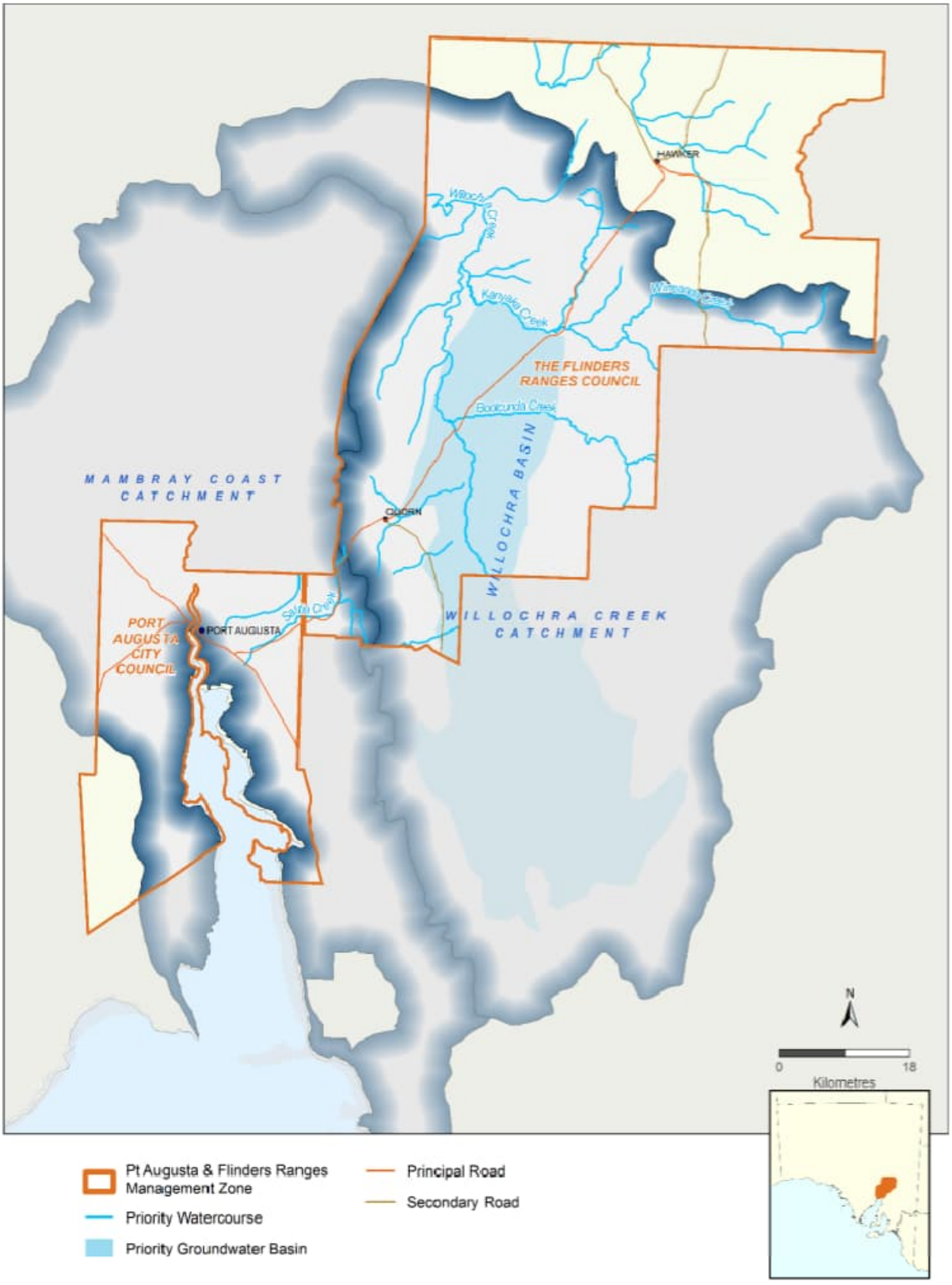


Figure 3-1. The Port Augusta and Flinders Ranges Management Zone showing priority areas for water affecting activities for groundwater, surface water and watercourses (SAALLB, 2021)

3.2 Environment Protection Act 1993 (South Australia)

The *Environment Protection Act 1993* (EP Act) addresses environmental protection, including matters related to water quality and pollution. The EP Act identifies Water Protection Areas that have been delineated for the purpose of providing special environmental protection for the protection of water (including groundwater) from pollution. The Project is not located within any defined Water Protection Areas (EPA, 2020b).

The EP Act establishes a general environmental duty which requires that persons undertaking an activity take all reasonable and practicable measures to prevent or minimise environmental harm.

The EP Act also outlines requirements and standards within Environment Protection Policies, including the *Environment Protection (Water Quality) Policy 2015* (Water Quality EPP).

3.2.1 Environmental Protection (Water Quality) Policy 2015 (South Australia)

The Water Quality EPP addresses water quality standards and objectives, specifying the environmental values to protect inland surface and marine waters (including estuarine). Freshwater and estuarine waters are present within the Project Area. Environmental values applying to the Project are summarised in **Table 3-3** and further explained below. These environmental values have specific water quality criteria that need to be achieved to protect these environmental values. The criteria are outlined in **Appendix A**.

Table 3-3. Environmental values applying to waters potentially affected by the Project.

Waters	Aquatic ecosystems	Recreation and aesthetics	Drinking water for human consumption	Primary industries – irrigation and general water uses	Primary industries – livestock drinking water	Primary industries – aquaculture and human consumption of aquatic foods
Marine waters	X	X				X
Inland surface waters	X	X		X	X	X

Protection of aquatic ecosystems

Aquatic ecosystems can include freshwater, estuarine and marine environments, and comprise the animals, plants and microorganisms that live in water and the physical and chemical environments in which they interact.

There are several indicators of water quality relevant to the protection of aquatic ecosystems that may be impacted by the Project if not appropriately managed and mitigated, including:

- Nutrients: nutrients in aquatic environments promote the growth of algae and increase turbidity which in turn reduces light and may affect plant growth.
- Total suspended solids (TSS) are a measure of the fine particles suspended in water and are important to aquatic ecosystems as high concentrations of sediment can reduce the light available for aquatic organisms. Additionally, the fine particles that comprise of TSS carry nutrients, metals and other pollutants from a variety of sources such as agricultural runoff, leaching of soil contaminants and point source pollution.

- pH is a measure of the acidity or alkalinity of a waterbody. Changes in pH can impact on the ability of aquatic organisms to maintain basic functions such as respiration. Acidity also controls the bioavailability of metals, nutrients, and other organic molecules.
- Heavy metals include metals and metalloids present in total or dissolved forms that may be directly toxic to instream organisms. There are acute and chronic toxicity effects depending on the concentration, pH, hardness, and dissolved oxygen levels. Certain heavy metals can bioaccumulate in aquatic ecosystems and biomagnify through food chains.

Aquatic ecosystems, in various forms including watercourses, saline lacustrine systems and Spencer Gulf are intersected by the Project or located in proximity to Project. However, it is noted that no salt lakes are intersected by the Project.

Recreation and aesthetics

The aesthetic appearance of a water body is important for passive and active recreation. As such, the water should be free from obvious pollution including debris, oil, scum, and other matter, including those that might contribute to visual pollution or visual clutter. Substances producing objectionable colour, odour, taste or turbidity and substances that produce undesirable aquatic life should not be apparent. The aesthetic quality of a waterway will be compromised if increases of key indicators result in fish deaths, anaerobic conditions, excessive plant growth and visible algal blooms.

Recreational uses of water bodies comprising freshwater within or adjacent to Project infrastructure is limited, given the temporary presence of water. Recreational use of the marine environment may include walking, fishing, boating, and snorkelling.

Primary industries – aquaculture and human consumption of aquatic foods

Aquaculture generally involves the production of food for human consumption, and suitable water quality is needed for maintaining viable aquaculture operations. The guidelines primarily relate to toxicant concentrations and reducing the potential for these to accumulate in the tissues of seafood that is likely to be consumed by humans.

Several aquaculture zones are located adjacent the east coast of the Eyre Peninsula.

Primary industries – irrigation and general water uses

There are a number of water quality characteristics that can affect the suitability of water for irrigation use which in turn can limit the productivity of irrigated agriculture land. Of particular relevance to the Project Area is salinity which is the presence of soluble salts in or on soils and waters. If high levels of salt are present in irrigation waters and/or soils, accumulation of salts can lead to reduce crop yield and land degradation.

Water for irrigation may be obtained via dams or abstraction of groundwater.

Primary industries – livestock drinking water

Good water quality is essential for successful livestock production. The Project may impact on the quality of groundwater and surface water which are both sources of drinking water for livestock through potential increases in concentrations of salt, nutrients, and other contaminants from discharges to watercourses. Mitigation measures to reduce the impacts from discharges are discussed in Section **7**.

The environmental values have been considered in the assessment of existing water quality and potential impacts as a result of the project.

3.3 Planning, Development, and Infrastructure Act 2016

The PDI Act governs the planning system in South Australia and sets out the process and pathways for granting development approvals, including approvals for major developments and assessment though an environmental impact statement (EIS).

The level of detail required to be addressed in an EIS is determined by the State Planning Commission (SPC) and guided by the Assessment Requirements published by the SPC pursuant to section 112 of the Act – the Assessment Requirements require the assessment of the impacts of the Project on matters of environmental, social, and economic importance, and the extent to which the development is consistent with the Planning and Design Code.

3.4 Other legislation and guidance related to surface water

- The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/AMRCANZ, 2000) (superseded by the Water Quality Guidelines; ANZG, 2018) are referenced by the Water Quality EPP and provide additional guidance on planning and managing water quality including derivation of guideline values. The nominated environmental values and guideline criteria are provided in **Appendix A**.

  The current Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), also referred to as the Water Quality Guidelines were released in 2018 as an online resource. They provide high-level guidance on the management context, ecological descriptions, biological indicator selection, regional default guideline values for physical and chemical stressors and other advice for three of Australia's 12 inland water drainage divisions. The ANZG (2018) should be used for ecoregions where physical and chemical stressor default values are not yet provided and local jurisdictions have not yet derived finer scale (e.g. catchment, basin or physiographic level) guideline values. The guideline values specified in **Appendix A** are derived from the ANZG (2018).

- Commonwealth Environment Protection and Biodiversity Conservation Act 1999: The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places — defined in the EPBC Act as Matters of National Environmental Significance (MNES). Under the environmental provisions of the EPBC Act, actions that are likely to have a significant impact on MNES are identified as 'controlled actions' and cannot be undertaken without referral to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) to determine the requirement for formal assessment and approval under the EPBC Act.

- If an action has the potential to have a significant impact on a MNES, the proposed action is referred to DCCEEW to determine the requirement for formal assessment and approval under the EPBC Act. A referral for the Project was submitted to DCCEEW on 19 December 2025, for a decision as to whether there was the potential for significant impacts to Matters of National Environmental Significance (MNES). The Project was determined to be a Controlled Action requiring approval under the EPBC Act, and the accredited assessment process under the South Australian PDI Act was decided as the pathway for the purposes of assessment of the proposed action.

- The South Australian Government's Climate Change Action Plan 2021-2025 outlines a comprehensive plan to address climate change and its potential impacts. The document emphasises the need to assess and address climate change risk in government infrastructure decisions, risk assessment, and audit processes. The plan identifies the need for developing a framework for integrated urban water management to inform investment decisions and assess the implications of climate change for ecosystems to inform critical adaptation strategies.

- South Australia Fisheries Management Act (Dept. of Primary Industries and Regions) provides for the conservation and management of aquatic resources in South Australia, including fish, aquatic invertebrates, and aquatic plants, and protection of aquatic habitat. The legislation provides the government with powers to ensure commercial fisheries are sustainable and that recreational fishing opportunities are maintained.
- The Eyre and Western Regional Plan (PlanSA, 2026a) and Far North Regional Plan (PlanSA, 2026b) outline strategies to address the impacts of climate change in the region. It covers a wide range of topics, including the potential effects of climate change on infrastructure, ecosystems, and communities.
- The plan also emphasises the importance of incorporating traditional knowledge and engaging with local communities in the adaptation process. Additionally, it provides case studies and examples of successful adaptation measures that have been implemented in the region. It identifies desalination as a potential action to support the maintenance of essential services.
- Environmental management of dewatering during construction activities (EPA 1093/21, 2021) is a guidance document on the obligation required under the EPA Act and the Water Quality Policy with respect to environmental management of dewatering during construction activities, at sites where earthworks will intersect groundwater or other non-groundwater related temporary dewatering activities. Any water removed during dewatering is classified as wastewater and must not be discharged directly or indirectly to surface waters.
- Construction environmental management Plan (CEMP 1095/24) (EPA, 2024) is a document to provide guidance on the information that should be included in a construction environmental management plan (CEMP) to ensure construction activities are managed to prevent impacts to water quality.
- Stormwater pollution prevention code of practices for the building and construction industry (EPA 1999) identifies strategies for the collection, treatment, storage, and disposal of stormwater during construction, while minimising the impact on the environment. The code is linked to the Water Quality EPP and designed to assist with complying with the general environmental duty under the EP Act.
- Bunding and spill management (EPA 080/16, 2016) guideline applies to facility that use or store liquid above ground and provided information on bunds or spill containment systems to minimise the risk of environmental harm from spills and leaks.
- Action Plan for South Australian Freshwater Fishes (Hammer et al, 2009) guideline was developed by Native Fishes Australia SA, Inc. and the South Australia Department for Environment and Heritage. It provides a comprehensive overview of issues and actions to protect and restore populations of threatened freshwater fish species and ecological communities. It also defines important fish habitats and their management jurisdictions in South Australia. Seven important fish habitats are defined in the South Australian Arid Lands and one in the Eyre Peninsula, none of which are intersected by the Project.

4. Assessment Method

4.1 Hydrology and catchment context

The surface water catchments related to the Project do not have any stream gauges installed and as such a quantitative assessment of the catchment hydrology cannot be completed. This includes assessing the flow regime that may be expected within ephemeral and permanent watercourse channels along the pipeline route. The method for the assessment of the catchment hydrology has instead involved a desktop review of available information that has focused on the following areas:

- Assessment of seasonal climate in Spencer Gulf Basin, Mambray Coast Basin, Gairdner Basin, and Lake Torrens Basin.
- Implications of antecedent conditions on runoff generation.
- Assessment of anticipated seasonal runoff for major watercourse crossings. (A crossing through or under a watercourse with the potential for high quantity and/or velocity flows capable of undermining the water main passing beneath it).
- Review of the January 2022 rainfall and runoff events, the most recent large rainfall event that has impacted the region.

Additionally, field surveys to assess topography, geology, and geomorphology were performed in November and December 2023. Watercourses planned to be crossed were assessed, with morphology, vegetation, flash flood susceptibility, and visible groundwater connections noted. Further details are presented in *Northern Water Project - Topography, Geology and Soils Assessment* (Jacobs, 2026a).

4.2 Water quality

The methodology for assessment of potential surface water quality impacts arising from the Project has included:

- Desktop review and analysis of existing surface water information to understand the existing environment, nominated environmental values and identify potential watercourse-specific risks.
- A qualitative assessment of the quality of pollutants that may be introduced during construction and operation, and the impact that this may have on surface water quality (with reference to the ANZG (2018) Water Quality Guidelines) and with regard to relevant environmental values.
- Proposed management measures to mitigate the impacts of construction and operation on surface water quality.

4.2.1 Environmental Values

As described in Section **3.4**, watercourses in the Study Area are categorised as inland surface waters and marine waters and have a number of environmental values nominated and applicable water quality guidelines for protecting these values which are described in **Appendix A**. These guidelines have been used to evaluate the potential of the Project to impact environmental values (such as aquatic ecosystems, use for irrigation, and use for stock watering) via altered water quality.

4.3 Flooding

A high-level desktop assessment was undertaken on available information in order to provide qualitative assessment of flood risk, including:

- Review of existing hydrological and flood data.
- Delineation of catchment boundaries along the Project Area. This was undertaken using a global digital elevation model (DEM).
- Peak flood estimation using the Regional Flood Frequency Estimation (RFFE) method (2021 version[1]).

Note that sections of the pipeline through low-lying coastal areas (e.g., southwest of Whyalla) may be vulnerable to coastal flooding. Coastal flooding and the risk of sea level rise was not assessed as part of this assessment.

4.3.1 Data review

To inform the flood assessment, the following data sources were reviewed:

- GIS data of watercourses, waterbodies, sub-catchments, catchments, and drainage basins published by the Department for Environment and Water, South Australia. It was found that there are significant gaps in the data coverage, particularly in the central and northern sections of the Project Area.
- LiDAR topography survey. As the data coverage was predominantly limited to a 3 km wide corridor along the project alignment, there is insufficient coverage of the upstream catchments. Therefore, LiDAR data was not used for this assessment.
- Given the limited availability of high-resolution topography data, a global DEM sourced from the Japan Aerospace Exploration Agency (JAXA, 2023) was used for this assessment.
- Flood overlays sourced from SA Property and Planning Atlas (PlanSA, 2026c). The vast majority of the Project Area is within the Hazards (Flooding – Evidence Required) Overlay, indicating unknown flood risk where no detailed flood study data is available.

4.3.2 Flood assessment constraints

While there have been past EIS assessments conducted in the region for other projects, there were no authoritative regional flood hydrology studies available to inform this assessment. Due to the sparsity of data (particularly streamflow data and spatial data) across the entire region, there is a high degree of uncertainty associated with the results presented in this section. The key uncertainties are:

- Drainage line and catchment delineation
  - The global DEM dataset used has a 30-metre grid resolution and with vertical errors of ± 5 metres. The vertical errors are particularly high relative to the topography gradient. Consequently, there is significant uncertainty in the catchment area boundaries, and in some cases, the direction of flow. This is particularly an issue in the inland area where the topography is broadly flat.
  - To address this uncertainty, drainage lines with large catchments (> 500 km^2) have been validated against other sources of information including aerial imagery, catchment and basin boundaries and watercourse lines sourced from WaterConnect[2] where available.

[1] https://rffe-2021.wmawater.com.au/

[2] https://www.waterconnect.sa.gov.au/Pages/Home.aspx

- Due to the large number of small and medium catchments (< 500 km^2) in the Project Area, it was not feasible to conduct a similar validation exercise. The results of small and medium catchments are reported collectively.

- RFFE method
  - The RFFE method is the recommended peak flow estimation method for ungauged catchments in Australian Rainfall and Runoff (ARR, 2019). It was first published in 2015 and was most recently updated in 2021 and released as a beta version. In simple terms, it is a statistical method for transferring flood frequency characteristics from the nearest gauged catchments to the location of interest. However, in the region of the Project, there is a sparsity of suitable gauged catchments. Consequently, it was necessary to transfer flood properties from catchments located hundreds of kilometres away (for example, on the other side of Spencer Gulf). As a result, the flood estimates reported have high uncertainty, as exemplified by the magnitude of the confidence intervals.

4.4 Aquatic ecology

4.4.1 Characterisation of aquatic communities including MNES

The scope of the desktop assessment of aquatic communities, includes the following flora and fauna groups:

- Freshwater fishes (i.e., those that primarily live in freshwater and/or inland salt lakes).
- Freshwater invertebrates (i.e., those that primarily live in freshwater and/or inland salt lakes).
- Freshwater turtles (despite there ultimately being none recorded).
- Riparian, aquatic, and inundation-dependent vegetation (i.e. floodplain). The assessment is informed by the following databases and material:
  - A search of the Protected Matters database via the online Protected Matters Search Tool (PMST), inclusive of a 5 km buffer surrounding the Project footprint (within the EPLB region) and 50 km buffer within the SAALLB region (Project Area as defined in Section **2.4**) was undertaken in November 2025 (See **Appendix C** for full results).
  - Review of all Biological Database of South Australia records (BDBSA) records within the Project Area undertaken in July 2025 (See **Appendix D**).
  - Review of Atlas of Living Australia (ALA) (2022-2026) records where there is a paucity of information available on government databases and extra justification is required.
  - Review of other publicly available literature.
  - Results of the *Northern Water Project – Terrestrial Ecology Baseline Report* (Jacobs, 2026b) that recorded vegetation communities in and around watercourses within the Project Area.

4.4.2 Likelihood of occurrence assessment

No aquatic Threatened Ecological Communities or threatened aquatic species (flora or fauna) were highlighted in the EPBC PMST output, or any other data sets, as potentially occurring within the Project Area (see also *Northern Water Desalination Plant and Water Transfer System Infrastructure Project EPBC referral no. EPBC 2025/10397*).

As such, a likelihood of occurrence assessment for Protected Matters was not required.

4.4.3 Aquatic habitat assessment

Twelve ecological field surveys were undertaken between 2021 and 2026 (including 10 by Jacobs and two by Lathwida Environmental). The surveys covered areas relevant to the current Project Area, as well as previous alignment revisions (see *Northern Water Project – Terrestrial Ecology Baseline Report* (Jacobs, 202b) and *Northern Water project - Ecology Survey Result Summary - Mullaquana Station Desalination Plant* (Jacobs, 2025a)) along with a soils and geomorphology assessment (November and December 2023) (see *Northern Water Project – Topography, Geology and Soils Assessment* (Jacobs, 2026a)), during which aquatic habitat was described to support this assessment[3].

As the desktop assessment did not identify any aquatic threatened species recorded in the vicinity of the Project Area, a specific aquatic habitat assessment was not undertaken. Rather, the aquatic ecological assessment was supported by the photos and observations collected during the terrestrial ecology and topography field surveys.

4.5 Risk assessment methodology

A risk assessment was conducted to:

- Identify and describe the key risks and effect pathways resulting from the construction and operation of the Project that have the potential to negatively impact aquatic flora and fauna and their habitat, or negatively impact MNES as defined in the EPBC Act.
- Evaluate the significance of potential adverse effects.
- Develop measures to avoid or limit the adverse effects to acceptable levels.

The environmental performance objective adopted for the risk assessment is to avoid and minimise impacts on any State and Commonwealth listed aquatic species (recognising that there are none likely to be present within or adjacent the Project Area), aquatic or marine ecosystem health, and commercial and recreational surface water values.

Risks to these environmental values were assessed using the likelihood and consequence scales that are described in **Table 4-1** and **Table 4-2**.

The level of effort directed at investigating and managing potential adverse effects has been based on the evaluated risk ratings outlined in **Table 4-3**, with greater effort directed to matters that pose a higher risk.

Table 4-1. Risk likelihood criteria used to judge key risks associated with the construction and operation of the Project.

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

[3] Note that the collection of aquatic habitat information was ancillary to objectives of this fieldwork and was not systematically described across the Project Area.

Table 4-2. Consequence criteria used to judge key risks associated with the construction and operation of the Project.

Consequence	Potential Adverse Effects
Severe	Long-term and possible permanent deleterious impact to: ▪ watercourse characteristics such as flow, morphology, or bank structure, ▪ threatened aquatic fauna or their habitat, ▪ aquatic ecosystem health such as a decrease in water quality, sedimentation, or benthic macroinvertebrate community, ▪ commercial values, such as usability for stock watering or industrial uses, beyond the construction footprint or maximum inundation areas.
Major	Substantial but reversible deleterious impact to: ▪ watercourse characteristics such as flow, morphology, or bank structure, ▪ threatened aquatic fauna or their habitat, or reduced breeding capacity for greater than one season, ▪ aquatic ecosystem health such as a decrease in water quality, sedimentation, or benthic macroinvertebrate community, ▪ commercial values, such as usability for stock watering or industrial uses, outside the construction footprint or maximum inundation areas.
Moderate	Measurable but reversible deleterious impact to: ▪ watercourse characteristics such as flow, morphology, or bank structure, ▪ threatened aquatic fauna or their habitat, or reduced breeding capacity for greater than one season, ▪ aquatic ecosystem health such as a decrease in water quality, sedimentation, or benthic macroinvertebrate community, ▪ commercial values, such as usability for stock watering or industrial uses, within the construction footprint or maximum inundation areas.
Minor	Insignificant deleterious impact to ▪ watercourse characteristics such as flow, morphology, or bank structure, ▪ threatened aquatic fauna or their habitat, ▪ aquatic ecosystem health such as a decrease in water quality, sedimentation, or benthic macroinvertebrate community, ▪ commercial values, such as usability for stock watering or industrial uses, within the construction footprint or maximum inundation areas. No adverse effect on breeding capacity of threatened aquatic fauna.
Negligible	Positive or no deleterious impact to: ▪ watercourse characteristics such as flow, morphology, or bank structure, ▪ threatened aquatic fauna or their habitat, ▪ aquatic ecosystem health such as a decrease in water quality, sedimentation, or benthic macroinvertebrate community, ▪ commercial values, such as usability for stock watering or industrial uses, within the construction footprint or maximum inundation areas.

Table 4-3. Risk Rating matrix derived from likelihood and consequence assessments.

	Consequence				
Likelihood	Severe	Major	Moderate	Minor	Negligible
Almost certain	Extreme	Extreme	Very High	High	Medium
Likely	Extreme	Very High	High	Medium	Low
Possible	Very High	High	Medium	Medium	Low
Unlikely	High	Medium	Medium	Low	Low
Rare	Medium	Medium	Low	Low	Low

Given that almost all watercourses crossed by the Project are ephemeral and often dry, and rainfall in the Project Area is infrequent, for most risks that involve rainfall, runoff, or flowing watercourses, the likelihood ranges from "possible" to "rare".

Watercourses that may be impacted more by particular risks due to hydrology, location, landform, and likelihood of being impacted by the Project have been identified as "considered to have potential high impact" for these risks. These are further described in Section **5.3.1**.

5. Existing Environment

5.1 Landscape Management regions

The Project falls within the South Australian Landscape Regions of the Eyre Peninsula and South Australian Arid Lands (see Section **3.1**).

5.1.1 Eyre Peninsula

The Eyre Peninsula region covers approximately eight percent of South Australia comprising a total natural resource area of 81,000 km^2, which includes approximately 51,000 km^2 of land area and large expanses (circa 30,000 km^2) of coast and marine waters (DEH, 2007; DEW, 2021a). The Eyre Peninsula is bordered by the Southern Ocean in the south, the Great Australian Bight to the west, the Gawler Ranges to the north, and Spencer Gulf in the east (Wen, 2005). It is managed by the EPLB (see Section **3.1**).

The hydrology of the Eyre Peninsula has resulted in three river basins (Eyre Peninsula, Gairdner, and Spencer Gulf). The southern extent of the Project Area falls within Spencer Gulf drainage basin, which covers the areas south of Whyalla to south of Cummins.

5.1.2 South Australian Arid Lands

The northern section of the Project falls within the South Australian Arid Lands Region. This Landscape Region covers more than half of South Australia in its north-east corner, extending to its borders with New South Wales, Queensland, and the Northern Territory. It exhibits semi-arid climatic conditions which are defined by hot dry desert summers and mild to cool winters with low, highly variable rainfall. The region includes some of the driest parts of the State and some of its most ecologically significant landscapes including conservation reserves and national parks, as well as two large inland water systems: Kati Thanda – Lake Eyre and the Great Artesian Basin. The main land use is sheep and cattle pastoralism; large mining and petroleum operations are also present. The region supports less than 2% of the South Australian population (SAALLB, 2024).

5.1.3 Topography overview

The topography of the Project Area is generally of low relief. The ground levels in the vicinity of the Mullaquana Station Desalination Plant site range from approximately 11 m AHD in the northwest to approximately 6 m AHD in the southwest. The intake pump station is at an elevation of approximately 4.2 m AHD. The ground surface elevation along the pipeline ranges from a minimum of approximately 5 m AHD at about 10 km south-west of Whyalla, to a maximum of approximately 217 m AHD at Carrapateena.

The topography of the Project Area consists of the following:

1. The Project Area corridor is offset from the coastline between Mullaquana Station and Whyalla. The pipelines traverse gentle easterly facing slopes with defined drainage features (either vegetated swales or active channels). Closer to the coast the slopes transition into sandy planes (typical dune/swale systems).
2. The Project Area corridor between Whyalla and Pimba consists of hills where slopes vary in steepness. The hills generally form shallow valleys with clearly defined drainage features. Low lying areas often contain clay pans and salt lakes.

3. The Project Area corridor between Pimba and Olympic Dam is generally flat with localised undulations. The plain has swales and generally shallow drainage features that dissect the landscape. There as some more extensive channel and escarpments where the land drops away to the salt lakes that form in fully or partially closed catchments, although the proposed pipeline alignment avoids the significant elevation changes.

5.2 River Basin overview

5.2.1 Southern section

The southern section of the Project Area refers to the area from the desalination plant at Mullaquana Station to Lake Dutton / Pernatty Lagoon. The section crosses Spencer Gulf Basin (KP 0 to KP 82), the Mambray Coast Basin (KP 82 to KP 135), Gairdner (KP 135 to KP 155 and KP 163 to KP 200) and Lake Torrens (KP 155 to KP 163) drainage basins.

This section is primarily characterised by steep escarpments and plateaus, divided by alluvial plains (BHP Billiton, 2009a). The drainage lines in this portion of the pipeline are well defined and weathered with active bed loads. Stormwater flow typically traverses the minor channels before joining into larger incised creeks and into the wider floodplain. Bed load varies in size and profile and can include alluvial scree, finer sands, and silty sands.

Vegetation varies between predominantly Low Bluebush on the stony tablelands of the Arcoona Plateau and the open woodlands of Western Myall (*Acacia papyrocarpa*), Black Oak (*Casuarina pauper*) and False Sandalwood (*Eremophila mitchellii*) and mixed Chenopod shrublands of Black Bluebush (*Maireana pyramidata*), Pearl Bluebush (*Maireana sedifolia*) and Bladder Saltbush on the flat to undulating plains (Jacobs, 2026a). Vegetation associated with waterbodies in this section are not well reported on in this specific area.

5.2.2 Northern section

The northern section of the Project Area is in a very low rainfall region that roughly extends from Lake Dutton / Pernatty Lagoon to Olympic Dam. The section crosses the Gairdner (KP 200 to KP 360) drainage basin.

The area south of Pimba is defined by extensive sandy and clayey plains, salt pans that form intermittent salt lakes, and defined drainage lines. Vegetation is often more highly concentrated around drainage lines. Although erosion is limited, it is visible in areas where flows are concentrated along roadside drainage systems and culvert features. Salt pans are notable in this region, in the vicinity of Pimba. The flatter terrain results in widespread surface water ponding and evaporation leading to concentration of salt and minerals. Vegetation in this area is also noted to be more salt-tolerant.

The area north of Pimba to Olympic Dam is characterised by extensive dunes, interdunal swales, clay pan depressions and low-lying, sparse vegetation. Topography within the region is relatively expansive, with generally larger catchments and flatter slopes when compared to the southern and central sections of the Project Area. Stream channels are often shallow and wide as water velocities are lower, so do not cut more incised channel shapes. However, catchments bound by the crest of the sand dunes can often be smaller in size and have steeper slopes.

The sandy dunes are highly permeable, and rainfall can infiltrate quickly through the sandy profile, before reaching the thick clayey soil under the dunes. Flows then drain into the nearby swales and clay pans which are less permeable due to their clayey soil profiles. Stormwater is able to infiltrate the surface cracks of the clay soils, resulting in swelling. This reduces infiltration into the soils, leading to surface water ponding (BHP Billiton, 2009).

Broad networks of watercourses are observed along the lateral branch pipeline, and consist of large, braided streams, with multiple sandbars and channels. Drainage lines in this section are mostly to partially vegetated with heavy scouring due to concentration of flows from culverts and road drainage.

The intensity of rainfall can heavily impact the duration of surface water ponding, with total duration of inundation in the region spanning from hours to weeks and even months. Surface water is generally fresh and of high quality, providing a valuable resource for native fauna and livestock (BHP Billiton, 2009c).

Primary productivity soars during these periods as plants germinate, grow, and reproduce quickly to take advantage of the moisture (Morton *et al.* 2011). Secondary productivity follows as the moisture and increased primary food source encourages reproduction and drives growth of insects and vertebrates (including fish such as the Lake Torrens Hardyhead (*Craterocephalus eyresii*)) that have evolved to rapidly take advantage of such sudden and temporary changes in conditions (Arthington and Balcombe, 2011). This in turn supports a rise in predator numbers, including waterbirds (Timms, 2007).

Furthermore, the flowing channels and flooded clay pans provide pathways for aquatic organisms residing in surface water refuges (e.g. Lake Torrens and permanent artesian springs) to disperse and potentially recolonise refugia in distant areas (Arthington and Balcombe, 2011). However, as rainfall ceases and the water bodies evaporate, the environment returns to its arid state. Vegetation withers, and food resources diminish, triggering a dramatic collapse in animal populations. Many species either retreat to refuge habitat or enter states of dormancy to survive the harsh conditions.

The vegetation associated with the watercourses is not particularly characteristic of a waterway environment (i.e., inundation dependent) (Jacobs, 2026b). That said, the vegetation types associated with waterways include:

Associated with drainage lines

- Black Bluebush / Bladder Saltbush (*Atriplex vesicaria*) low open shrubland with emergent Elegant Wattle (*Acacia victoriae*).
- Waterbush (*Myoporum montanum*) / Elegant Wattle closed shrubland / Black Bluebush.
- Curara (*Acacia tetragonophylla*) / Weeping Pittosporum (*Pittosporum angustifolium*) tall shrubland.
- Black Oak (Casuarina pauper) open woodland over Tussock Grasses (*Eragrostis setifolia* / *Enteropogon acicularis)* / Elegant Wattle.
- Sandhill Wattle (*Acacia ligulate*) tall closed shrubland.
- Western Myall (*Acacia papyrocarpa*) / Black Oak / open woodland over Sago Bush (*Maireana pyramidata*) and tall shrubland (Sandhill Wattle (*Acacia ligulate*) / Burkitt's Wattle (*Acacia burkittii*) / Senna spp.) / Native Pine (*Callitris gracilis*).

Associated with waterholes

- Typha (*Typha domingensis*) waterhole with River Redgum (*Eucalyptus camaldulensis* ssp. *Arida*) open woodland.

Associated with saltpan fringes

- Melaleuca (*Melaleuca xerophila*) tall closed shrubland (Tecticornia spp.).
- Samphire (*Tecticornia indica ssp. leiostachya*) / Clustered Lawrencia (*Lawrencia glomerata*) low shrubland.
- Tecticornia spp. (*indica ssp. leiostachya / halocnemoides*) low open shrubland.

5.3 Watercourses and waterbodies

There are a number of watercourses and waterbodies along the Study Area (shown in **Figure 5-1** (southern section) and **Figure 5-2** (northern section). These include permanent, and more commonly, ephemeral watercourses (salt lakes, and floodplains that only flow or hold surface water intermittently, in other words, are not permanent water bodies and only contain water during or following major rainfall events). The Study Area (both the southern and northern) crosses four basins:

- Southern: Northeastern edge of Spencer Gulf Basin, Mambray Coast Basin, Western edge of the Lake Torrens basin and eastern edge of Gairdner Basin.
- Northern: Eastern edge of the Gairdner Basin.

In Spencer Gulf Basin (**Figure 5-1**), the surface water features include:

- Minor drainages in the Department of Defence Cultana Training Area and Lincoln Gap. In particular, the 2023 field survey observed that Lincoln Gap shows a high level of stream power as evidenced by the large sized bedload. The short catchments of the Lincoln Gap hills also mean that any storm event could potentially rapidly impact the construction site/s.
- Land subject to inundation consisting of intertidal samphire wetlands along the coast between Mullaquana Station and Whyalla.
- Ephemeral lakes within close proximity to Whyalla (2-3 km from the pipeline alignment).
- Mainly dry lakes east of the pipeline in the Defence Cultana Training Area north of False Bay.
- Main drainage lines in the Project footprint are Myall Creek and Pine Creek.

In the Mambray Coast Basin (**Figure 5-1**), the surface water features include:

- Mainly minor drainage lines present across the Project Area.

In the Gairdner Basin (**Figure 5-2**), the surface water features include:

- Large intermittent salt lakes including Lake Dutton, Pernatty Lagoon, Lake Windabout, and Island Lagoon. Also, smaller intermittent lakes are scattered along the extent of the pipeline alignment. Pernatty Lagoon likely accesses the saline groundwater (JBS&G (2026).
- Many watercourse lines that drain into Pernatty Lagoon and Lake Torrens run adjacent to and sometimes intersect the lateral branch pipeline. The main drainages include Elizabeth Creek and Pernatty Creek (Pernatty Lagoon catchment).
- Pipeline alignment intermittently transects and / or runs adjacent to land between Woomera and Roxby Downs that may be subject to flooding and ponding following significant rain events.
- Ephemeral creeks running adjacent and sometimes transecting the main transfer pipeline alignment. The main drainages include Wirrawirralu Creek and Black Oak Creek, as well as the catchments of Coorlay Creek and Sanders Creek.
- Ephemeral creeks running adjacent and sometimes transecting the lateral branch pipeline alignment. The main drainages include Elizabeth Creek, Carra Creek, and Yeltacowie Creek.

In the Lake Torrens Basin (**Figure 5-2**), the surface water features include:

- One large intermittently inundated salt lake, Lake Torrens, which is 11 km from the pipeline alignment at its nearest point.
- Multiple minor watercourse lines that drain into Lake Torrens. The lateral branch pipeline crosses unnamed tributaries of Eliza Creek and Hilson Creek, which drain into Lake Torrens.

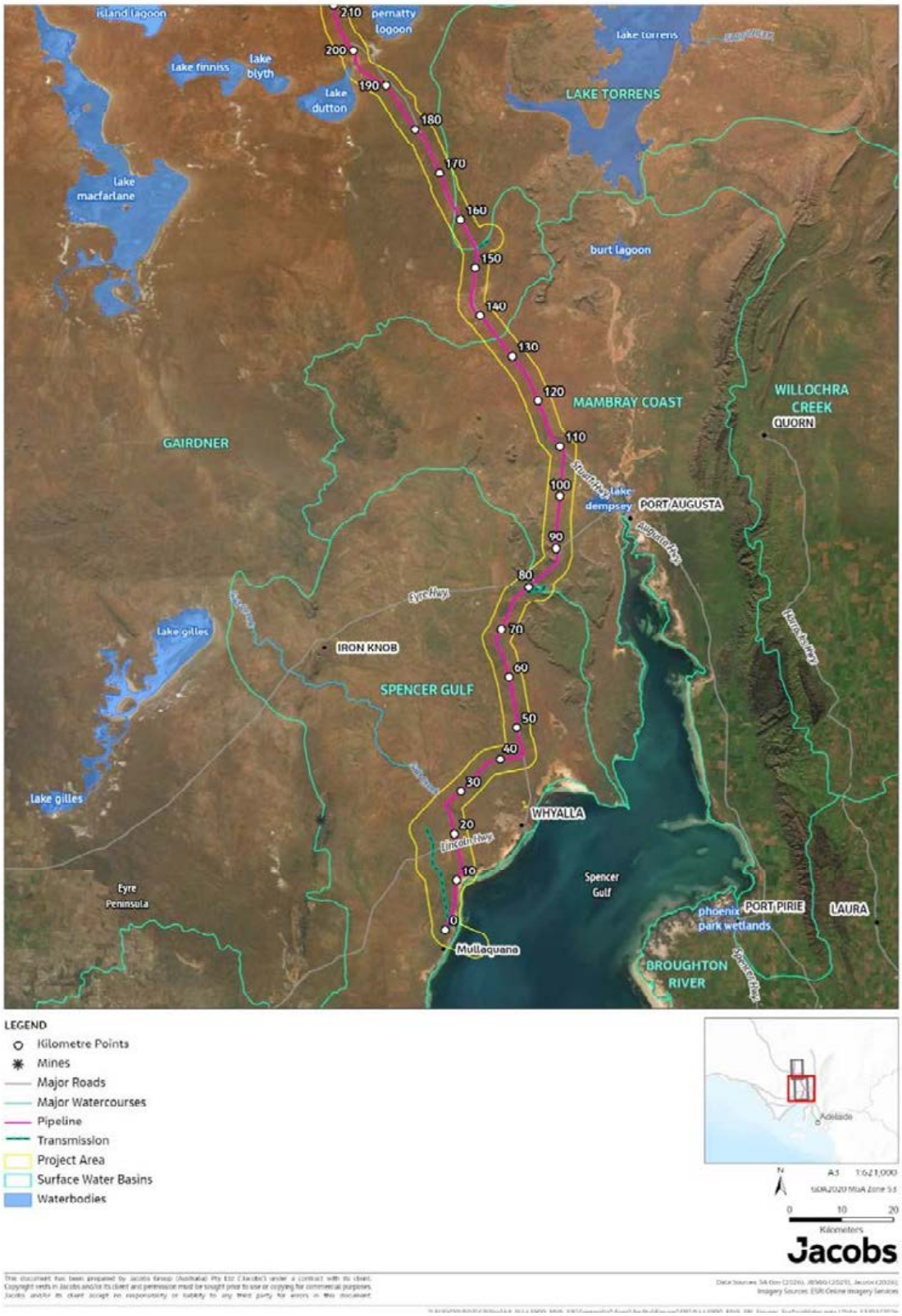


Figure 5-1. Watercourses and surface water basins in the southern Project Area

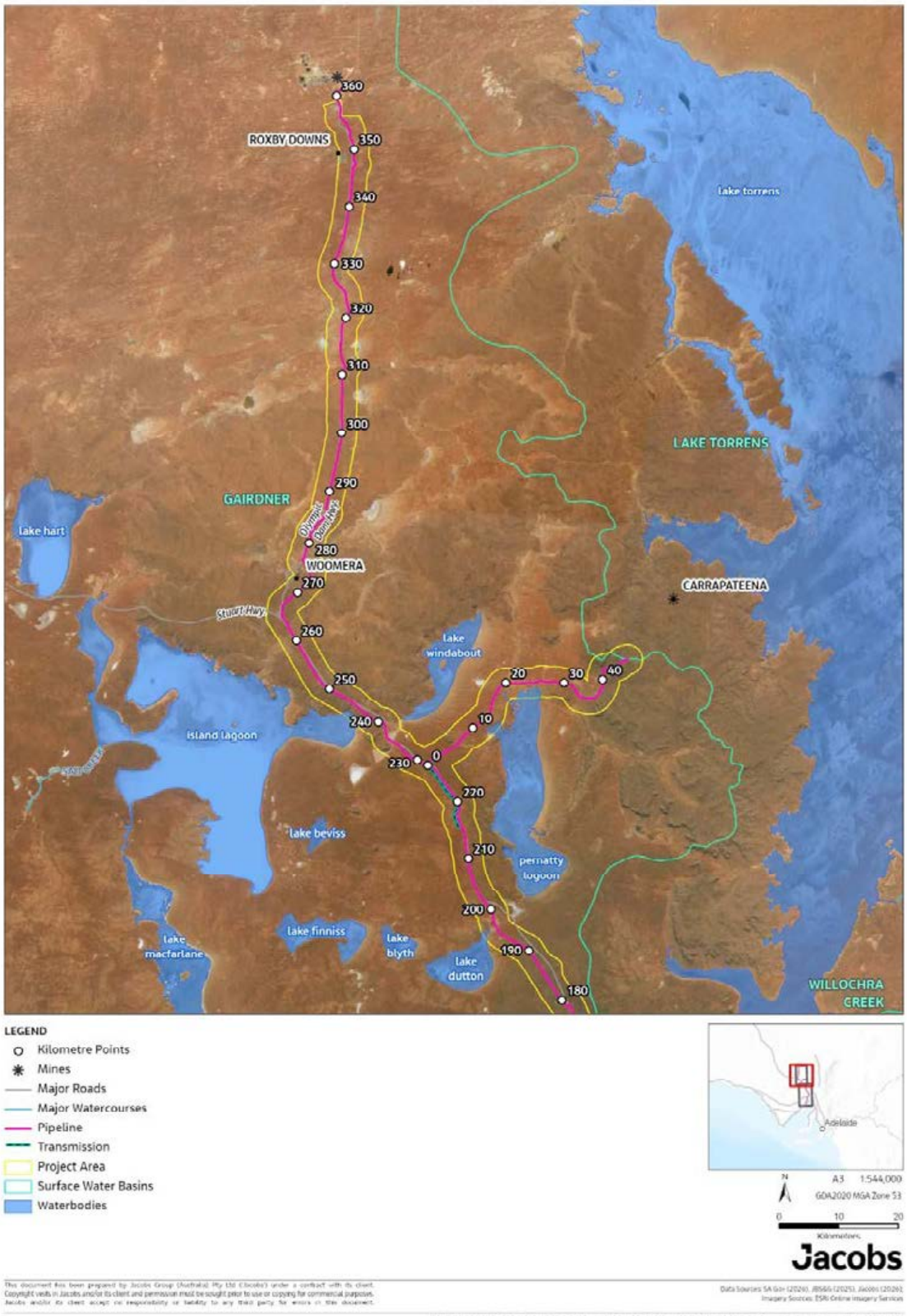


Figure 5-2. Watercourses and surface water basins in the northern Project Area

5.3.1 Watercourses considered to have potential high impact

Given the large number of watercourses being crossed by the pipeline and their dry/ephemeral nature, for the purpose of this assessment, watercourses that are likely to be more sensitive to construction and operational impacts, based on fieldwork undertaken for the *Northern Water Project - Topography, Geology and Soils Assessment* (Jacobs, 2026a) and *Northern Water Project - Terrestrial Ecological Baseline Report* (Jacobs, 2026b) are identified as watercourses "considered to have potential high impact".

Watercourses assessed as "considered to have potential high impact" (**Table 5-1**) have been identified based on their characteristics and associated risk profile. For example, a watercourse may be designated as "considered to have potential high impact" based on topography and geomorphology (e.g. the propensity to erode in response to high flows), soil type (e.g. the propensity to expose acid sulfate soils (ASS) or saline soils and impact water quality), hydrology (e.g. ephemeral or perennial, link to groundwater and the associated relative risk posed by construction), and/or ecology (presence of aquatic fauna or flora).

Such watercourses are considered in the risk assessment (Section **6**) as "considered to have potential high impact" watercourses and listed by name. All other watercourses are classified as "standard" (see **Figure 5-3** and **Figure 5-4**). Note that the label "considered to have potential high impact" is used in relation to the specific risk being assessed in Section **6** (i.e. a watercourse may be considered to have potential high impact from exposure of ASS but not to dewatering of groundwater). Watercourses designated as "considered to have potential high impact" based on groundwater connectivity were done so based on the risk of connectivity changing due to trenching, creating a conduit for groundwater to discharge to an ephemeral stream. Twenty watercourses were identified as "considered to have potential high impact", with some being minor unnamed creeks.

The reference design (GHD, 2025a) identifies 55 major watercourse crossings (defined as "a watercourse with the potential for high quantity and/or velocity flows capable of undermining the water main passing beneath it") where the water table is anticipated to be shallower than the proposed excavation depth for trenching, potentially requiring dewatering, treatment, and discharge of groundwater to nearby surface water bodies. These have been assessed for potential impacts from groundwater discharge in Section **6** and listed by name when "considered to have potential high impact". In addition to trenching and trenchless crossings, selected watercourses are proposed to be crossed using above-ground structures. For these locations, potential high-impact considerations include hydraulic interaction with flood flows, localised scour around support structures and the potential for debris accumulation during flood events.

An additional 163 crossings of ephemeral watercourses are considered likely to be trenched without encountering groundwater and unlikely to require dewatering, treatment, and discharge of groundwater to surface water. These have been assessed as standard watercourses in Section **6**.

Table 5-1. Watercourses considered to have potential high impact

Watercourses considered to have potential high impact	Impacts						
	Saline soils	ASS	Effects from vegetation removal	Effects from spoils runoff	Effects from construction discharge	Increased erosion from crossing	Effects from flooding
Southern							
Salt Creek (KP 26)					Yes	Yes	Yes
Myall Creek (KP 69)							Yes
Pine Creek (KP 75)							Yes
Unnamed watercourse along Lincoln Gap (KP 85)						Yes	Yes
Lake Dempsey Creek (KP 96)					Yes	Yes	Yes
Lake Dempsey Creek (KP 99)					Yes	Yes	Yes
Lake Dempsey Creek (KP102)					Yes	Yes	Yes
Lake Dempsey Creek (KP106)					Yes	Yes	Yes
Ranges View Creek (KP 153)				Yes	Yes	Yes	
Northern							
Black Oak Creek between Lake Dutton and Ironstone Lagoon (KP 197)	Yes	Yes					
Black Oak Creek (KP 200)	Yes		Yes		Yes	Yes	Yes
Unnamed channel South of Lake Windabout (KP 237)	Yes	Yes		Yes	Yes		Yes
Unnamed channel South of Lake Windabout (KP 238)	Yes	Yes		Yes	Yes		Yes
Wirrawirralu Creek (KP 270)			Yes				Yes

Watercourses considered to have potential high impact	Impacts						
	Saline soils	ASS	Effects from vegetation removal	Effects from spoils runoff	Effects from construction discharge	Increased erosion from crossing	Effects from flooding
Wirrawirralu Creek (KP 277)			Yes				Yes
Minor unnamed watercourses (KP 278 to 281)			Yes				
Elizabeth Creek (KP CA21)	Yes	Yes			Yes	Yes	Yes
Carra A Creek (KP CA29)	Yes				Yes	Yes	
Yeltacowie A Creek (KP CA35)	Yes	Yes			Yes	Yes	Yes
Yeltacowie B Creek (KP CA39)	Yes	Yes			Yes	Yes	Yes

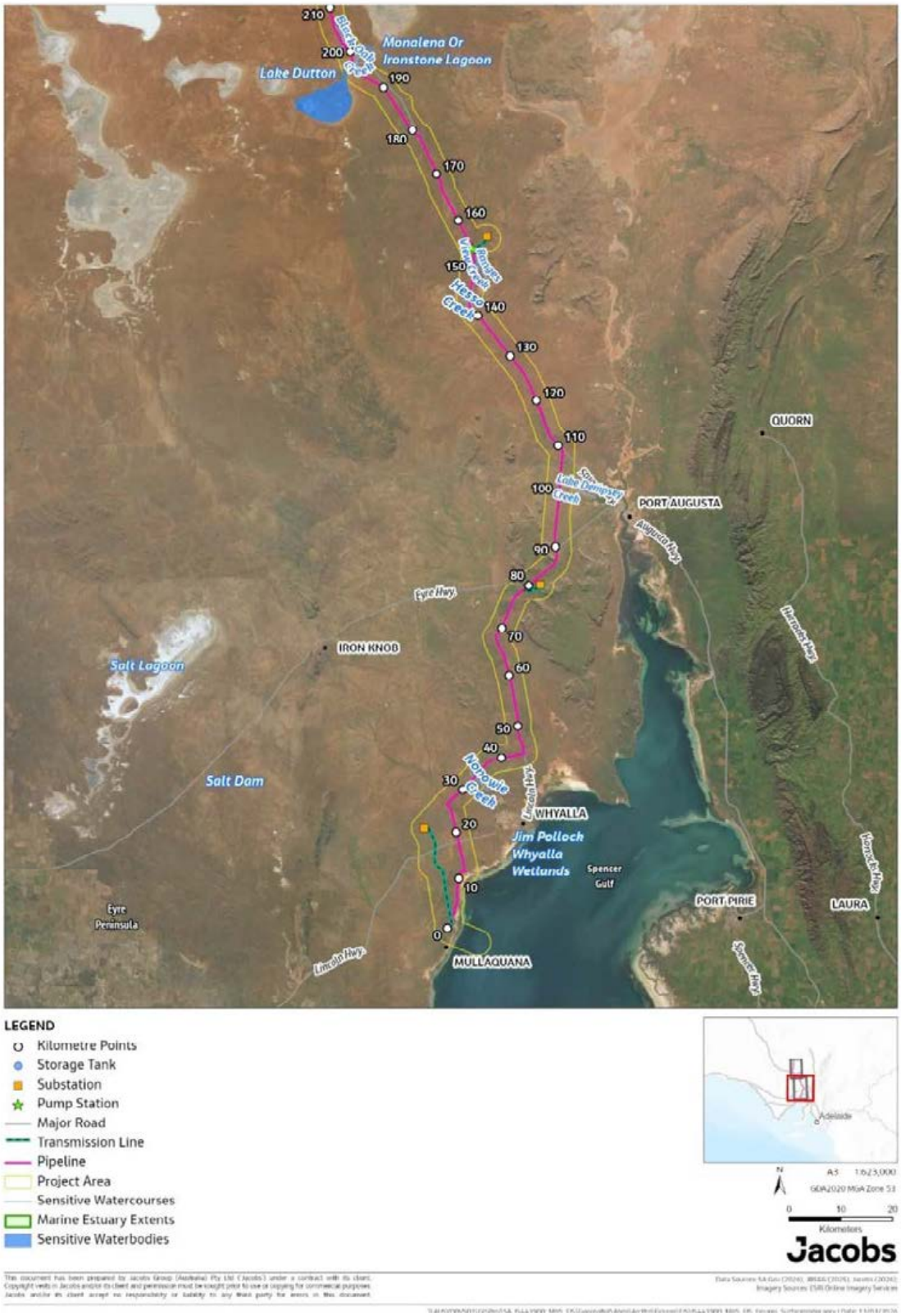


Figure 5-3. Watercourses considered to have potential high impact (southern Project Area)

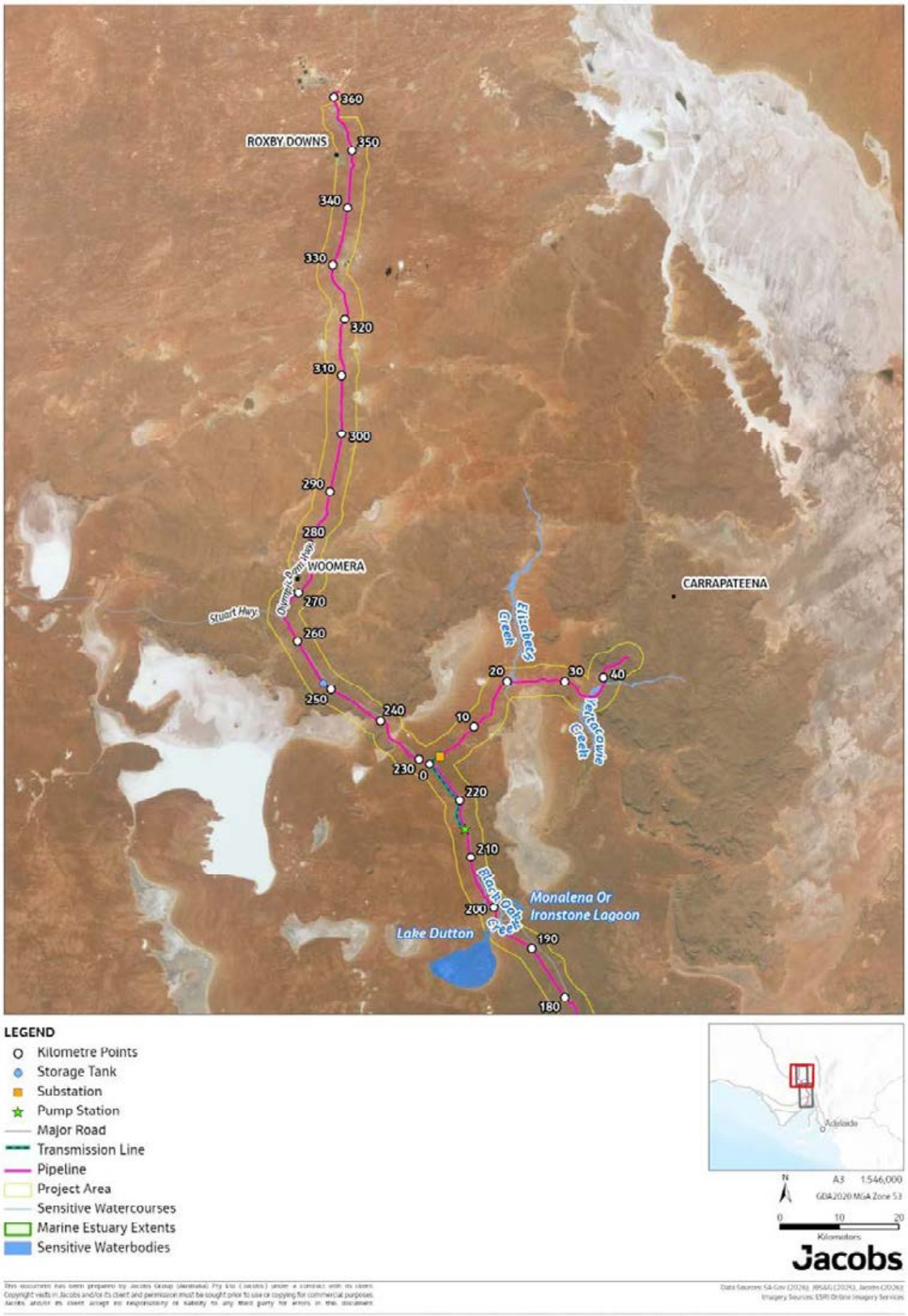


Figure 5-4. Watercourses considered to have potential high impact (northern Project Area)

5.4 Climate

The majority (87%) of the South Australian landscape is considered to have an arid climate with the remaining 13% considered a Mediterranean climate. Arid climates are characterised by warm to hot temperatures with low and erratic rainfall. Mediterranean climates are characterised by cool to warm temperatures tending to winter rainfall (EPA South Australia, 2018). The Project Area sits within the arid climatic zone.

Temperatures in the northern Project Area are higher than those in the southern Project Area. Mean monthly maximum summer temperatures reach 37°C at Olympic Dam (Roxby Downs), compared to 30°C in Whyalla. Monthly mean winter temperatures range from a minimum of 4.3°C at Olympic Dam (Roxby Downs) to 5.3°C in Whyalla (Bureau of Meteorology (BoM), 2026)).

There is a strong north-south rainfall gradient across the region of the Project Area, with rainfall significantly lower in the north when compared to the southern regions.

Figure 5-5 and **Figure 5-6** display the 10 km mean annual rainfall grid within a 50 km buffer along the pipeline route.

The long-term annual evaporation rate, recorded from 1967 to 2017 is also high at around 3,134 mm per year on average (measured at Woomera Aerodrome). The mean daily evaporation in each month for the Woomera Aerodrome is shown in **Figure 5-7**. Evaporation generally exceeds rainfall in every month of the year (BoM, 2024).

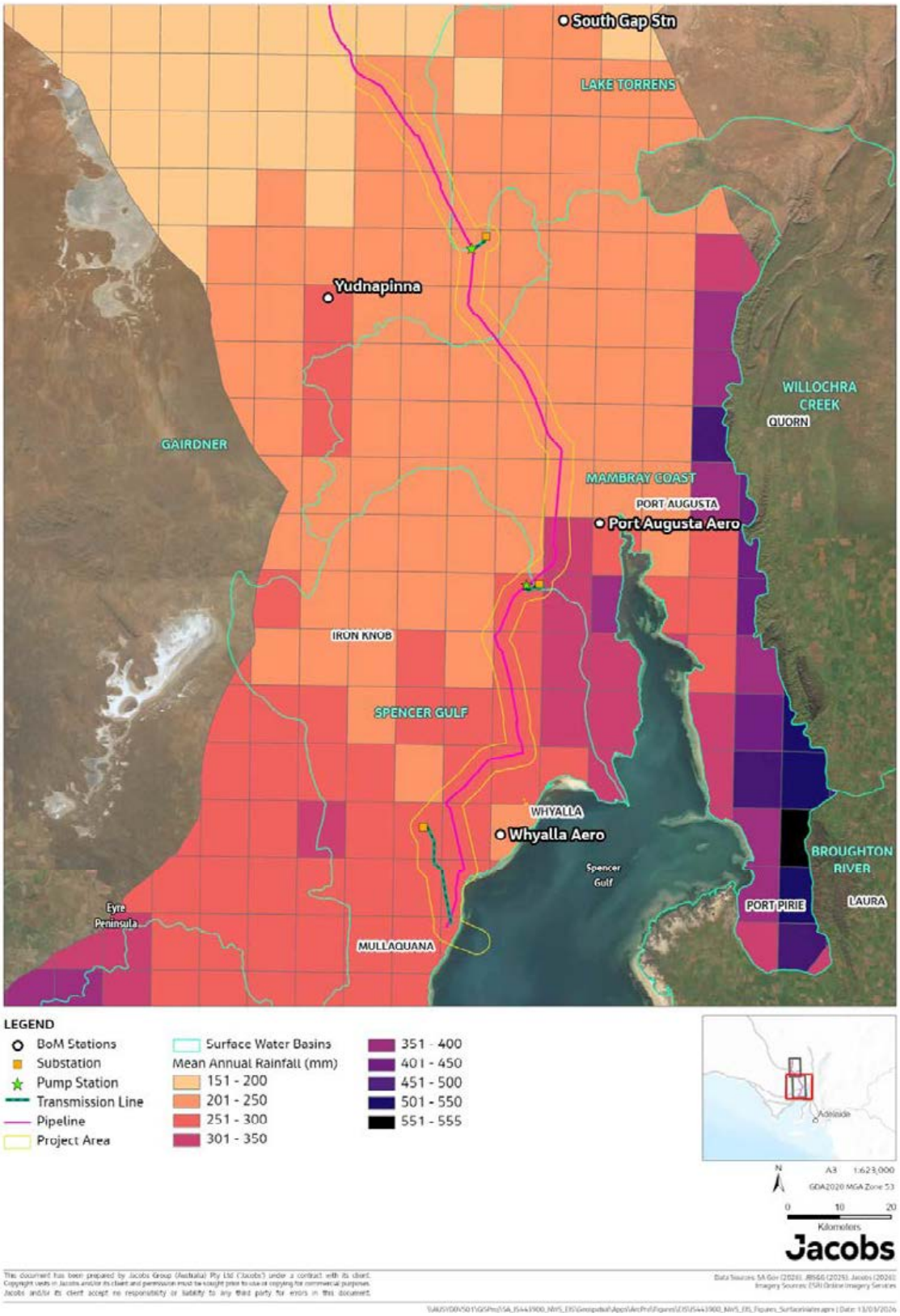


Figure 5-5. Mean annual rainfall (10 km grid) (NARCLIM 1.5 South Australian Climate Projections) and mean monthly rainfall for BoM Rainfall Stations for the Southern Basins (BoM, 2024)

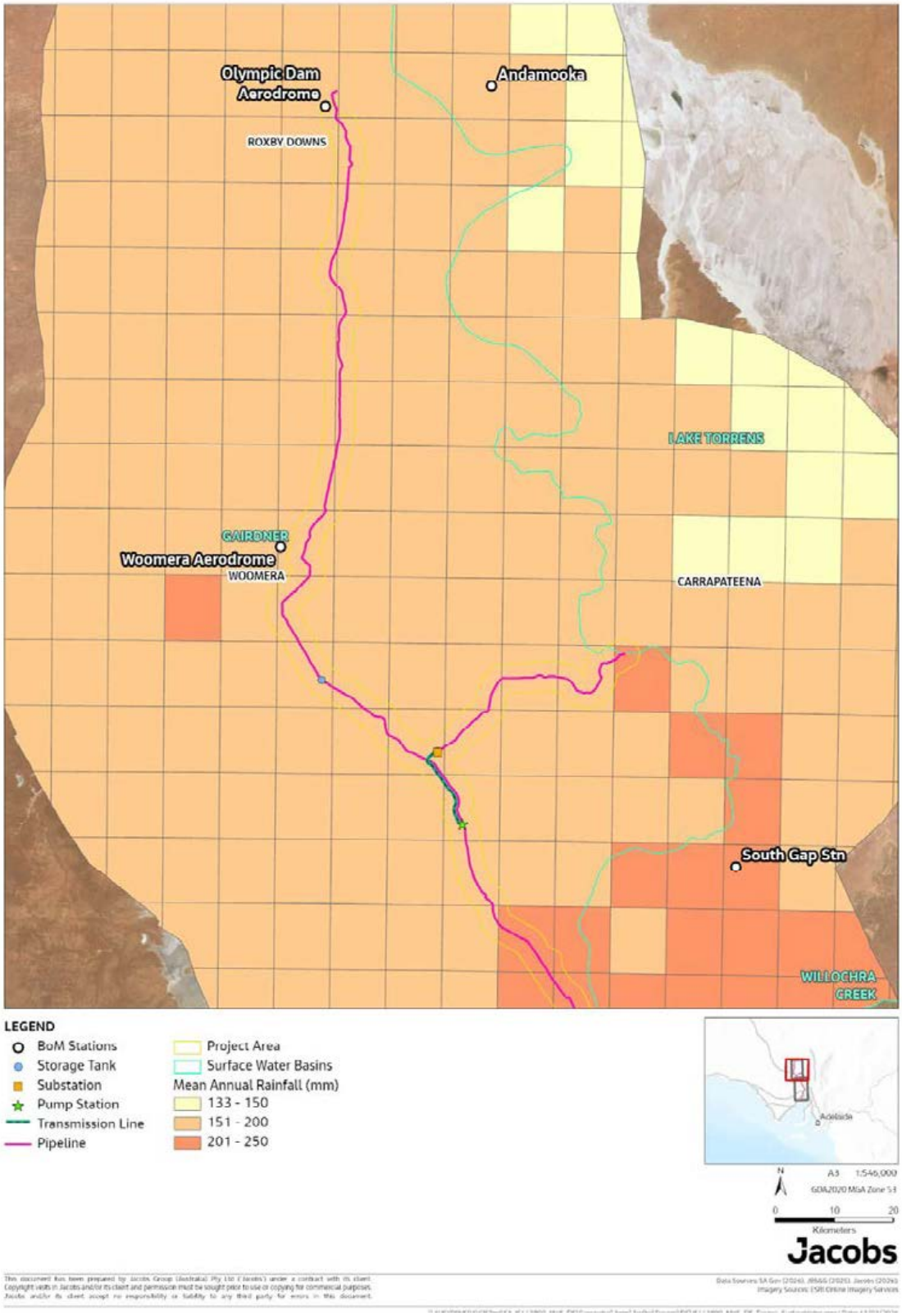


Figure 5-6. Mean annual rainfall (10 km grid) (NARCLIM 1.5 South Australian Climate Projections) and mean monthly rainfall for BoM Rainfall Stations in the Northern Basins (BoM, 2024)

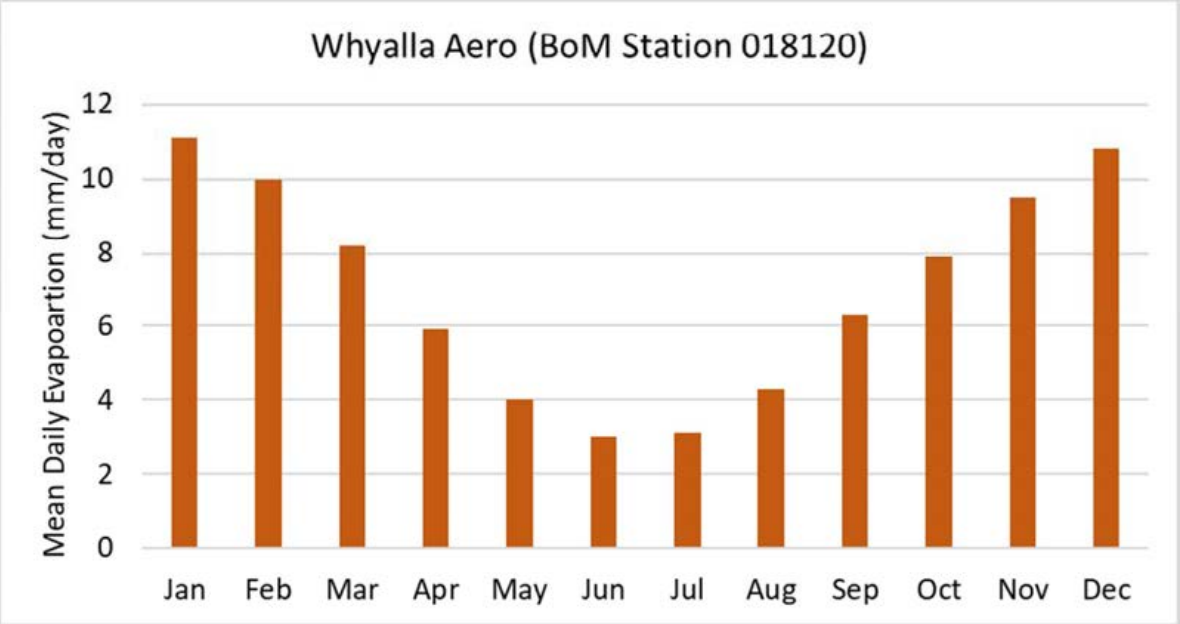


Figure 5-7. Mean daily evaporation in each month, Whyalla Aero 1993 to 2026 (BoM, 2026)

Long term rainfall data and Cumulative Departure from Mean Monthly Precipitation (CDMP) charts for Whyalla (northern Spencer Gulf Basin), Port Augusta (Mambray Coast Basin), Yudnapinna (south-eastern Gairdner Basin), and Olympic Dam (north-eastern Gairdner Basin) are presented in **Appendix C**.

The CDMP charts show a declining trend between 2016 and 2019 that is representative of 'drought' conditions across the entire Project Area. Since 2019, above average rainfall has resulted in a steep upward trend in CDMP charts for all Project Areas. It is noted that the peaks and troughs of the CDMP at Olympic Dam are more extreme than other Project Areas, reflecting greater variability in monthly rainfall when compared to long term monthly averages. The mean annual rainfall for the western portion of the Lake Torrens Basin within the 50 km buffer of the pipeline route is similar to the annual rainfall of the north-eastern portion of the Grainger Basin, therefore the CSMP and Annual rainfall charts for the Lake Torrens Basin are not included.

5.4.1 Climate seasonality

To assess the climate seasonality at the desalination plant site and along the pipeline route, monthly rainfall and, where available, monthly temperature from the BoM climate stations has been assessed and is described in this section.

The BoM climate stations that have been used for this assessment are:

- Whyalla Aero (BoM Station 018120).
- Yudnapinna (BoM Station 016046).
- Woomera Aerodrome (BoM Station 016001).

The location of these monitoring stations is shown in **Figure 5-8**.

Daily rainfall exceedance probability curves are included in the analysis as a method of highlighting the infrequent larger rainfall events, as this provides an indication of the likelihood of the historic daily rainfall volume being exceeded in any month.

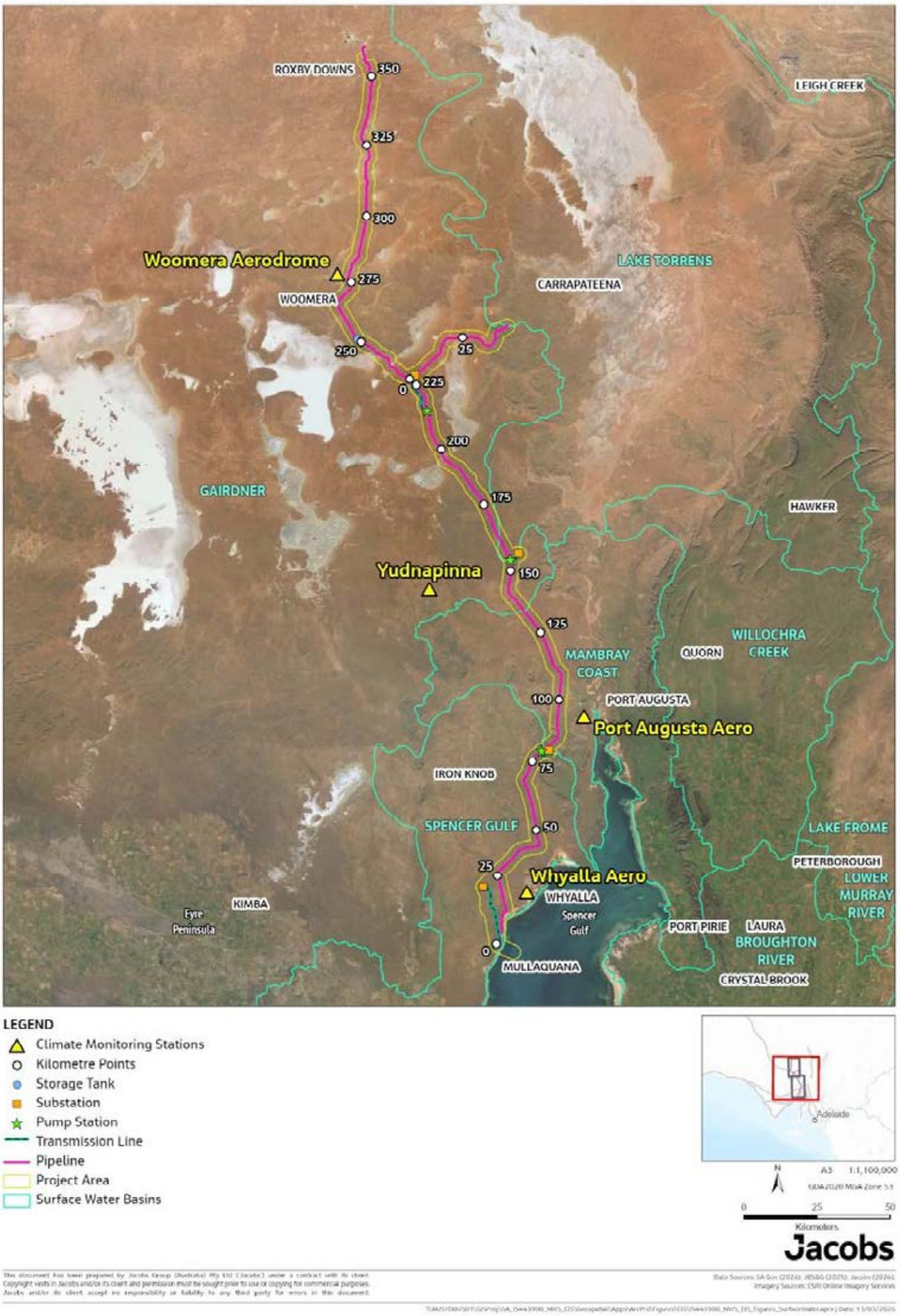


Figure 5-8. Locations of climate monitoring stations used in this assessment

5.4.1.1 Spencer Gulf and Mambray Coast Basin

Spencer Gulf Basin has a Mediterranean climate with hot and dry summers, and cool and moist winters. Rainfall is low and variable, with most precipitation occurring in winter. The evaporation rates are generally moderate to high due to the Mediterranean climate conditions, with increased rates during the hot summer months.

The Mambray Coast Basin has a semi-arid climate with mild winters and warm summers. Rainfall is moderate, and there is no clear seasonality. Evaporation rates are generally moderate, influenced by the semi-arid climate and rainfall, with higher rates during the summer months.

The mean monthly rainfall for the period 1 January 1945 to 31 December 2022 at the Whyalla Aero BoM Climate Station (018120) (**Figure 5-9**) is typical of the monthly rainfall of the Mambray Coast Basin. The climate station is located approximately 8 km east of the water delivery pipeline. The mean monthly rainfall during the period ranges from a low of 17.4 mm in March to a high of 27.5 mm in June. The mean annual rainfall during the assessment period is 253.6 mm/year.

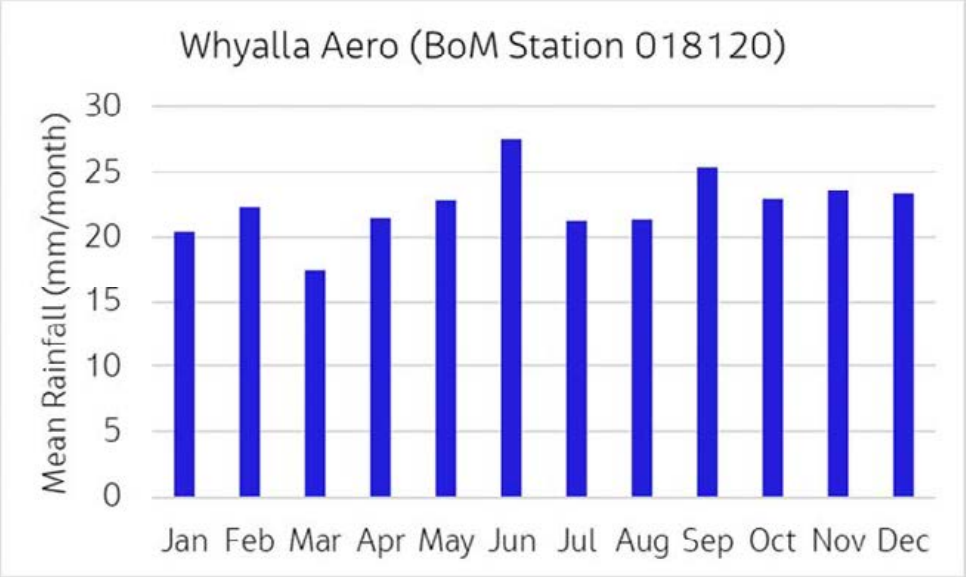


Figure 5-9. Mean monthly rainfall, Whyalla Aero (BoM Station 018120)

The Whyalla Aero BoM Station exceedance probability curve for daily rainfall (9am to 9am), for the period 1 January 1979 to 31 December 2022 is shown in **Figure 5-10**. This figure indicates that there is approximately a 21% chance that on any given day of rain that there will be 0.1 mm of rain or more. The maximum daily rainfall at this location during the period of analysis is 101.6 mm. **Figure 5-10** also indicates that there is a very low probability (almost 0%) that this volume of rainfall would be exceeded in any 24-hour period.

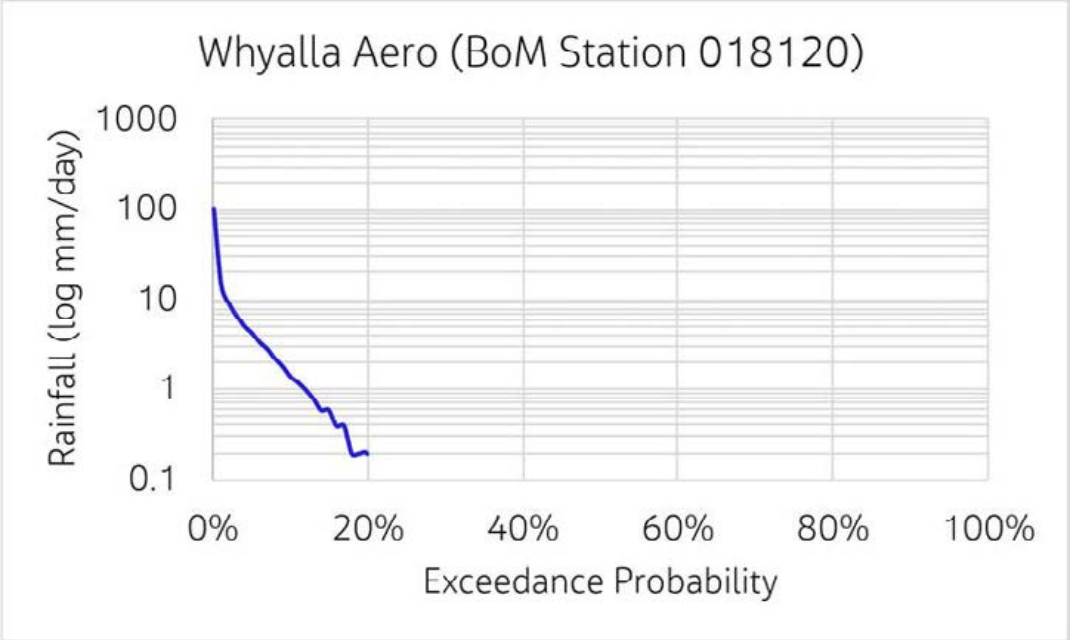


Figure 5-10. Daily rainfall exceedance probability curve, Whyalla Aero (BoM Station 018120)

The mean monthly minimum and maximum temperature along with the minimum to maximum temperature range for each month at the Whyalla Aero BoM Climate Station (018120) is shown in **Figure 5-11**. The maximum mean monthly temperature at this location ranges from a low of 17.1 C° during July to a maximum of 30.2 C° during January. The minimum mean monthly temperature ranges from a low of 5.3 C° in July to a high of 17.8 C° in January. The grey area in the figure illustrates the minimum to maximum observed temperatures for each month.

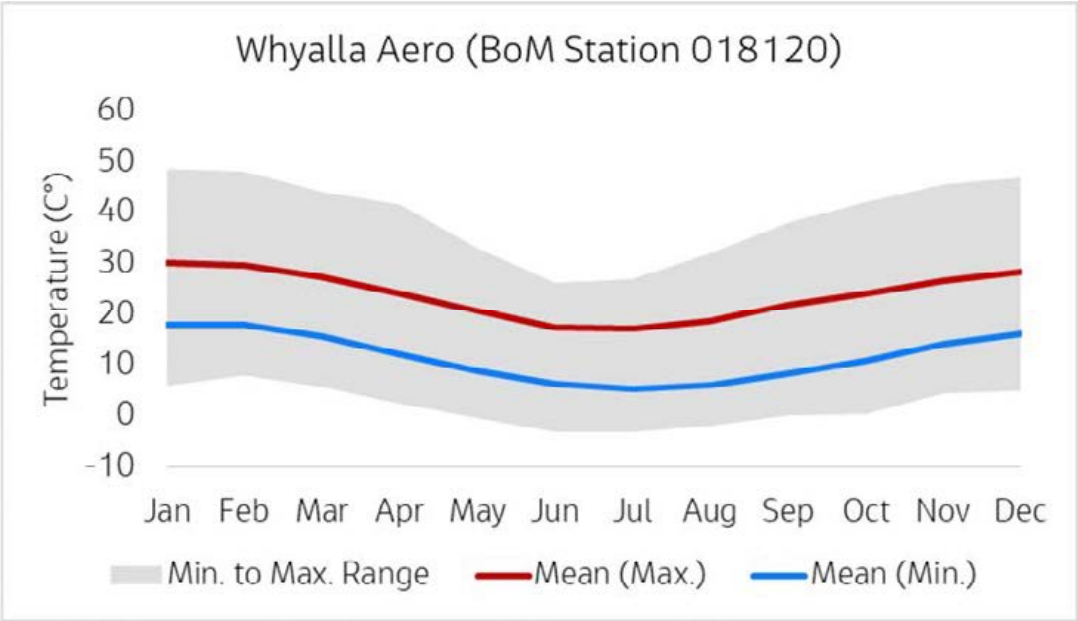


Figure 5-11. Mean monthly minimum and maximum daytime temperature and minimum to maximum observed daytime temperature range, Whyalla Aero (BoM Station 018120)

5.4.1.2 Gairdner Basin

The eastern portion of the Gairdner Basin has an arid climate with hot summers and cool to cold winters. However, temperatures of around 30 C° have been experienced during winter. Rainfall is low and occurs sporadically, mainly in winter. Evaporation rates are high due to the arid climate but are limited by the availability of rain.

The mean monthly rainfall for the period 1 August 1884 to 31 December 2022 for the Yudnapinna BoM Climate Station (016056) (**Figure 5-12**) is typical of the monthly rainfall of the mid-eastern region of the Gairdner Basin. The climate station is located approximately 27 km west of the pipeline. The mean monthly rainfall during the period ranges from a low of 14.1 mm in April to a high of 24.4 mm in June. The mean annual rainfall during the assessment period is 212.5 mm/year.

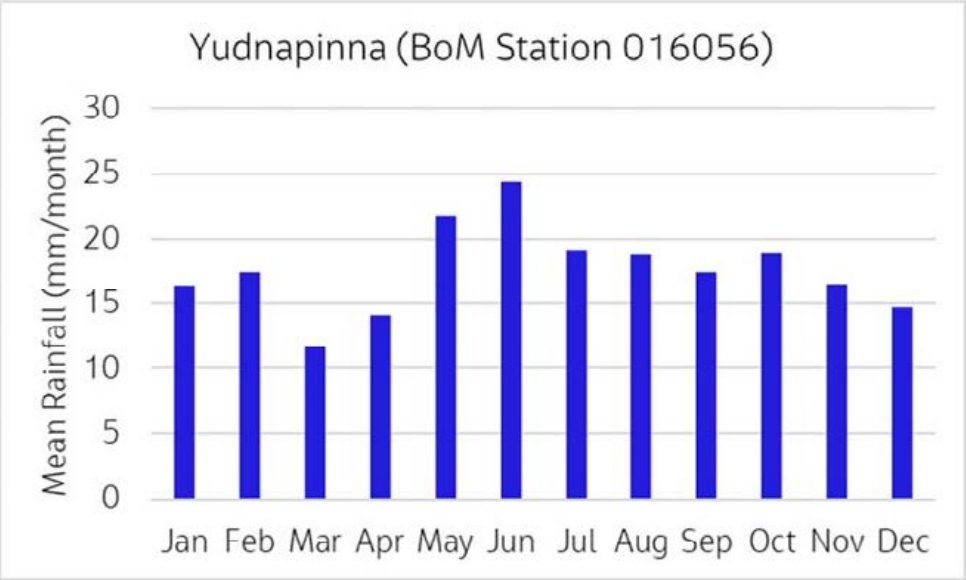


Figure 5-12. Mean monthly rainfall, Yudnapinna (BoM Station 016056)

The Yudnapinna BoM Station exceedance probability curve for daily rainfall (9am to 9am), for the period 1 January 1960 to 31 December 2022 is shown in **Figure 5-13**. This figure indicates there is around a 9% chance that on any given day of rain that there will be 0.5 mm of rain or more. The maximum daily rainfall at this location during the period of analysis is 103.0 mm. **Figure 5-13** also indicates that there is a very low probability (almost 0%) that this volume of rainfall would be exceeded in any 24-hour period.

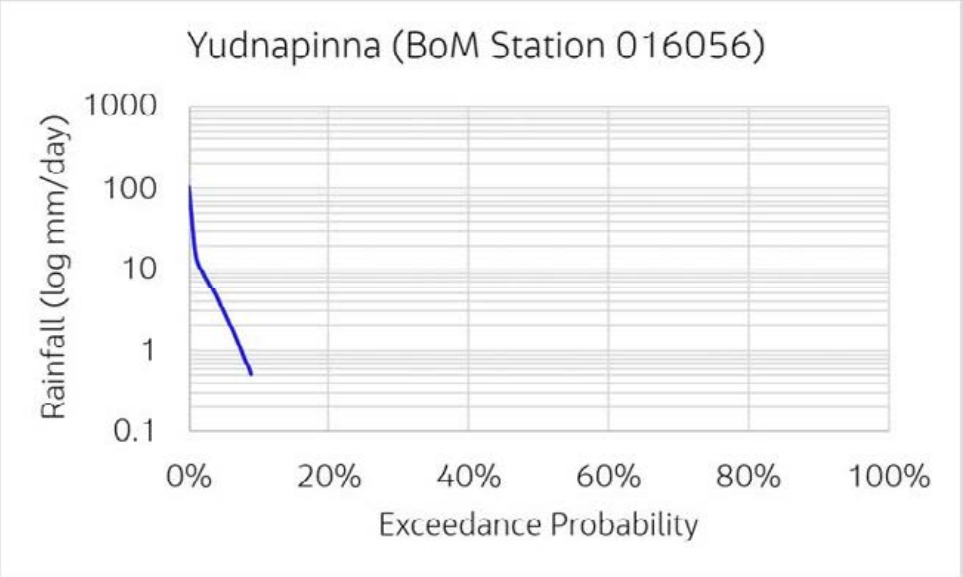


Figure 5-13. Daily rainfall exceedance probability curve, Yudnapinna (BoM Station 016056)

The mean monthly minimum and maximum temperature along with the minimum to maximum temperature range for each month at the Yudnapinna BoM Climate Station (016056) is shown in **Figure 5-14**. The maximum mean monthly temperature at this location ranges from a low of 16.8 C° during July to a maximum of 33.7 C° during January. The minimum mean monthly temperature ranges from a low of 4.4 C° in July to a high of 17.9 C° in February. The grey area in the figure illustrates the minimum to maximum observed temperatures for each month.

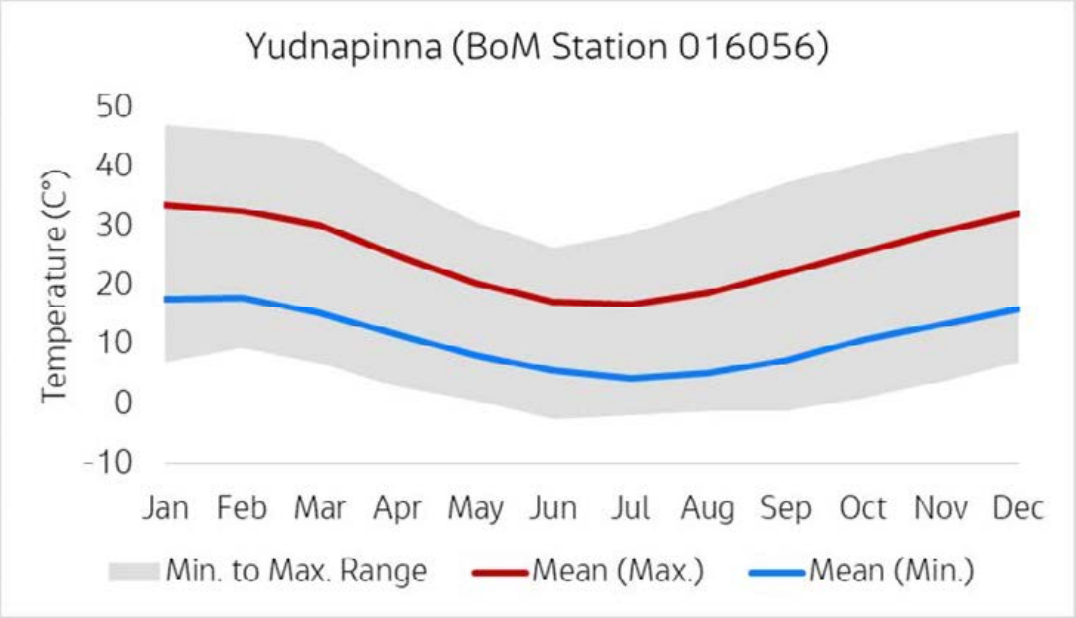


Figure 5-14. Mean monthly minimum and maximum daytime temperature and minimum to maximum observed daytime temperature range, Yudnapinna (BoM Station 016056)

The mean monthly rainfall for the period 1 January 1949 to 31 December 2022 for the Woomera Aero BoM Climate Station (016001) (**Figure 5-15**) is typical of the monthly rainfall of the north-eastern region of the Gairdner Basin, the climate station is located approximately 4 km west of the water delivery pipeline. The mean monthly rainfall during the period ranges from a low of 12.8 mm in August to a high of

18.9 mm in February. Rainfall in this part of the Gairdner Basin, and locations further north such as Olympic Dam, is largely due to summer ex-tropical cyclone events that can extend from the northern parts of Australia. The mean annual rainfall during the assessment period is 182.1 mm/year.

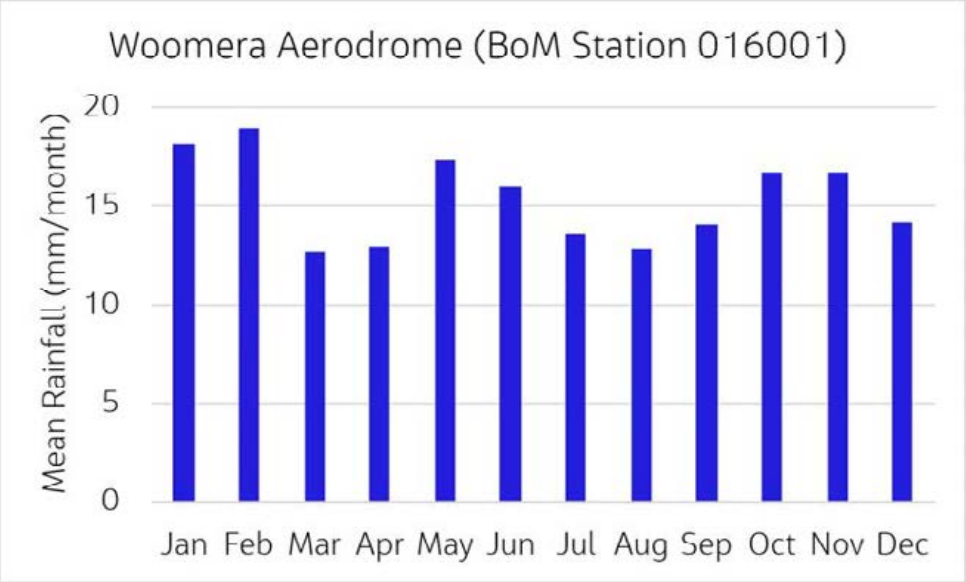


Figure 5-15. Mean monthly rainfall, Woomera Aero (BoM Station 016001)

The Woomera Aero BoM Station exceedance probability curve for daily rainfall (9am to 9am), for the period 1 January 1960 to 31 December 2022 is shown in **Figure 5-16**. This figure indicates there is around a 13% chance that on any given day of rain that there will be 0.2 mm of rain or more. The maximum daily rainfall at this location during the period of analysis is 138.4 mm. **Figure 5-16** also indicates that there is a very low probability (almost 0%) that this volume of rainfall would be exceeded in any 24-hour period.

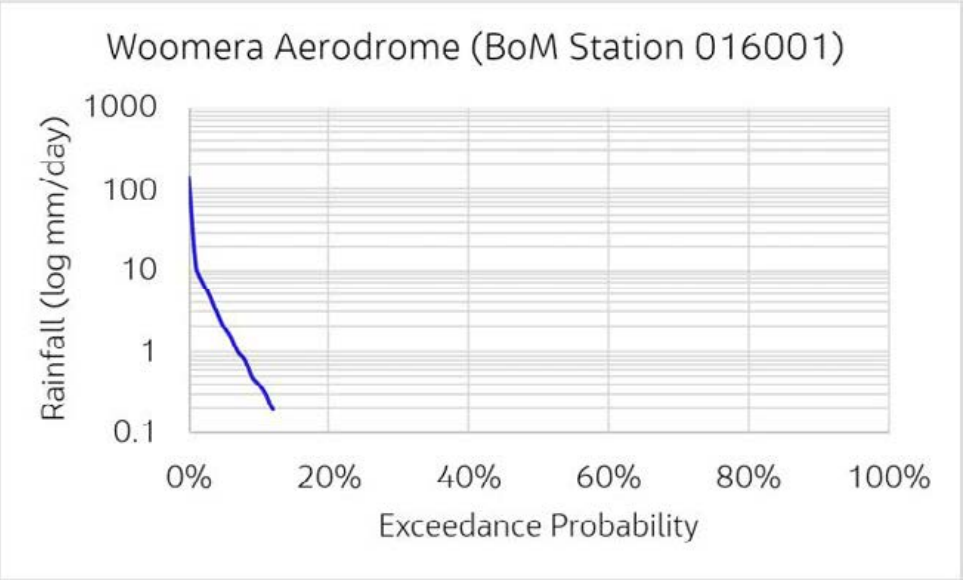


Figure 5-16. Daily rainfall exceedance probability curve, Woomera Aero (BoM Station 016001)

The mean monthly minimum and maximum temperature along with the minimum to maximum temperature range for each month at the Woomera BoM Climate Station (016001) is shown in **Figure 5-17**. The maximum mean monthly temperature at this location ranges from a low of 17.1°C during July to a maximum of 34.6°C during January. The minimum mean monthly temperature ranges

from a low of 5.8°C in July to a high of 19.6 °C in January. The grey area in the figure illustrates the minimum to maximum observed temperatures for each month.

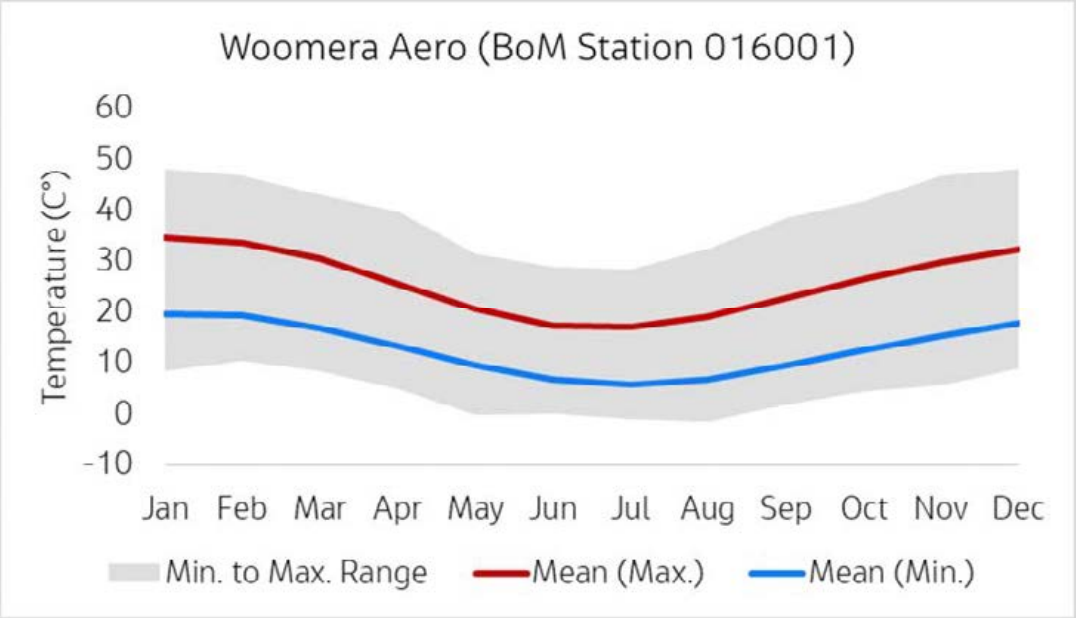


Figure 5-17. Mean monthly minimum and maximum daytime temperature and minimum to maximum observed daytime temperature range, Woomera Aero (BoM Station 016001)

5.5 Surface water hydrology

Monitoring of the surface water hydrology of the Eyre Peninsula and South Australian Arid Lands Landscape Regions is limited and there are no long-term hydrographic records available for the region.

5.5.1 Antecedent conditions

Antecedent conditions, referring to the moisture content in the soil or the state of the catchment before a rainfall event, plays a significant role in influencing surface water flows. In regions with low and sporadic rainfall, such as the arid and semi-arid areas described in Section **5.4**, antecedent conditions can have notable implications for surface water hydrology.

In the arid and semi-arid regions relevant to the Project Area, where rainfall is infrequent, the antecedent soil moisture content tends to be low. During dry periods, the soil may become desiccated, making it less permeable and more prone to runoff when rainfall occurs. The physical properties of the soil, whether it is clayey, sandy, or loamy also influences the ability to absorb water. These properties are essentially controlled by the local climate and topography and geology from which the soils are located and formed.

Conversely, in the immediate aftermath of rainfall events, the antecedent conditions can become wetter, and the soil more saturated. This saturation affects subsequent runoff, as the soil may reach a point where it cannot absorb additional water, leading to increased surface runoff. The rate that the point of soil saturation is reached is dependent upon the soils' water holding capacity, along with the rainfall duration and intensity. Understanding antecedent conditions is crucial for predicting the timing and magnitude of surface water flows. In regions with low annual rainfall, the antecedent conditions before a rainfall event may determine whether the rainfall is absorbed into the soil, contributes to increased runoff, or leads to localised flooding.

In winter months, land within Spencer Gulf Basin and southern reaches of the Mambray Coast Basin, where rainfall is more consistent, soil moisture will remain relatively stable, enabling more rainfall to be absorbed. Conversely, antecedent conditions in areas north of Port Augusta, will differ, due to the low frequency of rainfall throughout the year, resulting in soils having a greater propensity for becoming hydrophobic.

In drier seasons, whilst rainfall, topography and soil types differ throughout the Project Area, the antecedent conditions are expected to be similar. Soil will be less receptive to infiltration, and there will be a higher potential for runoff during larger intense rainfall events. Conversely, low volumes of rainfall may result in high infiltration.

In areas nearby the coast (~500 m), there is also potential for soil moisture to be higher than inland areas, due to increased rainfall and humidity.

5.5.2 Implications of climate on surface water hydrology

The seasonal climate assessment above indicates that in Spencer Gulf Basin, characterised by a semi-arid climate with low and variable rainfall, most of the rainfall occurs during the winter months, and therefore, the largest runoff events are expected to occur during this period. The influence of the semi-arid conditions and higher evaporation rates during hot summer months suggests that the runoff may decrease during this period.

Similarly, in the Mambray Coast Basin, where rainfall is moderate with no clear seasonality, runoff may be more evenly distributed throughout the year. However, larger runoff events during all seasons may occur as a result of periodic larger rainfall events of varying magnitude.

In the Gairdner Basin, the eastern portion (where the Project is to be located) experiences an arid climate with low and sporadic rainfall. However, occasional significant summer storm events can occur as a result of ex-tropical cyclones extending from northern Australia.

Factors influencing surface runoff include not only the amount, intensity, and timing of rainfall but also the high evaporation rates in arid and semi-arid conditions, which combined, influence the catchment's antecedent conditions. The availability of ponded surface water and vegetation also plays a role in controlling the evapotranspiration from the land surface. Therefore, areas with more sustained rainfall, particularly during seasons with lower evaporation rates, are expected to contribute to higher and more sustained surface water flows. **Table 5-2** below summarises the expected surface water hydrology that is relevant to each of the major watercourse crossings.

Table 5-2. Summary of hydrology characteristics at major watercourse crossings (GHD, 2025a)

Intercept ID	Approx. km point (km)	Basin	Feature	Crossing Type	General hydrology
WC 1	26	**Spencer Gulf**	Salt Creek	Above Ground	*Increased runoff May to October. Potential for larger flashy runoff events due to summer storms.*
WC 2	55		Unnamed watercourse		
WC 3	58		Unnamed watercourse		
WC 4	64		Unnamed watercourse		
WC 5	69		Myall Creek		
WC 6	75		Pine Creek		
WC 7	79		Unnamed watercourse		
WC 8	80		Unnamed watercourse		

WC 9	83	**Mambray Coast**	Unnamed watercourse		*No clear seasonality.* *Runoff should be similar across all months.* *Larger runoff events may occur throughout the year resulting from unpredictable storms.*
WC 10	85		Unnamed watercourse		
WC 11	87		Unnamed watercourse		
WC 12	88		Unnamed watercourse		
WC 13	88		Unnamed watercourse		
WC 14	93		Unnamed watercourse		
WC 15	95		Unnamed watercourse		
WC 16	96		Unnamed watercourse		
WC 17	99		Lake Dempsey Creek Crossing		
WC 18	102		Lake Dempsey Creek Crossing		
WC 19	106		Lake Dempsey Creek Crossing		
WC 20	141	**Gairdner**	Unnamed watercourse		*Potential for increased runoff May to July.* *Summer months may experience higher runoff due to occasional storm events.*
WC 21	153		Ranges View Creek Crossing		
WC 22	197		Black Oak Creek Crossing between Lake Dutton and Ironstone Lagoon		
WC 23	198		Unnamed watercourse		
WC 24	200		Black Oak Creek Crossing		
WC 25	202		Black Oak Creek Crossing		
WC 26	222		Unnamed watercourse		
WC 27	237		Unnamed watercourse south of Lake Windabout		
WC 28	238		Unnamed watercourse south of Lake Windabout		
WC 29	238		Unnamed watercourse south of Lake Windabout		
WC 30	239		Unnamed watercourse		
WC 31	240		Unnamed watercourse		
WC 32	240		Unnamed watercourse		
WC 33	241		Unnamed watercourse		
WC 34	241		Unnamed watercourse		
WC 35	243		Unnamed watercourse		
WC 36	244		Unnamed watercourse		
WC 37	256		Unnamed watercourse		
WC 38	265		Unnamed watercourse		
WC 39	270		Wirrawirralu Creek		
WC 40	277		Wirrawirralu Creek		

WC 41	279		Unnamed watercourse		
WC 42	280		Unnamed watercourse		
WC 43	281		Unnamed watercourse		
WC 44	331		Unnamed watercourse		
Carrapateena Lateral Pipeline					
WC 45	CA 21		Elizabeth Creek Crossing		*No clear seasonality. Runoff should be similar across all months. Summer months may experience higher runoff due to occasional storm events.*
WC 46	CA 27		Unnamed watercourse		
WC 47	CA 29		Carra A Creek Crossing		
WC 48	CA 31		Unnamed watercourse		
WC 49	CA 31		Unnamed watercourse		
WC 50	CA 33		Carra B Creek watercourse		
WC 51	CA 35		Yeltacowie Creek		
WC 52	CA 36		Yeltacowie Creek		
WC 53	CA 37		Yeltacowie Creek		
WC 54	CA 39		Yeltacowie Creek		
WC 55	CA 41		Unnamed watercourse		

* WC = Water Crossing

5.6 Historical flooding

While the region is known to experience episodic flooding, records of historical flood events and the drivers and impacts are limited and not readily accessible.

BHP (2009) reference a thunderstorm in January 2007 which resulted in localised flooding, with 143 mm of rain recorded in a 24-hour period near Woomera – with much of the rain occurring within a four-hour period.

In January 2022, flooding of areas throughout northern Eyre Peninsula and the State's Far North caused wide-spread damage.

Following the significant flood event, Jacobs conducted a flood study for an area immediately south of Woomera as part of a design services project to repair flood damage to the Olympic Dam Highway (**Figure 5-18**) (Jacobs, 2023). As part of the flood study, the climatic conditions during and immediately preceding January 2022 (as reported by BoM), were reviewed and utilised in the development of hydrologic models. This section summarises the climate data reported for January 2022 and outlines the expected hydrologic conditions as determined by the modelling process.

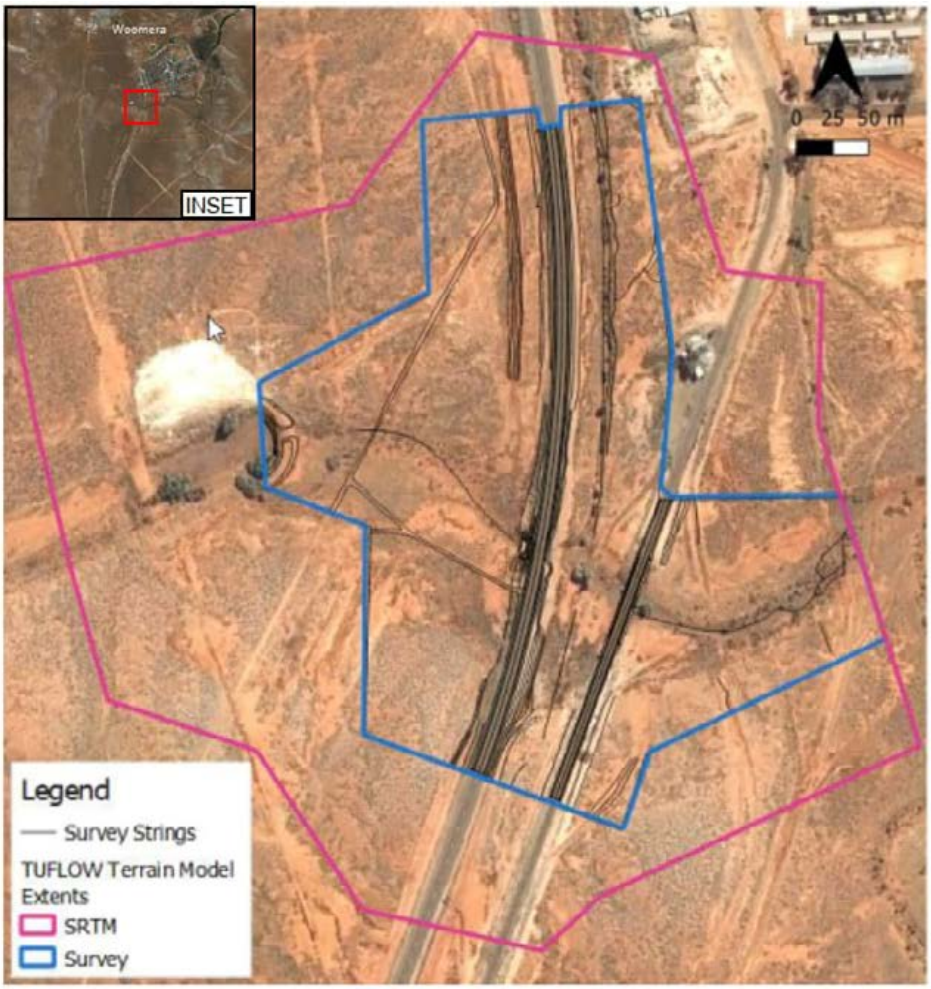


Figure 5-18. General area of January 2022 flood study, Woomera. This location is immediately south of Woomera village and is approximately 2.2km Northwest of the proposed pipeline at its closest point.

5.6.1 January 2022 climate

Rainfall during January 2022 was reported by the BoM as being 175% above the long-term monthly average for South Australia, and much of the Eyre Peninsula recorded five times the average rainfall for January. As a result of ex-tropical cyclone Tiffany, heavy rain through central Australia caused ponding and overland flow, together with rises in local creeks. Over the four-day period from January 21 to 24, 2022, many sites had their highest January daily rainfall on record (BoM, 2022).

BoM (2022b) report "Meteorological report on the heavy rainfall and flooding over South Australia, January 2022" indicated:

- November 2021 was the wettest November on record in South Australia.
- Overall, there was above average 3-month rainfall preceding the January 2022 rainfall event.
- This led to above average soil moisture levels which would reduce infiltration capacity of the catchments and increase runoff volumes in the heavy rain that was to come in January.

These combined conditions lead to major flooding with storm burst up to 1% AEP event at various locations.

In the region around Woomera, daily rainfall peaked at 61 mm on 22 January 2022 at the BoM Station 016025 (located approximately 60 km to the south-west of the town). The Woomera Aero BoM Station (016001 – located 5km north of Woomera) received 50.8 mm of rain during the 24-hour period (**Figure 5-19**). Assessment of rainfall intensities undertaken by Jacobs (2022) *Olympic Dam Highway Hydrology and Hydraulic Assessment* indicated that the recorded first rainfall burst of 40 mm in 6 hours, is approximately equivalent to a 20% AEP event, and the recorded second rainfall main burst (various hours later), is approximately equivalent to a 5% AEP event.

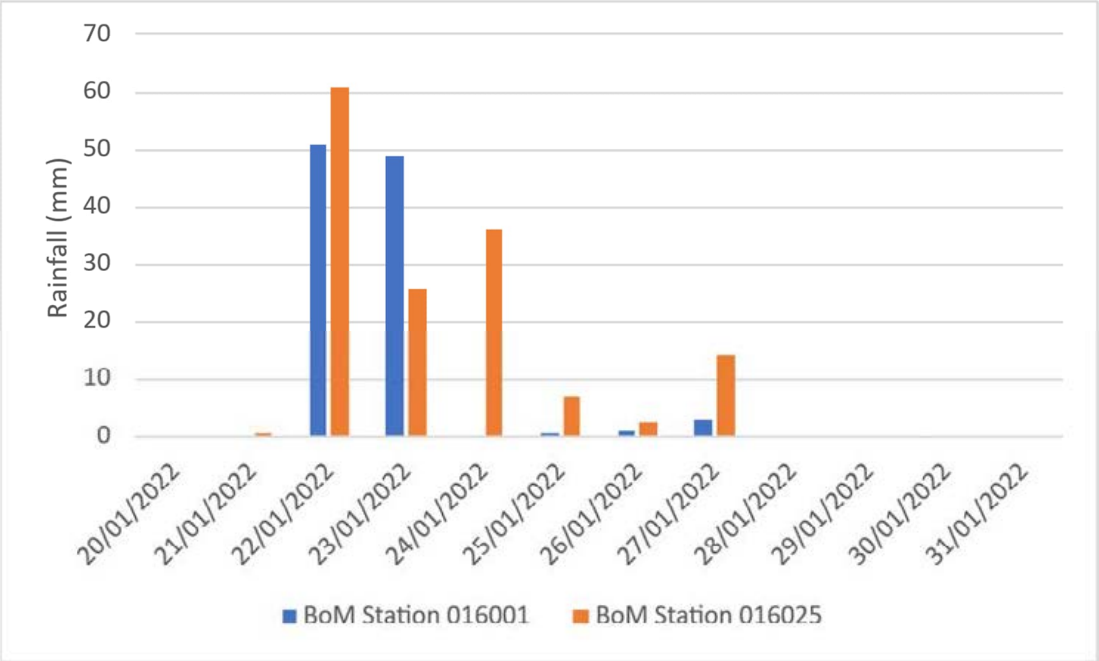


Figure 5-19. Daily rainfall for Woomera (BoM Station 016001) and nearby BoM Stations (20 January 2022 to 31 January 2022)

5.6.2 January 2022 flood impacts

Media reports by the Australian Broadcasting Corporation (ABC) described the following flood impacts which have been summarised in **Table 5-3**. The risks identified below primarily relate to Project construction and delivery, reflecting the types of impacts experienced during the 2022 flood event. Additional operational risks associated with flooding are discussed separately below.

Table 5-3. January 2022 flood impacts and potential impacts to the Project if similar circumstances occur

Impact	Cause	Risk to project if similar event occurs
Major emergency declaration by the South Australian government lasting 12 days between 28 January to 8 February 2022 (ABC, 2022g).	Extreme rainfall event and flooding	Construction workforce and resources may be diverted to emergency response activities, resulting in delays or temporary cessation of construction works. During operations, access to assets

Impact	Cause	Risk to project if similar event occurs
		may be temporarily restricted.
Threats to life and health due to floodwaters, with emergency crews conducting several flood rescues (ABC, 2022a).	Flash flooding	Cessation of works; Workplace safety; potential loss of asset
Major damage to railway tracks at 18 sites over a 300-kilometre section, resulting in closure of rail freight services from South Australia to Western Australia and the Northern Territory from 21 January to 15 February 2022 (ABC, 2022f).	Flooding and rail line washout	Potential loss of assets; delay in delivery of supplies; cessation of works / operations
Road closure including the Stuart Highway, the primary road link between South Australia and the Northern Territory, disrupting road freight services and delaying delivery of supplies (ABC, 2022c).	Flooding and road washout	Potential loss of assets, delay in delivery supplies; cessation of works / operations
Major damage to the Olympic Dam Highway, isolating the towns of Woomera, Roxby Downs, and Andamooka (ABC, 2022b).	Flooding and road washout	Potential loss of assets, delay in delivery supplies
Isolation of remote communities such as Coober Pedy and Oodnadatta, necessitating delivery of food and supplies by air (ABC, 2022e).	Flooding	Increased construction and maintenance costs associated with workforce support, logistics disruptions and supply of essential goods to isolated project areas.
Shortage of food and supplies at major supermarket chains in the Northern Territory (ABC, 2022d).	Flooding, disruption of supply routes	No impact
Increase in mosquito, flies, and snakes in communities and associated health risk (ABC, 2022e).	Increased standing water and inundation of habitat	Workplace safety; potential health impacts to team members due to increased stings and bites

For the operational phase, the primary flood-related risks are associated with access restrictions to Project infrastructure, localised erosion and scour around permanent assets, and potential disruption to maintenance activities following extreme rainfall and flooding. The constructability assessment (SYSTRA, 2025) identify the need for detailed consideration of drainage management, trench mounding, flood immunity of critical infrastructure and scour protection around permanent structures, including any above-ground pipeline crossings that may be adopted during detailed design.

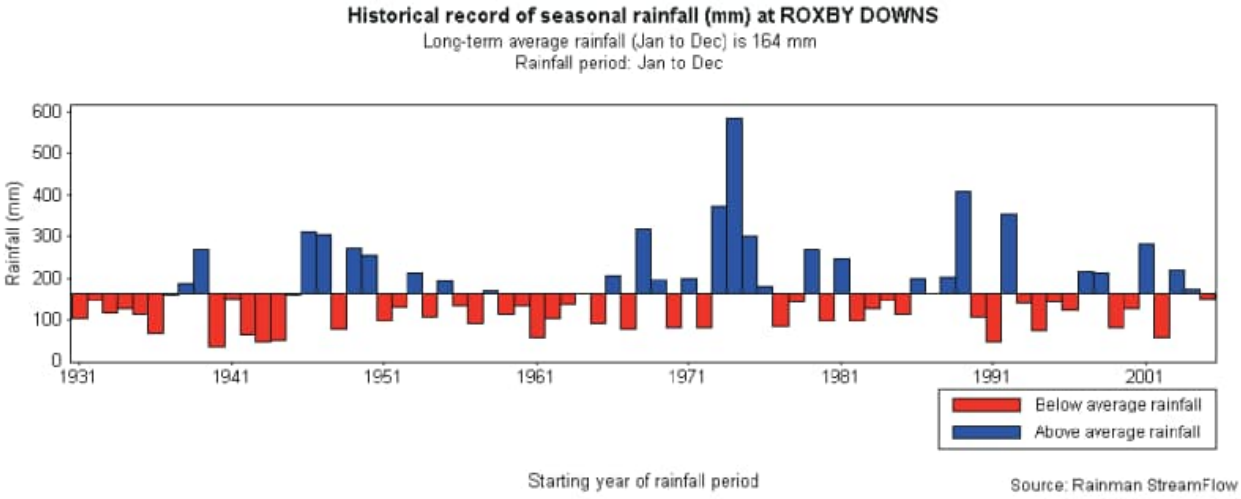
5.6.3 Other historic flooding

The Floods in South Australia 1836–2005 report (McCarthy et al, 2006) has identified flood events between 1836 and 2005, however there is minimal flooding details that are directly applicable to the Project Area. The report does highlight many flood occurrences at several locations along the pipeline alignment, but insufficient details are provided to differentiate the magnitudes of the flooding.

BHP (2009) chapter 11 indicated various significant flood events north of Whyalla. This report includes general flood information only, but some significant flood events are highlighted:

- Flooding of unsealed roads north of Olympic Dam is relatively common.
- Major roads and railway lines were closed due to flooding in December 1992 and February 2000.
- A significant event occurred in March 1989 that led to widespread flooding, many roadways closed due to washouts and filled Lake Torrens for first time in more than 100 years.

BHP (2009c) indicates annual rainfall data for two locations near the pipeline route, refer to **Figure 5-20** below. This offers a general comparison of rainfall over the indicated periods.



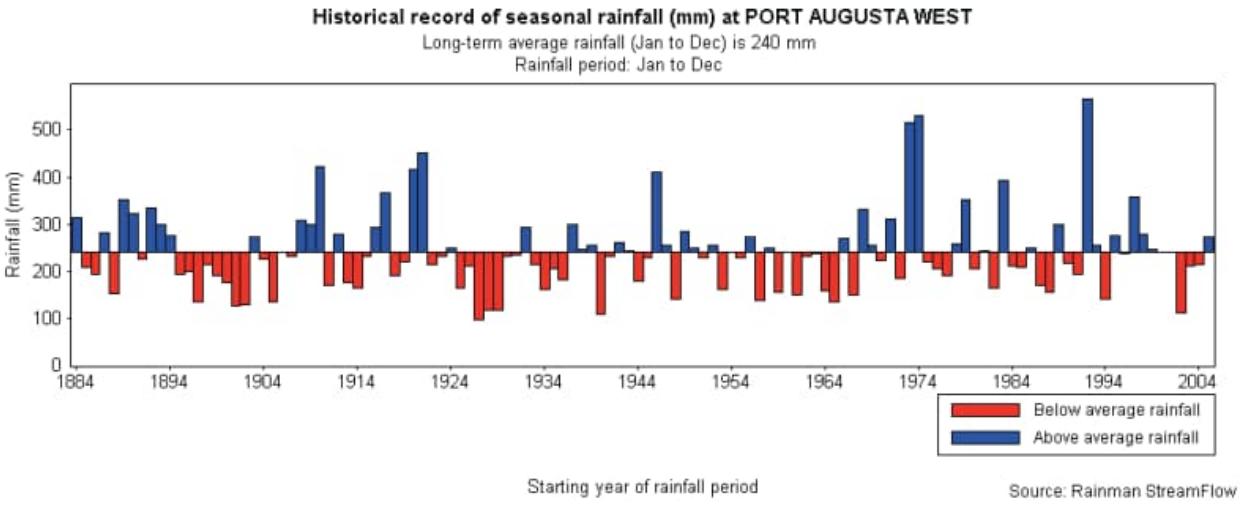


Figure 5-20. Historical records of seasonal rainfall near the Project Area (BHP, 2009e)

5.6.4 Effects of climate change

The climate change projections used for this assessment have been primarily sourced from DEW (2022). These are sourced from the Climate Change Risk Assessment report (Jacobs, 2026c). Projections relevant to this report are summarised in **Table 5-4**.

This includes dynamically downscaled projections for South Australia from the NARCliM 1.5 regional climate modelling project, which provides a more detailed appreciation of finer scale climate influences than is enabled by Global Climate Models (GCMs). It also includes projections from the Climate Change in Australia (CCIA) project from the CSIRO and BoM. DEW (2022) offers a portal to a range of climate projections from GCMs and downscaled results from Regional Climate Models (RCMs) using CMIP 5 models that informed the IPCC 5th Assessment Report.

The Climate Change Projections Guide (DEW, 2022) includes information on climate change factors for temperature and annual rainfall variables for Woomera, Port Augusta and Whyalla. Climate change factors represent the magnitude of projected change compared to baseline period of 1986–2005. To develop climate change projections for the three sites, the climate change factors from DEW (2022) have been applied to historical climate data collected from BoM sites for the three locations over the same baseline period of 1986-2005. Where additional historical data is available, the baseline period has been extended to cover the period 1976-2015 to capture more recent climate change observations.

Projections for extreme rainfall variables based on the methodology within version 4.2 of Australian Rainfall and Runoff (ARR) (Ball et al, 2019) and have been sourced from the ARR Data Hub (Geoscience Australia, 2024). ARR recommends an increase of 15% per degree of warming for shorter-duration events (less than 1hr) whilst longer events (over 24h) are recommended to adopt an increase of 8% per degree of warming. This may be partially offset by increases in the rate of losses due to changes in moisture conditions prior to the rainfall event, with changes to initial and continuing losses of 4.5% per degree of warming respectively for the Port Augusta and Whyalla regions (DCCEEW, 2023).

The annual mean daily maximum and minimum temperatures are expected to rise across all South Australian regions.

Projections suggest that average annual rainfall will continue to decline throughout the century across all three locations. Under RCP 8.5, a 35% decrease in average annual rainfall is possible for Port Augusta and Woomera by 2090.

Shorter-duration extreme rainfall events (i.e. 1% AEP, <1hr events) are projected to increase in intensity for all sites across both emissions scenarios. While changes in extreme rainfall are relatively similar for both emissions scenarios for the 2030- and 2050-time horizons, by 2090 there is a much greater uplift in extreme rainfall intensity under a high emissions scenario. By 2090, under a moderate emissions scenario all three locations could see a 40% uplift in short-duration extreme rainfall events, which increases to a 59% uplift under a high emissions scenario.

Longer-duration extreme rainfall events (i.e. 1% AEP, >24hr events) are also projected to increase in intensity. There is little difference in uplift between emissions scenarios for the 2030- and 2050-time horizons. By 2090, under a moderate emissions scenario all three locations could see a 20% uplift in longer-duration extreme rainfall events, which increases to a 29% uplift under a high emissions scenario.

Table 5-4. Climate change projections

Increase to average daily maximum temperature						
Year	2030		2050		2090	
Location	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Whyalla	1.1	1.1	1.6	1.8	2	3.7
Port Augusta	1.3	1.3	1.7	1.8	2.3	4.2
Woomera	1.4	1.3	1.8	2.2	2.5	4.7
Increase to average annual rainfall						
Year	2030		2050		2090	

Location	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Whyalla	-11.00%	-4%	-8.00%	-20%	-16.00%	-31%
Port Augusta	-10.0%	-7.0%	-13.5%	-12.5%	-17.0%	-35.0%
Woomera	-9.0%	-7.0%	-10.0%	-23.0%	-19.0%	-35.0%
Extreme rainfall (1% AEP, <1hr)						
Year	2030		2050		2090	
Region	SSP2-4.5	SSP3-7.0	SSP2-4.5	SSP3-7.0	SSP2-4.5	SSP3-7.0
Whyalla	1.18	1.18	1.27	1.29	1.4	1.59
Port Augusta	1.18	1.18	1.27	1.29	1.4	1.59
Woomera	1.18	1.18	1.27	1.29	1.4	1.59
Extreme rainfall (1% AEP, >24hr)						
Year	2030		2050		2090	
Region	SSP2-4.5	SSP3-7.0	SSP2-4.5	SSP3-7.0	SSP2-4.5	SSP3-7.0
Whyalla	1.1	1.1	1.14	1.15	1.2	1.29
Port Augusta	1.1	1.1	1.14	1.15	1.2	1.29
Woomera	1.1	1.1	1.14	1.15	1.2	1.29

5.7 Water quality

There is limited water quality data available for the Project Area. The watercourses within and adjacent to the Project Area are predominately dry and flow occurs only after significant or prolonged rainfall events.

The water quality of the Project Area is largely influenced by land systems.

The southern section of the Project Area generally comprises steep escarpments and plateaus with well-defined drainage paths. This area experiences overland flows and creeks that carry high water flows during storm events and therefore water quality is often turbid with low salinity (BHP Billiton, 2009c).

In the northern section of the Project Area, the area south of Pernatty Lagoon to Port Augusta is characterised by flat sandy plains with good surface water quality following rainfall that infiltrates to the groundwater or may pond for at least a month (BHP, 2009c). To the north, there are a number of large terminal salt lakes and ephemeral lagoons, including Pernatty Lagoon, Lake Torrens, and Lake Windabout. Rainfall events and water quality are highly variable with fresh water in the system during rain events, to highly saline when water evaporates leaving concentrated salts in the surface water.

In the vicinity of Roxby Downs there are no defined watercourses and the area is defined by highly permeable sand dunes underlain by thick clay soils. As such, rainfall infiltrates quickly, with water only ponding following significant rainfall events when water reaches the clay soils which are less permeable.

5.7.1 Eyre Peninsula Landscape Region

Due to climatic conditions, such as low rainfall, high evaporation, and the relatively flat topography of the catchment, only a small percentage of rainfall runs into surface watercourses. As such, most of these are brackish to saline during low flow conditions, seasonal, and predominantly dry during the warmer months.

The Gairdner River basin, in which a section of the Project Area is located in this region, has no major surface water drainage systems, with the majority of its rainfall resulting in ponding on the surface for short periods of time prior to infiltration (or evaporation), and contributes to the recharge of the local groundwater systems (Wen, 2005).

Water quality monitoring undertaken between 2002 and 2007 in the Eyre Peninsula Landscape Region indicated that, at times, nutrients and turbidity exceeded recommended guidelines, but that the rivers and watercourses which are mostly located in the south-eastern areas, were in good to moderate condition (EPA, 2008). More recent State of the Environment (SOE) reports have documented that rivers, streams and drains are in poor condition due to higher concentrations of nutrients, salt, and fine sediment likely due to a lack of improvement in land management practices being implemented at the sites, reach or sub-catchment scale (EPA, 2014; EPA, 2020a, EPA, 2023).

5.7.2 South Australian Arid Lands Landscape Region

Due to the region's arid to semi-arid climatic conditions, watercourses are ephemeral with most recent SOE reporting identifying this region as having fair ecological conditions at most of the sites, and whilst most watercourses have elevated sediments and nutrients, this appears to be natural for this type of catchment (EPA, 2014).

Opportunistic water quality monitoring of Mason Creek, Ironstone Lagoon and Lake Windabout was undertaken in 2009 following a rainfall event (BHP Billiton, 2009c). The quality of water following this event was indicative of the receiving environment, with low conductivity in the freshwater Mason Creek and higher conductivity representative of the salt lakes Ironstone Lagoon and Lake Windabout. Metal concentrations on that sampling occasion were generally low and below the limit of detection and the ANZG (2018) guidelines for protection of aquatic ecosystem. The exception was copper which exceeded the ANZG (2018) recommended limit at Mason Creek and Lake Windabout and cadmium which exceeded the ANZG (2018) guidelines at all Ironstone Lagoon and Lake Windabout (BHP Billiton, 2009c).

5.8 Sensitive receiving environments

Sensitive receiving environments have a conservation or community value, or support ecosystem, human or livestock uses of water that are particularly sensitive to pollution or water quality degradation. Sensitive receiving environments for this Project have been identified based on meeting one of the following criteria:

Presence of important aquatic fish habitats:

- Note that the Project does not intersect with or approach any important aquatic fish habitats in the relevant drainage divisions within the Eyre Peninsula management regions[4], as described by Hammer et al. (2009).

Watercourse classification (Fairfull and Witheridge, 2003).

- All watercourses within the proximity of the construction footprint are intermittent, classified as Class 3 (minimal fish habitat) or Class 4 (unlikely fish habitat).

Proximity to drinking water catchments:

- Water for domestic, irrigation, stock, and industrial use in the Eyre Peninsula is primarily sourced from local groundwater and supplemented with River Murray water piped in by SA Water (DEW, 2022).
- Drinking water for the other populated areas in the Project Area is supplied by SA Water, who does not have drinking water reservoirs within the vicinity of the Project and piped water from other areas in South Australia.
- Pastoral stations not served by SA Water obtain water for domestic and stock uses from bores and small dams on their properties (McBride, 2024).
- Water may be retained in ephemeral watercourses and rock holes for months after the most recent rain or high-flow event (BHP, 2009c). These waterholes are valuable sources of drinking water for native fauna and have deep cultural significance for traditional owners (Jenkin et al., 2011).
- Drinking water for Roxby Downs and Olympic Dam in the northern portion of the Project is sourced from the Great Artesian Basin. The pipeline terminates approximately 4 km from the southern boundary of the Great Artesian Basin. However, drinking water is sourced from over 200 km away near Lake Eyre (Roxby Council, 2023) and is unlikely to be affected by the Project.

Proximity to freshwater recreational swimming area:

- The only freshwater recreational swimming area in the vicinity of the Project is Lake Mary, which is 1.7 km upstream of the pipeline and unlikely to be affected. No freshwater recreational swimming areas are likely to be affected by the Project.

Groundwater-dependent ecosystems (GDEs) within the Study Area or construction footprint.

- Refer to the EIS report *Northern Water Project – Groundwater Impact Assessment* (JBS&G, 2026) for an assessment of GDEs.

5.9 Flood risk

A majority of the Project is located within the 'Hazards (Flooding – Evidence Required) Overlay'; prescribed under the Planning and Design Code. The Desired Outcome of the Overlay is that "development adopts a precautionary approach to mitigate potential impacts on people, property, infrastructure and the environment from potential flood risk through the appropriate siting and design of development."

During the detailed design of the Project, bench levels and floor levels of infrastructure and buildings will be determined, having regard to flood risk, local topography, and operational requirements. Pump stations and storages will be designed to be immune from 1% AEP flood event and overland flow paths designed for a 1% AEP storm event. Swales, drains, pipes and culverts for these facilities will be sized to

[4] Located in the South Australian Gulf and comprising coastal streams on Kangaroo Island, the southern Fleurieu Peninsula, the western Mount Lofty Ranges, Lake Torrens catchment including Willochra Creek and the western Flinders Ranges, and Yorke and Eyre peninsulas.

accommodate the 10% AEP storm event. Design criteria for the desalination plant will be the same, subject to risk assessment during the detailed design phase.

The assessment below includes a summary of the Stormwater Management Plan (GHD, 2025b) prepared for the Mullaquana Station desalination plant and provides a qualitative assessment regarding flood risk to remaining Project infrastructure.

5.9.1 Desalination plant

A desktop review of available spatial data indicates the desalination plant site features a predominantly flat and low-lying landscape, gently sloping from the western escarpment to the eastern coastline. **Figure 5-21** has been extracted from the *Stormwater Management Plan Northern Water Project – Desalination Plant* (GHD, 2025b) Figure 3. The direct catchment of the proposed desalination plant site is small and the risk of stormwater runoff can be adequately addressed with a suitably designed drainage swale system.

A series of diversion swales around the desalination plant site are proposed to protect the site from potential flood impact, refer to **Figure 5-22** ((GHD, 2025b) Figure 9).

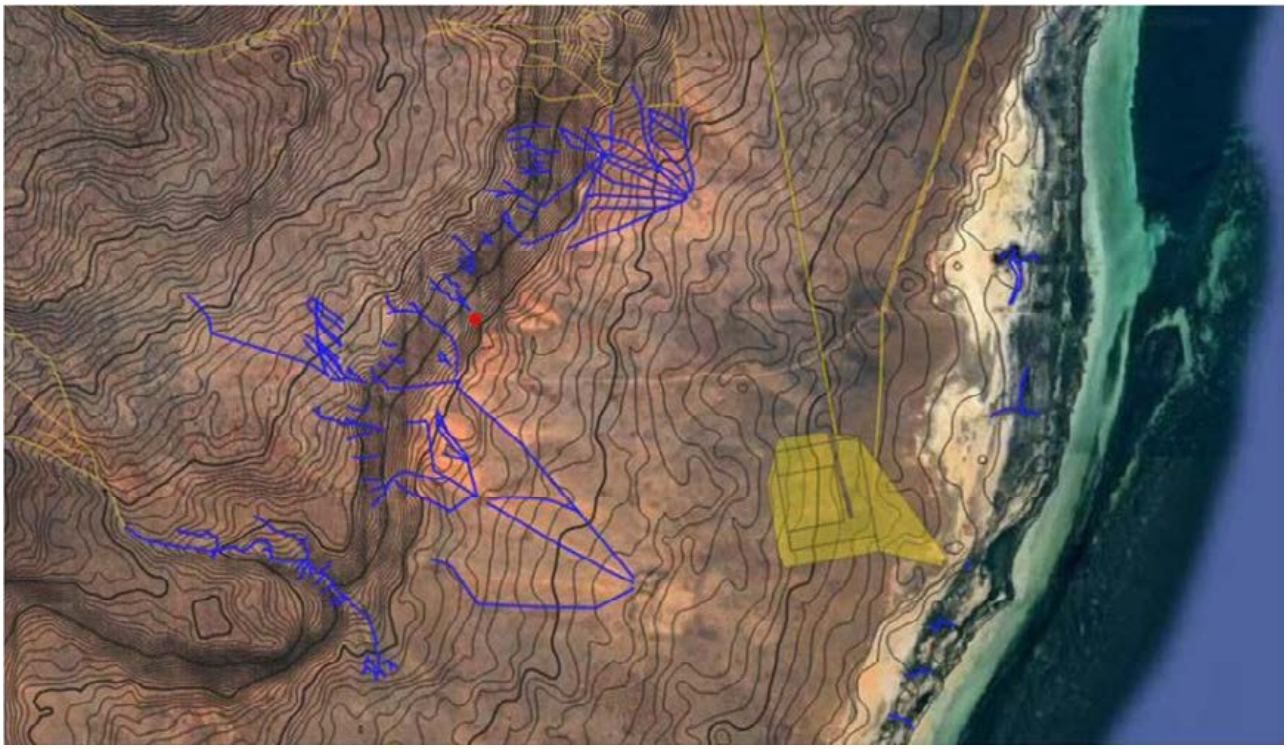


Figure 5-21. Catchment area of watercourse gully adjacent Desalination plant

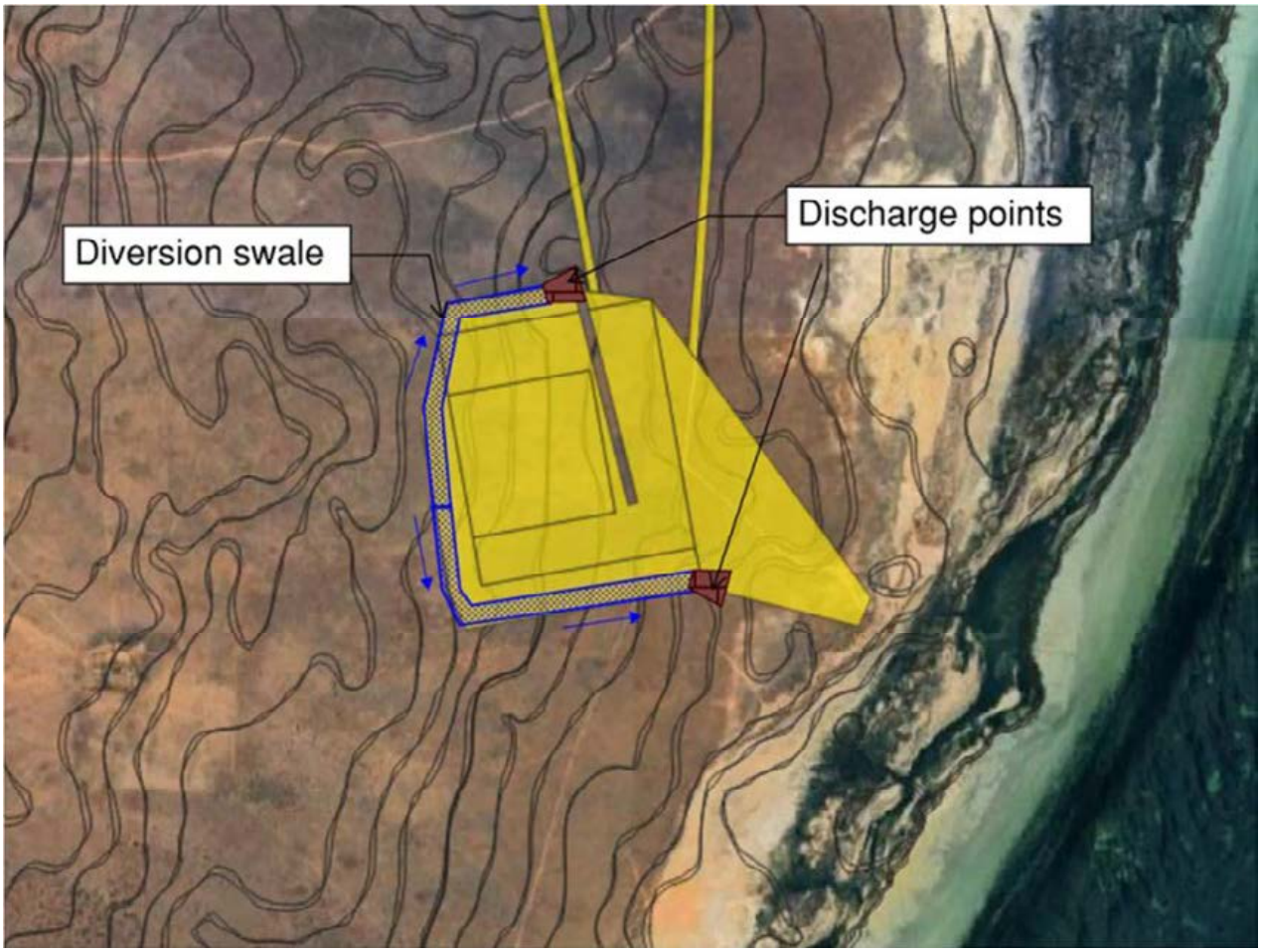


Figure 5-22. Proposed diversion swales around Desalination plant

5.9.2 Pump Stations, Storages and Substations

Pump stations and storages (most of which comprise a substation) are proposed at high points along the pipeline. All pump stations and storages are generally located away from watercourses and overland flow paths to ensure there is no perceivable flood risk. Pump stations and storages are shown in **Figure 5-23**, **Figure 5-24** and **Figure 5-25**.

Site grading would direct stormwater away from operational infrastructure and finished platform levels would be set above surrounding ground levels (typically by at least 300 mm) to promote positive drainage and minimise localised ponding. The stations and storages will be designed to divert stormwater flows from surrounding areas. Detailed flood assessments should be undertaken during detailed design to confirm any flood resilience and freeboard requirements for critical infrastructure. The risk of stormwater runoff from the sites can be adequately addressed with a suitably designed drainage system and implementation of suitable erosion and sediment controls.

5.9.3 Substations

The Corraberra Hill and Mount Gunson substations are to be upgraded, and site levels will be maintained for the upgrade to existing substations. Stormwater will be diverted around the substations, via extension of existing stormwater infrastructure, such as berms and/or swales. Where this infrastructure does not

exist, or is in need of repair, additional works will be undertaken to ensure the substation is immune from stormwater entry.

New substations at Mullaquana Station and Kootaberra would be designed such that critical infrastructure is located above the adopted 1% AEP flood level, including any required freeboard determined through detailed design. In addition, finished platform levels would generally be raised above surrounding ground levels, typically by at least 300 mm, to promote drainage and minimise localised ponding. Site grading, including berms/swales would be incorporated on the high side of the site to direct waters away from the substation. Detailed flood assessments should be undertaken during detailed design to confirm any flood resilience and freeboard requirements for critical infrastructure.

All areas comprising chemicals, oils and greases will be located in bunded areas, preventing these from reaching the surrounding environment in the event of a spill or leak in accordance with EPA guidelines.

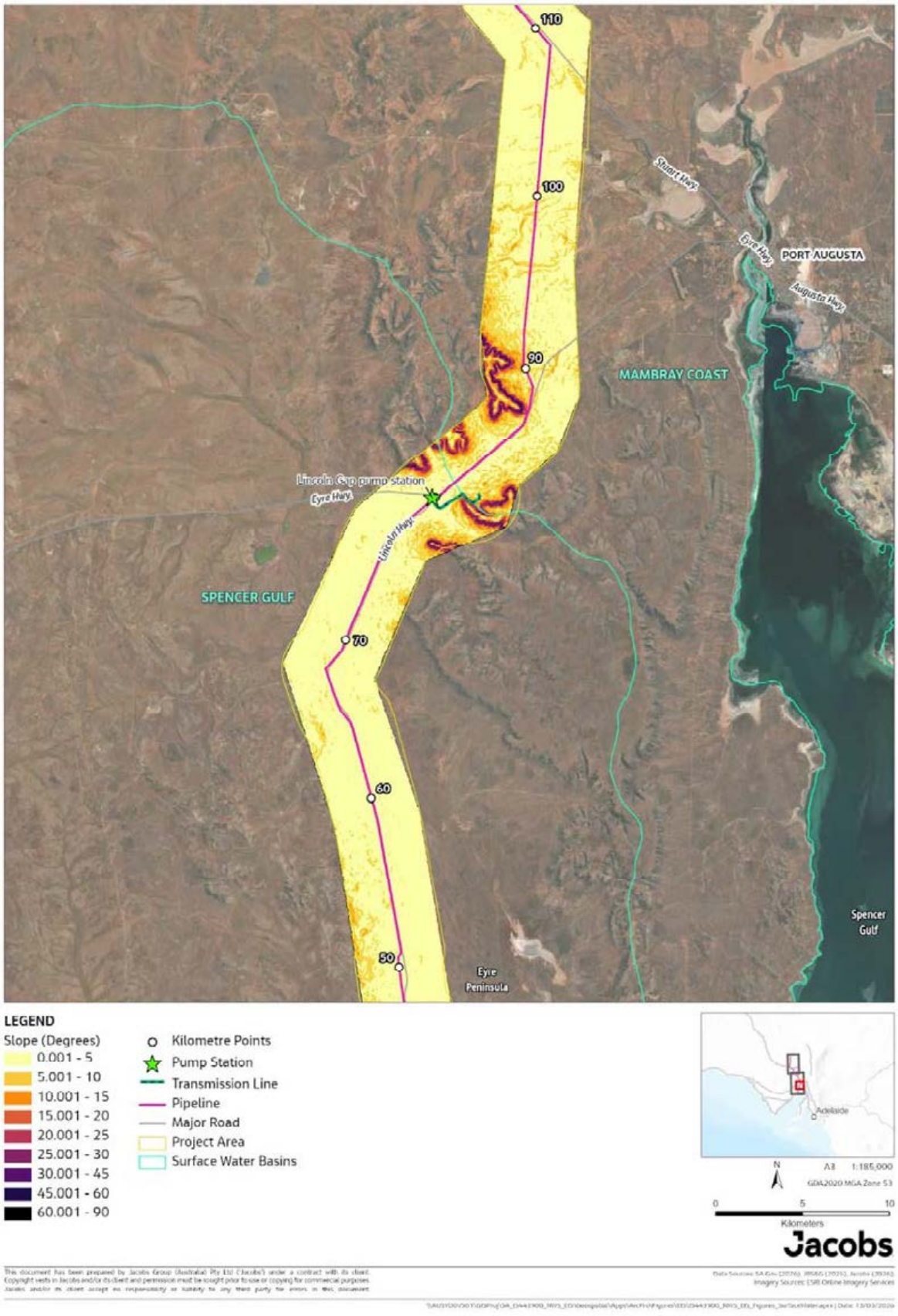


Figure 5-23. Pump station at Lincoln Gap

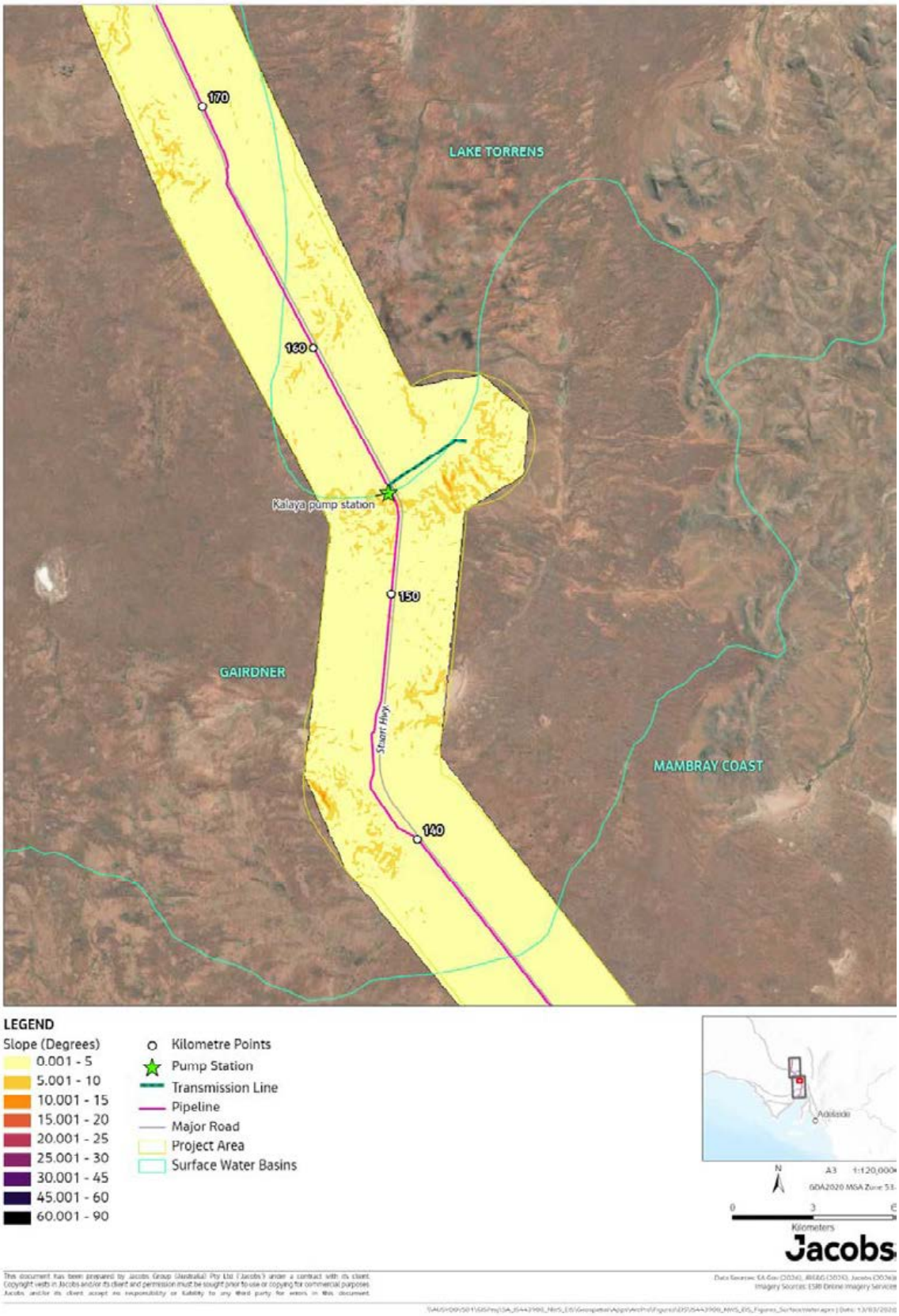


Figure 5-24. Pump station at Kalaya

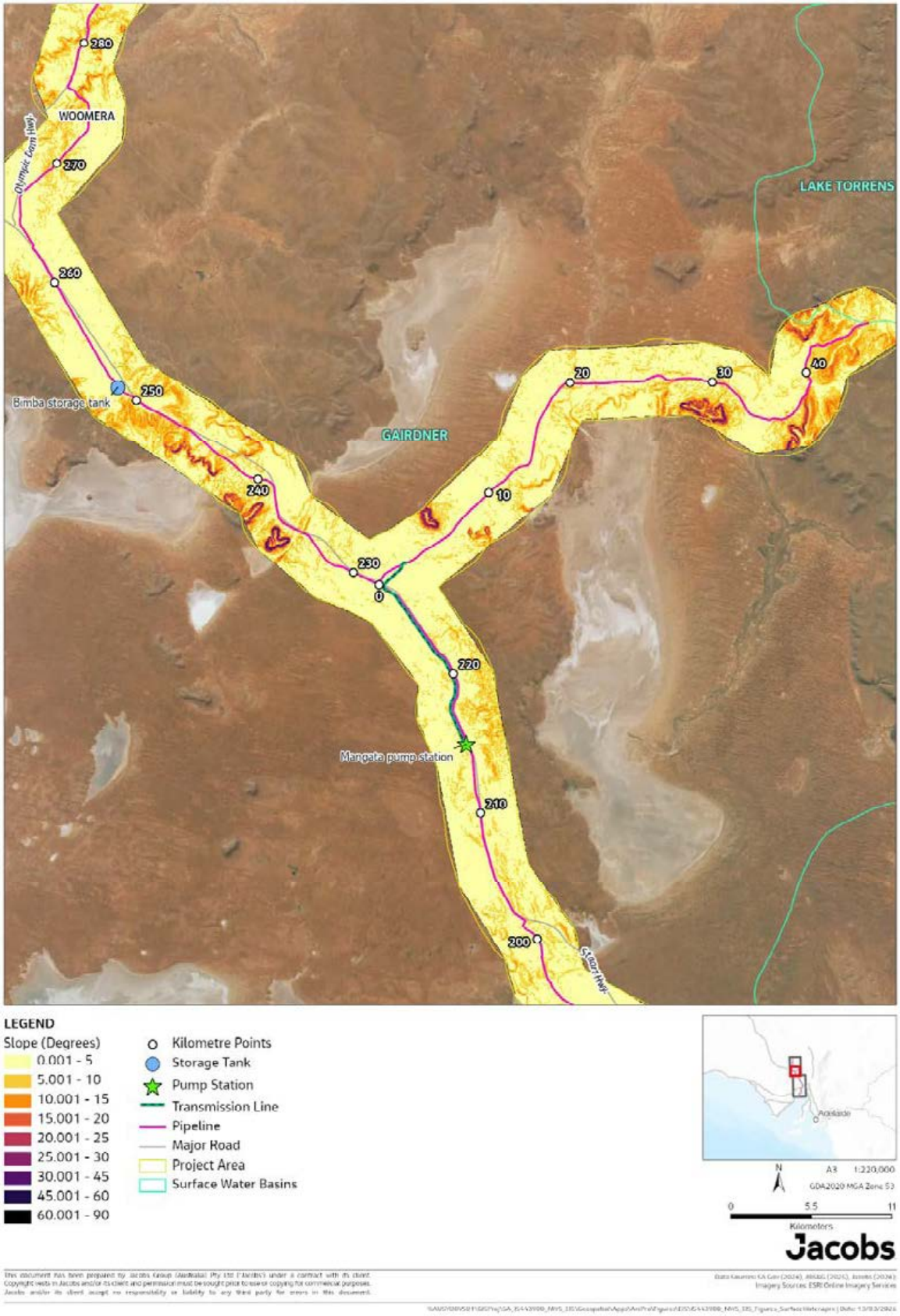


Figure 5-25. Pump station and storages near Mangata

5.9.4 Pipeline crossings

Based on the reference design, the majority of pipeline crossings are to be buried, using trenched and filled, or trenchless installation, subject to site constraints and geotechnical investigations. Construction of the pipeline will involve the placement of a 200mm thick trench mounding which has the potential to influence local surface water runoff and overland flow paths if not appropriately managed as discussed in Section **6.2.2.4**. In low-gradient areas, temporary mounding may locally impede sheet flow during rainfall events if not suitably profiled or managed.

A limited number of watercourse crossings would be installed above ground using driven steel pile supports and elevated headstocks. Support structures may interact with flood flows and would require consideration of local scour, erosion, debris accumulation and hydraulic performance during detailed design.

The subsequent section below indicates magnitude of flows for different AEPs for large catchments along the route.

5.9.4.1 Coastal catchments – Spencer Gulf and Mambray Coast basins

Within Spencer Gulf and Mambray Coast basins, six catchments larger than 100 km^2 were identified along the Project Area, four of which are greater than 500 km^2. Additionally, nine catchments between 10-100 km^2 were identified. The distribution of catchment areas is shown in **Table 5-5**.

The 10% and 1% annual exceedance probability (AEP) peak flood estimates for the largest coastal catchments are shown in **Table 5-6**

Table 5-6. Note the large discrepancy between the expected value estimate and the upper confidence interval indicating the high level of uncertainty.

The 10% and 1% AEP peak flood estimates for all the coastal catchments identified are plotted in **Figure 5-26** and **Figure 5-27**, respectively.

Table 5-5. Catchment area distribution – coastal catchments

Catchment area range	Number of catchments
10 – 30 km^2	3
30 – 100 km^2	6
100 – 240 km^2	2
500 – 2000 km^2	4

Table 5-6. Peak flood estimates – large coastal catchments

Intercept ID	Watercourse	Catchment area (km^2)	10% AEP flood expected value (m^3/s)	10% AEP flood upper confidence limit (m^3/s)	1% AEP flood expected value (m^3/s)	1% AEP flood upper confidence limit (m^3/s)
-	Nonowie Creek Catchment	1,400	90	670	310	4,900
-	False Bay inflow	1,500	80	610	280	4,400

Intercept ID	Watercourse	Catchment area (km²)	10% AEP flood expected value (m³/s)	10% AEP flood upper confidence limit (m³/s)	1% AEP flood expected value (m³/s)	1% AEP flood upper confidence limit (m³/s)
-	Illeroo Creek Catchment	1,000	70	530	240	3,800
WC 19	Lake Dempsey Creek Catchment	500	9	110	150	4,500

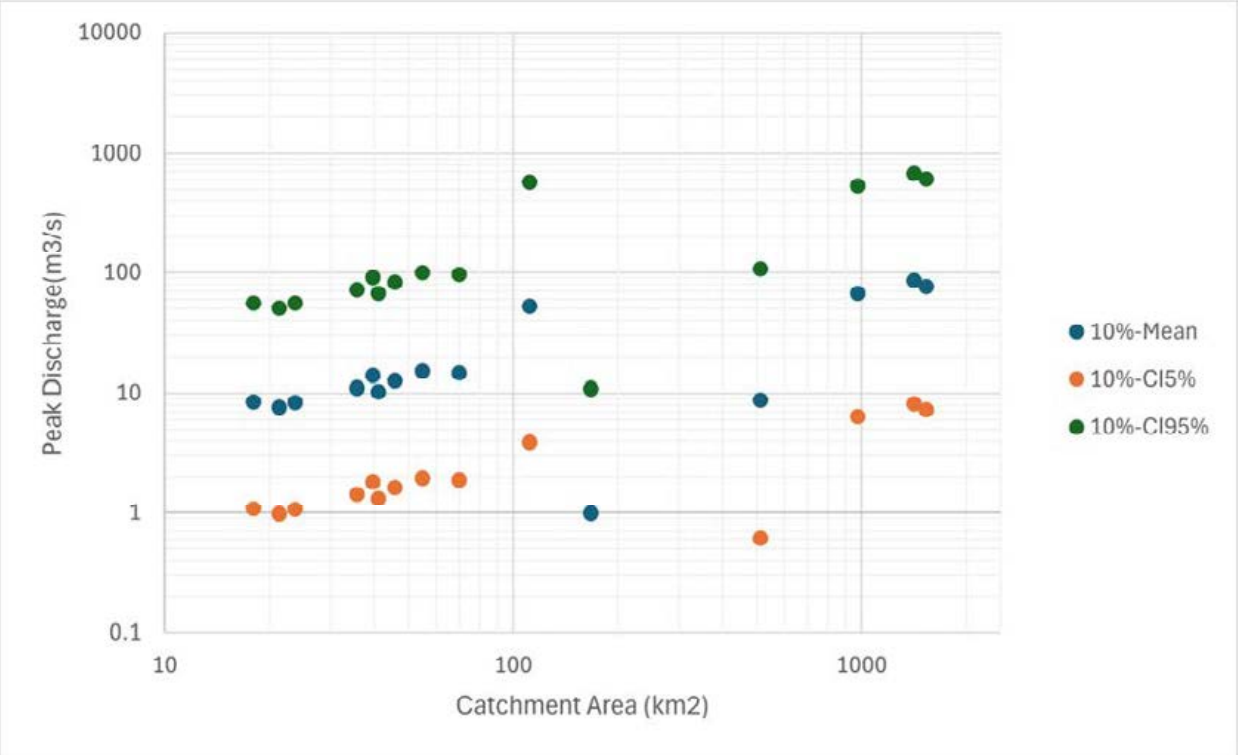


Figure 5-26. 10% AEP flood estimates for coastal catchments

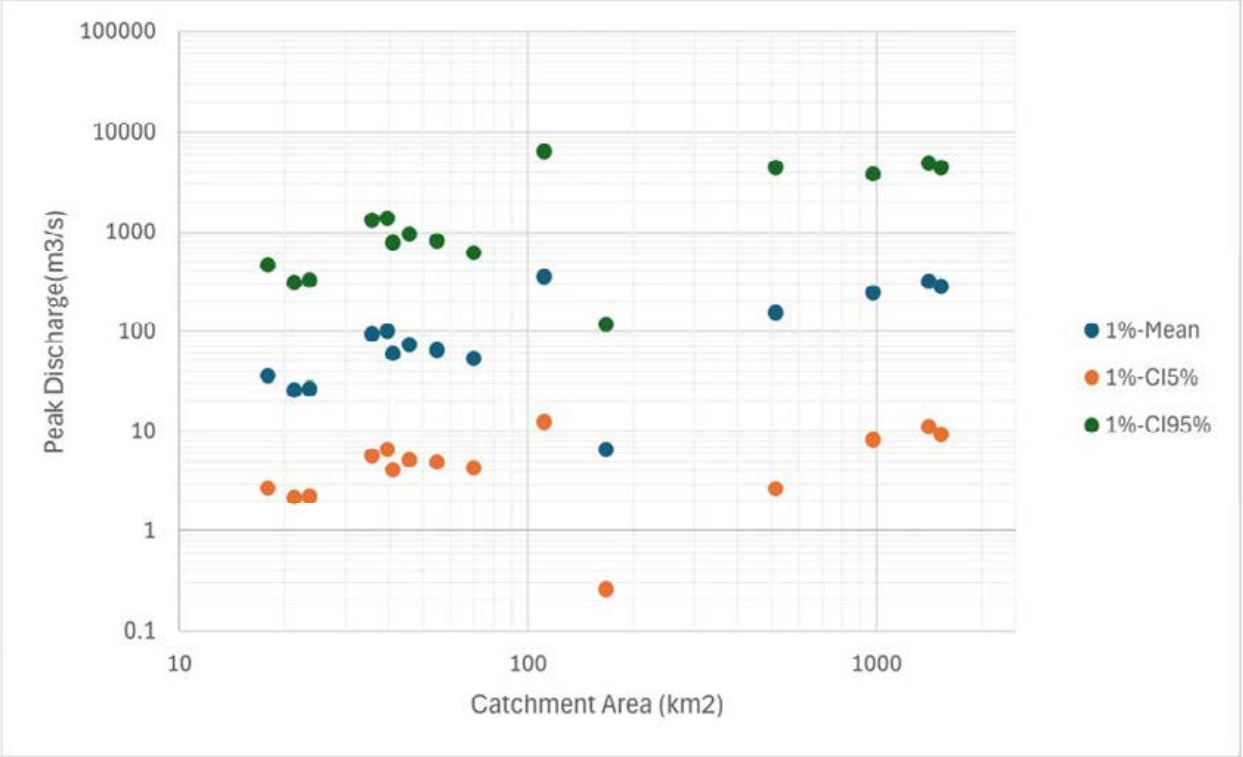


Figure 5-27. 1% AEP flood estimates for coastal catchments

5.9.4.2 Inland catchments – Gairdner and Torrens Basin

The limitations of the topographical data as discussed in Section **4.3.2** makes the analysis within the inland Gairdner and Torrens basins particularly challenging. The results in this section are presented with low confidence. Two catchments were identified with an area of 500 km^2 or larger, along with twenty catchments in the 10 – 500 km^2 range (**Table 5-7**).

The 10% and 1% AEP peak flood estimates for the largest inland catchments are shown in **Table 5-8**. The 10% and 1% AEP peak flood estimates for all the inland catchments identified are plotted in **Figure 5-28** and **Figure 5-29**, respectively.

Table 5-7. Catchment area distribution – inland catchments

Catchment area range	Number of catchments
10 – 30 km^2	7
30 – 100 km^2	7
100 – 500 km^2	6
500 – 2000 km^2	2

Table 5-8. Peak flood estimates – large inland catchments

Intercept ID	Watercourse	Catchment area (km2)	10% AEP flood estimate (m^3/s)	10% AEP flood upper confidence limit (m^3/s)	1% AEP flood estimate (m^3/s)	1% AEP flood upper confidence limit (m^3/s)
WC 46	Elizabeth Creek	640	60	450	200	3,000

Intercept ID	Watercourse	Catchment area (km2)	10% AEP flood estimate (m^3/s)	10% AEP flood upper confidence limit (m^3/s)	1% AEP flood estimate (m^3/s)	1% AEP flood upper confidence limit (m^3/s)
-	Coorlay Creek	500	50	420	210	3,400

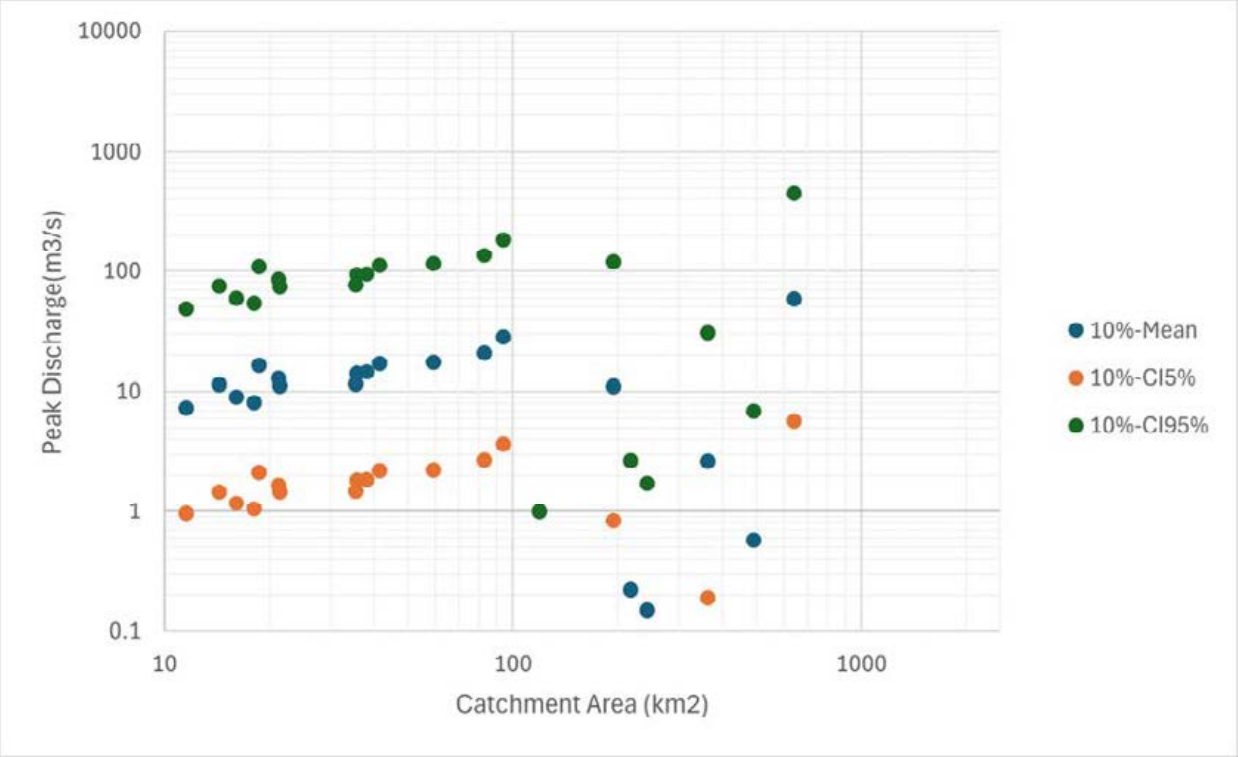


Figure 5-28. 10% AEP flood estimates for inland catchments

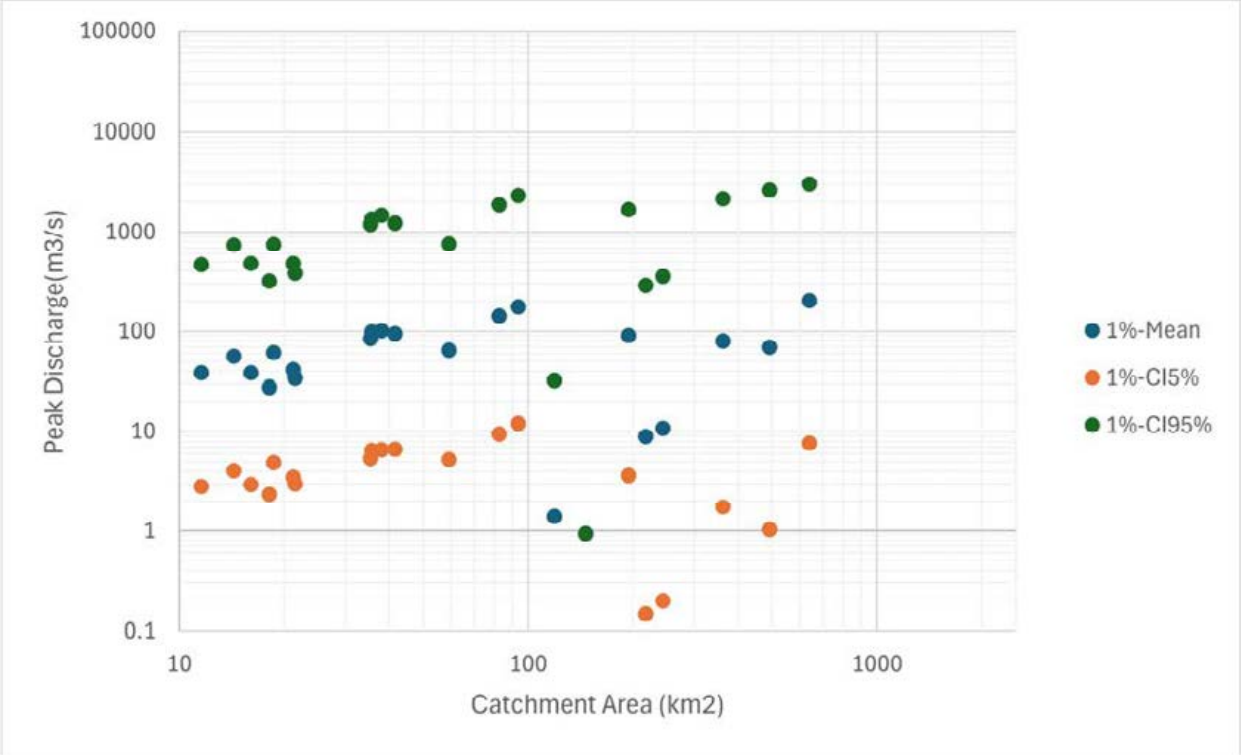


Figure 5-29. 1% AEP flood estimates for inland catchments

5.10 Aquatic Ecology

In the arid region of the Project Area, surface water is spatially and temporally limited. As such, access to, and the quality of this resource is of critical importance to local fauna.

Despite the challenging environment, many salt lakes support relatively depauperate but abundant and unique invertebrate and fish communities that play a critical role in the food web, serving as prey for migratory waterbirds and other species (Williams, 2002) (noting that waterbirds and other terrestrial species assessed in Jacobs, 2026b. Their presence contributes to overall biodiversity and sustains higher trophic levels. In particular, the periodically inundated salt lakes provide essential breeding grounds for migratory waterbirds that take advantage of the food rich, shallow water environments (Timms, 2007). This assessment focusses on obligate aquatic fauna including fish, turtles, and invertebrates and considers impacts to threatened species as well as any impact on aquatic species that may be felt up the food chain (e.g. loss of an important food source for waterbirds).

5.10.1 Threatened aquatic fauna species and communities

The PMST Report inclusive of the Project Area is provided in **Appendix C** (and see EPBC referral 02128). The report indicates that there are no EPBC Act listed or state conservation listed aquatic fauna likely to occur in the Study Area. The tidal reaches of waterbodies in the southern section only support widespread estuarine and diadromous (migratory) species, while the largely ephemeral waterways crossed in the northern section of the alignment would only present temporary pathways for aquatic fauna such as fish.

The EPBC Act listed Subtropical and Temperate Coastal Saltmarsh TEC was determined to be likely present in the southern end of the alignment within Spencer Gulf and Mambray Coast basins. There is potential for the EPBC Act listed Bead Glasswort (*Tecticornia flabelliformis*) to occur within this TEC. However, no Bead Glasswort was observed during the field surveys (Jacobs, 2026b).

5.10.2 Aquatic flora

Based on vegetation mapping conducted as part of the *Northern Water Project – Terrestrial Ecology Baseline Report* (Jacobs, 2026b) it appears that obligate aquatic flora is likely very rare along the pipeline alignment. Published reports of aquatic flora in the region are limited as the conditions are unsuitable for most aquatic plant species (e.g. Williams, 1990). Additionally, no aquatic plant species listed as MNES are recorded within 5 km of the Project alignment. Permanent waterbodies are restricted to the southern end of the alignment within Spencer Gulf and Mambray Coast basins and contain fringing estuarine and saltmarsh vegetation dominated by halophytic species.

Bead Glasswort was initially identified as a target species as it is listed as Vulnerable under the EPBC and NPW Acts, and records were identified within the Project Area relevant to a previous alignment, at Arno Bay located over 100 km from the current Project Area. Key habitat for Bead Glasswort is typically located in saline wetlands on coastal clay flats (sabkha) over gypsum deposits (fragipans) or on the margins of inland salt lakes (DCCEEW, 2024). Habitat matching this description was detected during field surveys, occurring in the Project Area adjacent to the Mullaquana Station. As such, targeted surveys for Bead Glasswort were conducted in these areas of key habitat during February of 2023. However, no individuals were observed within the Project Area and therefore no further investigations or assessment for this species was conducted.

The EPBC Act listed Vulnerable Subtropical and Temperate Coastal Saltmarsh threatened ecological community (TEC) was identified during field surveys along the coast in proximity to the construction footprint between Mullaquana Station and Whyalla. The Project Area intersects the TEC for approximately 230 m of the intake pipe. However, construction is not anticipated to impact the TEC due to the tunnelling construction method for the intake and outfall pipe infrastructure within this location.

Coastal saltmarsh also provides suitable habitat for threatened and migratory shorebirds listed under the EPBC and NPW Acts. However, overall, it is considered there is very little coastal saltmarsh in the construction footprint (<1 ha) therefore providing very limited habitat opportunities for these species. Refer to Jacobs (2026b) for further detail on coastal flora.

5.10.3 Aquatic fauna

5.10.3.1 Regional fish community

5.10.3.1.1 Coastal catchments – Spencer Gulf and Mambray Coast basins

The pipeline only crosses some ephemeral reaches of creeks in these regions. The regional fish community of Spencer Gulf Basin and Mambray Coast Basin which drain to the coast are generally depauperate of obligate freshwater fauna as they are predominantly saline. However, two species of diadromous (migratory) freshwater fishes have been observed in the permanent estuarine sections of these coastal catchments, including near the Project: the Common Galaxias (*Galaxias maculatus*) and Congolli (*Pseudaphritis urvillii*). Each of these species has high salinity tolerance and migrate between marine and freshwater environments during their lifecycle (Allen *et al.* 2002). The Common Galaxias is the only species that is likely to reach such areas, rarely and temporarily, during large rainfall events.

5.10.3.1.2 Inland catchments-Gairdner and Torrens Basins

The north-south alignment of the pipeline between the north of Whyalla and Olympic Dam does not cross any permanent waterbodies and would only be occupied temporarily by migrating freshwater fish species during flood events, if at all.

The main species of interest from a local biodiversity perspective, is the Lake Eyre Hardyhead. Although it is not Commonwealth or State-listed of conservation significance, it is an endemic Australian arid zone species with a relatively small range. The species has a limited distribution in Lake Eyre and its southern and western tributaries, and is also found in Lake Frome, Lake Torrens, and associated tributaries. It occupies in ephemeral rivers, streams, natural springs, salt lakes, and bores, usually around cover and over gravel substrates (McDowall *et al.* 2002).

Fish surveys conducted in and around Lake Torrens have identified populations in groundwater fed refuge waterholes in Willochra Creek in the Flinders Rages, and in scattered locations between the northern and southern extent of the western side of Lake Torrens. The most recent substantial survey was conducted in 2008 (see BHP Billiton 2009), and scattered records exist from as recently as 2010 (Atlas of Living Australia), meaning the data is somewhat dated.

The species exists in moderate to low numbers when persisting in refuge habitat, but breed prolifically during floods and spread widely before experiencing mass mortality as water levels recede. In this way, they are adept at colonising new habitats. It should be assumed that they would use the ephemeral tributaries of Lake Torrens that intersect with the proposed pipeline on rare occasions during major flood events.

5.10.3.2 Macroinvertebrates

Studies of freshwater invertebrate communities in the entire Study Area are sparse, but inferences can be made regarding the community composition based on substantial studies conducted by Williams et al. (1985) and Williams et al. (1998). It is expected that these communities would be present in all permanent water bodies that exhibit the salinity ranges typical of these inland arid zone habitats (not necessarily estuaries) and some species that would remain present where groundwater is near the surface, but surface water is otherwise absent. During flood events it is expected that they would be dispersed far more widely by the prevailing flows, before retracting to refuge habitat.

Williams et al. (1998) sampled macroinvertebrate communities in Lake Torrens during a period where it was full, recording 29 species in total. Crustaceans dominated the samples, with anostracan brine shrimp (*Parartemia minuta*), cladocerans (*Daphniopsis queenslandensis* and *Moina baylyi*), and ostracods (several species including *Trigonocypris subglobusus*) being the most abundant, and widespread. The fauna was dominated by widespread forms that were either part of a distinct assemblage found widely in central Australian salt lakes (e.g., *P. minuta*, *D. queenslandensis*, *M. baylyi*, and *T. subglobusus*, worldwide forms (*B. plicatilis*), or forms found widely in Australian salt lakes (e.g., *Diacypris compacta* and *Tanytarsus barbitarsis*).

Williams et al. (1985) collated macroinvertebrate species lists from salt lakes of varying salinity on the Eyre Peninsula, south-west of the Project Area (see **Figure 5-30**). The study included coastal salinas (dune lakes) where water salinity is predominantly influenced by marine groundwater interaction, and continental playas (endorheic drainage basins) that are influenced by fresh groundwater interaction. Overall, the fauna of the salt lakes on Eyre Peninsula lacked the central Australian salt lake species, but was still dominated by crustaceans, included some widespread Australian species (e.g., *D. compacta*, *Diacypris dietzi*, *Diacypris whitei*, *Platycypris baueri*), and included several species endemic to the region.

The fauna found in the salt lakes on the Eyre Peninsula appear to reflect the ambient salinity, in that moderately saline lakes generally contain the most species and the highly saline lakes the least (Williams 1985). This pattern has been observed elsewhere in Australian salt lakes (Timms, 1993, 1998). This means that the community composition changes to some degree over time as water salinity changes due to processes such as rainfall and evaporation.

Taxon		Salinity										
		4.9	26.7	31.0	31.2	36.2	37.0	39.0	66.5	73.6	156.8	195.3
FORAMINIFERAa	*Elphidium* sp.			+	+		+					
	Trochaminna inflata			+								
ANOSTRACA	*Parartemia cylindrifera*				+		+					
	P. zietziana		+							+	+	+
	Parartemia sp.							+				
CLADOCERA	*Daphniopsis pusilla*		+		+	+	+	+				
	Daphniopsis sp.						+					
COPEPODA	*Calamoecia salina*		+		+		+	+				
	Microcyclops dengizicus								+			
	Microcyclops sp.		+				+	+				
	Mesochra baylyi					+						
OSTRACODA	*Diacypris fodiens*		+		+		+			+		
	D. compacta		+		+			+				
	D. dictyote		+		+							
	D. whitei						+					
	D. spinosa					+						
	Australocypris robusta.							+				
	A. dispar		+									
	A. sp.						+			+		
	Australocypris sp.				+							
	Reticypris clava		+									
	Reticypris sp.								+			
	Reticypris				+							
	Platycypris baueri						+					
	Mytilocypris praenuncia					+						
ISOPODA	*Haloniscus searlei*		+	+	+			+				
AMPHIPODA	*Afrochiltonia australis*	+		+		+	+					
INSECTA	Chironomidae								+			
	Ceratopogonidae								+	+		
	Tabanidae								+			
	Stratiomyidae						+	+	+			
	Tipulidae							+				
	Anisoptera		+									
	Zygoptera		+									
	Coleoptera		+									
ARACHNIDA	Agelenidae				+							
MOLLUSCA	*Coxiella striata*		+				+	+				
	C. glauerti		+				+	+			+	

Figure 5-30. Inventory of invertebrates observed in Eyre Peninsula salt lakes (from Williams 1985)

5.10.4 Aquatic pests

No aquatic plant or animal pest species, including common pests such as Common Carp (*Cyprinus carpio),* have been recorded in the vicinity of the Project Area. The combination of ephemerality, isolation, and high salinity likely restrict the spread of invasive freshwater species.

6. Risk assessment

6.1 Overview

The risk assessment in this section is based on available information regarding catchment hydrology, water quality, flood risk, aquatic communities and habitat present in the Project Area (presented above in Section **5**).

The performance objective adopted for the risk assessment is for the Project to comply with the General Environmental Duty under section 25 of the *Environment Protection Act 1993*, to avoid and minimise impacts on water quality and aquatic ecosystem health, noting that no State and Commonwealth listed aquatic species were identified in the Project Area. Risks and environmental mitigation measures were identified and developed based on the construction methodology and operational requirements outlined in Section **2.5** and **2.6**.

The risk assessment involved:

- Identifying effect pathways through which aquatic environments may be impacted by the construction and operation of the Project and rating the risk that each effect pathway poses and the relative risk likelihood (i.e., likely, possible, unlikely, rare) and consequence (i.e., severe, major, moderate, minor, negligible).
- Developing mitigation measures that are required to manage the identified risk.
- Assessing the residual risk likelihood and risk rating following the implementation of the mitigation measures.

As noted in Section **5.3**, some watercourses may be more sensitive to construction and operational impacts than others depending on the type of watercourse, its location and landform. Such watercourses have been listed separately in the risk assessment as "watercourses considered to have potential high impact". All other watercourses are classified as "standard".

The assessment has investigated a broad range of effect pathways that have been categorised into potential impacts to animal passage, water quality, weeds and pest species, toxic substances, groundwater interactions, and direct impacts such as loss of habitat or the mortality of individuals or communities. Mitigation measures have been proposed to guide Project delivery across the construction and operation phases. Key risks are defined as having an initial rating of medium or above.

The assessment required consideration of the ecology and current distribution of aquatic flora and fauna likely present in the Project Area. Broad summaries of the ecological requirements of the local aquatic communities are presented in Section **5.10**. A summary of the potential effect pathways and associated mitigation measures are provided in **Table 8-1**.

6.2 Impact pathway identification and risk assessment

6.2.1 Construction

The proposed construction works for the Project could potentially impact on aquatic ecosystems and ecological values of watercourses where surface water is present via several effect pathways:

- Earthworks result in erosion and transport of sediment to downstream watercourses.
- Earthworks expose saline soils.
- Earthworks expose ASS.

- Removal of vegetation leads to increased erosion and sediment input into watercourses.
- Sediment runoff from stockpiles of soils and vegetation reaches watercourses.
- Transportation of excavated materials and the movement of heavy vehicles.
- Temporary dewatering of construction sites leads to discharge of contaminants or saline water into watercourses or scouring of watercourses related to discharge.
- Leaks and spills from fuels and chemicals and other potentially harmful substances used in construction enter adjacent watercourses.
- Construction methods at watercourse crossings lead to increased erosion and sediment mobilisation in watercourses.
- Effects related to temporary workforce accommodation and management of wastewater.
- Flooding occurs during construction, washing construction materials into watercourse/s.
- Testing and commissioning of the new infrastructure.

Direct impacts from sediments, chemicals, and other materials mobilising to downstream receivers would generally only be a risk to the watercourses which contain water at the time and may result in reduced water quality. As watercourses are largely ephemeral, the risk to water quality is generally low.

The effect pathways are described in detail in this section below, along with an initial likelihood, consequence, and overall rating, as well as residual risk rating once proposed mitigation measures are in place. These are also summarised in **Table 8-1**. Note that potential impacts to landscape features such as gibber stones are addressed in *the Northern Water Project - Topography, Geology and Soils Assessment* (Jacobs, 2026a). Potential impacts from temporary dewatering of construction sites leading to groundwater drawdown from nearby GDEs are assessed in the EIS report *Northern Water Project – Groundwater Impact Assessment* (JBS&G, 2026).

6.2.1.1 Earthworks result in erosion and transport of sediment to downstream watercourses

Construction of most Project elements will require excavation or earthworks thereby disturbing and exposing soils. Earthworks are required at all work areas, which as a minimum will involve clearing and preparing sites for works. Sedimentation can occur when wind and stormwater runoff come into contact with exposed areas, transporting sediment to receiving watercourses. Irrespective of soil type, once sediments enter watercourses they can directly and indirectly impact the aquatic environment. Direct impacts include reducing light penetration, clogging fish gills, altering watercourse geomorphology, smothering benthic organisms, and reducing visibility for fish, if sediments reach flowing watercourses. Indirect impacts of increased sediment occur over the longer term and include accumulation and the release of attached pollutants such as nutrients.

Without mitigation, the initial risk likelihood of this impact pathway to watercourses is considered to be “Possible,” the consequence “Moderate,” and the overall initial risk rating “Medium”. With the implementation of proposed mitigation measures MM 2 (Erosion and sediment control), the residual risk likelihood is reduced to “Unlikely” and a residual risk rating of “Low”.

6.2.1.2 Earthworks expose saline soils

Saline soils are known to occur within the construction footprint and present a risk to downstream watercourses containing water, if they are exposed and leach high concentrations of salt into runoff. Saline

soils can alter the salinity of the watercourses which can alter instream biodiversity and ecosystem function. Watercourses considered to have potential high impact are located within areas of highly saline soils include Black Oak Creek, salt lakes and unnamed watercourses in the northern extent of the Project Area (see **Figure 6-1** and **Figure 6-2**). However, risk of this impact is low as the receiving environment has habituated to catchment geology and existing saline impacted surface water flows. Black Oak Creek between the salt lakes, Lake Dutton and Ironstone Lagoon (KP 196 and 197), exhibits very salty, highly corrosive soils, and also highly disturbed areas near a salt lake (KP 235 to 237) could present a risk if mobilised during construction. Construction of the Carrapateena lateral branch pipeline between KP CA20 and CA29 will occur through a closed salt lake system and may also result in exposure of saline soils.

Without mitigation, the initial risk likelihood of this impact pathway to standard watercourses is considered to be "Unlikely," the consequence "Minor," and the overall initial risk rating "Low". For watercourses considered to have potential high impact, i.e. those known to be in areas of saline soils, the unmitigated initial risk likelihood is "Possible", the risk consequence is "Moderate" and overall rating "Medium". With the implementation of proposed mitigation measures MM 1 (Construction Environmental Management Plan) the residual risk likelihood is reduced to "Unlikely" for all watercourses and a residual risk rating of "Low".

6.2.1.3 Earthworks expose acid sulfate soils

Within the construction footprint there is a high potential for encountering ASS in sediments. Inland ASS are known to occur near the salt lakes, and coastal ASS are known to occur between Mullaquana Station and Port Augusta. Whilst both present a risk if exposed, generally inland ASS, which can react rapidly to form acid, present a greater risk as opposed to coastal ASS which become acidic over longer periods.

Areas of ASS occur around inland salt lakes, Yeltacowie Creek, Elizabeth Creek and Ironstone Lagoon (see **Figure 6-1**). Exposure of ASS during construction can pose a risk if not appropriately managed and may lead to oxidation and cause acid leachate formation. This could occur in situ or in excavated stockpiles during construction. Acid leachate may contain elevated heavy metals that can be transferred to downstream watercourses following rainfall, directly impacting aquatic life. Acid leachates can cause corrosion of construction materials such as concrete, iron and steel. As per *Northern Water Project – Topography, Geology and Soils Assessment* (Jacobs, 2026a), it is proposed that excavated materials are separated as per non-acid forming and potentially acid forming material, with treatment of potentially acid forming material with a neutralising agent.

Without mitigation, the initial risk likelihood of this impact pathway to standard watercourses is considered to be "Unlikely," the consequence "Minor," and the overall initial risk rating "Low". For watercourses considered to have potential high impact, i.e. those known to be in areas of potential ASS, the unmitigated initial risk likelihood is "Possible", the risk consequence is "Moderate" and overall rating "Medium". With the implementation of proposed mitigation measures MM 1 (Construction Environmental Management Plan) and MM 5 (Acid Sulfate Soils), the residual risk likelihood is reduced to "Unlikely" for all watercourses and a residual risk rating of "Low".

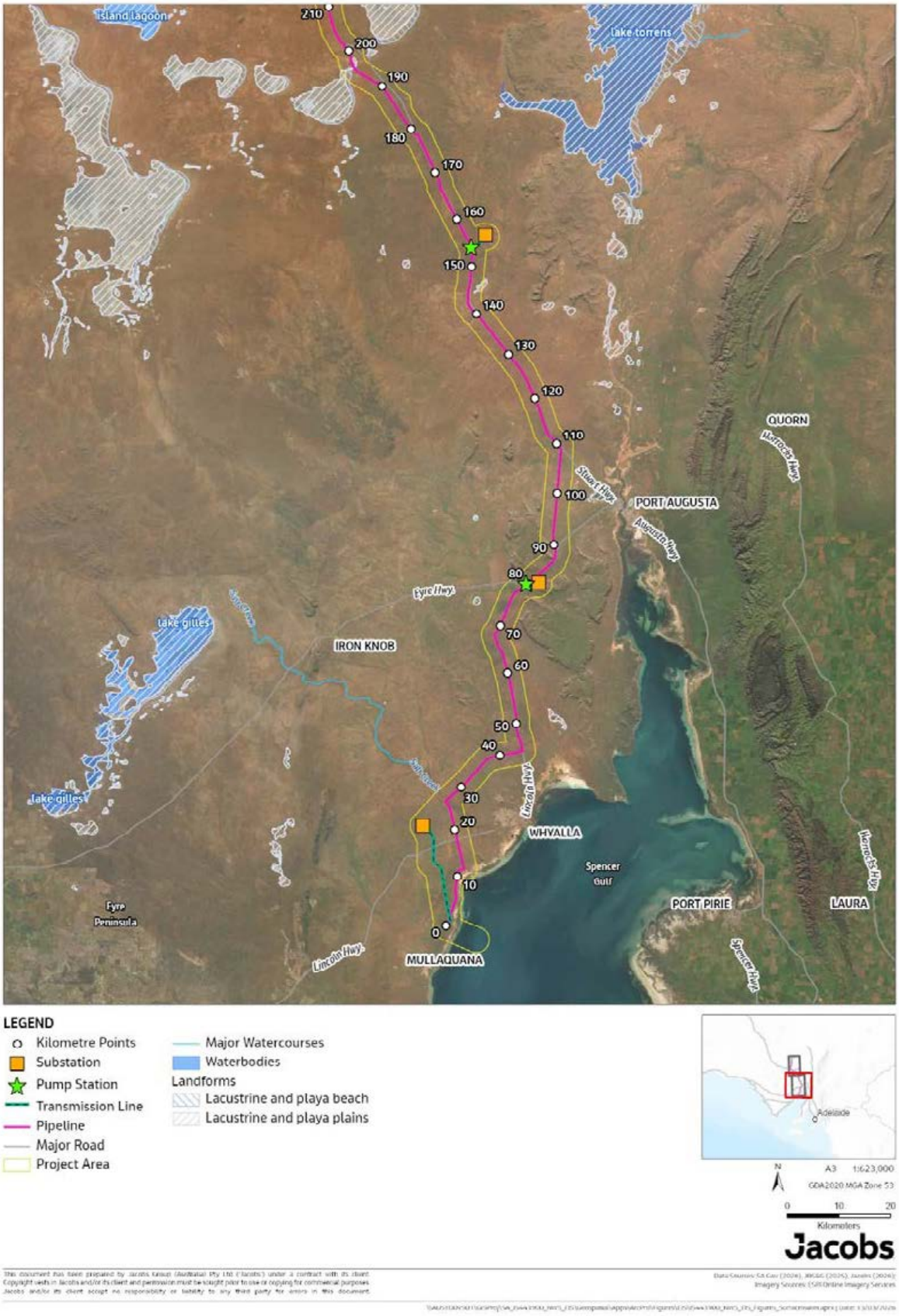


Figure 6-1. Watercourses within areas of highly saline soils – southern section

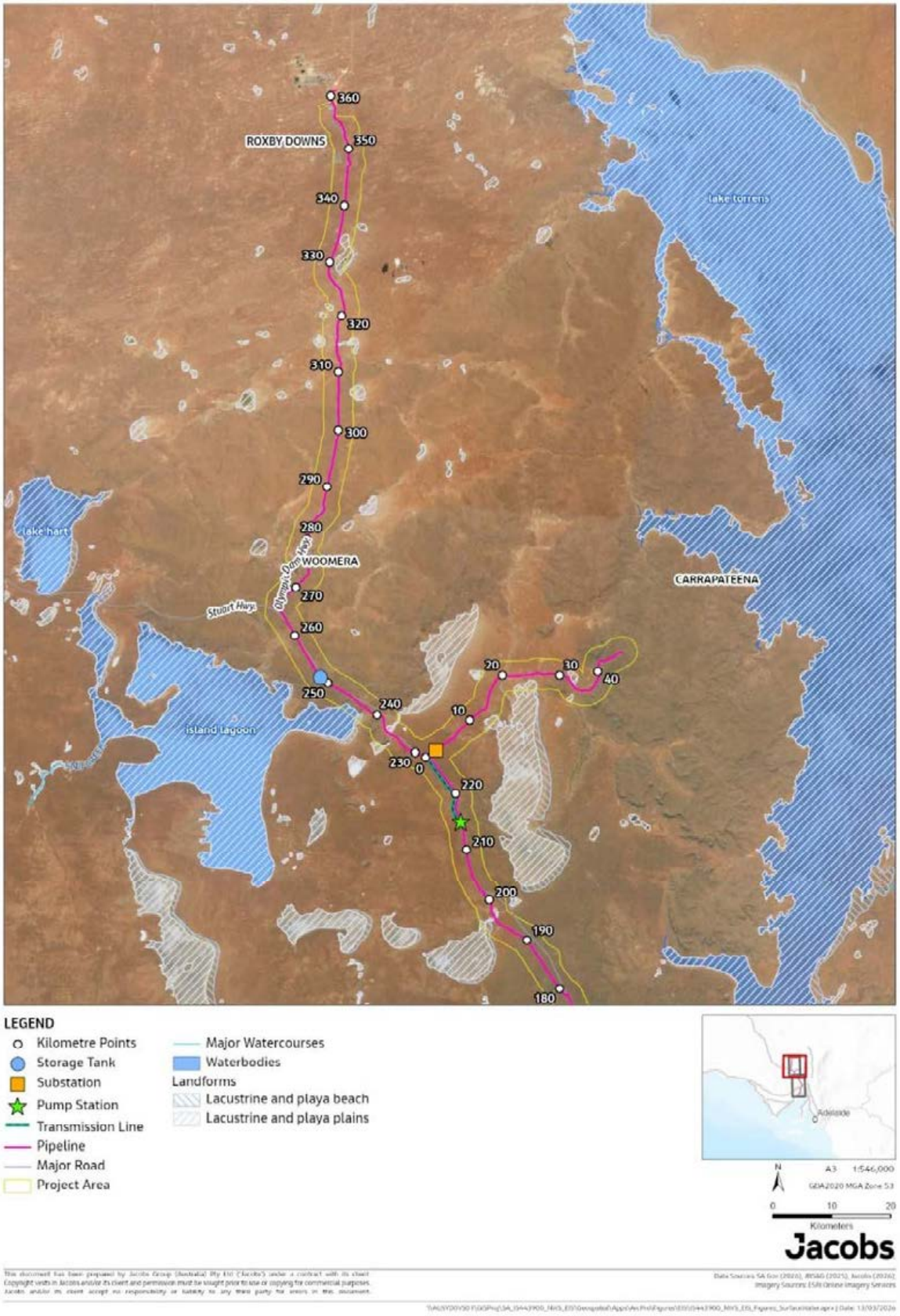


Figure 6-2. Watercourses within areas of highly saline soils – northern section

6.2.1.4 Removal of vegetation leads to increased erosion and sediment input into watercourses

Removal of vegetation can impact water quality during the construction phase if runoff is allowed to mobilise exposed soils. This can result in erosion and sedimentation within watercourses. Construction of most Project elements would require removal of vegetation, stripping of topsoil and excavation or earthworks, thereby disturbing and exposing soils.

As the pipeline route moves further north, aeolian dunes become the dominant permanently vegetated areas as they retain water and promote vegetation growth. Removal of this vegetation could increase the risk of erosion. Additionally, the soils in the dunes are prone to compaction. Therefore, increasing the likelihood of concentrating overland flows and subsequent erosion. Watercourses at greatest risk are those which may require removal of riparian vegetation, particularly if trenching is the preferred method. Creeks with known riparian vegetation include Black Oak Creek, a minor unnamed channel (KP 238) and Wirrawirralu Creek. For comprehensive mapping of vegetation along the Project alignment see Appendix B of the *Northern Water Project – Terrestrial Ecology Baseline Report* (Jacobs, 2026b).

Additionally, the estuaries and lakes in the Project Area contain vegetation, which may need to be removed during the pipeline construction, most notably Lake Dempsey Creek which drains to Lake Dempsey. There is also a lowland area near Woomera (KP 277-281) which contains salt bush and succulents.

Should water be present at the time of construction, the impact of vegetation clearance on water quality could include increased turbidity, suspended solids, nutrients, salinity, and contaminants from mobilising of soils. However, vegetation removal will be minimised as far as practicable, and due to the ephemeral nature of the watercourses, works would be able to be undertaken during dry conditions over a short duration with backfilling of subsoil and topsoils as soon as practicable while the watercourses are dry. The construction method may also utilise under boring watercourses (subject to further investigations and assessments), which would have minimal disturbance to riparian vegetation.

Unmitigated, the initial risk likelihood of this impact pathway to standard watercourses is considered to be “Unlikely”, the consequence “Negligible” and the overall initial risk rating “Low”. For watercourses considered to have potential high impact, i.e. those watercourses with known riparian vegetation that has the potential to be removed, the unmitigated initial risk likelihood is “Likely”, and the risk consequence is “Moderate” and rating “High”. With the implementation of proposed mitigation measures MM 2 (Erosion and Sediment Control) and MM 7 (Rehabilitation), the residual risk likelihood is reduced to “Unlikely” for all watercourses and both have a residual risk rating of “Low”.

6.2.1.5 Sediment runoff from stockpiles of soils and vegetation reaches watercourses

Construction of the pipeline and transmission lines would require stockpiling of excavated material before it is reused or transported off site. High rainfall events and high winds during construction can erode stockpiled areas and disturbed areas with exposed soils which can be transported downstream. This can result in sedimentation of watercourses, and if water is present may increase turbidity, lower dissolved oxygen, and increased nutrients.

Without mitigation, the initial risk likelihood of this impact pathway to standard watercourses is considered to be “Unlikely”, the consequence “Minor” and the overall initial risk rating “Low”. For watercourses considered to have potential high impact, the impact pathway is considered to be “Possible” the consequence “Moderate”, and the overall initial risk rating “Medium”. With the implementation of proposed mitigation measures MM 2 (erosion and sediment controls) and MM 4 (stockpiles), the residual risk likelihood is reduced to “Unlikely” for all watercourses and both have a residual risk rating of “Low”.

6.2.1.6 Transportation of excavated materials and the movement of heavy vehicles

Excavated material, as well as material brought to site to be used in construction would need to be transported to and from site via access tracks. The DBOM contractor will include appropriate controls, however this material has the potential to be lost from the vehicle if not appropriately secured. This could result in sedimentation to downstream watercourses if mobilised via wind or runoff. Material transported poses the highest risk to watercourses that are near or crossed by access tracks and watercourses in proximity to ancillary facilities or construction sites. As excavated materials will be reused for backfill as much as possible, they will not be transported over long distances unless unsuitable for reuse.

Operation of heavy machinery can disturb soils, particularly in areas where vegetation has been removed or topsoil has been stripped. This increases the potential for erosion and sedimentation in downstream receiving environments, particularly those near access tracks, construction laydown areas, and areas where construction vehicle, plant, and equipment would be used.

The initial risk likelihood of this impact pathway without mitigation is considered to be "Possible", the consequence "Minor", and the overall initial risk rating "Medium". Implementation of proposed mitigation controls including MM 2 (Erosion and Sediment Control) and MM 4 (Stockpiles), the residual risk likelihood is "Unlikely" and risk rating "Low".

6.2.1.7 Temporary dewatering of construction sites leads to discharge of contaminants or saline water into watercourses and/or scouring of watercourses

Trenching through or boring under watercourses will be required for placement of the main transfer and lateral branch pipelines. Trenching or under boring may encounter groundwater where the water table is anticipated to be shallower than the proposed excavation depth.

Temporary construction dewatering would be required where excavations occur below the water table, and management of abstracted waters would be required. If management options include discharge to surface water, this can present a risk to water quality.

Refer to the EIS report *Northern Water Project – Groundwater Impact Assessment* (JBS&G, 2026) and the EIS Surface water chapter for an assessment of dewatered groundwater from construction of watercourse, road and railway crossings.

The following approach will be adopted to manage dewatering of groundwater inflows in accordance with the EPA waste hierarchy:

- shallow pipeline construction to avoid groundwater disturbance where possible.
- testing to determine suitability for reuse.
- if suitable, reuse of extracted groundwater for dust suppression or water requirements for trenchless construction methodology.
- if unsuitable for re-use, discharge to environment where water quality meets EPA requirements for discharge.
- where water quality parameters do not meet EPA requirements for discharge, disposal at a licensed facility (particularly if there is a potential contamination risk).

Discharge of groundwater to a drainage line may occur during construction for once-off periods of up to 72 days during trenchless construction. As all groundwater which may be encountered is from shallow

groundwater aquifers (<3.3 m below ground level), once-off discharge of this water is not anticipated to impact upon vegetation or surface water quality as the vegetation would be currently accessing this water. For example, discharge of saline groundwater from trenching or trenchless launch shafts into the salt lake environment at Pernatty Lagoon is not expected to significantly increase salinity or impact receptors.

Discharge of water in an area with potential susceptibility for scouring or erosion would utilise erosion control methods such as temporary pipe lain in rip rap swale.

If dewatering is required at a location where a potentially contaminating activity has occurred or where potential acid sulfate soils (PASS) are present, additional testing would be required prior to construction commencing. The purpose of testing would be to identify the need for water treatment prior to re-use or discharge to ensure the quality standards set out in the Water Quality EPP are met. Alternatively, should discharge not be possible, water would be collected and disposed of at a licenced facility.

Details of construction through watercourses will be provided to support an application for a Water Affecting Activities (WAA) permit under the LSA Act (if required and following confirmation with the relevant landscape boards). Detailed construction methodology and strategies will be provided for each watercourse crossing including a dewatering management plan in accordance with EPA guideline Environmental management of dewatering during construction activities (EPA 1093/18). The activity of discharging dewatered groundwater to creeklines would also require an EPA licence if the water contains chemical water treatments, or high levels of turbidity and is at a rate above 50 kilolitres per day.

Unmitigated, the initial risk likelihood of this impact pathway to 'standard' watercourses is considered to be "Unlikely", the consequence "Minor", and the overall initial risk rating "Low". The risk to watercourses considered to have potential high impact is slightly higher with an unmitigated initial risk likelihood considered to be "Possible", the consequence "Moderate" and the overall initial risk rated "Medium". With implementation of proposed mitigation measure MM 1 (Construction Environmental Management Plan) and MM 6 (Dewatering) the residual likelihood is "Unlikely" for both standard and watercourses considered to have potential high impact, and the residual risk rating "Low".

6.2.1.8 Leaks and spills from fuels, chemicals and other potentially harmful substances used in construction enter adjacent watercourses

The release of potentially harmful chemicals and other substances in the environment may occur accidentally during construction due to leakage or spills of petroleum, oils and other toxicants from construction machinery, plant equipment, refuelling and vehicles travelling to and from site as well as leakage of fuels stored on site.

Spills and leaks could be transported to downstream watercourses if rain is falling or water is present, or infiltrate into the groundwater. Potential pollutants of concern include hydrocarbons, oil and grease, hydraulic fluids and other hazardous chemicals and can result in oily films on surface water, reducing the visual amenity and decreased biodiversity, loss of habitat and fish kills from increased toxicants. In consideration of the relatively small size of the construction site active at any given time, the amount of toxic substances that will be used in the construction process is not expected to be of a volume that would pose a significant risk to adjacent watercourses. Furthermore, along the pipeline alignment, the construction site will be 'mobile', with approximately 500 m of pipeline trenched in a day. Nonetheless, the storage of large plant and equipment, machinery and vehicles has the potential to result in spills.

Without mitigation, the initial risk likelihood of this impact pathway for all watercourses is considered to be "Possible", the consequence "Minor" and the overall initial risk rating "Medium", With the implementation of proposed mitigation measure MM 3 (Spills and Leaks) the residual likelihood is "Unlikely" and residual risk rating "Low".

6.2.1.9 Construction methods at watercourse crossings lead to increased erosion and sediment mobilisation in watercourses

Installation of the pipeline would require some under-boring, trenching or above ground bridging through watercourses in varying topography and land use areas.

Under-boring may be used for a number of watercourse crossings to minimise instream disturbance, and whilst disturbance of soil by machinery could increase potential for soil erosion and sedimentation, it presents a reduced risk to water quality and less disturbance to the watercourse compared to trenching. Under-boring would require the excavation of entry/exit pits for the launch and retrieval of the under-bored pipeline which will be open for the duration of the under-bored works and may require dewatering to maintain a safe working environment and excavation stability. Dewatering discharge will require disposal which can present a risk to water quality as discussed in Section **6.2.1.7**. The risk of erosion is influenced by the extent of vegetation clearance, soil disturbance, topography, and controls at the groundwater disposal point, but these works are to be set back a sufficient distance from the watercourse such that the risk to water quality from erosion would be minimal.

Installation by trenching involves excavating a trench typically between 2m and 2.3m below ground level (SYSTRA, 2025). (It is noted in the constructability report that due to the expected undulating topography the trench depth may at times exceed 2.3m.) Excavated material will be stockpiled[5] for later use during backfilling (if suitable). The pipe will then be laid in the trench above bedding materials (either excavated soils or imported fill, if required), secured with concrete thrust blocks and trenching spoils, and the trench backfilled with remaining spoils. The surface will be restored and stabilised.

There is potential for erosion to occur as a result of trenching and earthworks for pipeline construction. Banks and the beds of watercourses may become destabilised during the excavation process, and sediments may mobilise from adjacent soil stockpiles during rain events. The risk of erosion is influenced by the extent of vegetation clearance and soil disturbance and topography. Depending on the soil type, the impact to water quality could be caused by increased turbidity and salt loads due to increased mobilisation of sediment and/or exposure to ASS as discussed in Section **6.2.1.1**.

At selected watercourse crossings, the pipeline may be installed above ground using driven steel piles and elevated headstocks. Construction activities would involve temporary access to the watercourse and surrounding floodplain for piling equipment, material delivery, pile installation and assembly of the elevated pipeline structure. These activities have the potential to disturb soils and vegetation within the construction area, increasing the risk of localised erosion and sediment mobilisation. Pile installation may also require temporary work platforms, resulting in additional localised disturbance.

The primary sources of risk of increased erosion and sediment mobilisation are construction activities associated with watercourse crossings, including under-boring beneath, trenching across or constructing above-ground watercourses. These activities present a risk to the following watercourses: Salt Creek, Lake Dempsey Creek, Ranges View Creek, Black Oak Creek, and one unnamed watercourse (KP 85). The construction of Carrapateena Lateral Pipeline presents a risk to Elizabeth Creek, Carra Creek (A and B) and Yeltacowie (A and B) Creek (see watercourses considered to have potential high impact in (**Figure 5-3** and **Figure 5-4**).

Unmitigated, the risk to 'standard' watercourses is that the initial risk likelihood is considered to be "Possible", the consequence "Minor" and the overall initial risk rating "Medium". The risk to watercourses considered to have potential high impact is slightly higher with an unmitigated initial risk likelihood of this impact pathway considered to be "Possible", the consequence "Moderate" and the overall initial risk rated

[5] Soil stockpiles should be placed outside of watercourses to avoid mobilisation during rain events.

"Medium". Implementation of proposed mitigation measure MM 2 (Erosion and sediment control) reduces the risk such that both have a residual risk likelihood of "Unlikely" and a risk rating of "Low".

Refer to *Northern Water Project – Topography, Geology and Soils Assessment (*Jacobs, 2026a) for detailed consideration of the geotechnical and geomorphological risks associated with the Project.

6.2.1.10 Effects related to temporary workforce accommodation and management of wastewater

Current construction methodology assumes temporary workforce accommodation in approximately four construction camps spread throughout the Project Area (to be determined by the DBOM contractor). The four potential accommodation sites are in Whyalla, Port Augusta, Pimba and Roxby Downs (SYSTRA, 2025). Where available, accommodation sites will utilise existing capacity within sewage and wastewater networks or provide appropriate temporary wastewater treatment facilities during camp set up. Temporary wastewater systems would be in accordance with the *South Australian Public Health (Wastewater) Regulations 2013* and the *Environment Protection (Water Quality) Policy 2015*. Therefore, there is expected to be no risk to water quality as a result of the establishment and operation of the construction camps.

Without mitigation, the initial risk likelihood of this impact pathway is considered to be "Unlikely", the consequence "Negligible" and the overall initial risk rating "Low". Implementation of proposed mitigation measures, including MM 8 (Temporary accommodation) results in a residual risk likelihood of "Rare" and residual risk rating of "Low".

6.2.1.11 Flooding occurs during construction washing construction materials into the watercourse/s

Flood events in the Study Area have the potential to damage infrastructure and the environment, cause erosion, and impact communities. If a flood event occurred during the construction phase of the Project, there is a risk that construction materials could increase the debris load and the destructive force of the flood, potentially washing construction plant and materials into the watercourse and downstream, potentially resulting in destructive collisions. Spoil stockpiles and construction fuels and chemicals may also be washed into the watercourse during flood events, with negative impacts on downstream water quality such as increased turbidity, salinity, and contaminants.

The key impacts of a flood occurring during the constructions are:

- Increased scour and erosion of the channel bed and banks if they are excavated.
- Damage to the exposed pipework if it has not been completely installed.
- Damage to stockpiles (soil, ASS, and saline soils) and the sediment and erosion protection measures are overwhelmed and damaged leading to additional sediment entering the watercourse (particularly fines).
- Damage to construction infrastructure (roads, lay down areas, stockpiles, construction camps and watercourse crossings).
- Damage to machinery leading to spills of hydrocarbon or fuels stored on site.

Watercourse crossings considered to have potential high impact (as defined in Section **5.3.1** and past reporting) of flood risks include Salt Creek, Myall Creek, Pine Creek, unnamed watercourses along Lincoln Gap, Lake Dempsey Creek, Ranges View Creek, Black Oak Creek, Unnamed channel South of Lake Windabout (KP 237), Wirrawirralu Creek, Elizabeth Creek, and Yeltacowie (A and B) Creek.

These risks can be managed through the CEMP, and consideration will need to be given to:

- The management of surface flows on construction infrastructure and surface flows in/across the cleared construction corridor.
- The timing of works. Construction timing for watercourse crossings may need to be variable along the route. This should include scheduling works in watercourses to avoid the summer storm season, and times when heavy rainfall is forecast.
- The scheduling of the pipelaying works to limit the amount of exposed works prior to rehabilitation (e.g. length of excavation and time before being rehabilitated).
- The scheduling of significant watercourse crossings to occur in as short a period as possible.
- Consideration given to risks associated with under-boring and risks of 'blow outs' into the watercourse channel (these risks will need to consider geotechnical information, groundwater, the diameter of the pipe and time for construction) compared to the impacts of trenching and associated stability.
- The location of stockpiles, parking of machinery and storage of hydrocarbons and chemicals.
- Triggers for the cessation of works (e.g. no works commence in watercourses if significant rain/storms are forecast) and potentially short-term protection works to manage the threat of flooding to minimise any damage to the watercourse.

The initial risk likelihood of this impact pathway is considered to be "Unlikely" for standard watercourses and "Possible" for watercourses considered to have potential high impact, the consequence "Moderate" and the overall initial risk rating "Medium". Implementation of proposed mitigation measures such as MM 1 (CEMP), MM 3 (Spills or leaks), MM 4 (Stockpiles), which include staging stockpiles and equipment as far from watercourses as possible, results in a residual risk likelihood of "Unlikely" and "Rare" respectively and residual risk of "Medium" for watercourses considered to have potential high impact and "Low" for standard watercourses.

6.2.1.12 Testing and commissioning of the new infrastructure

Testing and commissioning of the new infrastructure (to demonstrable its operability) will be undertaken progressively as the final stage of construction period prior to handing over to operations. Commissioning of the water delivery pipeline would involve filling the pipe with water and inspecting and monitoring for leaks. Water used during testing may become turbid and exhibit elevated pH due to contact with the cement-lined pipeline. Following testing, the water would be managed through reuse, controlled discharge or disposal, as appropriate. Potential reuse options include supply to approved users, consistent with the proposed testing and commissioning approach (SYSTRA, 2025).

Disinfection of the water delivery pipeline using a chlorine-based disinfectant will be required prior to the pipeline becoming fully operational. This disinfected water is non-potable and will need to be released to the environment. This process poses a risk to water quality, as the released water may have pH and chlorine levels that are outside recommended limits for the protection of environmental values. Where water is to be discharged to the environment, water should be pH adjusted and dechlorinated prior to discharge to mitigate these risks.

There is potential for scour and erosion to occur as a result of water released from scour valves. The receiving environment, if not fortified with appropriate scour protection measures, may become eroded as water is regularly released. The risk of erosion will also be influenced by topography, soil types and the extent of vegetation clearance nearby.

Without appropriate design and implementation, this activity could result in:

- Initial scour of the local environment around the valve/release point as well as potential bank stabilisation and subsequent erosion.
- Downstream sedimentation.
- Reduction in downstream water quality due to release of water with high pH and elevated chlorine levels.
- Discharge of water with high suspended solids due to accumulated material, such as sediment, from inside the pipe.

Consequently, the potential impacts to water quality (where present) may include:

- Increased sediments resulting in increased nutrients and salts in watercourses can which lead to algal blooms or highly saline water. This reduces the environmental value of the water by limiting its potential uses.
- Sedimentation can result in increased turbidity of watercourses. Elevated turbidity could impact on aquatic organisms and reduce light penetration which can limit the growth of aquatic vegetation.
- Discharges with elevated pH could cause stress to aquatic organisms and reduce the diversity instream. Additionally, alkaline water can contain high concentrations of bicarbonate and carbonates which can cause calcium and magnesium to precipitate from the soil and affect plant growth.
- Discharges of water with high chlorine concentrations may compromise downstream water quality and can be toxic to fish and other aquatic life.
- Water with high organic loading can exert a high biochemical oxygen demand (BOD) on receiving waters which in turn decrease instream dissolved oxygen concentrations which can impact on aquatic organisms and lead to fish kills.

Sedimentation as a result of scouring and erosion of the local environment is likely to be minimal and mitigated through appropriate design of the scour pipework and discharge locations, as well as placement of the pipework as close to a watercourse as possible to minimise the amount of land the water has to flow over and potentially cause erosion. Discharges that occur during the testing and commissioning phase will also be treated (i.e. pH adjustment and/or dechlorination as required) to ensure quality is comparable to the receiving environment.

Unmitigated, the initial risk likelihood of this impact pathway is considered to be “Likely” the consequence “Minor” and the overall initial risk rating “Medium”. With the implementation of proposed mitigation measures MM 10 (Erosion and Sediment Control) and MM 13 (Operational Discharges), the residual risk likelihood is “Unlikely” and residual risk rating “Low”.

6.2.2 Operation

During the operational phase of the Project, all access roads for the construction of various Project elements would be maintained, cleared areas would be stabilised as required and permanent scour protection measures installed at all scour discharge locations along the water delivery pipeline alignment. Construction work sites would be progressively decommissioned following the completion of the installation works.

Potential effects to surface water quality (environmental values) and ecological values during the operation phase are expected to be associated with the following broad effect pathways:

- Effects from infrastructure installed under/or near watercourses.
- Effects from maintenance work – pipeline.

- Effects from stormwater runoff from the desalination plant, substations, and pump stations.
- Effects from proposed mounding along pipeline.

As for the assessment of the construction phase (see Section **6.2.1**), each of the effect pathway categories is considered in detail for the operational phase, with an initial likelihood, consequence and overall rating, as well as residual risk rating once mitigation measures are in place.

6.2.2.1 Effects from infrastructure within or adjacent to watercourses

Interaction with flood flows and flood loading

Potential effects of the above-ground pipeline crossings include localised scour around support structures, erosion of adjacent floodplain areas, flow diversion, debris accumulation and flood-induced loading on structural elements. These risks should be mitigated through detailed hydraulic design, structural design for flood events, routine inspection and maintenance, and implementation of scour protection where required.

Erosion and sedimentation

To avoid potential environmental impacts, all air valves and scour valves will not be located within watercourses. During the detailed design phase, the proximity of these valves to the bank of a watercourse should be maximised, as far as practicable.

There is a period of time following the completion of construction where recently disturbed soils (particularly those of the arid landforms and those that are highly dispersive) are susceptible to scour and erosion caused by rainfall and runoff. This results in sedimentation which can have direct and indirect impacts on water quality.

Direct impacts from large volumes of sediments mobilising to downstream receivers would only be a risk to the watercourses which contain water at the time and may result in increased turbidity and reduced visual amenity. As watercourses are largely ephemeral, the risk to water quality is low.

Indirect impacts of sedimentation occur over the longer term and include accumulation of sediments instream, altering watercourse geomorphology and release of pollutants such as heavy metals, salts, and nutrients.

Construction sites will be progressively decommissioned and rehabilitated following completion of the works with consideration for the potential for erosion. Provided appropriate controls are implemented, short-term impacts during the establishment period would be expected to be manageable with negligible impacts on receiving water quality.

Without mitigation, the initial risk likelihood of this impact pathway is considered to be “Likely”, the consequence “Minor” and the overall initial risk rating “Low”. With the implementation of proposed mitigation measure MM 10 (Erosion and Sediment), the residual risk likelihood is “Unlikely” and residual risk rating “Low”.

Accidental spills

Potential maintenance locations are proposed to be located at a number of sites including Port Augusta, Woomera and Roxby Downs, with exact locations to be determined by the DBOM contractor. Activities occurring at potential maintenance locations include travel to and from maintenance sites, asset maintenance and stored resources (e.g., fuel storage, operation and maintenance replacement parts and amenities). Chemicals and materials such as sodium thiosulfate, ascorbic acid and sodium hypochlorite will also be required to be stored and handled for use in chorine dosing at various inlet points in the

network, and chemicals required for the desalination process and maintenance of desalination equipment will be stored at the desalination plant site. There is potential for accidental spills of fuels, oils, lubricants and other chemicals associated with maintenance activities to be transported via overland flow, stormwater runoff or drainage pathways into downstream watercourses.

Spills and leakages can impact water quality by:

- Increasing toxicant concentrations into downstream watercourses which may be toxic to aquatic biota and fish.
- Creating oily surface films which can reduce the visual amenity of the watercourse.

While there is potential for minor impacts, maintenance activities are expected to be carried out in accordance with approved operating procedures which aim to ensure protection of the environment. Additionally, storage and handling of chemicals will follow procedures defined by Safe Work SA in accordance with the EPA (2016) *Bunding and spill management* guideline, South Australian *Dangerous Substances Act 1979,* and *Dangerous Substances (Dangerous Goods Transports) Regulations 2023*. As such, impacts would be managed through standard spill response procedures which are further discussed in Section **7**.

As with the construction phase, without mitigation measures, the initial risk likelihood of this impact pathway is considered to be "Possible", the consequence "Minor" and the overall initial risk rating "Medium". With the implementation of proposed mitigation measures MM 10 (Erosion and sediment control), MM 11 (Spills or leaks during operation) and MM 14 (Hydrology), the residual risk likelihood is "Unlikely" and residual risk rating "Low".

6.2.2.2 Effects from maintenance work on pipeline

System maintenance work during operation may require draining of the water delivery pipeline for planned maintenance activities and during emergencies.

Planned discharges of water to the receiving environment may be required to undertake maintenance activities, such as replacing faulty air valves, or replacement of any offtakes. As the works cannot be performed whilst the pipeline is in use, the relevant section of the pipeline will need to be drained. These planned discharges will be undertaken using the scour valves generally located adjacent to rivers, creeks, lakes, and local depressions. For any planned discharges, a WAAP or water licence under the LSA Act may be acquired.

Unplanned discharges can occur without warning due to pipeline breaks, valve failure and faulty air valves that can release water from the pipeline into the environment at any location. Unplanned discharges can also occur from storages via the overflow structures as water levels rise, however these are usually of short duration. Emergency discharges may be required if pipeline water quality is unsuitable and will require flushing via the scour valves, although modern management methods seek to minimise the amount of flushing carried out on a pipeline to reduce water losses.

Discharges, both planned and unplanned, can present a risk to water quality due to release of water that could result in scouring and increased sedimentation in the receiving watercourse and water that may be of unsuitable quality. Generally, planned discharges present a lower risk to water quality as water will be discharged from the pipeline into an energy dissipating pit and where possible at the minimum flow rate according to time available. This pipeline water may have chlorine levels greater than what is recommended in the receiving environment and toxic to invertebrates and therefore dichlorination should be undertaken when discharging to the environment. Chlorine can be removed by aeration, exposure to sunlight or by the addition of chemical reducing agents such as sodium thiosulfate or ascorbic acid. The

locations of potentially impacted environments are not yet known as scour valve locations will be determined during detailed design.

Unplanned discharges present a higher risk as there is no prior warning and can occur at any location along the pipeline. The longevity of these events is subject to the response time of operation and maintenance personnel to stop the discharge and prevent reoccurrence.

Planned, but unmitigated discharges have an initial risk likelihood of "Likely", the consequence "Minor" and the overall initial risk rating "Medium". With adoption of proposed mitigation measure MM 13 (Operational discharges), planned discharges from maintenance work has a residual risk likelihood of "Possible" and residual risk rating "Low".

Unplanned discharge without mitigation has an initial risk likelihood of this impact pathway considered to be "Rare" the consequence "Moderate" and the overall initial risk rating "Low". With the implementation of proposed mitigation measures MM 13 (Operational discharges) as soon as practicable, the residual risk likelihood is reduced to "Rare" and residual risk of "Low".

6.2.2.3 Effects from stormwater runoff from desalination plant, substations, and pump stations

The desalination plant and associated project infrastructure, such as substations and pump stations, will comprise built areas with large footprints, with the potential to capture rainwater from roofed areas and reuse. During rain events, stormwater may run off these facilities, especially hard or paved surfaces, and scour or transport sediment and accumulated contaminants to receiving watercourses.

Strategies for the collection, treatment, storage, and disposal of stormwater will be adopted with reference to the *Stormwater pollution prevention code of practices for building and construction industry* (EPA, 1999), *Best Practice Erosion & Sediment Control for building and construction sites* (IECA, 2025) and the development of stormwater management plans to manage potential impacts associated with stormwater runoff.

Stormwater Management Plan (GHD, 2025b) indicates the treatment train to achieve Water Sensitive SA (2021) SA MUSIC Guideline requirements.

For the desalination plant, the wastewater (including any water that has "contacted" process streams or spillage of chemicals, grease and oils etc.) areas will be bunded and roofed. There will be a separate wastewater treatment system to be documented in the detailed design phase.

Without mitigation, the initial risk likelihood of this impact pathway is considered to be "Likely", the consequence "Moderate" and the overall initial risk rating "High". With the implementation of proposed mitigation measure MM 15 (Stormwater), the residual risk likelihood is "Rare" and residual risk rating "Low". GHD (2025b) has also prepared a preliminary water quality risk assessment (WQRA) undertaken in accordance with the Department for Infrastructure and Transport's Environment and Heritage Technical Manual Attachment 6A *Protecting Waterways Guideline* (DIT, 2021a). Detailed consideration of specific treatment measures to address the risks will be undertaken during subsequent stages of the project design.

6.2.2.4 Effects from proposed mounding along pipeline

The proposed mounding along the pipeline alignment presents a surface water risk and landscape risk if not carefully managed. There are three significant risks with the use of the 200mm mound:

- The mound may impede local overland flow paths, divert runoff, and force the concentrating of flows along the alignment of the mound. Such concentration will increase local flow velocities and elevate

the risk of scour and erosion. This is possible during rainfall events, at low points, road crossings, or where flows are redirected toward watercourses or drainage lines. This concentration of flows, in the generally dispersive arid land soils, is likely to cause erosion and concertation of fines in the catchment's waterways.

- Overland flow as sheet flow is an important part of the landscape process, particularly in the gibber plains between Pimba and Roxby Downs. The mounding is expected to redirect overland flows, such that the 'downstream' side will receive less (or nil) water flow during rain events. This has the potential to have ecological impact on the downstream side of the mound.
- If the mound is constructed of local dispersive material, it may be eroded or rapidly washed away during flow events.

Alteration of natural drainage patterns and flow regimes may also result in downstream environmental impacts, including changes to sediment transport, impacts on receiving waterways and adjacent vegetation. To mitigate these risks, the mounding should incorporate frequent gaps or turn-outs to allow surface water to pass freely across the alignment and prevent damming or flow concentration. Where large contributing catchments or flow concentration zones are identified, additional measures such as localised scour protection may be required (in the form of diffusion of flows rather than rock riprap as the surrounding soils may erode).

Unmitigated, the initial risk likelihood of this impact pathway is considered to be "Likely", the consequence "Moderate" and the overall initial risk rating "High". Implementation of proposed mitigation measure MM 10 (Erosion and sediment control), MM 12 (Watercourse management during operation) and MM 14 (Hydrology), reduces the residual risk likelihood is "Possible" and the residual risk rating to "Medium".

7. Mitigation measures

This section identifies proposed measures to reduce the likelihood of the identified potential impacts occurring during Project construction and operation.

Impacts to surface water quality, due to construction, are largely related to mobilisation of poor-quality runoff and erosion/sedimentation (including specific risks from saline soils and ASS where these are present). The CEMP will describes how construction activities will be managed to avoid or mitigate environmental impacts, and how those environmental management requirements will be implemented.

Erosion and sediment control measures, such as sediment fences and temporary drainage, are expected to be installed in construction areas to prevent the mobilisation of runoff and sediment into the offtake channel. Specific erosion and sediment controls would be identified and developed for waterbody crossings which would be detailed in a construction soil and water management plan (CSWMP) as part of the CEMP.

Where impacts cannot be avoided, measures to minimise or manage impacts to surface water including water quality, aquatic ecology and flooding should be identified and implemented. Mitigation measures based on the risk assessment presented above are detailed in **Table 7-1**.

Table 7-1. Proposed mitigation measures to address the identified effect pathways

Impact being managed	Mitigation measures
Phase: Construction	
MM 1 – Construction Environmental Management Plan	Preparation of a CEMP will outline the measures to manage soil and water impacts associated with the construction works is proposed with reference to the EPA (2024) *Construction environmental management plan* guidance document and/or EHTM Attachment 10A *Guideline for the Preparation of a Contractor's Environmental Management Pl*an (DIT, 2021b). The CEMP will include, but not be limited to, the following: ▪ Measures to minimise/manage erosion and sediment transport within the disturbance area and off site with consideration of contingencies for moderate to high rainfall events. ▪ Measures to manage stockpiles, including locations and sediment controls and stabilisation. ▪ Measures to manage saline soils and ASS. ▪ Outline appropriate water quality criteria for discharge and re-use on-site. ▪ Measures to treat water collected in sediment basins for re-use on-site or discharged to downstream watercourses. ▪ Measures to manage water (including dewatering) and groundwater ingress from construction, including water collection protocols, water quality standards to be achieved for various reuse purposes and potential release to downstream environment. This should be included in a dewatering management plan that would be prepared as a subplan to the CEMP. ▪ Trenching of ephemeral watercourses or construction of above-ground crossings to be performed during low rainfall/runoff periods and when watercourse is dry.

Impact being managed	Mitigation measures
	▪ Removing all foreign objects (vehicles, plant, machinery) outside of watercourses at the end of each day. ▪ Staging work to avoid construction activities in/near watercourses where water is present or when heavy rain events are forecast. ▪ Protocols to liaise with the respective Landscape Board prior to and during the obtaining of a WAAP, and not to undertake work within a watercourse prior to obtaining a WAAP or confirmation from the Landscape Board that a WAAP is not required.
MM 2 - Erosion and sediment control	Implement site specific control measures proposed to manage potential erosion or sedimentation impacts including, but not limited to, the following: ▪ Scheduling construction activities to minimise the duration of works within a watercourse as far as practicable. ▪ Undertake works within watercourses when the watercourse is dry. ▪ Scheduling works in and near watercourses to avoid forecast heavy rain events. ▪ Minimise clearance of vegetation and retain existing vegetation as much as possible. ▪ Develop a site erosion and sediment control methodology with consideration of contingencies for moderate to high flows during instream works. ▪ Wherever possible, prefabricate structural elements such as pipes prior to trench installation to avoid the requirement for concrete works instream. ▪ Above-ground crossing support structures to be located and constructed in accordance with detailed hydraulic, scour and erosion assessments with disturbance to the watercourse, banks and riparian vegetation minimised where practicable. ▪ Install sediment controls around stockpiles to contain coarse soil and sediment, as applicable to prevent sedimentation of watercourses. ▪ Placement of stockpiles away from the watercourse (at least 20 m from creek channels where possible). ▪ Limiting stockpile height, to no more than 2 m, to reduce wind erosion. ▪ Stabilise exposed soil where applicable with the appropriate structural materials and media for the construction activities (e.g., stabilisation matting, rock armour or vegetation). ▪ Erosion and sediment controls established prior to commencement of vegetation clearing or earthworks. ▪ Disturbed areas of the watercourse and banks to be stabilised and reinstated following completion of the works. ▪ These controls to be documented in the CEMP.

Impact being managed	Mitigation measures
MM 3 - Spills or leaks	Site specific controls are proposed to be developed to manage the risk of accidental spills or leaks of fuels, oils, and chemicals (such as hydraulic oils), or concrete, during construction. These controls are to be documented in the CEMP and would include: ▪ Emergency spill response procedure in accordance with SA Government incident management protocols, the EPA (2016) Bunding and spills management guidelines document for implementation of bunds and spill containments systems and AS 1940–2004 The storage and handling of flammable and combustible liquids. ▪ Site specific controls to reduce the risk of the release of potentially harmful chemicals from spills or leaks entering watercourses downstream. ▪ Storage of hazardous materials such as oils, chemical and refuelling activities in bunded areas within contractor's temporary work areas. ▪ Bunded receptacles for concrete waste including concrete slurries and washout water provided at the work sites to capture, contain, and appropriately dispose of any concrete waste at a suitably licenced waste facility. These will be located as far from watercourses as feasible.
MM 4 - Stockpiles	Stockpiles, spoil loading and transport will be managed to minimise the potential for mobilisation and transport of dust, sediment, contamination, and leachate in runoff. This is proposed to include: ▪ Minimising the number of stockpiles, the areas used for stockpiles and the time they are left exposed. ▪ Designing and locating temporary stockpiles away from drainage lines and watercourses and managing stockpile areas (including during inclement weather events). ▪ Stabilising stockpiles, establishing appropriate sediment controls such as bunding and silt curtains, and supressing dust as required. ▪ Separation of non-acid forming and potentially acid forming materials and subsequent treatment of potentially acid forming materials with a neutralising agent. ▪ Vehicles transporting excavated material will be covered to minimise the loss of transported spoils to wind.
MM 5 – Acid Sulfate Soils	▪ Strategies for the management of ASS with consideration to the National Acid Sulfate Soils Guidance - Guidance for the dewatering of acid sulfate soils in shallow groundwater environments (Shand et al, 2018).
MM 6 - Dewatering	▪ Dewatered groundwater should be disposed of with reference to the EPA (2021) Environmental management of dewatering during construction activities guidance document. Disposal of dewatered groundwater to downstream watercourses provided the water is of suitable quality, within background concentrations, and erosion control measures are applied. If

Impact being managed	Mitigation measures
	not appropriate, the discharge may need to be collected and disposed to an appropriate site away from the source (JBS&G, 2026). ▪ Disposal of dewatered groundwater will need an appropriate dewatering management plan.
MM 7 - Rehabilitation	▪ The pipeline disturbance corridor will be rehabilitated as soon as possible after pipe laying, with the exception of access roads (outside of watercourse crossings), agricultural land, and other land use types which were otherwise not naturally vegetated. In areas where native vegetation was cleared, natural regeneration of native flora will be allowed to occur. ▪ For watercourses that have been trenched across, the bed will be restored to the same grade and substrate as prior to construction, to prevent changes in flows through the watercourse. ▪ Rehabilitation at construction sites to include replacing topsoil. ▪ Rehabilitation to include the rehabilitation and management of surface water flows across the landscape.
MM 8 – Temporary accommodation	▪ Project will provide appropriate temporary wastewater treatment facilities during camp set up. Temporary wastewater systems would be in accordance with the *South Australian Health (Wastewater) Regulations 2013* and the *Environment Protection (Water Quality) Policy 2015*. ▪ Temporary accommodation plans will need suitable stormwater management measures, like those proposed for the desalination plant (Section 5.9.1) and other infrastructure (Section 5.9.2), to achieve the runoff quality performance targets for development in South Australia is the Department of Environment, Water and Natural Resources (DEWNR) (2013) *Water Sensitive Urban Design, Creating more liveable and water sensitive cities in South Australia*. Details to be confirmed at detailed design.
MM9 – Testing and commissioning	▪ Prior to water discharges being released from the pipeline during testing and commissioning, water should be tested and potentially treated to neutralise water with potentially high pH or dechlorinate water where chlorine levels could be elevated. ▪ A Construction Environmental Management Plan (MM 1), including procedures for testing, commissioning, water management, discharge controls and spill response, will be prepared and implemented to ensure compliance with section 104 of the LSA Act, 2019, to minimise impact on water sources. ▪ Scour protection and flow controls measures should be designed and implemented at the outlet locations to reduce risk of erosion and sedimentation. ▪ Scour protection, such as a scour pit, should be placed downstream of scour valves to ensure the drainage path is not eroded when water is released during maintenance.

Impact being managed	Mitigation measures
Phase: Operation	
MM 10 - Erosion and sediment control	▪ Undertake detailed hydraulic design to determine the potential effects of the above-ground pipeline crossings, addressing potential impacts such as: o localised scour around support structures o erosion of adjacent floodplain areas o flow diversion o debris accumulation, and o flood-induced loading on structural elements. ▪ Erosion and sediment controls, including semi-permanent controls along the watercourse bed and bank as required, will be maintained post construction until disturbed areas are stabilised. ▪ Undertake regular visual assessments after significant rainfall events to assess and identify any areas requiring reparation.
MM 11 - Spills or leaks during operation	▪ Site environmental management, inclusive of spill response measures, will be in accordance with broader SA Government and SA EPA environmental management procedures, the EPA (2016) Bunding and spills management guidelines document for implementation of bunds and spill containments systems and AS 1940–2004 The storage and handling of flammable and combustible liquids for operations.
MM 12 – Watercourse management during operation	▪ All operation personnel would be informed of environmental responsibility with respect to the preservation of surface water quality for the protection of aquatic and terrestrial fauna and their habitat and pastoral, recreational, and cultural uses. ▪ All vehicles driven by operation personnel to remain on designated tracks.
MM 13 – Operational discharges	▪ Temporary measures to minimise impact of scour and erosion during unplanned/maintenance discharges will be implemented and may include silt rocks, hay bales or lay flat hose to redirect water and minimise risk of erosion. The Operational Environmental Management Plan (OEMP) will include procedures for management of operational discharges to ensure compliance with section 104 of the LSA Act, 2019 to minimise impact on water sources.
MM 14 - Hydrology	▪ Once the Project structures have been in operation through an appropriate operational cycle, the Operational Environmental Management Plan (OEMP) will be updated taking into account system monitoring results, identified operating risks, and ecological response.
MM 15 - Stormwater	▪ As part of the detailed design of the Project, ensure that stormwater flow is directed away from Project infrastructure and working areas, by appropriately grading the area to direct stormwater into swale drains as necessary.

Impact being managed	Mitigation measures
	▪ Above-ground watercourse crossings to incorporate appropriate scour protection and be designed to minimise afflux and accommodate flood flows, debris loading and local erosion processes. ▪ Desalination plant designs include a stormwater detention and bioretention basin to collect and release stormwater in a controlled manner to allow for settling of sediments and to minimise scouring. ▪ The design of substations, pump stations, storage tanks and any other large, sealed areas to include locating the infrastructure in a flat area, grading land to direct stormwater runoff into swale drains and treating stormwater likely to contain contaminants, prior to disposal.

8. Residual risk assessment

Section **6.2** identifies the potential impact pathways resulting from construction and operation of the Project. Section **7** identifies proposed measures to mitigate the risk posed by these impact pathways. This section provides a summary of the assessment of the residual risk that the impact pathways are expected to pose, following the implementation of proposed mitigation measures.

In general, all risks associated with the construction and operation of the Project can be reduced with the proposed mitigation measures detailed in **Table 7-1**.

During the construction and operation phases, the highest risk effects pathways have a residual rating of "Medium" after proposed safeguards are implemented. All other effect pathways are reduced to or maintained at a "Low" residual risk rating. The Project is considered to be low risk overall with the implementation of proposed mitigation measures.

The results of the residual risk assessment are provided in **Table 8-1**.

Table 8-1. Effects pathways, mitigation measures, and risk ratings

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
Construction							
Earthworks result in erosion and transport of sediment to downstream watercourses	All watercourses	Possible (e.g., in the case of an unforecasted rain event)	Moderate	Medium	MM 2 (Erosion and sediment control) measures will also be implemented to control runoff.	Unlikely	Low
Earthworks expose saline soils that are then transported into watercourses	Watercourses that are considered to have potential high impact due to proximity to known saline soils (Black Oak Creek, Salt Lakes, channels between Lake Dutton and Ironstone Lagoon and watercourses along the Carrapateena lateral branch pipeline between KP CA20 and CA29)	Possible	Moderate	Medium	MM 1 (Construction Environmental Management Plan) includes measures to manage saline soils.	Unlikely	Low
	All other watercourses	Unlikely	Minor	Low		Unlikely	Low
Earthworks expose ASS that are then transported into watercourses	Watercourses that are considered to have potential high impact due to proximity to known ASS (inland salt lakes, Yeltacowie Creek, Elizabeth Creek and channels between Ironstone Lagoon and Lake Dutton)	Possible	Moderate	Medium	MM 1 (Construction Environmental Management Plan) and MM 5 (Acid Sulfate Soils) include measures to manage ASS including the preparation of an ASS management plan.	Unlikely	Low

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
	All other watercourses	Unlikely	Minor	Low		Unlikely	Low
Removal of vegetation leads to increased erosion and sediment input into watercourses	Watercourses that may require removal of significant amounts of riparian vegetation for crossing (Black Oak Creek, a minor unnamed channel (KP 238), Wirrawirralu Creek unnamed channel near km point 239-240 and Lake Dempsey Creek)	Likely	Moderate	High	MM 2 (Erosion and sediment control) and MM 7 (Rehabilitation) include measures to minimise clearance of vegetation, retain existing vegetation wherever possible, and rehabilitate impacted areas.	Unlikely	Low
	All other watercourses	Unlikely	Negligible	Low		Unlikely	Low
Sediment runoff from stockpiles of soils and vegetation reaches watercourses	All	Unlikely	Minor	Low	MM 2 (Erosion and sediment control) and MM 7 (Rehabilitation) include measures to minimise clearance of vegetation, retain existing vegetation wherever possible, and rehabilitate impacted areas.	Unlikely	Low
Impacts to watercourses due to loss of transported excavated materials and the movement of heavy vehicles	All	Possible	Minor	Medium	MM 2 (Erosion and sediment control) includes measures to minimise clearance of vegetation. MM 4 (Stockpiles) includes locating stockpiles 20m from watercourses and covering of vehicles transporting spoils.	Unlikely	Low

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
Temporary dewatering of construction sites leads to discharge of contaminants or saline water into watercourses and/or scouring of watercourses	Watercourses with potential for groundwater interception (Refer to EIS report *Northern Water Project – Groundwater Impact Assessment* (JBS&G, 2026))	Possible	Moderate	Medium	MM 1 (Construction Environmental Management Plan) includes a dewatering management plan which would be prepared to detail the methodology for dewatering watercourses and wetlands. Discharge of water would be undertaken in accordance with the Water Quality EPP. MM 6 (Dewatering) includes requirements for dewatered groundwater to be discharged if only of suitable quality, with reference to the EPA (2021) *Environmental management of dewatering during construction activities* and in accordance with an appropriate dewatering management plan. Erosion protections would also be included in the management plan.	Rare	Low
	All other watercourses	Unlikely	Minor	Low		Rare	Low
Leaks and spills from chemicals and other potentially harmful substances used in construction enter adjacent watercourses	All	Possible	Minor	Medium	MM 3 (Spills or leaks) includes site specific controls and procedures to be developed and implemented in accordance with SA Government incident management protocols to reduce the risk of leaks and spills. All fuels and chemicals would be stored away from watercourses in a bunded area.	Unlikely	Low
Construction methods at	Watercourses considered to have potential high impact	Possible	Moderate	Medium	MM 1 (Construction Environmental Management Plan) includes measures to avoid trenching across	Unlikely	Low

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
watercourse crossings lead to increased erosion and sediment mobilisation in watercourses	(Salt Creek, Lake Dempsey Creek, Ranges View Creek, Black Oak Creek, unnamed watercourse (KP 85), Elizabeth Creek, Carra Creek (A and B) and Yeltacowie (A and B) Creek (see Watercourses considered to have potential high impact in **Table 5-1**).				watercourses or construction of above-ground crossings when water is present or during rain events. MM 2 (Erosion and sediment control) includes erosion and sediment control measures to be implemented at all sites including hydraulic, scour and erosion assessments of above-ground crossing support structures.		
	All other watercourses	Possible	Minor	Medium		Unlikely	Low
Effects related to temporary workforce accommodation and management of wastewater	All	Unlikely	Negligible	Low	MM 8 (Temporary accommodation) Workforce accommodation will be placed in towns and camps that have pre-existing infrastructure or provide appropriate wastewater management during camp set up of sufficient capacity to accommodate workforce. Accommodation will be equally spaced throughout the Project Area to minimise distance travelled and reduce risks.	Rare	Low
Flooding occurs during construction washing construction materials into the watercourse	Watercourses considered to have potential high impact due to flood risk (Salt Creek, Myall Creek, Pine Creek, unnamed watercourses along Lincoln Gap, Lake Dempsey Creek, Ranges View Creek, Black Oak Creek, Unnamed channel South of Lake Windabout (KP 237), Wirrawirralu Creek, Elizabeth Creek, and	Possible	Moderate	Medium	MM 1 (Construction Environmental Management Plan) include measures to manage water. MM 2 (Erosion and Sediment Control) includes detailed hydraulic and scour assessment of above-ground crossing locations to be undertaken. MM 3 (Spills or leaks) includes site specific controls and procedures to be developed and implemented in accordance with EPA bunding and spill management guidance (EPA, 2016) to reduce the risk of leaks and	Unlikely	Medium

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
	Yeltacowie (A and B) Creek) (see Watercourses considered to have potential high impact in **Table 5-1**).				spills. All fuels and chemicals would be stored away from watercourses in a bunded area. MM 4 (Stockpiles) locating stockpiles away from the watercourses and managing stockpile areas including during inclement weather conditions.		
	All other watercourses	Unlikely	Moderate	Medium		Rare	Low
Effects from testing and commissioning, such as discharge of disinfection water and scour valve water leading to erosion and reduced water quality	All	Likely	Minor	Medium	MM 9 (Testing and commissioning) controls include semi-permanent controls along the watercourse bed and bank as required, which will be maintained post construction until disturbed areas are stabilised. MM 1 (Construction Environmental Management Plan), including procedures for testing, commissioning, water management, discharge controls and spill response will be prepared, and water will be discharged from the pipeline into an energy dissipating pit at the minimum flow rate according to time available to reduce risk or erosion and scour and treatment of water via pH adjustment and/or dichlorination as required.	Unlikely	Low
Operation							
Erosion, scour, sedimentation and flood related effects associated with structures at watercourse crossings	All	Likely	Minor	Low	MM 10 (Erosion and sediment control) includes detailed hydraulic assessment of above-ground crossings and implementation of scour protection, erosion controls and inspection requirements where required. Suitable stabilisation and management techniques which would be implemented during the periods of vegetation establishment to minimise the potential for erosion within areas of rehabilitation.	Unlikely	Low

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
Accidental spills due to maintenance of structures under watercourses	All	Possible	Minor	Low	MM 11 (Spills or leaks during operation) states that storage and handling of chemicals to follow procedures defined by Safe Work SA in accordance with South Australian *Dangerous Substances Act 1979*, *Dangerous Substances (Dangerous Goods Transports) Regulations 2023*, the EPA (2016) *Bunding and spills management* guidelines document for implementation of bunds and spill containments systems and AS 1940–2004 *The storage and handling of flammable and combustible liquids.* MM 14 (Hydrology) includes an OEMP update taking into account system monitoring results, identified operating risks, and ecological response.	Unlikely	Low
Effects from planned maintenance work on pipeline	All	Likely	Minor	Medium	MM 13 (Operational discharges) proposes that in order to manage risks to water quality, water will be discharged from the pipeline into an energy dissipating pit and where possible at the minimum flow rate according to time available. This water may have chlorine levels greater than what is recommended in the receiving environment and therefore dechlorination of the water discharges can also be undertaken. MM 14 (Hydrology) includes an OEMP update taking into account system monitoring results, identified operating risks, and ecological response.	Unlikely	Low
Effects from unplanned	All	Rare	Moderate	Low	MM 13 (Operational discharges) proposes that in order to manage risks to water quality from unplanned discharges, temporary measures to minimise impact of	Rare	Low

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
maintenance work on pipeline					scour and erosion during unplanned/maintenance discharges will be implemented and may include silt rocks, hay bales or lay flat hose to redirect water and minimise risk of erosion. MM 14 (Hydrology) includes an OEMP update taking into account system monitoring results, identified operating risks, and ecological response.		
Effects from stormwater runoff from associated project infrastructure, such as the desalination plant, substations and pump station	All	Likely	Moderate	High	MM 15 (Stormwater) proposes design measures to mitigate stormwater effects. As part of the detailed design of the Project, ensure that stormwater flow is directed away from Project infrastructure and working areas, by appropriately grading the area to direct stormwater into swale drains as necessary. Desalination plant designs include a stormwater detention and bioretention basin to collect and release stormwater in a controlled manner to allow for settling of sediments and to minimise scouring. The design of substations, pump stations, storage tanks and any other large, sealed areas to include locating the infrastructure in a flat area, grading land to direct stormwater runoff into swale drains and treating stormwater likely to contain contaminants, prior to disposal.	Rare	Low
Effects from proposed mounding along pipeline	All	Likely	Moderate	High	MM 10 (Erosion and sediment control) includes suitable stabilisation and management techniques which would be implemented where large contributing catchments or flow concentration zones are identified. MM 12 (Watercourse management during operation) includes informing operational personnel of environmental responsibility with respect to the	Possible	Medium

Effect pathway	Watercourses	Initial risk likelihood (Table 4-1)	Risk consequence (Table 4-2)	Initial risk rating (Table 4-3)	Proposed Mitigation Measures (Table 7-1)	Residual risk likelihood	Residual risk rating
					preservation of surface water quality for the protection of aquatic and terrestrial fauna and their habitat and pastoral, recreational, and cultural uses. MM 14 (Hydrology) allows for an OEMP update taking into account system monitoring results, identified operating risks, and ecological response. Monitored effects on overland flow paths to be recorded and mitigated if necessary. The mounding should incorporate frequent gaps or turn-outs to allow surface water to pass freely across the alignment and prevent damming or flow concentration.		

9. Conclusion

The objective of the desktop surface water review and assessment is to characterise the existing environment and identify potential risks to surface water from the construction and operation of the Project.

The Project Area sits within the arid climatic zone (characterised by warm to hot temperatures with low and erratic rainfall).

There are a number of surface water features along the length of the study area, across four drainage basins (Spencer Gulf, Mambray Coast, Gairdner, and Lake Torrens). These include ephemeral watercourses, salt lakes and floodplains that only flow or hold surface water intermittently. The proposed pipeline is proposed to cross over 200 separate watercourses across its ~360 km length. The report identified no records of aquatic MNES within 5 km of the Project alignment, and the predominantly ephemeral watercourses are unlikely to accommodate fish habitat.

The assessment used available information from state and national databases, local studies for other projects and data collected during fieldwork for Project terrestrial ecology (Jacobs, 2026b) and topography, geology, and soils technical reports (Jacobs, 2026a).

The assessment reviewed potential impacts to surface water from construction functions such as earthworks, dewatering, construction through watercourses, stockpiling, and vegetation removal, as well as operations and maintenance of the planned desalination plant (refer to GHD, 2025b) and water distribution pipeline (risks including scour and water quality impacts from planned and unplanned discharge).

Impact assessments were undertaken for two categories of watercourses – “watercourses considered to have potential high impact” (those more at risk from construction in or nearby due to landform, hydrological, location or ecological characteristics) and “standard” (those less at risk). Negative impacts of flood events occurring during the construction phase of the Project may be increased if construction equipment and materials, spoils stockpiles, and fuels and chemicals are washed downstream. Implementation of a CEMP, staging work to avoid construction activities in/near watercourses when heavy rain events are forecast, storing chemicals in a bunded area away from watercourses, and locating stockpiles away from watercourses reduce the risk to “Medium” for watercourses considered to have potential high impact and “Low” for standard watercourses. Negative impacts of the proposed mounding over the pipeline during the operational phase of the Project may be increased due to impeding local overland flow paths, diverting runoff and possible concentration of flows on overland flow paths. The implementation of the proposed design and monitoring the hydrological and environmental processes during the operational phase, reduce the residual risk to “Medium”. No other risks associated with the construction or operations of the Project had a residual risk rating higher than “Low”.

Overall, with the implementation of proposed mitigation measures, the Project is considered to be low risk to the quality and flow regime of surface waters, resident aquatic fauna, and cultural and commercial values within and adjacent the Project footprint.

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Williams, W. D., de Deckker, P., and Shiel, R. J. (1998). The limnology of Lake Torrens, an episodic salt lake of central Australia with particular reference to unique events in 1989. *Hydrobiologia* 384: 101–110.

Williams, W. D. (1985). Salt Lakes pp. 119-126 In. Twidale, C.R., Tyler, M.J., and Davies, M, (Eds). Natural History of Eyre Peninsula, Royal Society of South Australia Inc.

Appendix A. Environmental Values and Applicable Water Quality Guidelines

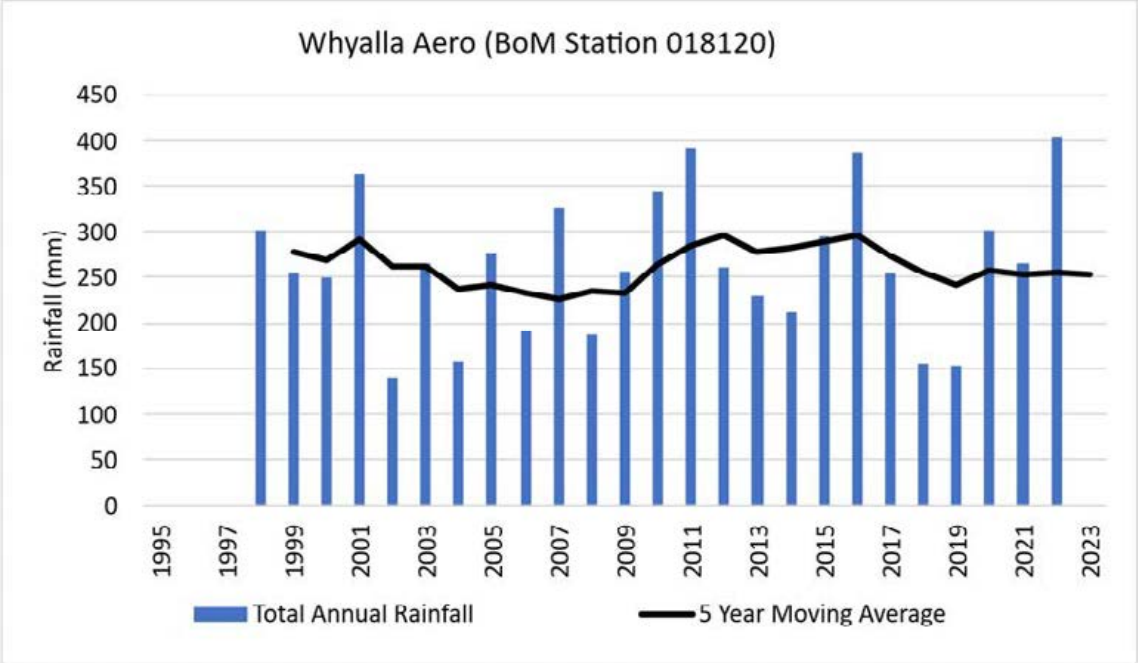
The environmental values, their indicators, and recommended guidelines for protection of these environmental values are provided in **Table A-1**. The EPP (2015) recommend that water quality meet the recommended guideline values in the 'water quality guidelines' which the EPP (2015) states as the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* (ANZECC/ARMCANZ). The water quality guidelines were updated in 2018 to incorporate new science and knowledge, as such the ANZG (2018) *National Water Quality Guidelines for Fresh and Marine Water Quality* have been referred to in the table below as well as the NHMRC (2008) Guidelines for Managing Risks in Recreational Waters. Additionally, the EPP (2015) recommends that toxicants must not exceed the protection of 95% of species.

Table A-1. Environmental Values and guidelines for watercourses in the Project Area

Environmental values	Indicator	Guideline
Aquatic ecosystems	Total Phosphorus	0.1mg/L (Inland and Estuarine)
	Total nitrogen	1mg/L (Inland and estuarine)
	Chlorophyll-a	NG (inland), 0.005mg/L (estuarine)
	Turbidity	1-50NTU (inland), 0.5-10NTU (estuarine)
	Salinity (electrical conductivity)	100-5000µS/cm (inland), NG (estuarine)
	Dissolved oxygen	>90% saturation (inland and estuarine)
	pH	6.5-9 (inland and estuarine)
	Toxicants	As per ANZG (2018) toxicant default guideline values for water quality in aquatic ecosystems
Recreation and aesthetics	Aesthetics	Water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum, and other matter; substances producing objectionable colour, odour, taste, or turbidity; and substances and conditions that produce undesirable aquatic life.
	Recreation	As per the NHMRC 2008 Guidelines for managing risk in recreational waters
Primary industries – irrigation and general water uses	As per Chapter 4.2 of the Water Quality Guidelines – A trigger value for an indicator: • Has been reached or exceeded for a chemical substance or a characteristic; or • In the case of a minimum level specified for a characteristic, has not been reached.	
Primary industries – livestock drinking water	As per Chapter 4.3 of the Water Quality Guidelines – a trigger value for an indicator: • Has been reached or exceeded for a chemical substance or a characteristic; or • In the case of a minimum level specified for a characteristic, has not been reached.	
Primary industries – aquaculture and human consumption of aquatic foods	As per Chapter 4.4 of the water quality guidelines – a guideline value for an indicator: • Has been reached or exceeded for a chemical substance or a characteristic; or • In the case of a minimum level specified for a characteristic, has not been reached.	

NG – no guideline

Appendix B. Long term rainfall data and CDMP charts



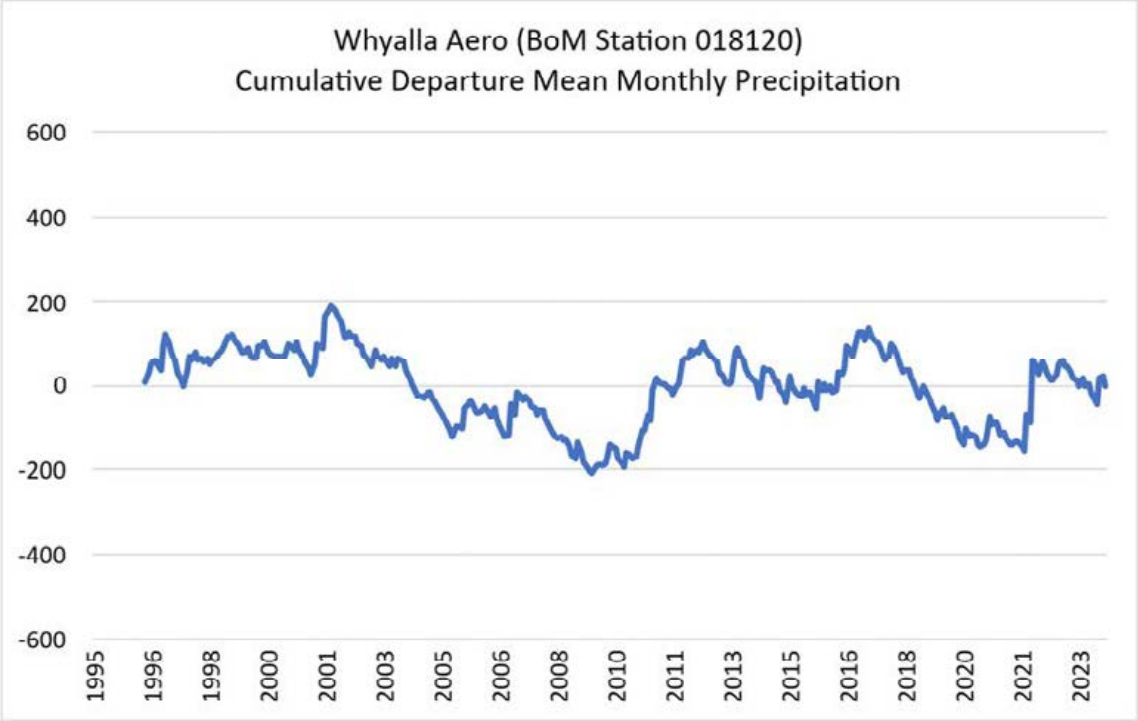


Figure B-1. Annual rainfall and CDMP charts for the southern Spencer Gulf Basin

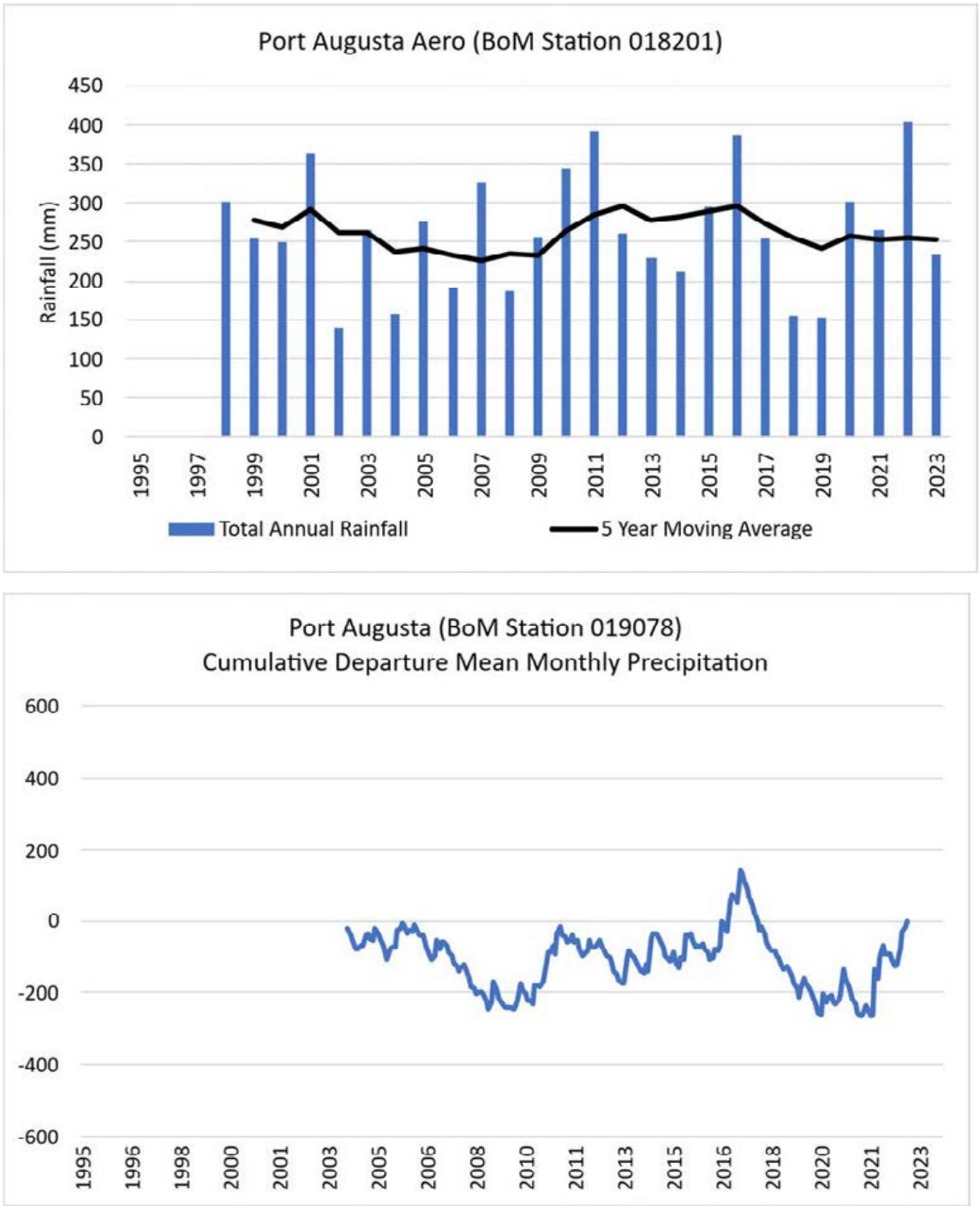


Figure B-2. Annual rainfall and CDMP charts for the Mambray Basin

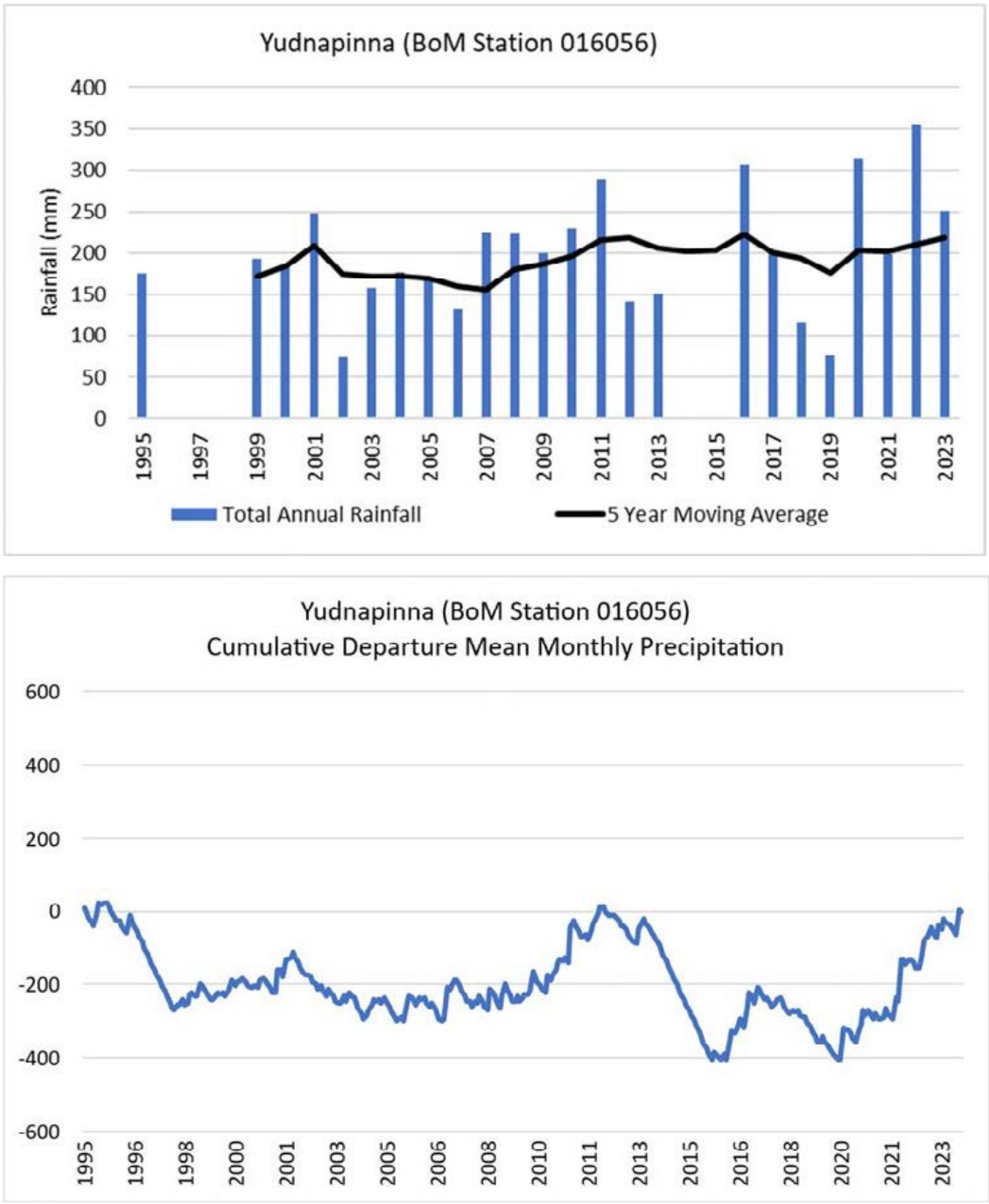


Figure B-3. Annual rainfall and CDMP charts for the south-eastern Grainger Basin

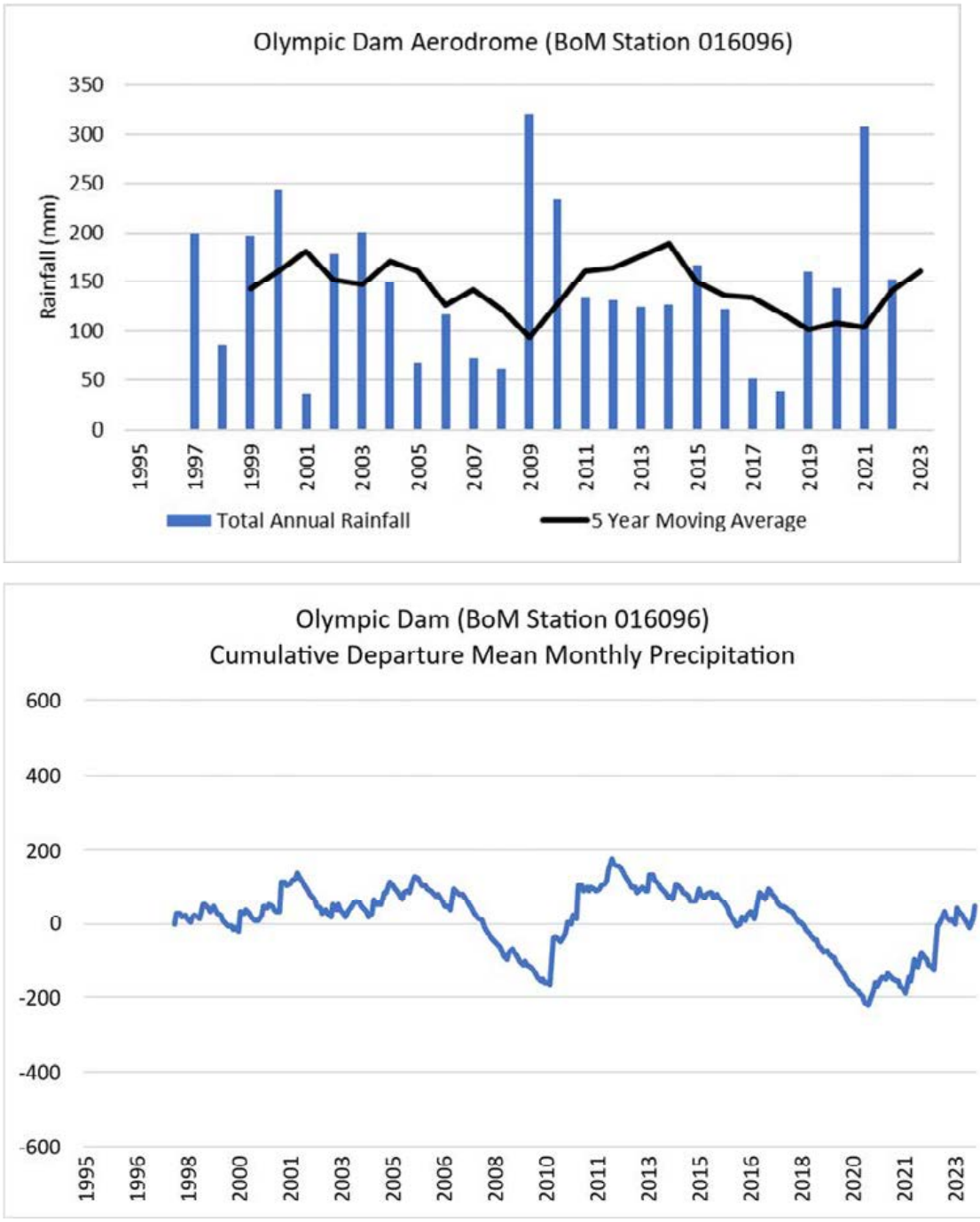


Figure B-4. Annual rainfall and CDMP charts for the north-eastern Grainger Basin

Appendix C. Protected Matters Search Tool results

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 13-Nov-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	46
Listed Migratory Species:	42

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	72
Whales and Other Cetaceans:	8
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	3
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	18
Key Ecological Features (Marine):	None
Biologically Important Areas:	3
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Amytornis textilis myall			
Western Grasswren (Gawler Ranges) [64454]	Vulnerable	Species or species habitat known to occur within area	In feature area
Aphelocephala leucopsis			
Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area	In feature area
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat may occur within area	In feature area
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area
FISH			
Seriolella brama			
Blue Warehou [69374]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only
MAMMAL			
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In buffer area only
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In buffer area only
Sminthopsis psammophila			
Sandhill Dunnart [291]	Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			
Frankenia plicata			
[4225]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pterostylis xerophila](#) Desert Greenhood [7997]	Vulnerable	Species or species habitat may occur within area	In feature area
[Swainsona pyrophila](#) Yellow Swainson-pea [56344]	Vulnerable	Species or species habitat likely to occur within area	In feature area
REPTILE			
[Aprasia pseudopulchella](#) Flinders Ranges Worm-lizard [1666]	Vulnerable	Species or species habitat may occur within area	In feature area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
SHARK			
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Galeorhinus galeus](#) School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
[Ardenna carneipes](#) Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Thalassarche melanophris](#) Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
[Thalassarche steadi](#) White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
[Balaenoptera edeni](#) Bryde's Whale [35]		Species or species habitat may occur within area	In buffer area only
[Caperea marginata](#) Pygmy Right Whale [39]		Species or species habitat may occur within area	In buffer area only
[Carcharias taurus](#) Grey Nurse Shark [64469]		Species or species habitat may occur within area	In buffer area only
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
[Eubalaena australis as Balaena glacialis australis](#) Southern Right Whale [40]	Endangered	Breeding known to occur within area	In buffer area only
[Lagenorhynchus obscurus](#) Dusky Dolphin [43]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In buffer area only
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In buffer area only
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ruficollis Red-necked Stint [860]		Species or species habitat likely to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Transport and Regional Services - Australian National Railways Commission		
Commonwealth Land - Australian National Railways Commission [41565]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41425]	SA	In feature area

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40934]	SA	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
[Calidris ruficollis](#) Red-necked Stint [860]		Species or species habitat likely to occur within area overfly marine area	In buffer area only
[Chalcites osculans as Chrysococcyx osculans](#) Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
[Diomedea antipodensis](#) Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
[Diomedea exulans](#) Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area	In feature area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Sterna striata White-fronted Tern [799]		Migration route may occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Thinornis cucullatus as Thinornis rubricollis](#)			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat may occur within area overfly marine area	In feature area
[Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis](#)			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
[Tringa nebularia](#)			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Fish			
[Acentronura australe](#)			
Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area	In buffer area only
[Filicampus tigris](#)			
Tiger Pipefish [66217]		Species or species habitat may occur within area	In buffer area only
[Heraldia nocturna](#)			
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In buffer area only
[Hippocampus breviceps](#)			
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In buffer area only
[Histiogamphelus cristatus](#)			
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In buffer area only
[Hypselognathus rostratus](#)			
Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In buffer area only
[Kaupus costatus](#)			
Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In buffer area only
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In buffer area only
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In buffer area only
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In buffer area only
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In buffer area only
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In buffer area only
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In buffer area only
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In buffer area only
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In buffer area only
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In buffer area only
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In buffer area only
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In buffer area only
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In buffer area only
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In buffer area only
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In buffer area only
Vanacampus vercoi Verco's Pipefish [66286]		Species or species habitat may occur within area	In buffer area only
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In buffer area only
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area	In buffer area only
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In buffer area only
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In buffer area only
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area	In buffer area only
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In buffer area only
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In buffer area only
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area	In buffer area only
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In buffer area only
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In buffer area only
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Unnamed (No.HA1588)	Heritage Agreement	SA	In buffer area only
Upper Spencer Gulf	Marine Park	SA	In buffer area only
Whyalla	Conservation Park	SA	In buffer area only

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Upper Spencer Gulf	SA	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Cultana Solar Farm project	2023/09658		Assessment	In buffer area only
Magnetite Expansion Project Stage 2 / SIMEC Mining	2024/09878		Assessment	In feature area
Mara team testing - Release 37 Wei	2024/09831		Post-Approval	In buffer area only
Northern Water Desalination and Pipeline Infrastructure Project, SA	2023/09717		Assessment	In feature area
Port Bonython Bulk Commodities Export Facility, SA	2012/6336		Completed	In feature area
South Australian Government Renewable Hydrogen Power Station, Electrolysers and Storage Facility	2023/09759		Post-Approval	In feature area
Whyalla Hydrogen Pipeline (WHP)	2024/09873		Approval	In buffer area only
Controlled action				
Arafura Whyalla Rare Earths Complex	2011/5877	Controlled Action	Completed	In buffer area only
Expansion of the Cultana Training Area	2010/5316	Controlled Action	Post-Approval	In feature area
Expansion of the Olympic Dam copper, uranium, gold and silver mine, processing plant and associated	2005/2270	Controlled Action	Post-Approval	In feature area
Pig Iron Smelter	2001/473	Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Pig Iron Smelter (Cultana)	2001/466	Controlled Action	Completed	In buffer area only
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Project Magnet	2004/1724	Not Controlled Action	Completed	In feature area
Whyalla Solar Farm Project, SA	2017/7910	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Small scale uranium In-situ Recovery Field Trial	2010/5751	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Biologically Important Areas			[Resource Information]
Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna tenuirostris			
Short-tailed Shearwater [82652]	Foraging (in high numbers)	Likely to occur	In buffer area only
Phalacrocorax fuscescens			
Black-faced Cormorant [59660]	Foraging	Known to occur	In buffer area only
Sternula nereis			
Fairy Tern [82949]	Foraging	Known to occur	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 13-Nov-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	80
Listed Migratory Species:	50

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	194
Commonwealth Heritage Places:	None
Listed Marine Species:	88
Whales and Other Cetaceans:	8
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	24
Regional Forest Agreements:	None
Nationally Important Wetlands:	2
EPBC Act Referrals:	40
Key Ecological Features (Marine):	None
Biologically Important Areas:	3
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Natural			
Cuttlefish Coast Sanctuary Zone	SA	Listed place	In buffer area only

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area	In buffer area only
Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia	Critically Endangered	Community likely to occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Amytornis merrotsyi merrotsyi			
Short-tailed Grasswren (Flinders Ranges) [86269]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Amytornis modestus			
Thick-billed Grasswren [84121]	Vulnerable	Species or species habitat known to occur within area	In feature area
Amytornis textilis myall			
Western Grasswren (Gawler Ranges) [64454]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Aphelocephala leucopsis](#) Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Ardenna grisea](#) Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Arenaria interpres](#) Ruddy Turnstone [872]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Calidris canutus](#) Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
[Calidris tenuirostris](#) Great Knot [862]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Charadrius mongolus](#) Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Diomedea antipodensis](#) Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
[Diomedea epomophora](#) Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat may occur within area	In buffer area only
Limosa limosa Black-tailed Godwit [845]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In buffer area only
Thinornis cucullatus cucullatus			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In feature area
FISH			
Seriolella brama			
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In buffer area only
MAMMAL			
Bettongia lesueur lesueur			
Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Translocated population known to occur within area	In buffer area only
Dasyurus geoffroii			
Chuditch, Western Quoll [330]	Vulnerable	Translocated population known to occur within area	In feature area
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In buffer area only
Leporillus conditor			
Wopilkara, Greater Stick-nest Rat [137]	Vulnerable	Translocated population known to occur within area	In buffer area only
Macrotis lagotis			
Greater Bilby [282]	Vulnerable	Translocated population known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Neophoca cinerea](#) Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In buffer area only
[Notomys fuscus](#) Dusky Hopping-mouse, Wilkiniti [125]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Perameles bougainville](#) Shark Bay Bandicoot [278]	Endangered	Translocated population known to occur within area	In buffer area only
[Petrogale xanthopus xanthopus](#) Yellow-footed Rock-wallaby (SA and NSW) [66646]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Pseudomys australis](#) Plains Rat, Palyoora, Plains Mouse [108]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Sminthopsis psammophila](#) Sandhill Dunnart [291]	Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			
[Acanthocladium dockeri](#) Spiny Everlasting, Spiny Daisy [17632]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
[Brachyscome muelleri](#) Corunna Daisy [18836]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Caladenia gladiolata](#) Bayonet Spider-orchid, Clubbed Spider-orchid [8079]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Caladenia tensa](#) Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Caladenia woolcockiorum](#) Woolcock's Spider-orchid [55023]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caladenia xantholeuca White Rabbits, Flinders Ranges White Caladenia [55025]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Codonocarpus pyramidalis Slender Bell-fruit, Camel Poison [19507]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Dodonaea subglandulifera Peep Hill Hop-bush [11956]	Endangered	Species or species habitat may occur within area	In buffer area only
Frankenia plicata [4225]	Endangered	Species or species habitat known to occur within area	In feature area
Hibbertia crispula Ooldea Guinea-flower [15222]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Limosella granitica Granite Mudwort [6704]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Olearia pannosa subsp. pannosa Silver Daisy-bush, Silver-leaved Daisy, Velvet Daisy-bush [12348]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum pallidum Pale Leek-orchid [20351]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum validum Sturdy Leek-orchid, Mount Remarkable Leek-orchid [10268]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Pterostylis xerophila Desert Greenhood [7997]	Vulnerable	Species or species habitat may occur within area	In feature area
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Senecio megaglossus](#) Superb Groundsel [13374]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Swainsona pyrophila](#) Yellow Swainson-pea [56344]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Tecticornia flabelliformis](#) Bead Glasswort, Bead Samphire [82664]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Veronica parnkalliana](#) Port Lincoln Speedwell [17458]	Endangered	Species or species habitat known to occur within area	In buffer area only
REPTILE			
[Aprasia pseudopulchella](#) Flinders Ranges Worm-lizard [1666]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only
[Notechis scutatus ater](#) Krefft's Tiger Snake (Flinders Ranges) [82287]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
SHARK			
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In buffer area only
Migratory Marine Species			
Balaenoptera edeni			
Bryde's Whale [35]		Species or species habitat may occur within area	In buffer area only
Caperea marginata			
Pygmy Right Whale [39]		Species or species habitat may occur within area	In buffer area only
Carcharias taurus			
Grey Nurse Shark [64469]		Species or species habitat may occur within area	In buffer area only
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only
[Eubalaena australis as Balaena glacialis australis](#) Southern Right Whale [40]	Endangered	Breeding known to occur within area	In buffer area only
[Lagenorhynchus obscurus](#) Dusky Dolphin [43]		Species or species habitat may occur within area	In buffer area only
[Lamna nasus](#) Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In buffer area only
[Megaptera novaeangliae](#) Humpback Whale [38]		Species or species habitat likely to occur within area	In buffer area only
Migratory Terrestrial Species			
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
[Arenaria interpres](#) Ruddy Turnstone [872]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris pugnax as Philomachus pugnax Ruff [91256]		Species or species habitat known to occur within area	In buffer area only
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area	In buffer area only
Calidris tenuirostris Great Knot [862]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area	In buffer area only
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Gallinago stenura](#) Pin-tailed Snipe [841]		Species or species habitat known to occur within area	In buffer area only
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
[Limosa limosa](#) Black-tailed Godwit [845]	Endangered	Species or species habitat known to occur within area	In buffer area only
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat known to occur within area	In feature area
[Thalasseus bergii](#) Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
[Tringa brevipes](#) Grey-tailed Tattler [851]		Species or species habitat known to occur within area	In buffer area only
[Tringa nebularia](#) Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In feature area
[Tringa stagnatilis](#) Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - AIRTC WHYALLA [40170]	SA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Defence - CULTANA TRAINING AREA [40104]	SA	In buffer area only
Defence - CULTANA TRAINING AREA [40106]	SA	In buffer area only
Defence - CULTANA TRAINING AREA [40103]	SA	In buffer area only
Defence - CULTANA TRAINING AREA [40102]	SA	In buffer area only
Defence - DEFENCE SUPPORT CENTRE - WOOMERA [40019]	SA	In feature area
Defence - EL ALAMEIN - PORT AUGUSTA [40105]	SA	In buffer area only
Defence - EL ALAMEIN - PORT AUGUSTA [40013]	SA	In buffer area only
Defence - EL ALAMEIN - PORT AUGUSTA [40014]	SA	In buffer area only
Defence - EL ALAMEIN - PORT AUGUSTA [40015]	SA	In buffer area only
Defence - EL ALAMEIN - PORT AUGUSTA [40011]	SA	In buffer area only
Defence - EL ALAMEIN - PORT AUGUSTA [40012]	SA	In buffer area only
Defence - LAUNCHER SITE RANGE - WOOMERA [40023]	SA	In buffer area only
Defence - Range Head (Range E) ; LAUNCHER SITE RANGE - KOOLYMILKA [40021]	SA	In buffer area only
Defence - Range Head (Range E) ; LAUNCHER SITE RANGE - KOOLYMILKA [40022]	SA	In buffer area only
Defence - WHYALLA TRAINING DEPOT [40172]	SA	In buffer area only
Defence - WHYALLA TRAINING DEPOT [40171]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40059]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40043]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40069]	SA	In feature area
Defence - WOOMERA AIR WEAPONS RANGE [40078]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40036]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40086]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40070]	SA	In feature area
Defence - WOOMERA AIR WEAPONS RANGE [40080]	SA	In buffer area only
Defence - WOOMERA AIR WEAPONS RANGE [40081]	SA	In buffer area only
Defence - Defence Housing Authority		

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Defence Housing Authority [40689]	SA	In buffer area only
Commonwealth Land - Defence Housing Authority [41344]	SA	In buffer area only
Commonwealth Land - Defence Housing Authority [41343]	SA	In buffer area only
Commonwealth Land - Defence Housing Authority [41338]	SA	In buffer area only
Commonwealth Land - Defence Housing Authority [41342]	SA	In buffer area only
Immigration and Multicultural and Indigenous Affairs - Aboriginal and Torres Strait Islander Commission		
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [40684]	SA	In buffer area only
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [40686]	SA	In buffer area only
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [40687]	SA	In buffer area only
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [40682]	SA	In buffer area only
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [41341]	SA	In buffer area only
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [41340]	SA	In buffer area only
Commonwealth Land - Aboriginal & Torres Strait Islander Commission [40683]	SA	In buffer area only
Immigration and Multicultural and Indigenous Affairs - Minister of Aboriginal Affairs		
Commonwealth Land - Minister of Aboriginal Affairs [41348]	SA	In buffer area only
Transport and Regional Services		
Commonwealth Land - Minister of Transport [40709]	SA	In buffer area only
Transport and Regional Services - Australian National Railways Commission		
Commonwealth Land - Australian National Railways Commission [41015]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41412]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41133]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41426]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40730]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40688]	SA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40731]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40720]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41425]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40721]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41014]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40685]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40738]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41134]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41337]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40681]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41013]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40700]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41012]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41429]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41011]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41431]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40703]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41430]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40806]	SA	In feature area

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [41432]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40724]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40727]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40726]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41010]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40725]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40801]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40800]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40744]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41008]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40808]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41456]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40694]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40795]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41127]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40695]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40692]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40723]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41451]	SA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40708]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41533]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41452]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41009]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40704]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41414]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40741]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41535]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41534]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41537]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41536]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41355]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41007]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41612]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40735]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40802]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40732]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41611]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40733]	SA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40742]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40698]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40699]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40814]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40736]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41402]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41427]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40734]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41411]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40737]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40697]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40722]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40693]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40799]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40702]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41128]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40696]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40701]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40706]	SA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40707]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40705]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40729]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41336]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41347]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41502]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41544]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41129]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40796]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41543]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41388]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41545]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40728]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40797]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40713]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40714]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40717]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40716]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40718]	SA	In feature area

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40719]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40740]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40798]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40650]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40826]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40821]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40827]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40822]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40820]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40823]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40825]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41565]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41606]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40807]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40805]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41470]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40813]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41449]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40812]	SA	In feature area

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian National Railways Commission [40819]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41579]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41469]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40712]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40711]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40710]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40809]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41578]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [40934]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [40739]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41572]	SA	In feature area
Commonwealth Land - Australian National Railways Commission [41574]	SA	In buffer area only
Commonwealth Land - Australian National Railways Commission [41577]	SA	In feature area
Unknown		
Commonwealth Land - [41349]	SA	In buffer area only
Commonwealth Land - [40833]	SA	In buffer area only
Commonwealth Land - [41494]	SA	In buffer area only
Commonwealth Land - [40834]	SA	In buffer area only
Commonwealth Land - [40811]	SA	In buffer area only
Commonwealth Land - [40691]	SA	In buffer area only
Commonwealth Land - [40690]	SA	In buffer area only
Commonwealth Land - [41339]	SA	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [41580]	SA	In feature area
Commonwealth Land - [41428]	SA	In feature area
Commonwealth Land - [41346]	SA	In buffer area only
Commonwealth Land - [41345]	SA	In buffer area only
Commonwealth Land - [40829]	SA	In buffer area only
Commonwealth Land - [40828]	SA	In buffer area only
Commonwealth Land - [40715]	SA	In buffer area only
Commonwealth Land - [40824]	SA	In buffer area only
Commonwealth Land - [40927]	SA	In buffer area only
Commonwealth Land - [41604]	SA	In buffer area only
Commonwealth Land - [40804]	SA	In buffer area only
Commonwealth Land - [40810]	SA	In buffer area only
Commonwealth Land - [40803]	SA	In feature area

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris pugnax as Philomachus pugnax Ruff [91256]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Calidris tenuirostris Great Knot [862]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius leschenaultii			
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus			
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area	In buffer area only
Charadrius ruficapillus			
Red-capped Plover [881]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Charadrius veredus			
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Chroicocephalus novaehollandiae as Larus novaehollandiae			
Silver Gull [82326]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis			
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Diomedea epomophora			
Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea exulans			
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago stenura Pin-tailed Snipe [841]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Limosa limosa Black-tailed Godwit [845]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In buffer area only
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In buffer area only
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat likely to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In feature area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Sterna striata			
White-fronted Tern [799]		Migration route may occur within area	In feature area
Sternula nereis as Sterna nereis			
Fairy Tern [82949]		Breeding known to occur within area	In buffer area only
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In buffer area only
Thalasseus bergii as Sterna bergii			
Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Tringa brevipes as Heteroscelus brevipes](#) Grey-tailed Tattler [851]		Species or species habitat known to occur within area	In buffer area only
[Tringa nebularia](#) Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
[Tringa stagnatilis](#) Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Fish			
[Acentronura australe](#) Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area	In buffer area only
[Filicampus tigris](#) Tiger Pipefish [66217]		Species or species habitat may occur within area	In buffer area only
[Heraldia nocturna](#) Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In buffer area only
[Hippocampus breviceps](#) Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In buffer area only
[Histiogamphelus cristatus](#) Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In buffer area only
[Hypselognathus rostratus](#) Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In buffer area only
[Kaupus costatus](#) Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In buffer area only
[Leptoichthys fistularius](#) Brushtail Pipefish [66248]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In buffer area only
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In buffer area only
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In buffer area only
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In buffer area only
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In buffer area only
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In buffer area only
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In buffer area only
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In buffer area only
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In buffer area only
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In buffer area only
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Urocampus carinirostris](#) Hairy Pipefish [66282]		Species or species habitat may occur within area	In buffer area only
[Vanacampus margaritifer](#) Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In buffer area only
[Vanacampus phillipi](#) Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In buffer area only
[Vanacampus poecilolaemus](#) Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In buffer area only
[Vanacampus vercoi](#) Verco's Pipefish [66286]		Species or species habitat may occur within area	In buffer area only
Mammal			
[Arctocephalus forsteri](#) Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In buffer area only
[Arctocephalus pusillus](#) Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area	In buffer area only
[Neophoca cinerea](#) Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In buffer area only
Reptile			
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In buffer area only
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area	In buffer area only
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In buffer area only
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In buffer area only
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area	In buffer area only
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In buffer area only
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In buffer area only
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Buckaringa	Private Nature Reserve	SA	In buffer area only
Franklin Harbor	Marine Park	SA	In buffer area only
Lake Torrens	National Park	SA	In buffer area only
Mount Brown	Conservation Park	SA	In buffer area only
Mount Remarkable	National Park	SA	In buffer area only
Munyaroo	Conservation Park	SA	In buffer area only
The Dutchmans Stern	Conservation Park	SA	In buffer area only
Unnamed (No.HA105)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1135)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1278)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1279)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1280)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1281)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1394)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1462)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1483)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1507)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1523)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1572)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1588)	Heritage Agreement	SA	In buffer area only
Unnamed (No.HA1636)	Heritage Agreement	SA	In buffer area only
Upper Spencer Gulf	Marine Park	SA	In buffer area only
Whyalla	Conservation Park	SA	In buffer area only
Winninowie	Conservation Park	SA	In buffer area only

Nationally Important Wetlands

[Resource Information]

Wetland Name	State	Buffer Status
Inland Saline Lakes	SA	In buffer area only
Upper Spencer Gulf	SA	In feature area

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Aurora Energy Project (AEP)	2025/10119		Referral Decision	In feature area
BHP Olympic Dam Corporation Pty Ltd - Evaporation Pond 7 Project	2023/09655		Referral Decision	In buffer area only
Cultana Pumped Hydro Energy Scheme, near Port Augusta, SA	2019/8420		Completed	In buffer area only
Cultana Solar Farm project	2023/09658		Assessment	In buffer area only
Magnetite Expansion Project Stage 2 / SIMEC Mining	2024/09878		Assessment	In buffer area only
Mara team testing - Release 37 Wei	2024/09831		Post-Approval	In buffer area only
Morgan Whyalla Pipeline No.1 Renewal ? Stage 1	2022/09438		Post-Approval	In buffer area only
Northern Water Desalination and Pipeline Infrastructure Project, SA	2023/09717		Assessment	In feature area
Oak Dam Underground Access Project, SA	2023/09696		Completed	In feature area
Olympic Dam Resource Development Strategy	2019/8570		Completed	In feature area
Olympic Dam Smelter Refinery Expansion (SRE) Project.	2024/10096		Referral Decision	In feature area
Port Bonython Bulk Commodities Export Facility, SA	2012/6336		Completed	In buffer area only
South Australian Government Renewable Hydrogen Power Station, Electrolysers and Storage Facility	2023/09759		Post-Approval	In buffer area only
Whyalla Hydrogen Pipeline (WHP)	2024/09873		Approval	In buffer area only
Controlled action				
Arafura Whyalla Rare Earths Complex	2011/5877	Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Carrapateena Project copper -gold mining and ore processing, SA	2017/7895	Controlled Action	Post-Approval	In feature area
Construction and operation of a coal storage facility	2001/463	Controlled Action	Completed	In buffer area only
Expansion of the Cultana Training Area	2010/5316	Controlled Action	Post-Approval	In feature area
Expansion of the Olympic Dam copper, uranium, gold and silver mine, processing plant and associated	2005/2270	Controlled Action	Post-Approval	In feature area
National Low Level Radioactive Waste Repository, Central-North SA	2001/151	Controlled Action	Post-Approval	In buffer area only
Nava-1 Cable System	2001/510	Controlled Action	Completed	In feature area
Pig Iron Smelter	2001/473	Controlled Action	Completed	In buffer area only
Pig Iron Smelter (Cultana)	2001/466	Controlled Action	Completed	In buffer area only
Prominent Hill Copper-Gold Project	2005/2040	Controlled Action	Post-Approval	In feature area
Wilcherry Hill Project	2010/5478	Controlled Action	Post-Approval	In feature area
Not controlled action				
132kV Electricity Transmission Line for the Prominent Hill Copper-Gold Project	2006/3110	Not Controlled Action	Completed	In buffer area only
Carrapateena Deposit - Advanced Exploration Works, SA	2012/6494	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Increasing a wall height of the tailings storage facility (TSF4), Olympic Dam, SA	2015/7416	Not Controlled Action	Completed	In buffer area only
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In buffer area only
Olympic Dam Evaporation Pond 6	2019/8526	Not Controlled Action	Completed	In feature area
Olympic Dam Operations Tailings Storage Facility Six, SA	2019/8465	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Pilot desalination plant, Olympic Dam Expansion Project	2007/3391	Not Controlled Action	Completed	In buffer area only
Port Augusta Renewal Energy Park, SA	2015/7614	Not Controlled Action	Completed	In buffer area only
Project Magnet	2004/1724	Not Controlled Action	Completed	In buffer area only
Whyalla Solar Farm Project, SA	2017/7910	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Asteroid sampler re-entry vehicle recovery	2002/544	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Olympic Dam Heap Leach Trial, Roxby Downs, SA	2014/7280	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Small scale uranium In-situ Recovery Field Trial	2010/5751	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Biologically Important Areas			[Resource Information]
Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging (in high numbers)	Likely to occur	In buffer area only
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Foraging	Known to occur	In buffer area only
Sternula nereis Fairy Tern [82949]	Foraging	Known to occur	In buffer area only

Bioregional Assessments			[Resource Information]
SubRegion	BioRegion	Website	Buffer Status
Arckaringa	Lake Eyre Basin	BA website	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix D. Biological Database of South Australia Search Results

Genus	Species	Common Name	Latitude	Longitude	Landscape Region	Bioregion	Bio Subregion
Pseudogobius	*olorum*	Swan River Goby	-33.9223	136.568	Eyre Peninsula	Eyre Yorke Block	Eyre Mallee
ATHERINIDAE	spp.	Hardyheads, Silversides	-33.0509	137.5658	Eyre Peninsula	Gawler	North Spencer Gulf (IMCRA)
Aldrichetta	*forsteri*	Yelloweye Mullet	-33.9223	136.568	Eyre Peninsula	Eyre Yorke Block	Eyre Mallee
Favonigobius	*lateralis*	Southern Longfin Goby	-33.9223	136.568	Eyre Peninsula	Eyre Yorke Block	Eyre Mallee
Atherinosoma	*microstoma*	Smallmouth Hardyhead	-33.9223	136.568	Eyre Peninsula	Eyre Yorke Block	Eyre Mallee
Pseudaphritis	*urvillii*	Congolli	-33.9223	136.568	Eyre Peninsula	Eyre Yorke Block	Eyre Mallee
Favonigobius	*lateralis*	Southern Longfin Goby	-33.0509	137.5658	Eyre Peninsula	Gawler	North Spencer Gulf (IMCRA)
Pseudaphritis	*urvillii*	Congolli	-33.0509	137.5658	Eyre Peninsula	Gawler	North Spencer Gulf (IMCRA)
Pseudogobius	*olorum*	Swan River Goby	-33.0509	137.5658	Eyre Peninsula	Gawler	North Spencer Gulf (IMCRA)
Bathygobius	*krefftii*	Krefft's Frillgoby	-33.9223	136.568	Eyre Peninsula	Eyre Yorke Block	Eyre Mallee

Appendix H-4:

Hydrogeological Conceptual Model and Groundwater Impact Assessment Report for the Pipeline Alignment

Northern Water

Department for Infrastructure and Transport

Hydrogeological Conceptual Model and Groundwater Impact Assessment Report for the Pipeline Alignment

63753 | 171,552 (Revision 0)

7 July 2026



We acknowledge the Traditional Custodians of Country throughout Australia and their connection to land, sea and community.

We pay our respect to Elders past, present and emerging and in the spirit of reconciliation we commit to working together for our shared future where every person is respected, valued and has strong sense of belonging.

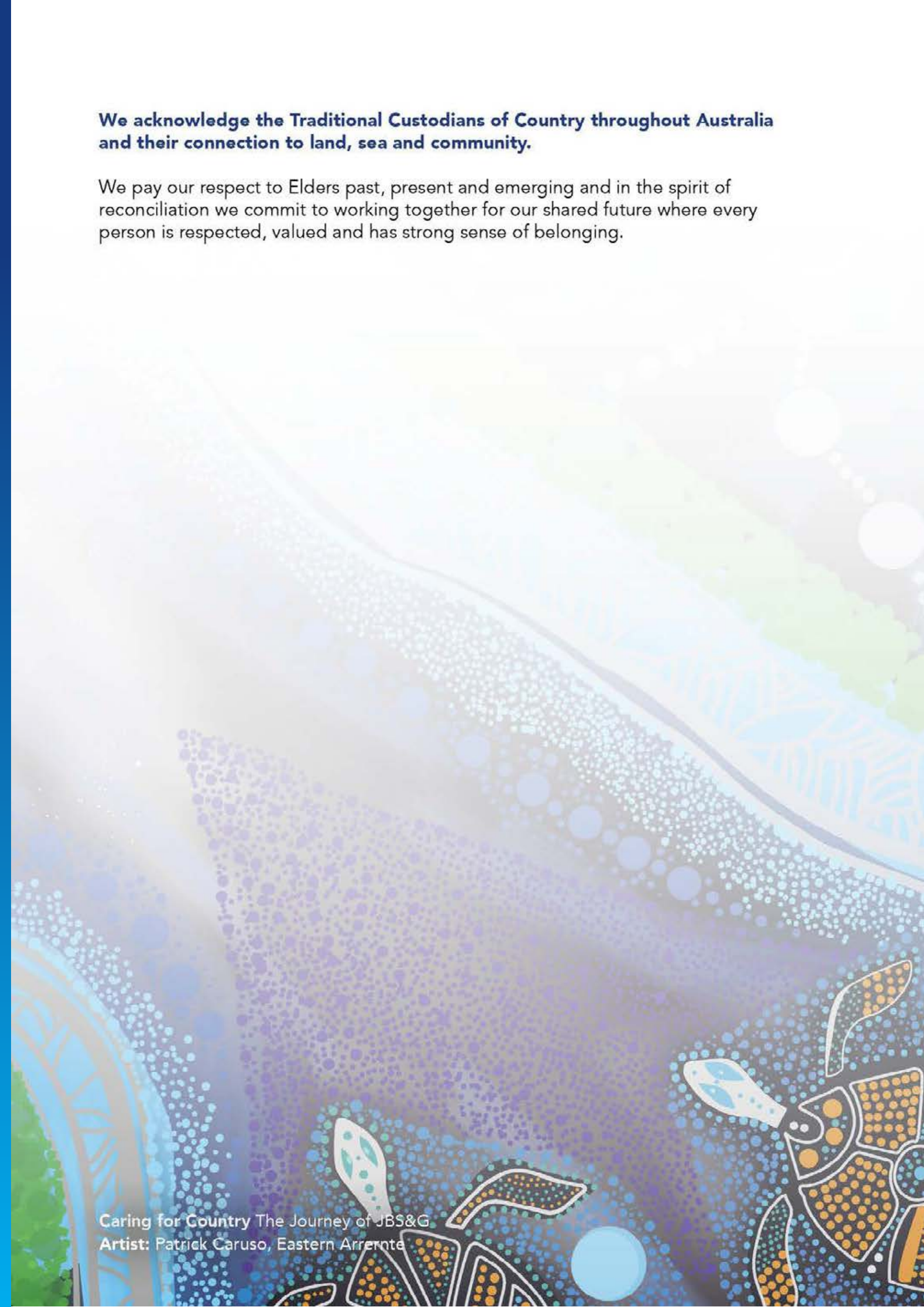


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Abbreviations

Term	Definition
BGL	Below ground level (depth in metres)
BOM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
DEM	Department for Energy and Mining
DIT	Department for Infrastructure and Transport
EIS	Environmental Impact Statement
EP Act	*Environment Protection Act 1993*
EPA	Environment Protection Authority, SA
EP LMR	Eyre Peninsula Landscape Management Region
GDE	Groundwater Dependent Ecosystem
GL/y	Gigalitres per year
HCM	Hydrogeological Conceptual Model
HSU	Hydrostratigraphic Unit
IAIA	International Association for Impact Assessment
IBRA	Interim Biogeographic Regionalisation of Australia
KL/d	Kilolitres per day,
km	kilometres
Kmc	Bulldog Shale unconfined;
KP	Kilometre Point (distance along pipeline from desalination plant)
L/s	Litres per second
Landscape Act	*Landscape South Australia Act 2019*
LMR	Landscape Management Region
m	metres
mAHD	Metres Australian Height Datum
max	maximum
min	minimum
ML/d	Megalitres per day
mg/L	milligrams per metre
mm	millimetres
M-p	Pandurra Formation (geology symbol)
Nnt	Tapley Hill Formation; siltstone, dolomitic and pyritic grading upwards to calcareous, thinly laminated; dolomite; limestone conglomerate; greywacke
PWA	Prescribed Wells Areas
Q	Quaternary (geology symbol)
Qa	Quaternary alluvial/fluvial sediments; gravels, sands and clays
Qe	Quaternary aeolian sediments
SA	South Australia(n)
SAAL LMR	South Australian Arid Lands Landscape Management Region

Term	Definition
SARIG	SA Resource Information Gateway
T	Tertiary (geology symbol)
TpQa	Undifferentiated Quaternary and Tertiary; silts, clays and sands
TDS	Total dissolved solids
Water Quality EPP	*Environment Protection (Water Quality) Policy 2015*
Ymm	Moonabie Formation; volcaniclastic grit and pebbles

Glossary

Term	Definition
Environmental Values	Elements having a particular value or use of the environment that is important for a health ecosystem or for public benefit, health, safety or welfare.
Conjunctive groundwater environment	Management of groundwater and surface water connectivity, emphasising adaptive, resilient and integrated strategies for groundwater and surface water system sustainability.
Groundwater dependent ecosystem (GDE)	Ecosystems that need access to groundwater to meet all or some of their water requirement to maintain their communities of plants and animals, ecological processes and ecosystem services.
Hydrogeological Conceptual Model (HCM)	Describes and quantifies the relevant geological characteristics, flow conditions, hydrogeochemical and hydrobiological processes, anthropogenic activities and their interactions (European Commission, 2003).
Hydrostratigraphic unit (HSU)	Describes a body of rock, formation or multiple formations with similar hydrogeologic properties and act as a discrete groundwater resource unit, such as an aquifer or aquitard.
Metres Australian Height Datum (mAHD)	Elevations (e.g. groundwater levels and topography) relative to the Australian Height Datum (AHD). Increasing values indicate increasing groundwater levels.
Perched aquifer	Conceptualised as a local aquifer that is disconnected laterally from the wider regional water table aquifer. Generally, these types of aquifers are not specific to the sedimentary processes or formation that leads to regional aquifer development. Perched groundwater can be hosted within upper/shallow weathered horizons of outcropping sediments or within localised sedimentary formations, such as, aeolian dune systems and river and creek bed sediment deposition.
Project	Describes all proposed activities associated with the elements in Section 1.2.
Water table aquifer	The shallowest HSU, which is described generally within the Quaternary/Tertiary sediments of the Project or within outcropping sediments of an underlying HSU.

Executive Summary

The Northern Water Project (the Project) aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf and Far North. Delivery of the Project will involve the construction and operation of a 51 gigalitre per year (GL/y) seawater reverse osmosis desalination plant located at Mullaquana Station on the Upper Spencer Gulf, and associated water transfer system (including pipelines, transfer pump stations, and product water storages) and electricity infrastructure.

The scope of this report assesses the potential hydrogeological impacts associated with construction of the transfer system for the Northern Water Project. The potential hydrogeological impacts associated with the proposed desalination plant site at Mullaquana Station are addressed in other scopes of work.

The methodology employed in preparing this Hydrogeological Conceptual Model and Groundwater Impact Assessment Report includes a detailed characterisation of geology and hydrogeology within the Study Area (see section 2.1 for a definition of Study Area). This involves reviewing data sources such as WaterConnect groundwater data well records and historical field drilling logs from Department for Energy and Mining (DEM) (SARIG, 2025). The report identifies groundwater values and characterises the sensitivity of the receiving environment as well as the magnitude of potential impacts to determine their significance.

Four key shallow groundwater environments were identified in the Study Area including:

- shallow groundwater tables
- surface expression of deeper aquifers
- perched groundwater systems in the banks of creeks; and
- perched groundwater within the sediment banks of extensive sand dunes systems.

The magnitude of potential impact depends on the type of groundwater system that is present. Connected aquifers (shallow groundwater table) will likely recover quickly following temporary disturbance associated with pipeline construction, while perched groundwater systems (including sand dunes) will likely dewater quickly but only effectively recharge again after a major rainfall event.

There is potential for minor, localised changes in hydrogeological conditions due to trenching and underboring along the pipeline. Potential impacts would be temporary, occurring during the Project construction period only. It is recommended that the associated CEMP includes strategies and management to address the scenario of groundwater being identified during construction along the pipeline alignment.

Potential impact to registered groundwater users along the pipeline alignment are not expected.

Potential impact to native vegetation and terrestrial GDEs (along the pipeline alignment) from groundwater drawdown are not expected (due to the shallow pipeline depth and temporary nature of drawdown). However, should minor impacts be necessary as a result of construction dewatering, they would be addressed as part of statutory requirements relating to clearance and provision of significant environmental benefit.

1. Introduction

Northern Water (the Project) aims to provide a secure climate resilient water source for industry in South Australia's Upper Spencer Gulf (USG) and Far North of South Australia. The Project would enable the growth of industries and key mining resources crucial for contributing to decarbonisation initiatives, sustainability and unlocking long-term economic prosperity for South Australia

The Project traverses the local government areas of Whyalla City Council, Port Augusta City Council, Municipal Council of Roxby Downs and the Unincorporated Areas of South Australia. The proposed pipeline is also partially located on Department of Defence land at Cultana.

Delivery of the Project will involve the construction and operation of a 51 GL/y seawater reverse osmosis desalination plant and associated marine structures on the USG, a water transfer system and required power supply infrastructure. The proposed desalination plant location is on the western shore of the USG at Mullaquana Station, approximately 25 km south-west of Whyalla and the water transfer system runs generally north from the desalination plant to delivery points at the Olympic Dam and Carrapateena copper-gold mines refer Figure 1-1).

JBS&G Australia Pty Ltd (JBS&G) has been engaged by the Department for Infrastructure and Transport (DIT) to undertake a hydrogeological conceptual model (HCM) and prepare a report assessing the potential groundwater impacts for construction of the water transfer pipeline.

1.1 Purpose of the Report

The purpose of the HCM and assessment of potential groundwater impacts are to characterise the existing groundwater environment within the Study Area and identify potentially adverse impacts to groundwater and groundwater dependent ecosystems (GDEs) from construction of the transfer pipeline and to make predictions about and management for groundwater dewatering, if required.

The groundwater Study Area is defined in section 2.1 and the HCM and potential groundwater impacts assessment are based on the transfer pipeline alignment revision 5 endorsed by DIT.

This report has been prepared with consideration of the *Landscape South Australia Act 2019* and the *Environment Protection Act 1993* and associated policies and guidelines. Where potential impacts may affect the recognised environmental values of groundwater, the assessment aims to identify mitigation measures to avoid and minimise those impacts as far as reasonably practicable.

1.1.1 Key objectives

The key objectives of this groundwater study are to:

- Describe current legislation, policies, regulations and guidelines to provide a clear understanding of environmental objectives and adverse impacts in a risk-based context for the minimisation and management of potential impacts to groundwater.
- Characterise the existing groundwater conditions of the Study Area based on the desktop review of available information.
- Undertake a desktop assessment of hydrogeological conditions and develop a HCM for the Study Area to provide sufficient understanding of what adverse impacts on groundwater could occur and be attributed to the construction of the Project.
- Undertake a groundwater impact assessment for construction of the transfer system pipeline alignment that will form part of the Environmental Impact Statement (EIS) for the Project.

- Identify potential impacts to the conjunctive groundwater environment, which include terrestrial GDEs.
- Determine management measures for impact minimisation to groundwater during Project construction works.
- Identify residual groundwater impacts where further investigations and monitoring programs may be required to demonstrate achievement of environmental objectives.

1.1.2 Scope of the report

The scope of this report is to assess the hydrogeological impacts resulting from the construction of the transfer system pipelines associated with the Northern Water project (i.e. the main transfer pipeline and the Carrapateena lateral branch) (refer section 1.2).

The assessment has not considered operational impacts to groundwater along the transfer system as no impacts are expected during operations (all trenches have been backfilled with inert material to ground level and no groundwater exposed).

Hydrogeological impacts as a result of construction and operation of the desalination plant are addressed as part of a separate scope of work.

Construction and operation of electricity supply infrastructure, temporary camps and laydowns have also been excluded as the potential for impacts to groundwater from these activities are considered very unlikely.

1.2 Project Description

The Project comprises the following key elements:

- a 51 GL/y seawater reverse osmosis desalination plant located at Mullaquana Station approximately 25 km south-west of central Whyalla
- marine intake and outfall tunnels extending underneath the seabed and into the Spencer Gulf
- seawater intake pipe within the marine tunnel and associated intake structure and pumps
- diffuser structures for discharge of return water into the Spencer Gulf
- a transfer system consisting of:
    - ~360 km of main transfer pipeline, largely constructed underground, terminating at the delivery point at the Olympic Dam copper-gold mine
    - ~46 km of lateral branch pipeline to a delivery point at the Carrapateena copper-gold mine (which may be constructed above or below ground)
    - associated transfer pump stations and storage tanks
- high voltage electricity supply including powerlines, network and facility substations to provide power to the desalination plant and transfer pump stations
- associated temporary construction-related infrastructure (e.g. construction camps, site offices and amenities, yards, storages and laydown areas)
- access tracks including upgrading existing tracks and establishing new tracks
- enabling roadworks and road upgrades.

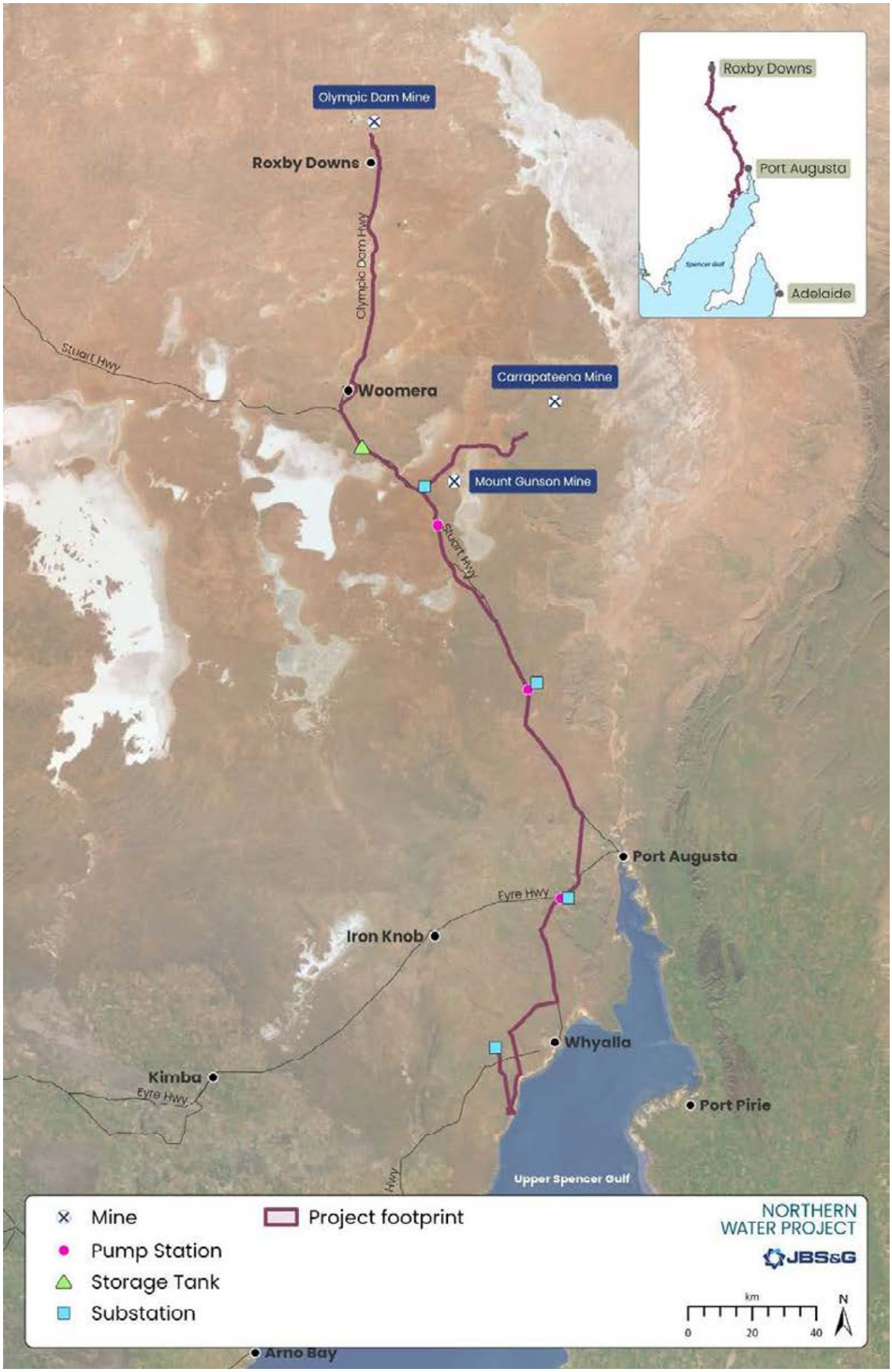


Figure 1-1: Project location

1.3 Legislation

Groundwater within South Australia is regulated under the *Landscape South Australia Act 2019* (Landscape Act) and the *Environment Protection Act 1993* (EP Act). The Landscape Act regulates the quantity of groundwater available for all users (including environmental users of water) and the EP Act regulates the quality of groundwater and the general environmental duty on all persons in South Australia.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* also requires consideration of impacts to a range of matters of National Environmental Significance (MNES) which may be of relevance to groundwater.

1.3.1 Landscape South Australia Act 2019

The Landscape South Australia Act (LSA Act) promotes the sustainable and integrated management of the State's landscapes and natural resources. The LSA Act divides the State into Landscape Management Regions (LMRs) with regional plans for managing natural resources. The Project Area crosses the Eyre Peninsula LMR and the South Australian Arid Lands (SAAL) LMR. Under the LSA Act, groundwater is regulated by way of 'prescribed water resources' where the Minister administering the Act (currently the Minister for Climate, Environment and Water) may declare a water resource to be subject to specific rules, water licences, and water access entitlements. Water allocation plans may be developed for groundwater systems to set the sustainable take and use of the resource.

The Project does not cross any prescribed water resource areas.

Water affecting activities, such as, excavating material below the water table, drilling and backfilling wells and bores must be undertaken in accordance with the principles outlined in the water affecting activity control policies for each landscape board.

1.3.2 Environment Protection Act 1993

The EP Act provides for a general environmental duty and sets out environment protection policies developed for specific issues and the activities of environmental significance which require licencing. The general duty of environmental care is set out in section 25 of the EP Act. In relation to development activities, the general environmental duty requires that all reasonable and practicable measures are taken to prevent or minimise environmental harm if potentially polluting activities are undertaken.

A number of Environment Protection Policies (EPPs) are established under the EP Act, each of which set out requirements, standards, goals and guidelines relating to matters including water quality. The *Environment Protection (Water Quality) Policy 2015* (Water Quality EPP) provides the structure for regulation and management of water quality of surface and ground waters and specifies relevant environmental values to be protected. The Water Quality EPP references to the Water Quality Guidelines (ANZG 2018) for environmental values of waters.

1.3.3 Environment Protection ad Biodiversity Conservation Act 1999

The EPBC regulates impacts to MNES including from actions on water resources, in relation to a coal seam gas, large coal mining developments and all types of unconventional gas developments (known as the 'water trigger').

Relevant MNES can also include threatened species and / or ecological communities such as groundwater dependent ecosystems (GDEs) and species.

2. Assessment Method

The method used to develop the HCM and assess the potential groundwater impacts associated with the Project transfer system in construction considers the environmental values present in the Study Area. The method adopted includes:

- Define the Study Area by reference to the transfer system alignment with a qualitative summary of surrounding geological features.
- Characterise the baseline environment, including geology, hydrostratigraphy, water quality, uses, users, GDEs, aquifer depth, standing water levels are assessed along with influencing factors such as climate, hydrology, land use.
- Develop the HCM (as presented in Figure 2-1).
- Predict changes in the groundwater in response to the transfer pipeline construction methodology, such as the potential for groundwater dewatering and impact on terrestrial GDEs.
- Qualitatively assess the sensitivity of groundwater aquifers to change and potential magnitude of change.

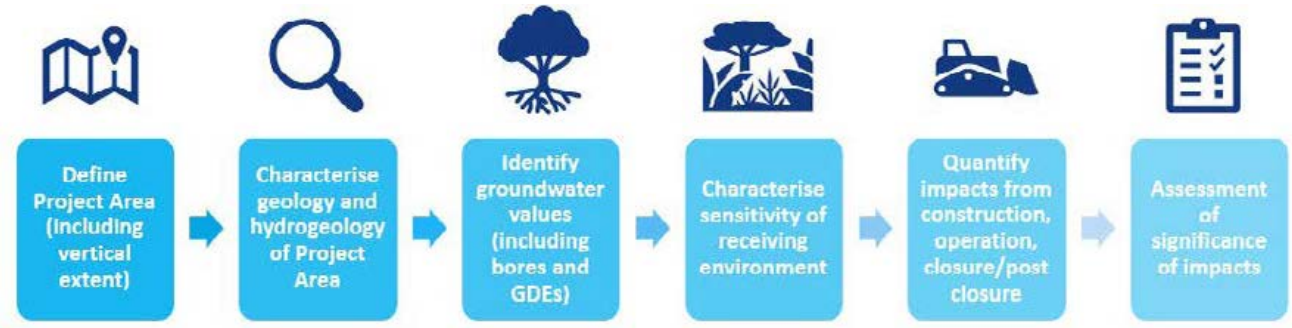


Figure 2-1: Hydrogeological Conceptual Model

2.1 Study Area

The Study Area has been defined based on a conservative view of the extent to which groundwater and receptors have the potential to be impacted by the Project. A vertical extent was defined to limit assessment to the shallowest aquifers noting deeper aquifers will not be impacted by Project activities.

Following an initial review of the Project description, the groundwater Study Area for investigation of existing groundwater wells and lithology investigation drill holes has been defined as a 1 km buffer area from the centre line of the main transfer and lateral branch pipeline footprints (excluding the desalination plant site). However, a conservative zone of influence based on potential drawdown is limited to within 100 metres of any trenching or underboring pipeline infrastructure construction.

The depth of the pipeline will depend on the pipe diameter and is in line with minimum cover values calculated using the relevant Australian standard. The depth of the pipeline is dependent on a number of factors including pipe material characteristics, pipeline pressures, weight of trench fill, and design loads. A nominal 10 m vertical Study Area limit has been set for the depth of investigation. Preliminary engineering design has indicated pipeline infrastructure will be to a depth of 2.1m for trenching and 2.6 m for underboring, although there is potential for infrastructure to be slightly deeper in sections. Given variations in topography over the transfer system alignment, and potential refinement in detailed design, the overall depth of impact for pipeline construction is not expected to extend past 10 m.

The Study Area for this report includes the transfer system only and excludes the desalination plant. For the purposes of this report linear infrastructure references the transfer system. The hydrogeology within the desalination plant area is assessed in a separate technical study and within the relevant EIS chapter.

Having said that, this report references (and shows in all maps), the total Project Area definition for the EIS which comprises a 2.5 km buffer of the desalination plant footprint and either side of the alignment of linear infrastructure (i.e. a 5 km wide corridor).

2.2 Geological and Hydrogeological Characterisation

2.2.1 Data sources

A desktop review of available information was undertaken to describe the aspects of the existing environment likely to be affected by the Project. The review included assessment of publicly available groundwater data from the following sources:

- South Australian (SA) Government Location SA MapViewer
- Department for Energy and Mines (DEM), SA Resource Information Gateway (SARIG)
- Department for Environment and Water
    - SA WaterConnect Groundwater Data database (WaterConnect)
    - SA NatureMaps
- Environment Protection Authority, SA (EPA), Public Register and Site Contamination Index.
- Bureau of Meteorology (BOM)
    - Climate data
    - Groundwater Dependent Ecosystem Atlas

To strengthen the understanding of the HCM with stratigraphically logged and modelled groundwater data, additional data has been reviewed from the BHP Olympic Dam Expansion EIS, including published reports of geotechnical and hydrogeological investigations, including test pit data and bore data from BHP projects.

2.2.2 Information considered

The scope of the desktop literature and data review included:

- identification of underlying mapped geology and major aquifer from various resources including published geological records
- review of data from WaterConnect to identify registered groundwater wells and lithologically mapped drill holes. Where available the review considered the depth of the aquifer, confining nature of the aquifer, yield and salinity of groundwater
- review of climate data from the BOM weather stations
- identification of areas subject to groundwater management or special conditions, such as Prescribed Wells Areas and Water Allocation Plans
- identification of relevant surface water features within the Study Area
- identification of mapped wetlands and terrestrial GDEs
- analysis of topography and determine if there is an influence on groundwater conditions
- broad characterisation of published hydraulic properties of aquifers in the Study Area, and
- review known site contamination within the Study Area.

Information from the Reference Design Report (GHD 2025) and Reference Design Constructability Report (Systra 2025) prepared for the Project has also been utilised in the development of the HCM.

2.2.3 Baseline groundwater characterisation

A baseline characterisation and HCM of existing groundwater conditions within the Study Area is based on desktop review of published literature and data from the Eyre Peninsula and Far North landscape regions. The HCM provides an understanding of the existing groundwater conditions along the pipeline alignment.

The baseline groundwater characterisation for the purpose of the HCM is described spatially including a qualitative description of the hydrostratigraphic unit (HSU) along the pipeline alignment and the likely presence of groundwater within the water table aquifer and perched groundwater within the groundwater systems and mapped terrestrial GDEs within the vicinity of water courses.

The baseline characterisation assists in determining target areas, initially inferred by the understanding in the HCM and where field verification may be recommended.

Groundwater from all monitoring wells, and any other suitable wells (such as domestic, stock and mineral drill holes) can be used to collect baseline groundwater data for the development of the HCM. Ideally wells used for the collection of baseline groundwater quality should be constructed in accordance with the Minimum Construction Requirements of Water Bores in Australia (NUDCL, 2020) and previous published editions, however, historical wells of unknown construction can still provide usable information from drillers logs and subsequent monitoring.

Due to the limited data available within the Project Area, description of the temporal variability in groundwater levels has not been able to be quantified. To account for potential temporal variability in groundwater levels, an additional 1 m was added to the highest known groundwater level, as described in section 2.4.1.

2.3 Identify and Characterise Impacts

Potential impacts to groundwater resulting from Project construction activities, have been assessed prior to applying any controls, such as avoidance and mitigation measures.

2.3.1 Environmental values of groundwater

The Water Quality EPP and the Water Quality Guidelines (ANZG 2018) assist in defining which environmental values apply to groundwater, based on salinity (i.e., the lower the salinity, the greater the range of environmental values that apply).

Groundwater is divided into six environmental (community) values which are defined as having a particular value or use of the environment that is important for a healthy ecosystem or for public benefit, health, safety or welfare (ANZG 2018):

- aquatic ecosystems (including GDEs) — the health or integrity of the waterway's ecosystem(s)
- cultural and spiritual values — water is particularly important for indigenous people
- drinking water — water is suitable for human consumption
- industrial water — water is suitable for use by industry, for example mining, manufacturing, cooling and electricity generation
- primary industries — water is suitable for irrigation, livestock drinking water, aquaculture and human consumers of aquatic foods
- recreational water and aesthetics — recreation can be undertaken without risk of sickness or disease or loss of aesthetic appeal.

Aquatic ecosystems, drinking water and recreational water do not apply to the groundwater resources in the Study Area. Primary industries environmental values apply to some areas depending upon the baseline quality of the groundwater.

2.3.2 Sensitivity assessment of environmental values

The sensitivity of the environmental values that are identified for groundwater and GDEs is determined considering the following criteria (Napier, 2019) as they relate to the aquifers on which they rely:

- Protection status – assigned to an environmental value by governments (regulating authorities) or recognised international organisations.
- Intactness – an assessment of how intact the environmental value is.
- Uniqueness or rarity – an assessment of its occurrence, abundance and distribution within and beyond the assessment area.
- Resilience to change – determined by the extent to which an environmental value can cope with change including that posed by threatening processes.
- Replacement potential – the potential for a representative or equivalent example of the environmental value to be found to replace any losses.

The criteria for the different sensitivity levels of each aquifer are described in Table 2-1 based on the aquifer's capacity to support groundwater values.

Table 2-1: Definitions for the sensitivity of aquifers[1]

Sensitivity criteria	Very high sensitivity (4)[2]	High sensitivity (3)	Moderate sensitivity (2)	Low sensitivity (1)	Not sensitive (0)
ENVIRONMENTAL VALUES OF GROUNDWATER Potential uses of groundwater related to the suitability of the water to support ecosystems and consumptive and productive uses.	• Groundwater supports ecosystems with features of high ecological importance and/or hold cultural or spiritual significance. • Groundwater is a vital support as a potable water supply and the use in agricultural and/or stock and food production.	• Groundwater supports ecosystems that are of high importance but may be slightly modified by pre-existing influences. • Groundwater provides a secondary support for domestic supply and some agricultural /stock uses.	• Groundwater supports ecosystems that are slightly to moderately modified or disturbed. • Biodiversity and ecological value may be reduced. • Groundwater quality is degraded from natural conditions, partly affecting some environmental values. • Groundwater provides support for construction and irrigation. • Groundwater not able to provide support for potable water supply but may support short-term agricultural/ stock uses.	• Groundwater unlikely to support ecosystems of ecological importance due to groundwater system modification. • Groundwater quality is highly altered from natural conditions. • Groundwater supports a limited range of consumptive and/or productive uses (industrial/construction).	• Groundwater quality, occurrence and volume are no longer or have never been suitable ecosystem support. • Groundwater quality may have been degraded from natural conditions and potentially impacted by site contamination. • Groundwater cannot support consumptive and/or productive uses without treatment.
UNIQUENESS AND RARITY Abundance of the aquifer type and availability of equivalent or representative alternatives. Uniqueness of the aquifer or connected feature that carries conservation status.	• Groundwater system (which includes connected features) is unique and there are no known available alternatives. • Groundwater system, or connected feature, is listed on a recognised or statutory state, national or international register as being of conservation significance.	• Groundwater system is locally unique but has some similarity to other regional systems. • Groundwater system, or connected feature, is listed on a recognised or statutory state or national register as being of conservation significance.	• Groundwater system is locally unique but has representative similarities to other regional systems. • Groundwater system, or connected feature, is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers.	• Groundwater system is common on a regional and national basis. • Groundwater system, or connected feature, is not listed on any recognised or statutory register.	• Groundwater system is common on a local and regional scale. • Groundwater system is large and widespread in distribution. • Impacts to groundwater system would not result in unavoidable losses. • Groundwater system, and connected features, are not listed on any recognised or statutory register, or recognised locally by relevant suitably qualified experts or organisations.

[1] Developed from abstract and presentation by B Napier at the International Association for Impact Assessment (IAIA) Conference 2019

[2] For the Impact Assessment (Section 5), sensitivity scores (0 to 4) are applied to each criteria, then a mean score is calculated from the five criteria. The mean is rounded to the nearest whole number.

Sensitivity criteria	Very high sensitivity (4)[2]	High sensitivity (3)	Moderate sensitivity (2)	Low sensitivity (1)	Not sensitive (0)
RESILIENCE TO CHANGE Groundwater properties such as water level or pressure changes, and quality change, and the nature of the aquifer's connection to the environment.	• Groundwater system, or connected features, have a very low capacity to adjust to level or quality change. • Intrinsic properties, such as aquifer media and chemical properties of the groundwater system are very highly susceptible to change. • Groundwater system cannot recover from disturbance. • Function of groundwater system would result in permanent alteration.	• Groundwater system, or connected features, have a low capacity to adjust to groundwater level or quality changes. • Intrinsic properties of groundwater system are highly susceptible to change. • Groundwater system has limited ability to recover from disturbance. • Function of groundwater system would be altered in the long term.	• Groundwater system, or connected features, have a moderate capacity to adjust to level or quality changes. • Intrinsic properties of groundwater system are moderately susceptible to change. • Groundwater system has some ability to recover from disturbance. • Function of groundwater system could be partly and/or temporarily altered.	• Groundwater system, or connected features, have a high capacity to adjust to level or quality changes. • Intrinsic properties of groundwater system are slightly resistant to change. • Groundwater system can recover from disturbance. • Overall function of groundwater system remains relatively unchanged.	• Groundwater system, or connected features, have a very high capacity to adjust to level or quality changes. • Groundwater system can fully recover from disturbance. • Intrinsic properties of groundwater system are resilient to change. • Overall function of groundwater system is unchanged. **OR** • Groundwater system and connected features are confined and deep. • Groundwater system is not connected to disturbance.
RECOVERY POTENTIAL Potential for groundwater systems to recover from a level or quality change naturally.	• Groundwater system has very low recharge rates and very long recovery periods. • Permanent quality or quantity changes may occur.	• Groundwater system has low recharge rates and slow recovery periods. • Recovery potential is limited. • Impact may require decades to centuries to resolve.	• Groundwater system has moderate recharge rates and medium-term recovery periods. • Recovery is likely to be slow or only partially successful.	• Groundwater system has relatively high recharge rates and short recovery periods. • Recovery will be successfully achieved in most cases.	• Groundwater systems with very high recharge rates and very short recovery periods. • Recovery will be successfully achieved in all cases.
REPLACEMENT POTENTIAL Potential for temporary replacement with alternative supply where relevant.	• No local water features (surface water or groundwater) that could provide alternative water sources to users.	• Very limited local water features (surface water or groundwater) could provide an alternative water source to users.	• Limited local water features (surface water or groundwater) that could provide alternative water sources to users.	• Several local water features (surface water or groundwater) that could provide alternative water sources to users.	• Numerous local water features (surface water or groundwater) that could provide alternative water sources to users.

2.3.3 Magnitude assessment

The significance of impacts on an environmental value is determined by the sensitivity of the value itself and considering the aquifer and perched groundwater on which it relies, and the magnitude of the change it experiences (refer Table 2-2).

Table 2-2: Description of magnitude of impacts[3]

Significance of impact	Description
Severe	An impact that causes permanent changes and irreversible harm to the environmental values of the groundwater system, including capacity to support terrestrial GDEs. Avoidance or mitigation through appropriate design responses are the only effective controls.
Major	A widespread impact, that can be long lasting where substantial change to environmental values can result. Can create either temporary or permanent changes. Avoidance or mitigation through appropriate design responses is preferred to preserve its intactness or conservation status.
Moderate	An impact that extends beyond the construction area to the environmental values. Although reasonably resilient to change, the groundwater system may be degraded due to the scale of the impacts or its susceptibility to further change.
Minor	A localised impact to environmental values of the groundwater system and its connected features that is short term and could be effectively mitigated through standard environmental management controls.
Negligible	Localised impact to environmental values of the groundwater system that is temporary and does not extend beyond the construction area.

2.3.4 Significance assessment

A significance assessment matrix (refer Table 2-3) demonstrates how the significance of impacts is determined by considering the sensitivity of the environmental value and the magnitude of the expected change. All impacts in this report were assessed prior to applying any controls, such as avoidance and mitigation measures.

Table 2-3: Significance assessment matrix

Magnitude of impact	Sensitivity of environmental value				
	Very high	High	Moderate	Low	Not Sensitive
Severe	Major	Major	Major	High	Moderate
Major	Major	Major	High	Moderate	Low
Moderate	High	High	Moderate	Low	Low
Minor	Moderate	Moderate	Low	Low	Very Low
Negligible	Moderate	Low	Low	Very Low	Very Low

[3] Developed from abstract and presentation by B Napier at the International Association for Impact Assessment (IAIA) Conference 2019

2.4 Quantify Impacts

2.4.1 Pipeline construction – hydrogeological assessment method

This assessment considers the change in hydrogeological conditions during pipeline construction where trenching and underboring could intersect groundwater and temporary dewatering may be required. To construct the HCM, this assessment assumes the following key parameters based on the Reference Design (GHD 2025):

- pipeline size - 450 to 1200 mm diameter
- pipeline trench width - up to 5.9 m wide; and
- pipeline trench depth - up to 2.6 m deep.

The potential therefore the transfer system to interact with groundwater (where the maximum groundwater level including seasonal fluctuations) is within 2.6 m of ground surface.

Based on the key parameters, the preliminary assessment methodology used available published sources of groundwater wells in WaterConnect (WaterConnect 2025) and historical field drilling and logging sheets from DEM (SARIG, 2025) to identify target areas:

1. Depth to groundwater was calculated along the pipeline alignment at an average of 5 km intervals by extrapolating from the nearest groundwater wells with recorded depth to aquifer. Depth to aquifer (water cut) is recorded rather than standing water level measurements due to the access of some wells into semi-confined or confined aquifers, where the standing water level reading may be above the depth to aquifer (water cut) level reading.
2. A conservative estimate of depth to groundwater was considered by applying a further 1 m to the average groundwater elevation to account for temporal /seasonal variations that are not reflected in the published data (conservative groundwater level).
3. Sections of pipeline infrastructure that will not extend below the conservative groundwater level (as defined in point 2 above) are considered to have a low likelihood of impact from construction activities.
4. Sections of pipeline infrastructure that may extend below the conservative groundwater level will be considered to have a likelihood of impact from construction activities.
5. Sections of pipeline infrastructure where vegetation and high-level mapped terrestrial GDEs along water courses suggests the presence of perched groundwater will be considered to have a likelihood of impact from construction activities.

2.4.2 Groundwater yield assessment

Where data is available in WaterConnect, yield calculations can be made to estimate the possible amount of dewatering required from construction activities, and by extrapolation, the potential for groundwater drawdown that may occur around the trenching and underboring excavations. The purpose of the calculations is to conservatively inform potential dewatering impacts from construction activities on nearby groundwater users or terrestrial GDEs.

Conservative assumptions for hydraulic properties and predicted inflow have been made from WaterConnect for the water table aquifers and perched groundwater that are likely to be encountered during construction.

A yield per day estimate has been conducted in different aquifer settings including:

- Quaternary sediments – alluvium clays, sands and gravels
- Quaternary sands – aeolian quartz rich sands with calcrete pipes

- Quaternary / Tertiary silcretes – undifferentiated silcretes of both Quaternary and Tertiary age
- Tapley Hill Formation – Siltstones of with dolomitic to calcareous gradings and limestone conglomerates
- Tent Hill Formation (Corraberra Sandstone Member and Arcoona Quartzite Member) – sandstones and blocky quartzites.
- Volcanics (Beda Basalt and Moonabie Formation) – basalt and volcaniclastic grit.

During the trenching and underboring construction for the pipeline infrastructure, groundwater gravity inflow or active dewatering of groundwater is expected where the water table aquifer is intercepted. The quantity of expected groundwater inflows can be predicted using calculations based on parallel flow during trench excavations depending on the understanding of aquifer hydraulic conductivity, transmissivity, saturated thickness and the specific yield of the aquifer.

As field hydrogeological investigations within the Study Area was not within the scope of this assessment, these properties are required to be estimated based on available literature and modelled using analytical calculations and will generally provide overestimated values of water inflow. This is primarily due to variations in aquifer anisotropy and heterogeneity and hydraulic conductivity variations. Based on the Edelman (1927) theory for parallel flow during long trench excavations, groundwater inflow during trenching and underboring construction is considered applicable based on the assumption that groundwater flows in a straight line towards the trench from both sides.

Preliminary groundwater yield estimates were considered to give a steady-state analytical solution for short-term groundwater inflow into the open excavations within the alluvium sediments. Assumptions for this theory include that the water table aquifer as a continuous porous medium, is homogeneous and isotropic, and flow is steady and laminar with continuous flow through.

Where yield estimates are high, on ground monitoring during construction can confirm potential inflow estimates and be used to design the dewatering system for managing groundwater inflow during trenching and underboring.

When considering perched groundwater, the groundwater can be considered as above, but flow is finite, and unquantifiable.

2.4.3 Groundwater bore assessment

The assessment of potential impacts on groundwater bores has been conducted by assessing the likelihood of a bore accessing the shallow aquifer and the current use of the registered groundwater bore. It is noted there may be several unregistered bores within the Study Area. These bores cannot be identified from desktop assessment and will be addressed through engagement and associated with land access agreements. The assessment involved:

- Identification of all bores within Study Area (or 1000 m of pipeline alignment).
- Screening bores to those within shallow aquifers with potential to be impacted by Project.
- Identification of environmental values assigned to the groundwater bore including current use and potential use based on the available water quality data.

Potential drawdown of the shallow aquifer from trenching and underboring has not been calculated due to insufficient recorded aquifer hydraulic property data, including transmissivity, for shallow aquifers that the pipeline would intersect within the Study Area.

2.4.4 Terrestrial GDE impact assessment

The assessment of potential groundwater impacts to terrestrial GDE's has been conducted by assessing the likelihood of sediments surrounding ephemeral water courses to maintain perched groundwater supporting

vegetation. Depending on the type of vegetation, terrestrial GDEs may be supported by a constant or episodic presence of groundwater or a combination of available surface and groundwater.

The terrestrial GDE impact assessment considers:

1. Lithological logs of groundwater wells and exploration drill holes.
2. Small areas of terrestrial vegetation within riparian corridors that may be dependent on shallow perched groundwater.
3. Areas of constant vegetation, around brackish to saline springs and seeps located along the lower reaches of many of the region's major creeks or salt lakes.
4. Sections of pipeline infrastructure where trenching or underboring will occur through vegetated areas that may be supported by groundwater.

3. Existing conditions

The following existing environment was considered in the development of the HCM.

3.1 Climate

Climate and observed weather conditions are variable along the pipeline infrastructure alignment. The environmental setting of the Project transitions from a coastal setting south of Whyalla to the arid zone of the Far North of SA, covering different climatic zones. To adequately characterise the climate in the Project Area, BOM weather stations considered representative of each environmental setting have been selected and reviewed.

The Project Area to the south within the Whyalla region typically experiences wet winters and low summer rainfall. At the BOM Whyalla (Station ID: 018120) the mean annual minimum and maximum temperatures range from 11.6°C to 23.8°C. Whyalla Aerodrome records mean annual rainfall of 262.5 mm (BOM, 2025).

The nearest coastal wind monitoring station to the alignment is at Port Augusta where morning wind direction is predominantly from the south for most of the year and from the north in winter. Afternoon winds at Port Augusta are predominately from the south but range from the south through the north-west and north in winter.

The proposed pipeline alignment follows the north-eastern side of Eyre Peninsula and then heads inland from Whyalla and north to Roxby Downs. This region is mostly semi-arid to arid and typically experiences hot dry summers and cold winters with low rainfall (refer Figure 3-1 and Figure 3-2). At BOM Roxby Downs (Station ID: 016096) the mean annual minimum and maximum temperatures range from 12.7 to 27.87°C with mean annual rainfall of 151.4 mm (BOM, 2025).

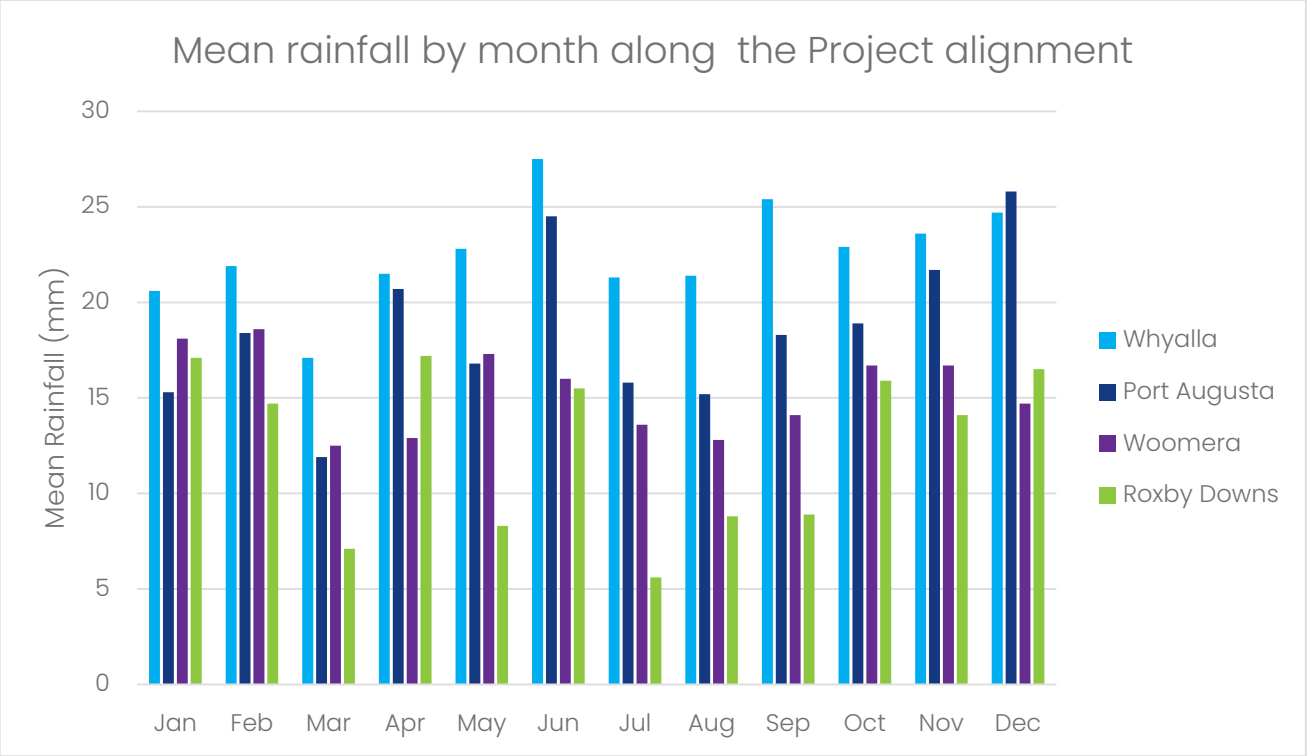


Figure 3-1: Mean rainfall along the Project alignment

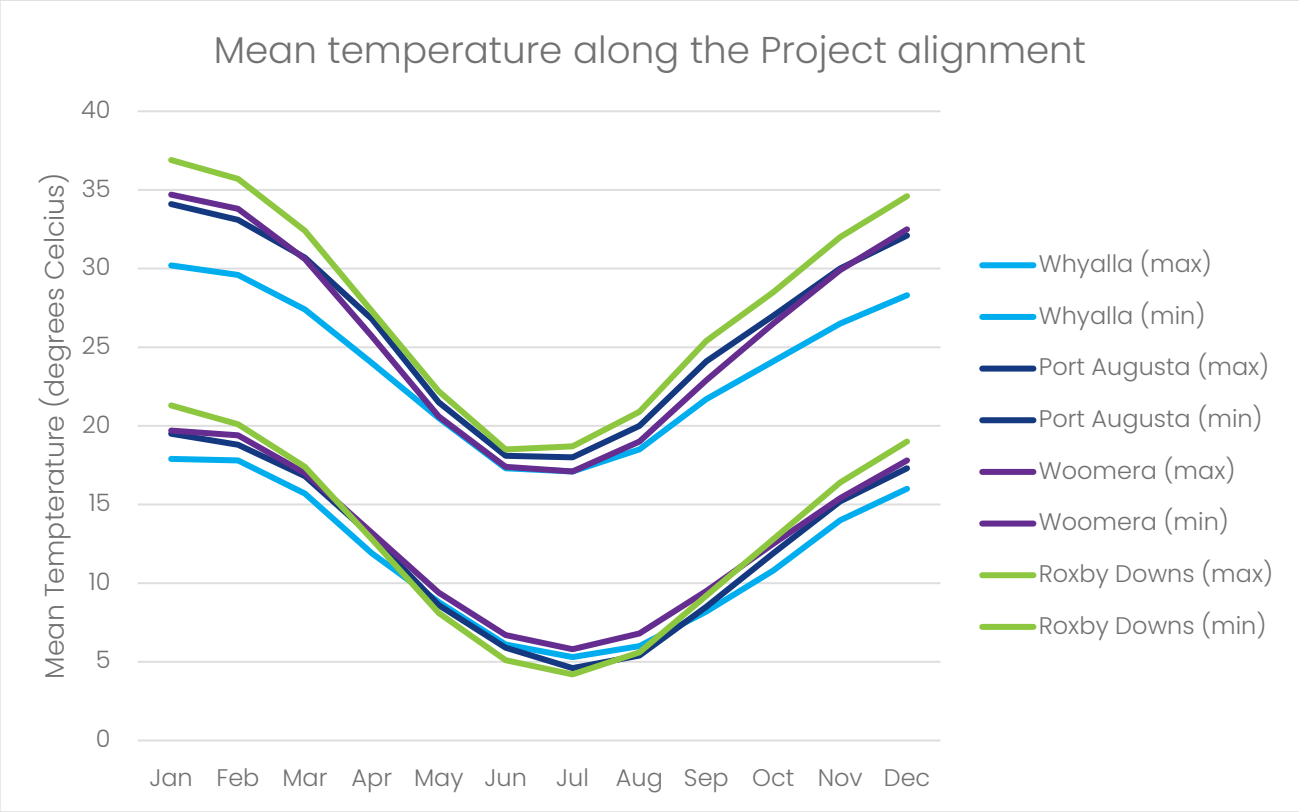


Figure 3-2: Mean Temperature along the Project alignment

3.2 Land Use

Land use can have a direct influence on the hydrogeological conditions within a groundwater catchment area. Land management activities on the land, the amount and type of vegetation cover and infrastructure development can potentially alter groundwater recharge rates, levels and flow directions, and affect groundwater quality.

In general, the land along the pipeline infrastructure alignment is primarily used for agriculture (stock grazing). Groundwater conditions beneath agricultural land are often characterised by higher rates of recharge, particularly when land has been substantially cleared for stock grazing which can, after significant rain events, raise groundwater levels and contribute to elevated nitrate concentrations commonly associated with livestock wastes. Uncontrolled stock access to waterways can also result in increased nutrients and suspended solids in surface water resources and can impact connected groundwater environments.

A number of towns and rural communities are in the region of the Study Area. While the townships have wastewater treatment plants, there may be septic systems in the vicinity of the pipeline alignment which can be sources of nitrate, ammonia, and microbiological groundwater contaminants.

3.3 Geology

Eastern Eyre Peninsula geology is characterised by Quaternary aged sediments and exposure of Tertiary aged sediments with outcropping of older Neoproterozoic, Tapley Hill Formation and volcanics and metamorphic rocks of Mesoproterozoic and Paleoproterozoic age.

3.3.1 Desalination plant site

At the Mullaquana Station desalination plant site, the surficial lithology is expressed as coastal sands of the Saint Kilda Formation and the colluvial, and alluvial / fluvial sands and clays of the Semaphore Sands member. The Semaphore Sands Member is typically an unconsolidated while bioclastic Quartz-carbonate beach sand (refer Figure 3-4).

3.3.2 Water transfer pipeline system

North of the desalination plant along the southern portion of the water transfer pipeline alignment, the sands become the more quartz rich Moornaba Sands, which are formed through aeolian deposition rather than alluvial (SKM, 2010). The sediments of the Saint Kilda Formation are generally calcareous, fossiliferous sand and clay derived from coastal and estuarine deposited sediments, which overlie the red-brown clayey sand and gravel alluvial sediments of the Pooraka Formation (Parker and Fanning, 1998). The Pooraka Formation is widespread on the alluvial plains around the Middleback Ranges to Whyalla.

The Gawler Craton forms the basement rocks around the Port Augusta – Whyalla region with the Gawler Range Volcanics dominating followed by the Donington Suite in the south-west. The Hiltaba Suite is found in the south-east with outcropping occurrences of the Corunna Conglomerate and the Moonabie Formation (Watt et al, 2012).

Coastal exposures of the granodiorite gneiss dominated Donington Suite is observed along both the Eyre and Yorke Peninsulas within the southern Gawler Craton (Reid et al 2008). The Donington Suite extends north and hosts the mineralisation of the Carrapateena mine (Oz Minerals, 2022).

With increasing aridity from Port Augusta to the Far North of SA, the depositional environments change from fluvial to aeolian sediments. Further north past Port Augusta and towards the Olympic Dam mine, the geology of the Stuart Shelf becomes relevant along the pipeline alignment with exposures of the Simmens Quartzite Member, Corraberra Sandstone Member and Tregolana Shale of the Tent Hill Formation. These quartzites sandstones and shales are expressed as near-surface or outcropping exposures. Underlying stratigraphy of the coarse-grained Whyalla Sandstone (near Mount Gunson) and the Woocalla Dolomite

Member of the Tapley Hill Formation was noted as outcropping or near-surface within the vicinity of the pipeline alignment on the western portion of the Stuart Shelf. The lower stratigraphy of the sandstones and quartzites of the Pandarra Formation outcrops along the western part of the Stuart Shelf in a north-south trending ridge (Mount Gunson, Emmie Bluff and Oak Dam West) are known as the Pernatty High (Schmid et al, 2024).

Various volcanic intrusions of the Beda Basalt, tholeiitic basalt interfingered with the Backy Point Formation are observed to be outcropping in the southern part of the Sturt Shelf, north of Whyalla (Tonkin et al 2021). The older Gawler Range Volcanics and the volcanoclastic grits and conglomerates of the Moonabie Formation are observed as outcropping exposures and near-surface expressions (near Myall Creek and Roopena, respectively) along the northern pipeline alignment (Curtis et al 2018).

A summary of surface geology along the pipeline alignment is presented in Table 3-1 and Figure 3-3.

Table 3-1: Summary of surface geology along the pipeline alignment

Geological Unit	Symbol	Origin	Description	Distribution
Quaternary	Q	Tidal flats to lacustrine in origin.	Surficial sands above outcropping of volcanoclastic grits and conglomerates of the Moonabie Formation.	Mullaquana Station to Whyalla - coastal plains of the southern area to Whyalla
Pandurra Formation	M-p	Carriewerloo Basin – Early Mesoroterozioic fluvial red bed sediments.	Mottled sandstones and red silty shales.	North of Whyalla to Lincoln Hwy
Quaternary and Tertiary	Q and T	Alluvial and colluvial sediments and Late Proterozoic (Wilpena Group)	Wilpena Group quartzites, shales and sandstones.	Lincoln Hwy to Port Augusta
Quaternary and Tertiary	Q and T	Alluvial and colluvial sediments and Late Proterozoic (Wilpena Group)	Wilpena Group quartzites, shales and sandstones.	Port Augusta to Lake Dutton
Pandurra Formation	M-p	Carriewerloo Basin – Early Mesoroterozioic fluvial red bed sediments.	Mottled sandstones and red silty shales.	Lake Dutton to Oakden Hills
Quaternary	Q	Holocene Terrestrial alluvial and aeolian desert dunes.	Calcreted calcarenite dune rises overlain by quartz sands.	Oakden Hills to Carrapateena
Quaternary	Q	Holocene Terrestrial alluvial and aeolian desert dunes.	Calcreted calcarenite dune rises overlain by quartz sands.	Oakden Hills to Lake Windabout
Tertiary Sediments	T	Late Proterozoic (Wilpena Group)	Wilpena Group quartzites, shales and sandstones and undifferentiated Cambrian, Permian, Mesozoic and Tertiary sediments.	Oakden Hills to Woomera
Tertiary Sediments	T	Tertiary aeolian sediments and Late Proterozoic (Wilpena Group)	Wilpena Group quartzites, shales and sandstones and undifferentiated Cambrian, Permian, Mesozoic and Tertiary sediments.	Woomera to Roxby Downs

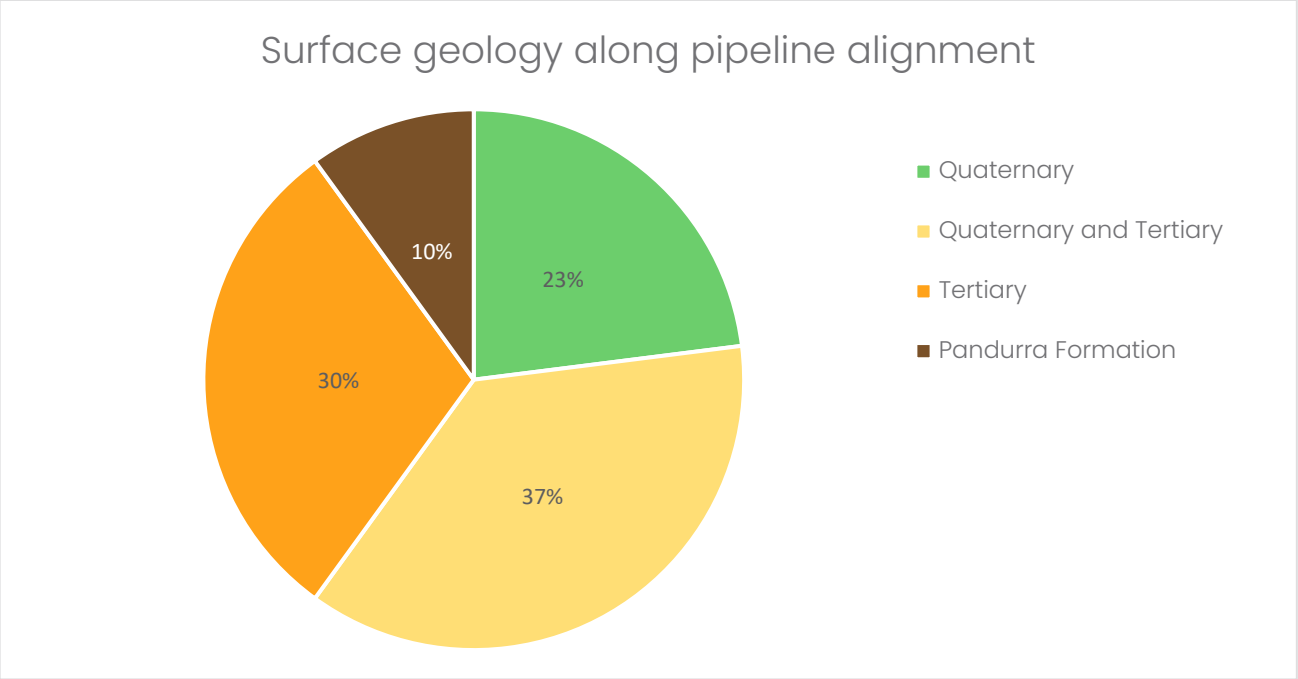


Figure 3-3: Mapped surface geology along the pipeline alignment

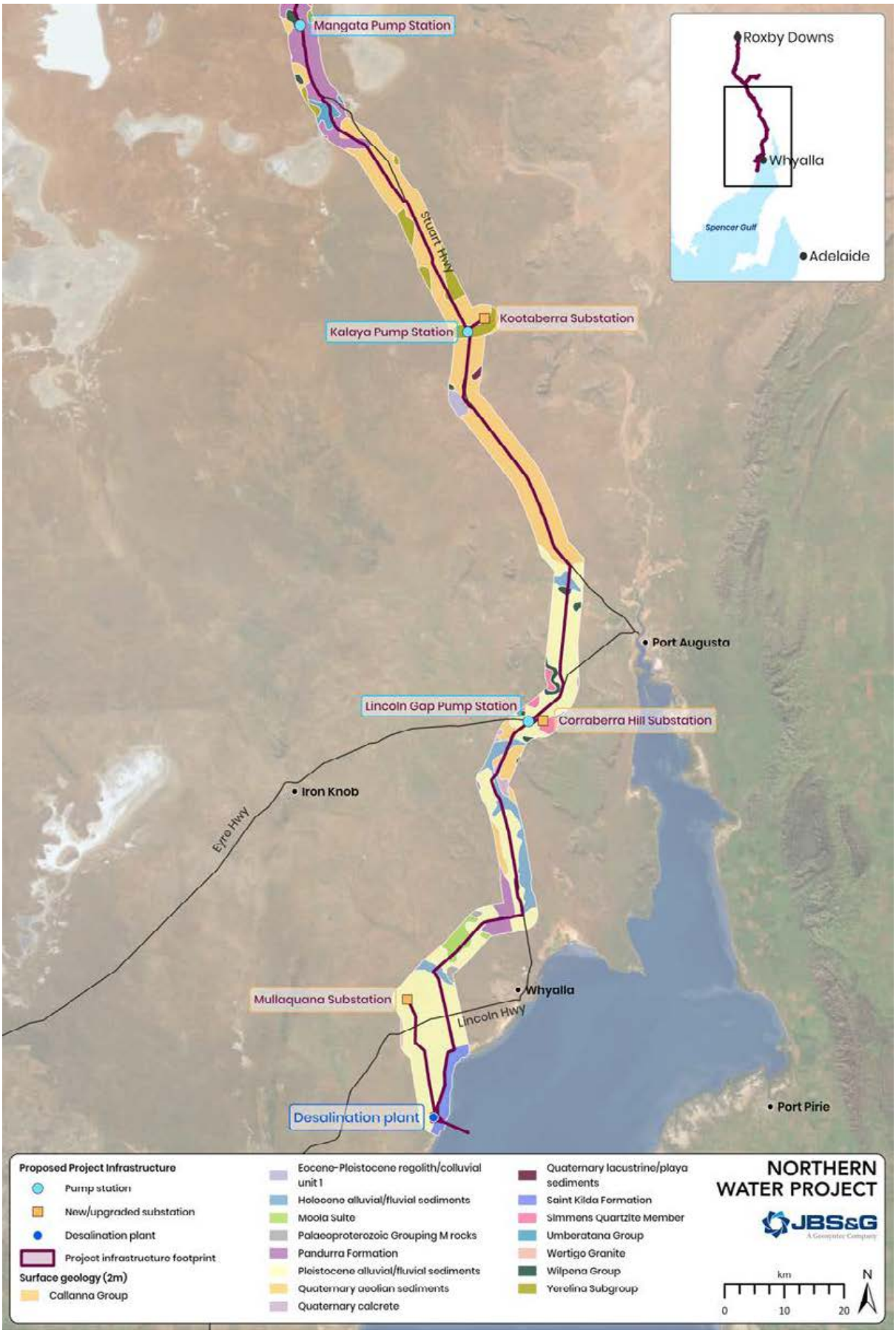


Figure 3-4: Surface geology in the Project Area - southern section

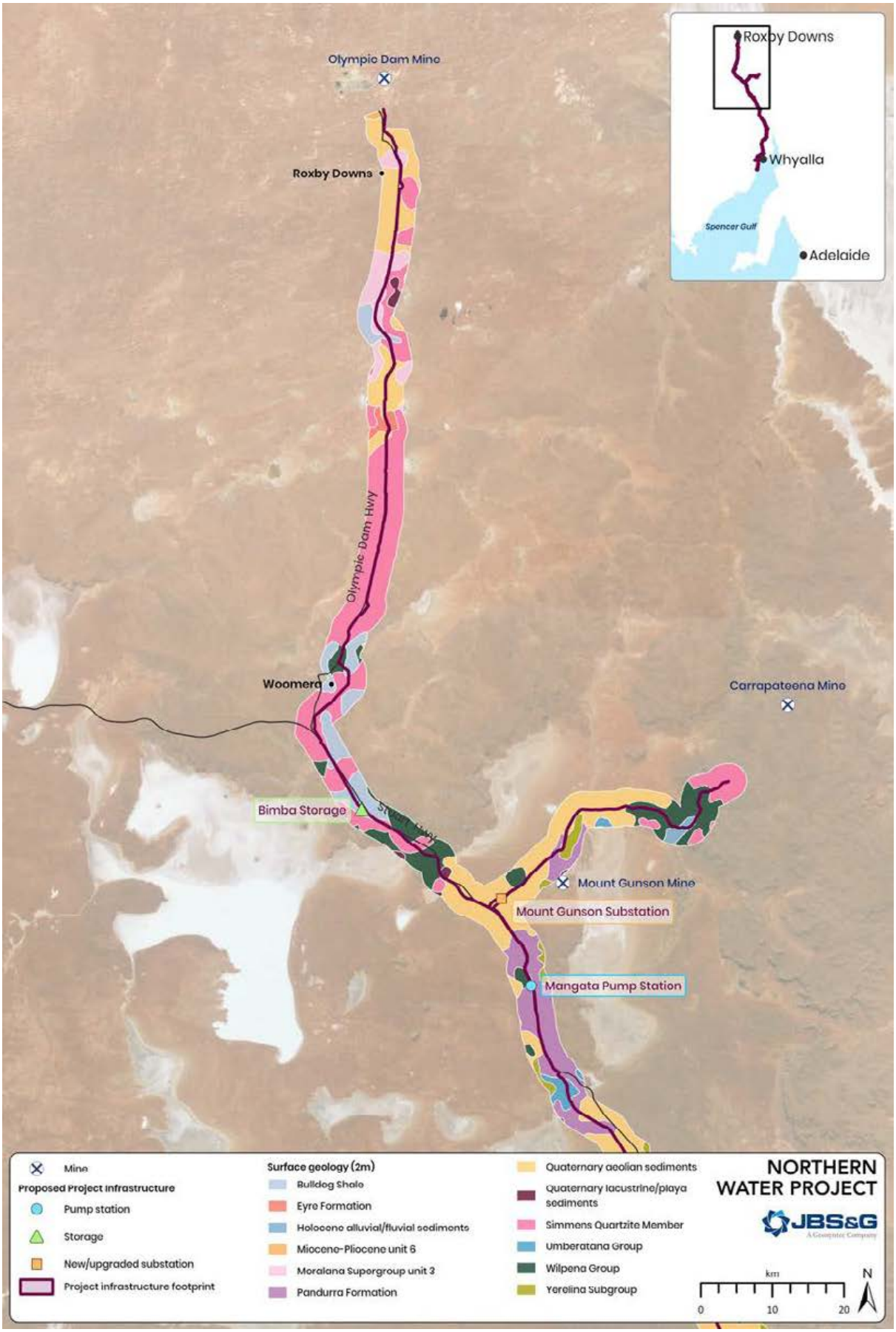


Figure 3-5: Surface geology in Project Area – northern section

3.4 Hydrology

Surface water within the Study Area is ephemeral and is broadly characterised by:

- Ephemeral creeks and rivers, which form a network of gullies and watercourses between Whyalla and Port Augusta. These networks predominantly serve as drainage lines from elevated landscapes within the area and are typically dry except during and immediately following rainfall events.
- Extensive flat plains with highly permeable sandy soils (Port Augusta to south of Pernatty Lagoon) which allow rapid infiltration of surface waters, with flooding occurring after large rainfall events.
- Well-defined drainage lines and catchments that have formed several large terminal salt lakes and ephemeral lagoons in the northern section of the proposed alignment.
- Terminal drainage in many small, enclosed catchments between dunes in the northern section of the alignment. Typically, each catchment includes bounding dunes, an interdune swale and a lower depression within the swale (often a claypan). In the northern section of the alignment, no defined watercourses are present and surface waters from the small catchments rarely flow into the neighbouring catchments.
- Arcoona Lakes wetlands, northeast of Woomera, are a network of ephemeral fresh to saline surface water bodies on the Arcoona Tableland within the vicinity of the pipeline alignment and include Lake Mary, Red Swamp, Lake Richardson and Coorlay Lagoon. The pipeline avoids Arcoona Lakes, with Lake Mary being the closest lake of the Arcoona complex to the pipeline (greater 1.5km away). The Arcoona Lakes Wetlands support a wide diversity of water birds following rainfall events (Key Biodiversity Areas Partnership 2025).

Potential interactions between surface waters and groundwater are discussed in section 3.6.

3.5 Hydrogeology

3.5.1 Regional hydrogeological setting

The Project Area covers approximately 406 km of water transfer pipeline (including the lateral branch to the Carrapateena mine) and three distinct shallow groundwater environments which roughly align with the Interim Biogeographic Regionalisation of Australia (IBRA) Sub-Regions. A description of the shallow groundwater environments is set out in Table 3-2 with locations shown in Figure 3-6 and Figure 3-7.

3.5.1 Baseline groundwater characterisation results

Groundwater yield estimates have been recorded for approximately 30% of the groundwater and mineral water wells identified as part of this study (refer Table 3-3).

3.5.1.1 Groundwater yield

Groundwater yield data collated from WaterConnect for the pipeline alignment indicates that most of the shallow watertable aquifers have very low yield of less than 0.5 L/s, with an occasional well indicating a yield of greater than 5 L/s (refer Table 3-3).

3.5.1.2 Groundwater quality

There is limited shallow groundwater quality data available along the pipeline alignment. Regional groundwater salinity mapping has been adopted to provide an indication of expected total dissolved solid (TDS) concentrations along the alignment. Groundwater salinity along the pipeline alignment is expected to approximately range from less than 500 mg/L to over 50,000 mg/L. The lower TDS concentrations in groundwater generally coincides with the occurrence of the Upper Tertiary/Quaternary aquifer (refer Table 3-3).

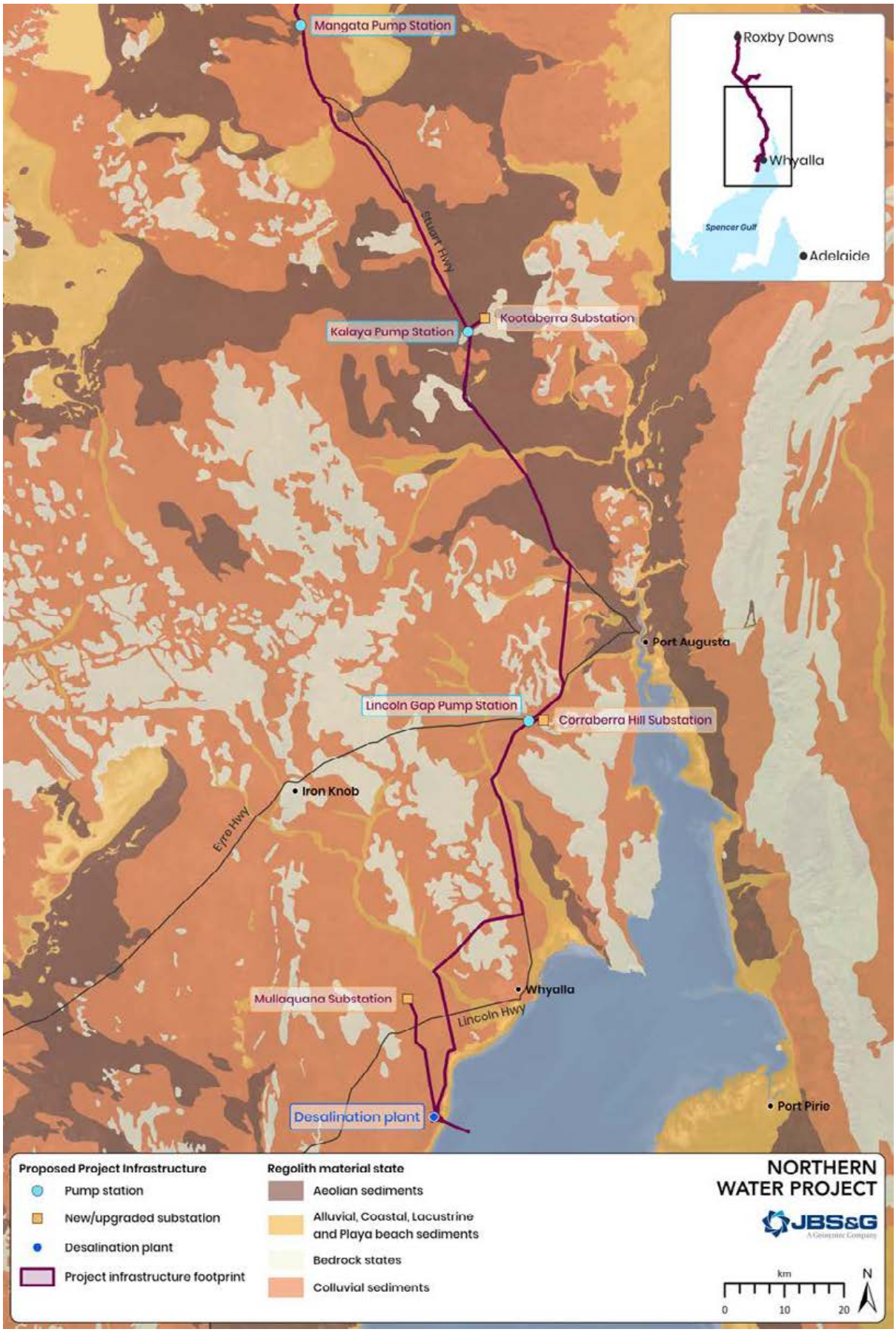


Figure 3-6: Shallow groundwater environments in Project Area – southern section

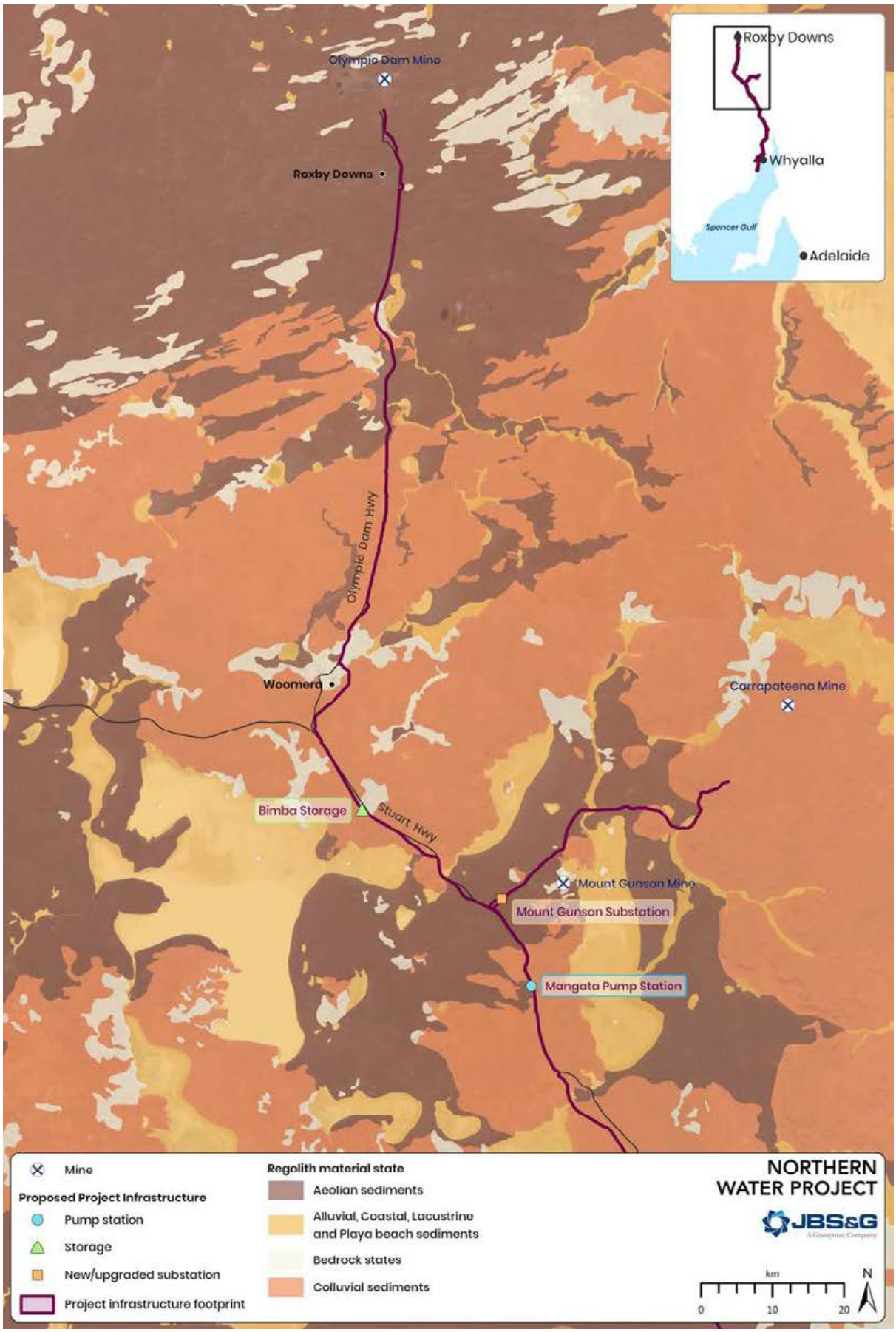
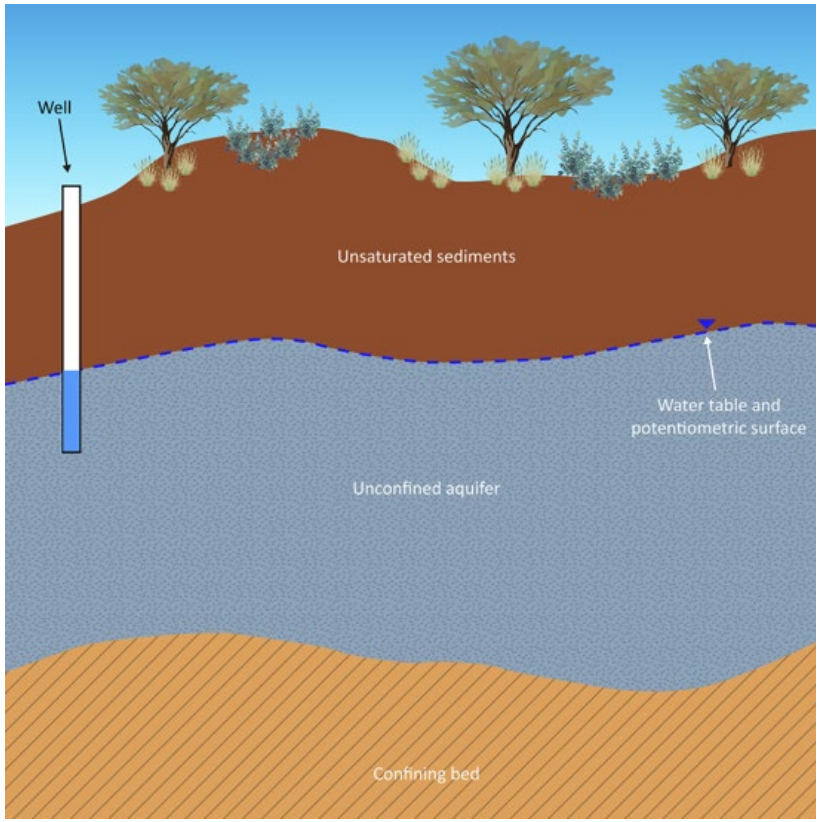
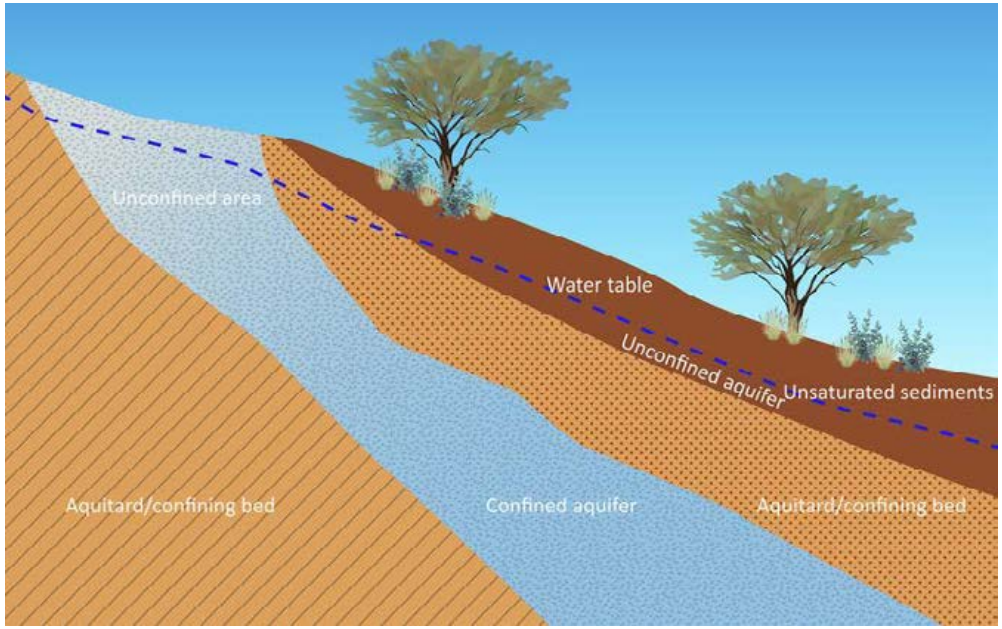
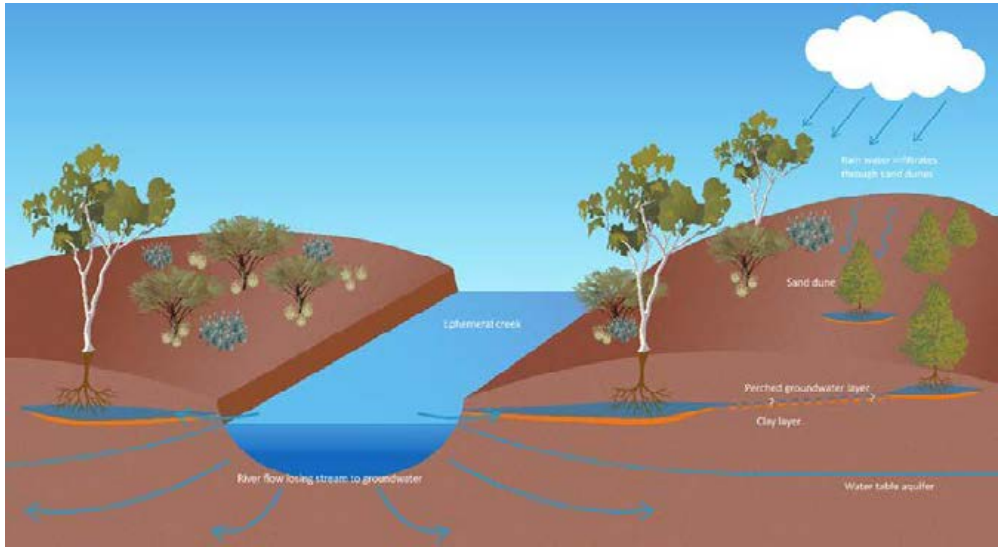


Figure 3-7: Shallow groundwater environments (Project footprint – northern section)

Table 3-2 Description of shallow groundwater environments

IBRA Region (Location)	Shallow sediments	Characterisation of shallow groundwater environment	Conceptualisation
Myall Plains (Mullaquana Station to Lincoln Gap)	Colluvial sediments (those deposited from sheet flow down a hillside). There is some outcropping of bedrock near the Study Area, however, the alignment avoids these areas.	**Shallow groundwater table** Shallow groundwater is generally held within undifferentiated quaternary & tertiary sediments. Water quality is generally lower salinity compared with elsewhere on the pipeline and where present yields are generally low. Some groundwater in this area is suitable for domestic and stock water supply. Ephemeral drainage lines are common through the Study Area carrying run off from the hills to the west. Where the groundwater is close to the drainage lines, terrestrial GDEs are found (e.g. Lake Dempsey).	

IBRA Region (Location)	Shallow sediments	Characterisation of shallow groundwater environment	Conceptualisation
Gawler Lakes / Arcoona Plateau (Lincoln Gap to Lake Mary / Red Swamp)	Transported sediments with outcropping of bedrock.	**<u>Surface expression of deeper aquifers</u>** Groundwater is generally held in the larger aquifers (e.g. Tent Hill Aquifer) with overlying aquitards (e.g. Arcoona Quartzite Aquitard). Shallow groundwater expression of generally confined aquifers is a combination of outcropping of aquifer hosting geological formations (e.g. Corraberra Sandstone of the Tent Hill Formation) and an absence of confining beds, which have the potential to express near Lake Windabout and within the Arcoona Lakes Wetlands (noting that the pipeline avoids Lake Windabout and Lake Mary (the closest lake of the Arcoona complex to the pipeline)). Groundwater quality from surface expressions of deeper aquifers is generally more saline with a higher yield.	

IBRA Region (Location)	Shallow sediments	Characterisation of shallow groundwater environment	Conceptualisation
Myall Plains (South of Port Augusta) and Gawler Lakes (The Elizabeth Creek and Yeltacowie Creek)	Braided ephemeral riverbeds with a surface water connection to riverbank sediments.	**<u>Perched aquifers</u>** Within the unconsolidated sediments of creek beds and riparian zones, lenses of water can be captured and retained by clay material acting as localised confining beds. Known as perched groundwater or aquifers, these areas capture the seepage of rainwater through the overlying unsaturated sediment. These aquifers can support terrestrial GDEs by providing an ongoing water source for longer periods following rainfalls. The water in these perched aquifers is generally of low salinity, but with limited specific yield. Historically these aquifers have been accessed by shallow pastoral wells for domestic and stock watering demands.	

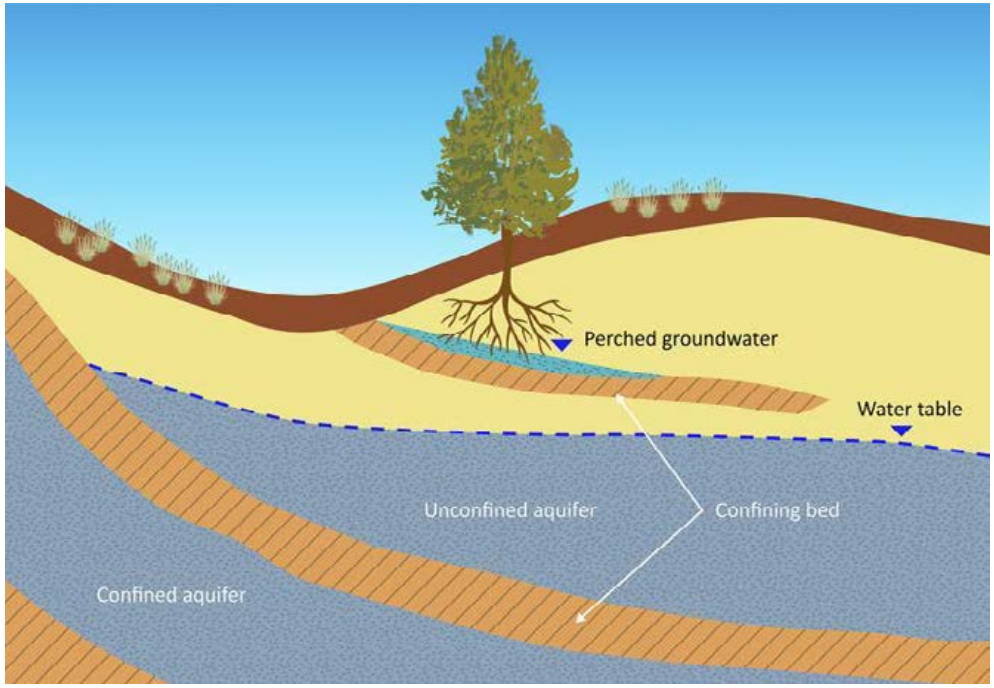
IBRA Region (Location)	Shallow sediments	Characterisation of shallow groundwater environment	Conceptualisation
Roxby Region (Lake Mary / Red Swamp to Olympic Dam)	Aeolian sediments (sand dunes frequently underlain with clay beds and inter-swale locations).	**Sand dunes** Sand dunes will drain rapidly, but if underlain by a confining clay material, can capture and store small volumes of water. This water can be retained similarly to a perched aquifer. Like a perched aquifer this groundwater, which is generally of low salinity, can support vegetation by providing a water source for a longer period of time following rainfall events. However, like perched aquifers has a limited specific yield.	

Table 3-3: Hydrostratigraphic units (HSU) and existing groundwater data

HSU	Lithological description[4]	Location	IBRA Sub-region	Groundwater well purpose	Recorded yield (KL/d)	Salinity (TDS) mg/L
Quaternary Sediments	Pooraka Formation – red brown gravels, sand and clay with soft powdery carbonate of the Loveday Soil with soil mantles, including gypsiferous soils with a soft platy and nodular carbonate horizon.	Mullaquana	Myall Plains	Investigation	2.5 up to 4.5	52,000
		Myall Creek	Myall Plains	Investigation	43	22,500
		Lake Dempsey	Arcoona Plateau	Stock	2.5	3,000
	Quaternary Sand dunes and clay pans – red-brown to cream clayey sand of aeolian origin, unconsolidated and porous.	Lake Dutton	Arcoona Plateau	Stock and domestic	3 up to 130	2,000 to 3,500
		Mt Gunson/Oakden Hills	Gawler Lakes	Stock and domestic	0.8 up to 28	500
Tertiary Sediments	Sandy white clays and white clays	Kells Swamp	Kingoonya	Investigation	-	15,000
Coorikiana Sandstone / Bulldog Shale	Predominately carbonaceous, clayey, fine-grained sandstone and siltstone grading to light green to grey-brown silty shale bioturbated, fossiliferous and shaly; minor silt to very fine-grained sandstone intervals.	Woomera – Wirrawirralu Creek and Phillip Ponds	Arcoona Plateau	Investigation	3	3,000
Tent Hill Aquifer • Arcoona Quartzite / Corraberra Sandstone / Woomera Shale transition zone	• Arcoona Quartzite – fine to coarse grained quartzite with shale interbeds. • Corraberra Sandstone – fine to medium grained micaceous sandstone with interbedded shale and siltstone. • Woomera Shale – laminated shale comprising detrital quartz and dolomite of the Nuccaleena Formation.	Woomera –Wirra wirralu Creek and Phillip Ponds	Arcoona Plateau	Investigation	600	16,000
		Lake Windabout	Arcoona Plateau	Investigation	11 up to 190	8,500 to 30,000
		Kells Swamp	Kingoonya	Investigation	-	22,000
		Yeltacowie	Gawler Lakes	Stock	130 up to 1080	4,000 to 16,000

[4] SARIG

HSU	Lithological description[4]	Location	IBRA Sub-region	Groundwater well purpose	Recorded yield (KL/d)	Salinity (TDS) mg/L
Tapley Hill Formation	Siltstone, grey to black, dolomitic and pyritic grading upwards to calcareous, thinly laminated, locally cross-bedded; dolomite, grey, flaggy to massive; limestone conglomerate, intraformational; greywacke.	Lake Dutton	Arcoona Plateau	Industrial	520	120,000
		Myall Creek	Myall Plains	Investigation	43	23,000
Crystalline Basement, including Breccia Complex	Moonabie Formation – Breccia and mafic dykes and granite units.	Salt Creek	Myall Plains	Stock	43	6,500

3.5.1.3 Groundwater levels and flow directions

The interpretation of groundwater levels and flow directions within the eastern EP and the SAAL LMRs can be complex when considering the multiple aquifers present throughout the groundwater Study Area. Groundwater well data has been collated along the pipeline alignment, hydraulic head data has been plotted and interpolated using ArcGIS to produce a potentiometric surface from the well data points. The potentiometric surface identified from the well data represents the groundwater within various hydrostratigraphical units, including unconsolidated sediments, karstic limestone, sandstones, igneous and metasedimentary units. The purpose of creating potentiometric surfaces within ArcGIS is to provide a preliminary composite overview of groundwater levels and hydraulic gradients for the region.

This HCM and groundwater impact assessment, which considers only the near-surface environment, focuses on the continuous, unconfined water table aquifer and perched groundwater.

Groundwater levels have been assessed along the pipeline alignment from publicly available groundwater wells and exploration drill holes. The water table groundwater level is expected to follow the ground surface topography, with rainfall infiltration recharging across the region and migrating from high elevation to low elevation, discharging to the coast, lagoons, lakes and playas.

Groundwater to surface water interactions occur when water moves or flows from groundwater to surface water or vice versa. These flow dynamics can change or be absent in the various surface water catchments along the pipeline alignment and can also vary in magnitude or reverse over time.

Groundwater is rarely in isolation from surface water, with recharge and discharge of groundwater occurring from and to sustaining, intermittent and ephemeral waterways. In the context of the Study Area this includes rivers, creeks, bogs, swamps and temporary land flow following periods of rainfall which can therefore be groundwater interactive for part of or during extended periods of the year, depending on these rainfall events. The sustaining or intermittent interaction of surface and groundwater can give rise to groundwater dependent ecosystems with varying ecological water requirements (Ponce et al, 2024).

Shallow creek bank and perched aquifers (shallow alluvial) in arid areas form localised forms of saturation above the main water table aquifer. These areas are generally associated with sand clay, where bank storage is available and an impermeable clay layer impedes the downward movement of the water into the underlying aquifer (Wilson et al 2024). Perched groundwater is likely to occur along the pipeline alignment where ephemeral streams can create perched aquifers through infiltration of streamflow into the stream bed (Villeneuve et al, 2015), or within dune-swale landscapes where rainwater seepage is retained at the base of sand dune rises. The Tregolana Shale Member of the Tent Hill Formation occurs extensively in the subsurface beneath Myall Creek (McAvaney et al, 2016). Clay or shale base to creek lines can provide a suitable impermeable base for perched water capture within the overlying colluvial creek bank sediments.

Local catchment scale flow systems exist around minor creeks and wetlands which direct rainfall to recharge laterally shallow perched aquifers. Where these perched systems are not reported specifically within the pipeline alignment Study Area, they are considered as possibly present.

Within the area of the proposed desalination plant and commencement of the pipeline alignment, tidal influences extend onshore into the freshwater aquifer system. This natural tidal influence decreases with distance from the coast, creating a fresh water – saline water dispersion zone, which typically extends onshore into the freshwater aquifer. The spring tidal range in the Upper Spencer Gulf is approximately 2.7 m (BMT WBM, 2011).

At Mullaquana Station, the Study Area may present similar interactions between groundwater and the marine environment where aquifers are connected in the coastal zone. At low tide, the water table within the surrounding groundwater system may be higher than the coastal waters and groundwater will discharge into the marine environment of the Spencer Gulf. At high tides, the marine water level may be higher than the onshore groundwater level, resulting in reversal of hydraulic gradients and the recharge of saline water back into the groundwater system (Barnett, 2022).

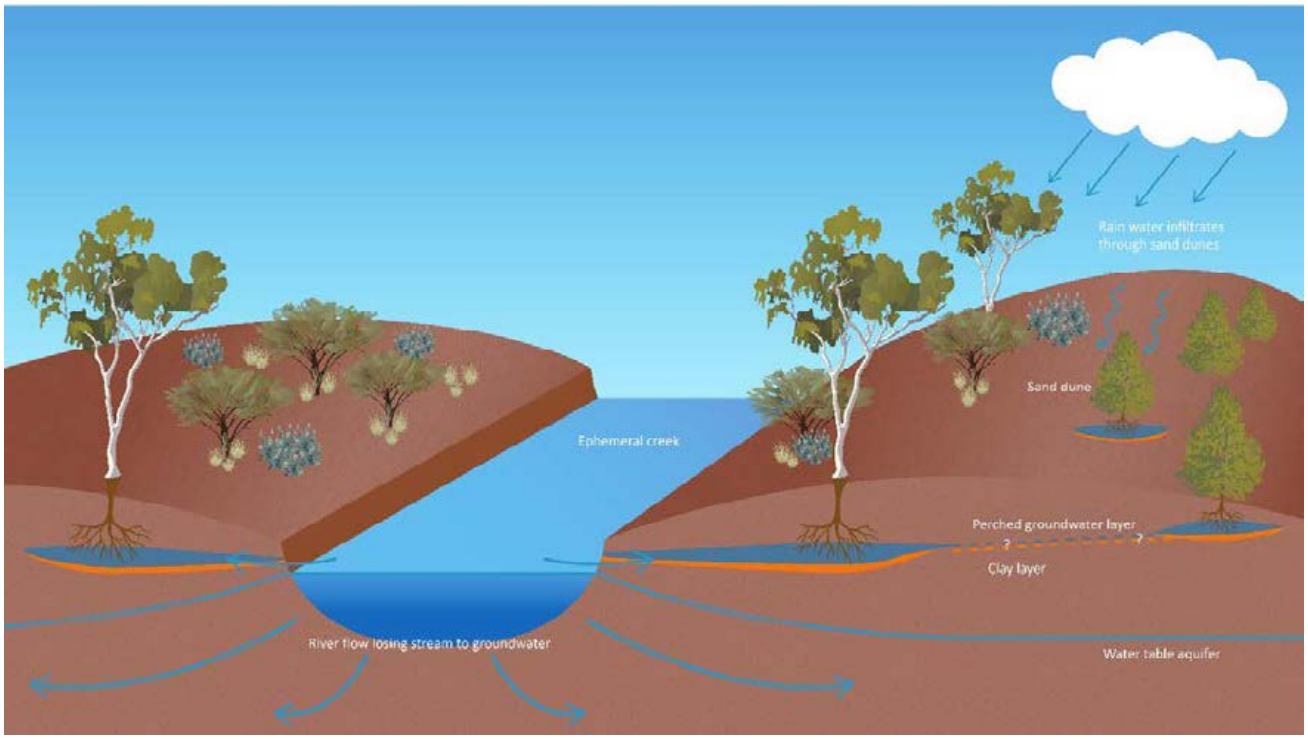


Figure 3-8: Conceptual model perched aquifer

Within the Carrapateena area, shallow creek bank and perched aquifers have been identified within the sediments along ephemeral creeks and comprise Quaternary alluvium of clays, gravels and sand (Watt et al, 2012). These aquifers are rainfall recharged during intense rainfall events followed by a more sustained losing stream discharge back into the stream systems. Shallow aquifer discharge between rainfall events enabling the development and continued support for groundwater dependent ecosystems, which in some cases include larger vegetation (Currie et al, 2023). Groundwater abstracted from the alluvial aquifers is a continuing supplementary source of water for pastoral station stock watering.

3.6 Groundwater Bores

Groundwater well information has been sourced from WaterConnect and SARIG to determine the details of the water table aquifers that exist along the alignment.

Table 3-4 outlines the registered groundwater bores identified generally within 5 km of alignment with any available details of aquifer depth, HSU, water quality and yield.

The bore locations referred to in Table 3-4 are shown in Figure 3-9 and Figure 3-10.

Table 3-4: Registered groundwater wells generally within 5 km of alignment

Location	Well ID	HSU[5]	Well depth (m bgl)	Water cut (m bgl)	Standing Water Level (m bgl)	Yield (l/s)	Salinity µg/L	Metres (m) from alignment
Mullaquana Station	6331-561	TpQa[6]	16	7	7	0.03	not recorded	380
Mullaquana Station	6331-563	TpQa	18	7	7	0.05	not recorded	330
Mullaquana Station	6331-617	TpQa	13	7	10	not recorded	52,500	2,000
Salt Creek	6331-383	Ymm[7]	30	12	14	0.5	6,579	230
Salt Creek	6332-56	Qa[8]	67	12	15	not recorded	not recorded	130
Myall Creek	6432-21	Qrn/Nnt[9]	143	2	6	0.5	22,593	270
Myall Creek	6432-38	TpQa	114	5	5	not recorded	not recorded	170
Lincoln Gap	6432-990	Qpap[10]	60	7	7	not recorded	not recorded	740
Lake Dempsey	6433-31	Qpap	3	2	2	0.13	3,886	7,310
Kells Swamp	6333-82	Nst[11]	15	3	3	not recorded	22,085	2,480
Kells Swamp	6333-86	TpQa	14	5	5	not recorded	15,000	2,480
Kells Swamp	6333-96	TpQa	10	5	8	not recorded	15,000	2,480
Lake Windabout	6235-70	Nst	226	10	10	2.2	27,584	460
Lake Windabout	6335-25	Nst	15	12	12	0.13	8,576	15,470

[5] Hydrostratigraphic definitions sourced from Department for Energy and Mines (DEM), SA Resource Information Gateway (SARIG) and WaterConnect
[6] TpQa – Undifferentiated Quaternary and Tertiary; silts, clays and sands
[7] Ymm – Moonabie Formation; volcaniclastic grit and pebbles
[8] Qa – Quaternary alluvial/fluvial sediments; gravels, sands and clays
[9] Nnt – Tapley Hill Formation; siltstone, dolomitic and pyritic grading upwards to calcareous, thinly laminated; dolomite; limestone conglomerate; greywacke
[10] Qpap – Pooraka Formation
[11] Nst – Tent Hill Formation

Location	Well ID	HSU[5]	Well depth (m bgl)	Water cut (m bgl)	Standing Water Level (m bgl)	Yield (l/s)	Salinity µg/L	Metres (m) from alignment
Phillips Ponds	6235-30	Kmc[12]	4	0.6	0.6	0.03	3,066	120
Phillips Ponds	6235-31	Kmc	10	0.6	0.6	0.03	3,066	50
Phillips Ponds	6235-71	Nst	40	6	4	7	16,509	300
Lake Dutton	6334-6	Qe[13]	7.6	4.57	4.57	0.03	not recorded	4,600
Lake Dutton	6334-27	Qe	77	10	5	0.07	not recorded	30
Lake Dutton	6334-25	Qe	12	10	10	0.42	3,361	780
Lake Dutton	6334-51	Nnt	57	8	8	6	116,016	620
Lake Dutton	6334-233	Qe	22.5	16	8	0.75	3,528	740
Lake Dutton	6334-318	Qe	23	13	8.9	1	1,957	950
Lake Dutton	6334-379	Qe	18	12	12	1.5	2,328	980
Lake Dutton	6334-380	Qe	20	10	8	0.75	2,700	980
Old Oakden Hills	6335-37	Qe	18	5	7	0.32	409	2,390
Mt Gunson	6335-35	Qe	11	10	10	0.01		610
Yeltacowie	6335-31	Nst	9	9	9	not recorded	16,393	1,090
Yeltacowie	6335-34	Nst	18	12	12	not recorded	7,026	5,540
Yeltacowie	6335-506	Nst	21	5	6	1.5	4,332	1,130
Yeltacowie	6335-554	Nst	70	7	5	12.5	not recorded	50

[12] Kmc – Bulldog Shale (unconfined); fossiliferous and shaly mudstone, minor silt to very fine-grained sandstone intervals.
[13] Qe – Quaternary aeolian sediments

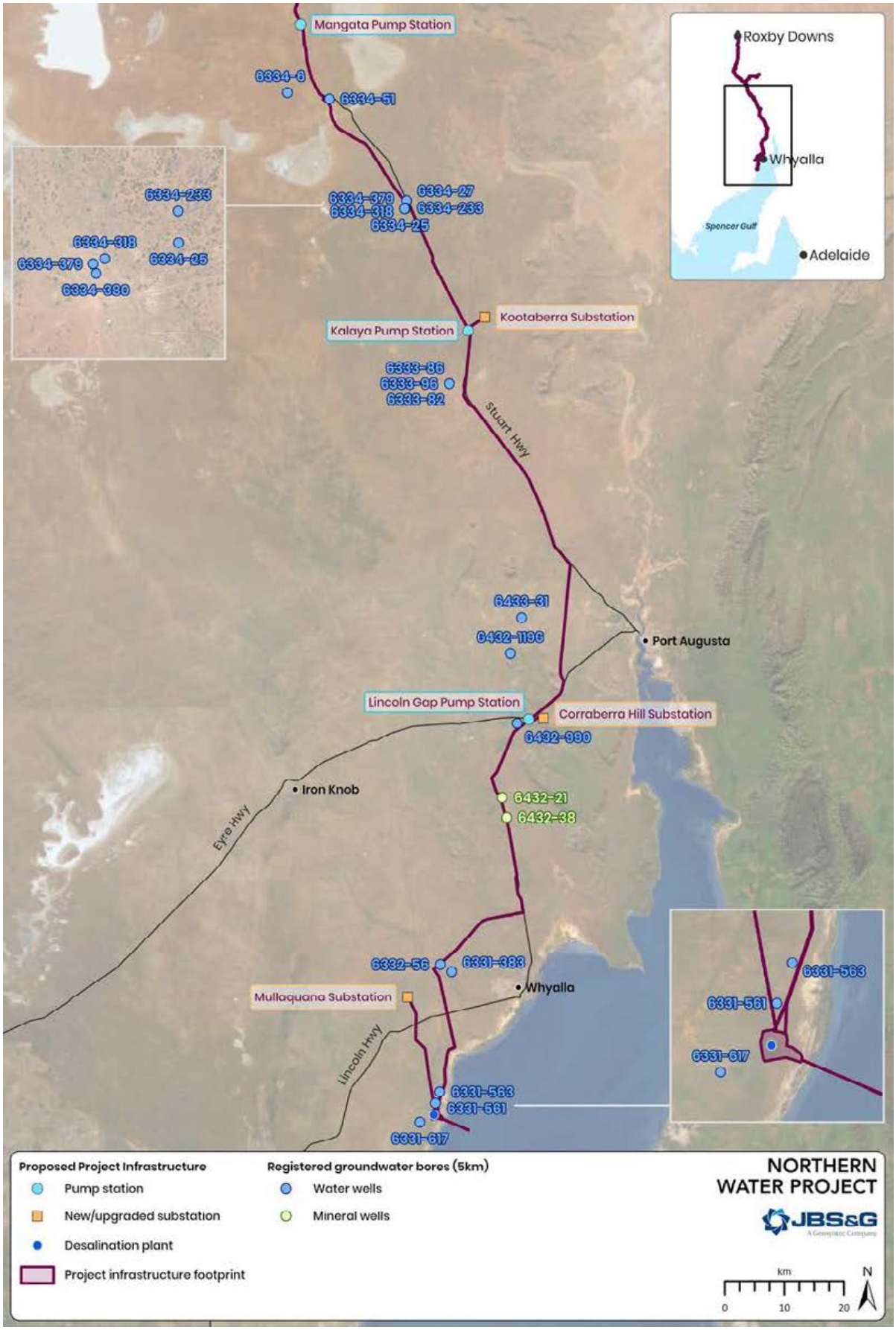


Figure 3-9: Groundwater wells within 5 km of the pipeline alignment - southern section



Figure 3-10: Groundwater wells within 5 km of the pipeline alignment - northern section

3.7 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems rely wholly or partially on groundwater for their water needs and in the context of this HCM and groundwater impact assessment are:

- Terrestrial GDEs – ecosystems that rely on the sub-surface presence of groundwater, including all vegetation ecosystems (also referred to as groundwater dependent vegetation
- Aquatic GDEs – ecosystems that rely on the surface expression of groundwater, including surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs (can also describe marine ecosystems dependent on submarine groundwater discharge), and
- Subterranean GDEs – ecosystems within caves and the saturated aquifer matrix, such as stygofauna and troglofauna (BOM, 2025a).

The BOM GDE Atlas was accessed (BOM 2025a) to identify the range of landscapes within and around the Study Area (within 500m of the pipeline alignment) that may potentially contain terrestrial GDEs for some or all their water requirements. The desktop assessment did not identify aquatic or subterranean GDEs in the Study Area.

3.7.1 Terrestrial GDEs

The identification of terrestrial GDEs requires understanding of landscape setting, remote sensing data, vegetation type, and likely interactions with groundwater. Conservative assumptions based on the above can give an estimation of the potential presence of terrestrial GDEs and whether further investigation is required.

The pipeline alignment crosses large areas of pastoral land comprised of native vegetation that has been subjected to low intensity grazing. Larger and denser areas of vegetation is typically found around road reserves and property boundaries, along ephemeral creek or drainage lines. Isolated pockets of Eucalyptus mallee forest and Casuarina woodland are present in low-lying areas, corresponding to areas of high likelihood of terrestrial GDEs, which rely on water table, groundwater and perched groundwater to meet some or all their water needs (Doody et al, 2014).

The mapped occurrences of likely terrestrial GDEs are presented in Figure 3-11 and Figure 3-12.

The coincidence of likely terrestrial GDEs and areas where construction activities are likely to require dewatering (i.e. where depth to groundwater is potentially within 5 m of ground surface) is further discussed in section 5.3.1.

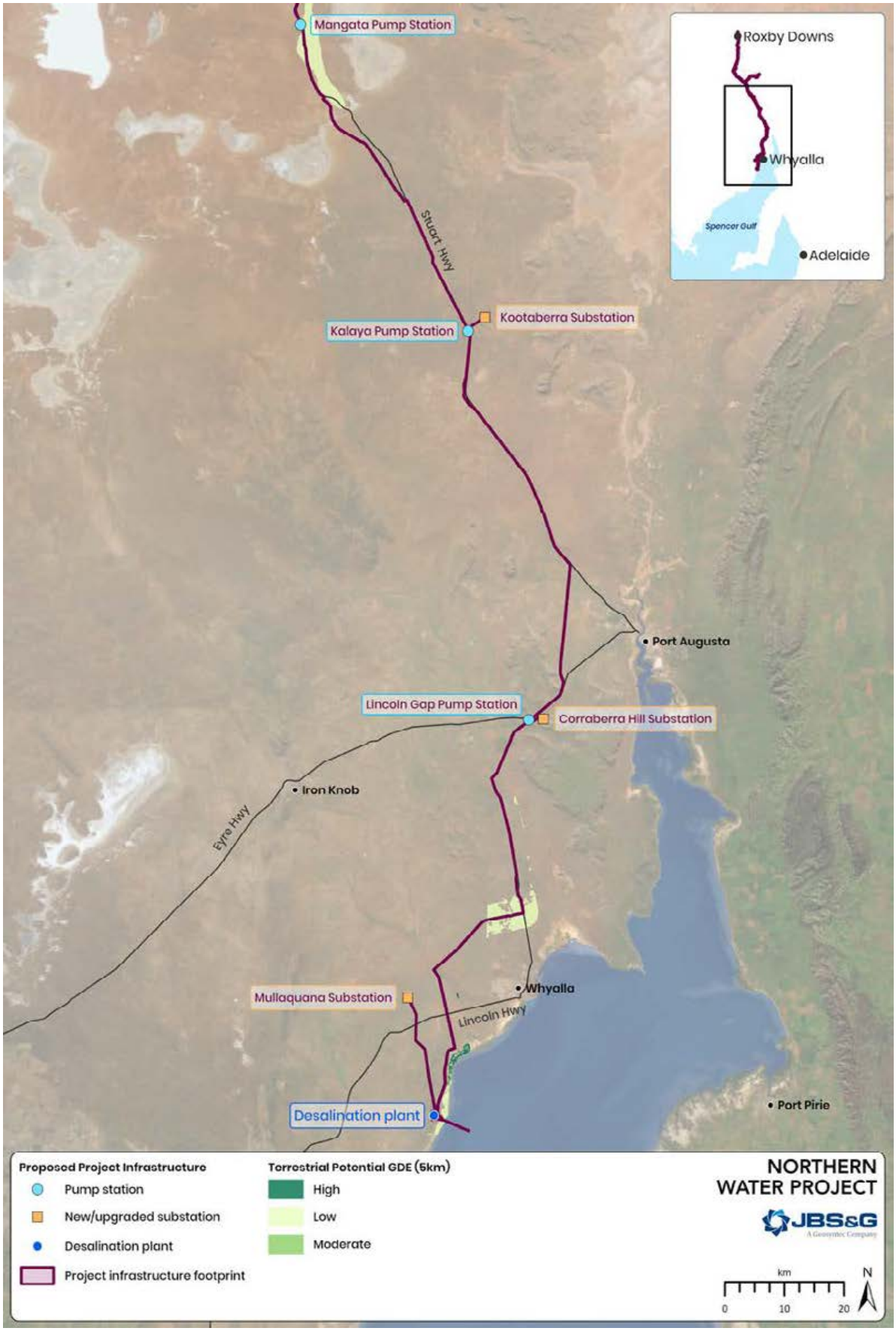


Figure 3-11: Likely Terrestrial GDEs – southern section
[Source: BOM 2025]

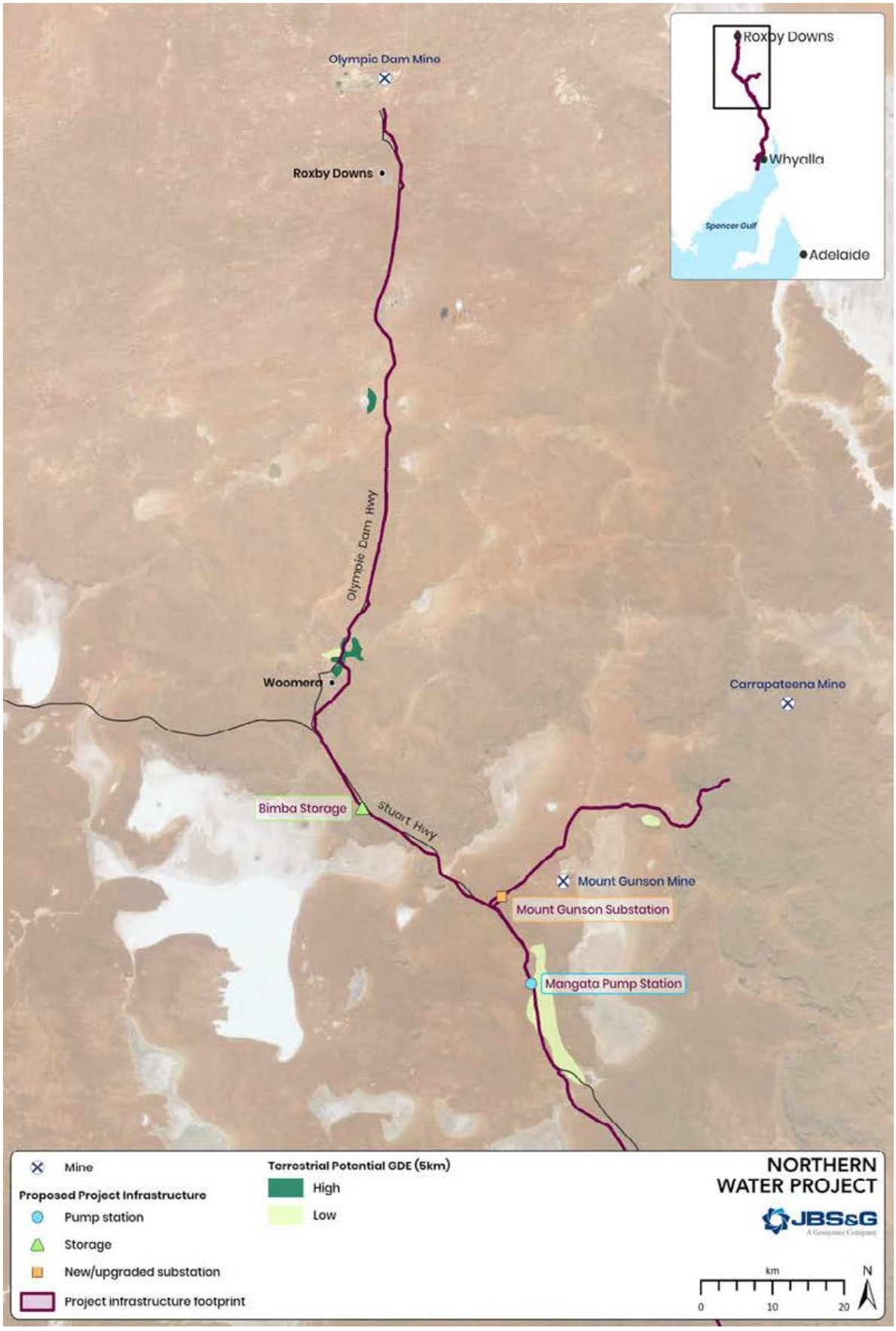


Figure 3-12: Likely Terrestrial GDEs – northern section
[Source: BOM 2025]

4. Qualitative Groundwater Impact Assessment

This section provides a summary of the groundwater impacts based on the HCM to determine potential impacts to groundwater and groundwater users (including terrestrial GDEs) due to groundwater dewatering via trenching or underboring during construction. Where there will be differences between how the shallow groundwater environments will react (refer to Table 3-2), these impacts are discussed separately.

4.1 Project Dewatering Requirements

The purpose of this section is to identify the potential for Project construction activities to extend either below the water table or within a perched groundwater area and which may therefore require temporary dewatering. This has been assessed for the purpose of the impact assessment by applying the assessment method outlined in section 2.3.2.

The results of the assessment identified six main sections of the pipeline alignment where dewatering is predicted to be required. These sections may include several hundred metres of alignment that are likely to extend below the water table aquifer.

The Mullaquana Station location for the desalination plant is a nearshore area where groundwater levels are shallow. Dewatering at the desalination plant site is addressed in a separate EIS technical study.

The following six sections correspond to areas where the pipeline alignment crosses the alluvial aquifers (shallow water table aquifers) that exist around surface drainage lines and creek tributaries.

- Lake Dempsey tributaries (KP 96 - KP 106)
- Carriewerloo (KP 129-KP 130) - Illeroo Creek
- Kells Swamp – Kells Camp Reservoir (KP 146-150) - Kells Swamp tributaries (Hesso)
- Lake Dutton (KP 195 – KP 200) - Black Oak Creek
- East of Red Lake (2km east of KP 276 - KP 277) Wirrawirralu Creek and Phillip Ponds
- Pernatty Lagoon (KPCA 34 – KPCA 39) - Yeltacowie Creek

Additional eleven (11) areas exist where intermittent, short sections of the pipeline alignment may need dewatering where the alignment crosses creek beds, sand dunes and drainage lines where typically Quaternary and Tertiary sands accommodate and retain streamflow and rainfall capture. These areas include:

- Salt Creek (KP 26)
- Myall Creek (KP 64)
- Lincoln Gap pump station (KP 78 – KP 81) - Lincoln Gap Creek
- Carriewerloo Station (KP 111) - Braided stream tributaries
- Kootaberra Dam (KP 153) Kootaberra drainage lines - Range View Rest Area
- Lake Windabout (KP 235 – KP 240) - Mason Creek
- West of Lake Richardson (KP 290) - Saunders Creek
- West of Lake Mary (KP 315) - Lake Mary drainage lines
- West of Coorlay Lagoon (KP 330) - Coorlay Lagoon drainage lines
- North of Pernatty Lagoon (KPCA 21) - The Elizabeth Creek
- East of Pernatty Lagoon (KPCA 31 – KPCA 33) - Bonney Bluff drainage lines

Management of extracted groundwater from dewatering activities will be required to minimise potential impacts to the environment as a result of discharge of groundwater.

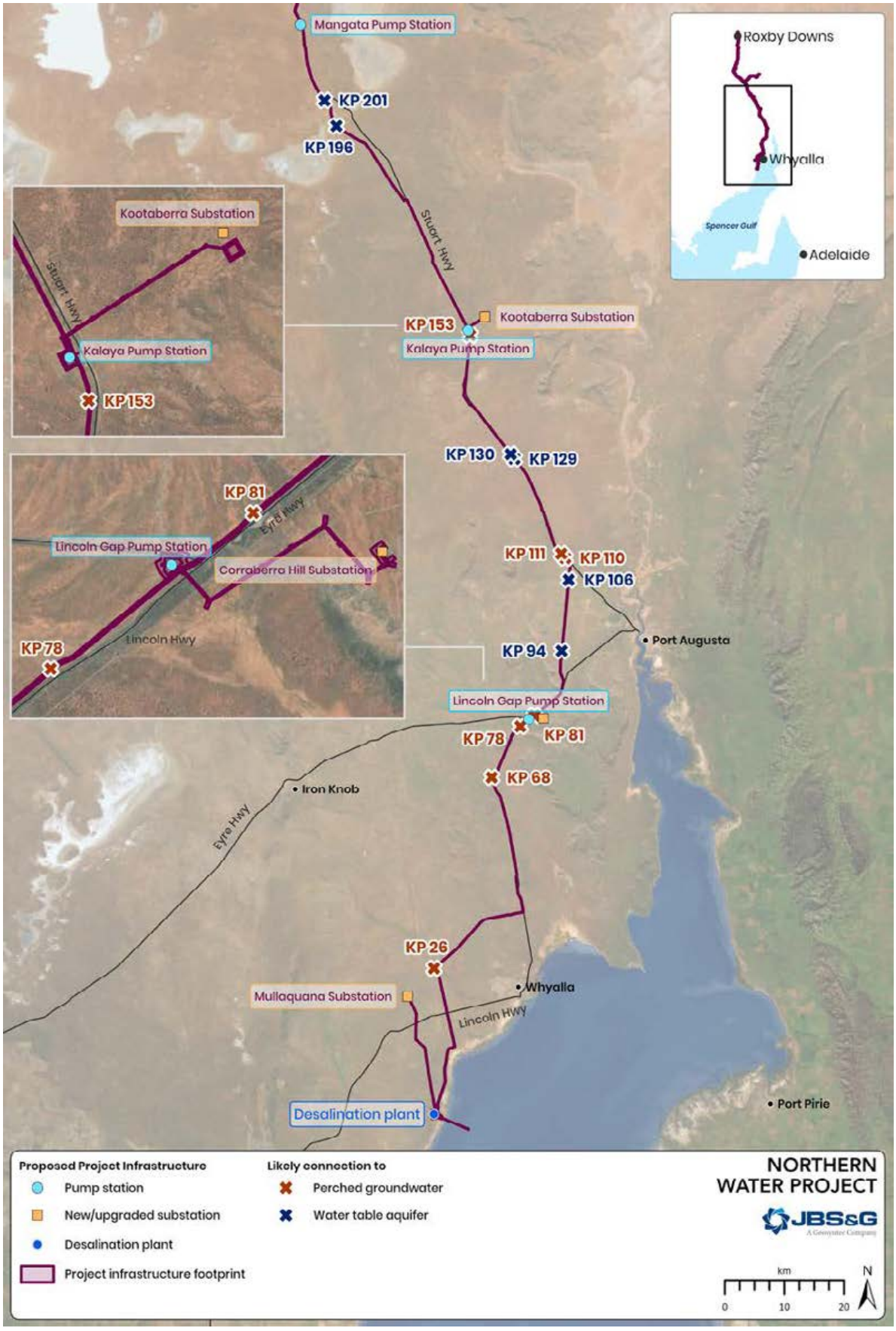


Figure 4-1: Mapped areas of potential dewatering (southern section)

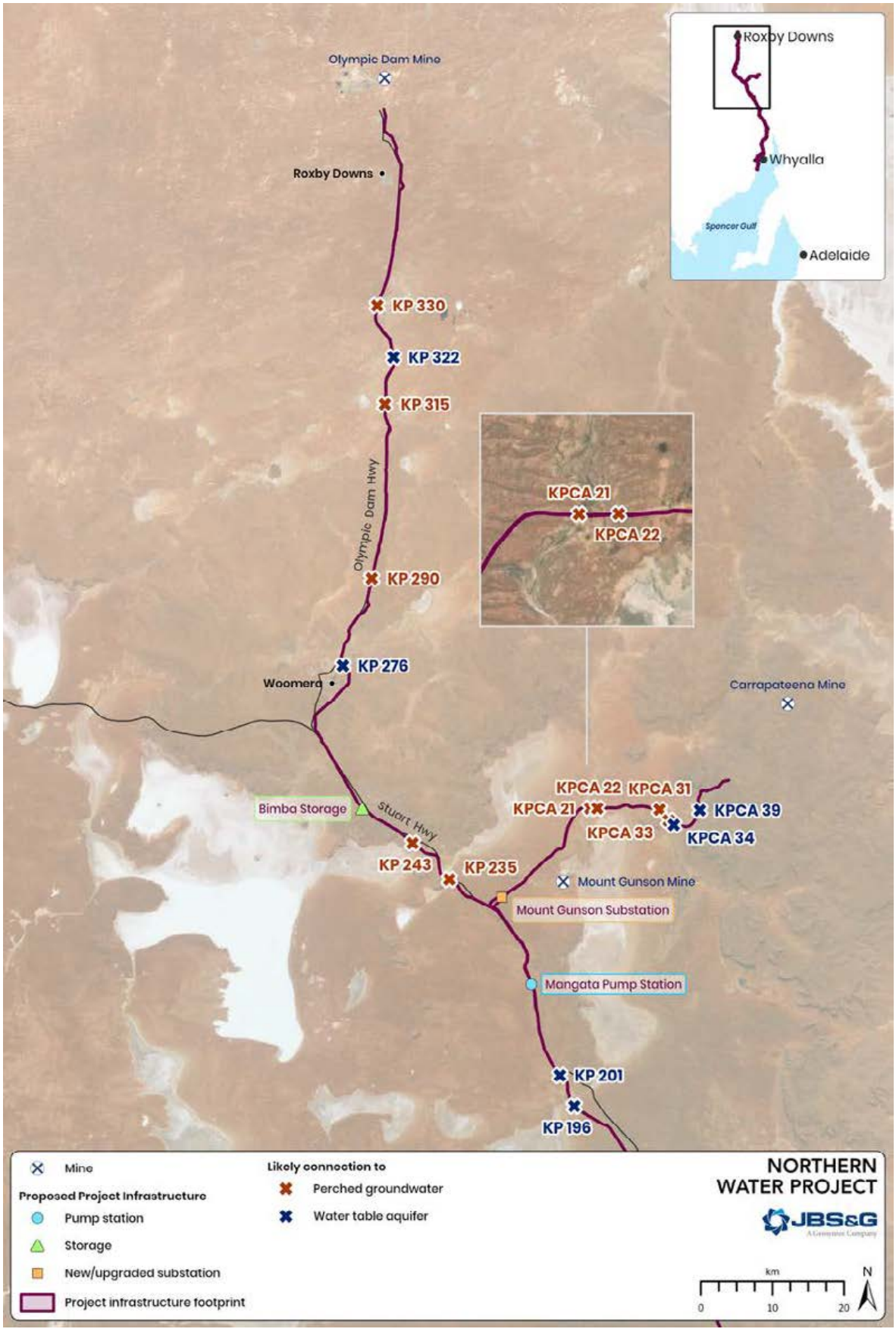


Figure 4-2: Mapped areas of potential dewatering (northern section)

4.2 Groundwater Inflow Estimates

Trenching of the pipeline and excavation of shafts for trenchless construction have the potential to intersect areas of shallow groundwater, most likely near watercourses but intersection can occur in other areas. Where this occurs, groundwater will flow into the excavation. The volume of water expected, and quality of water will determine the management requirements and is dependent upon the aquifer the groundwater is located in.

The following sections provide further information about the groundwater inflows for perched aquifers and shallow water table aquifers.

4.2.1 Perched aquifers

Perched aquifers are generally located in sedimentary aquifers, and the water is generally of low salinity, but with limited specific yield. Historically these aquifers have been accessed by shallow pastoral wells for domestic and stock watering demands but may only provide intermittent water source. As perched aquifers are highly localised and the inflows will be determined by the amount of water stored at the time of intersection, the lack of site-specific data means inflows are unable to be accurately calculated.

The limited yield, intermittent nature as a water source and fresher water quality means impact to receptors are unlikely both from loss of water due to drawdown and management of water from inflows (which could be used for construction water or discharged on vegetation depending upon water quality).

4.2.2 Shallow water table aquifers

Potential inflow yields of the shallow aquifer from trenching and underboring has not been calculated due to insufficient recorded aquifer hydraulic property data, including transmissivity, for shallow aquifers that the pipeline would intersect within the Study Area. Section 4.1 identifies the following locations as having potential to intersect shallow, water table aquifers:

- Lake Dempsey tributaries (KP 96 - KP 106)
- Carriewerloo (KP 129-KP 130) - Illeroo Creek
- Kells Swamp – Kells Camp Reservoir (KP 146-150) - Kells Swamp tributaries (Hesso)
- Lake Dutton (KP 195 – KP 200) - Black Oak Creek
- East of Red Lake (2km east of KP 276 - KP 277) Wirrawirralu Creek and Phillip Ponds
- Pernatty Lagoon (KPCA 34 – KPCA 39) - Yeltacowie Creek

Details about the recorded yields and salinities from the aquifers intersected is set out in Table 3-3. As can be seen from the Pooraka Formation yields and water quality are highly variable (measured TDS varies from 52,000 mg/L at Mullaquana Station to 3,000 mg/L at Lake Dempsey).

While groundwater inflows from shallow water table aquifers may have elevated salinity, as it is shallow the adjacent vegetation is likely adapted to encountering these salinities. Examples of saline groundwater would occur around Pernatty Lagoon, a natural salt lake, and should discharge of saline, shallow groundwater be necessary the ecosystem is well adapted.

5. Impact Assessment

The impact assessment considers potential impacts to groundwater levels, quantity and quality from the construction activities within the Study Area.

5.1 Potential Impacts

Groundwater levels and quantity:

- Temporary dewatering of pipeline trenches, underboring and associated entry / exist pits during construction leads to potential groundwater dewatering of perched aquifers and drawdown potentially impacting groundwater users (including terrestrial GDEs).
- Temporary groundwater drawdown potentially reduces water availability to groundwater users.

Groundwater quality:

- Temporary dewatering and groundwater level drawdown potentially mobilises existing groundwater contamination.
- Release of saline groundwater generated during dewatering to the environment (noting that baseline salinity of groundwater and potential baseline groundwater contamination has been addressed in a separate report).
- Potential for groundwater acidification due to temporary dewatering and groundwater level drawdown.

5.2 Significance Assessment

Table 5-1 presents the results of the significance assessment including the sensitivity of the environmental values (as outlined in Table 2-1) and magnitude of the impacts (as outlined in Table 2-2).

Table 5-1: Sensitivity assignments for HSUs within the Study Area

HSU	Assessment	Environmental values	Uniqueness and rarity	Resilience to change	Recovery potential	Replacement potential	Overall sensitivity (Table 2-1)	Magnitude of impact (Table 2-2)	Level of risk (Table 2-3)
Quaternary sediments	Sensitivity assignment	High (3)	Low (1)	Moderate (2)	Low (1)	Moderate (2)	Moderate (Mean 1.8)	Minor	Low
	Justification	Groundwater system support ecosystems that are of high importance but may be slightly modified.	Alluvial aquifers and their connected features are generally common throughout the Study Area on a regional basis.	Recharge rates and groundwater-surface water interactions likely allows moderate resilience and capacity to adjust to level or quality change.	Alluvial aquifers have relatively high recharge rates and short recovery periods.	There are several local water features (groundwater)that could provide alternative water sources to users. However, no sustaining surface water features.			
Tertiary Sediments	Sensitivity assignment	High (3)	Low (1)	Moderate (2)	Low (1)	Moderate (2)	Moderate (Mean 1.8)	Minor	Low
	Justification	Consistent with assessment of Quaternary alluvial sediments	Consistent with assessment of Quaternary alluvial sediments	Consistent with assessment of Quaternary alluvial sediments	Consistent with assessment of Quaternary alluvial sediments	Consistent with assessment of Quaternary alluvial sediments			
Coorikiana Sandstone / Bulldog Shale	Sensitivity assignment	High (3)	Moderate (2)	Moderate (2)	Moderate (2)	High (3)	Moderate (Mean 2.4)	Moderate[14]	Moderate
	Justification	Groundwater system support ecosystems that are of high importance but may be slightly modified.	Groundwater system (including connected features) is locally unique.	Recharge rates and groundwater-surface water interactions likely allows moderate resilience and capacity to adjust to level or quality change.	Groundwater systems with moderate recharge rates and medium-term recovery periods. Recovery is likely to be slow or only partially successful.	There are limited local water features (surface water or groundwater) could provide an alternative water source to users.			
Tent Hill Aquifer	Sensitivity assignment	High (3)	Low (1)	Moderate (2)	Low (1)	Low (1)	Moderate (Mean 1.6)	Minor	Low
	Justification	Groundwater system support ecosystems that are of high importance but may be slightly modified.	Alluvial aquifers and their connected features are generally common throughout the Study Area on a regional basis.	Recharge rates and groundwater-surface water interactions likely allows moderate resilience and capacity to adjust to level or quality change.	Alluvial aquifers have relatively high recharge rates and short recovery periods.	There are several local water features (surface water or groundwater) that could provide alternative water sources to users.			
Tapley Hill Formation	Sensitivity assignment	High (3)	High (3)	Moderate (2)	Low (1)	Moderate (2)	Moderate (Mean 1.6)	Minor	Low
	Justification	Groundwater system support ecosystems that are of high importance but may be slightly modified.	Groundwater system (including connected features) is unique. There are no known available alternatives.	Recharge rates and groundwater-surface water interactions likely allows moderate resilience and capacity to adjust to level or quality change.	Alluvial aquifers have relatively high recharge rates and short recovery periods.	There are several local water features (surface water or groundwater) that could provide alternative water sources to users.			
Crystalline Basement, including Moonabie Formation	Sensitivity assignment	Moderate (2)	Low (1)	Moderate (2)	Moderate (2)	Low (1)	Moderate (Mean 1.6)	Minor	Low
	Justification	Low yields and higher salinity support secondary domestic supply and some agricultural uses. Groundwater not preferred water resources but contribute some baseflow to terrestrial GDEs.	Formation is regionally extensive and does not support groundwater systems.	Where outcropping, the aquifer is susceptible to effects of surface activities. Low hydraulic conductivity and secondary fracture porosity limits radial extent of level or quality change.	Fractured rock aquifers have lower recovery potential particularly for quality changes. Remediation is more challenging should contamination occur.	There are several local water features (surface water or groundwater) that could provide alternative water sources to users.			

[14] A moderate score is conservative noting that the pipeline avoids the Arcoona Lakes, with Lake Mary being the closest lake to the pipeline within the Arcoona Lakes complex (greater 1.5km away). A literature review has not identified evidence that Lake Mary is groundwater fed. Impacts to Lake Mary are not expected due to the large separation distance.

5.3 Impacts to Groundwater Users (environmental values)

5.3.1 GDEs

The BOM GDE Atlas (BOM 2025a) identifies potential GDEs along the Project alignment as having a low, medium or high likelihood of dependence on the groundwater for environmental values. As these potential GDEs were identified from a national level assessment they represent an initial screening tool to indicate whether there is a connection to groundwater and whether the vegetation is partially or wholly dependent upon groundwater.

Most ephemeral drainage lines have a low likelihood of being dependent on groundwater for some or all their flow during dry periods. Table 5-2, Table 5-3 and Table 5-4 list locations in the Study Area which have a moderate to high likelihood of the ecosystems being dependent on groundwater. Potential terrestrial GDEs located within 500 m of areas where there is a potential for dewatering are described in Section 3.7.1 and are summarised below in Table 5-2, Table 5-3 and Table 5-4.

The assessment in Section 3.7 did not identify aquatic or subterranean GDEs within the Study Area.

The pipeline alignment crosses several water features that have been identified with moderate or high likelihood of being groundwater dependent (Table 5-2, Table 5-3 and Table 5-4). Underboring is being considered as a construction method for creek crossings that are considered to be high sensitivity areas as this technique minimises the impacts of trench drawdown in the immediate vicinity of base-flow fed water table aquifers and perched groundwater. However, dewatering of trenches and underboring entry and exit excavations may cause groundwater level drawdown to propagate away from the excavations towards the surface water features, adversely affecting terrestrial GDEs. Depending on the duration of propagated drawdown in the surface water feature, surface water quality and flow dynamics can alter.

The uncertainty associated with determining the individual water sources and potential for some identified terrestrial GDEs as groundwater users can be reduced by minimising construction periods where there will be a relatively minor period of lowered groundwater levels.

5.3.1 Cultural and spiritual values

For Indigenous People water, including water under the ground is essential for life and considered sacred. The Aboriginal culture understands connection of all waters sees a natural flow that nourishes the aquatic ecosystems that lie at the heart of their spirituality (ANZG 2018).

5.3.2 Industrial and primary industry water use

Groundwater bores have been developed since 1891 within the vicinity of the proposed Project. Very few would be within range of temporary drawdown potential from the pipeline infrastructure construction where a loss of a groundwater resource would be realised and only two registered bores are within the proposed pipeline infrastructure corridor.

5.3.3 Recreational water and aesthetic values

Recreational water and aesthetics as an environmental value of groundwater, is generally centred around terrestrial GDEs and their role in providing visually pleasing and culturally significant landscapes around the springs and wetlands they create. Within the Study Area, these landscapes are generally associated with terrestrial GDEs and the sustaining nature of the ecosystem that is supported by the degree of access to groundwater.

Table 5-2: Drainage lines with low to high likelihood for groundwater dependence along the pipeline alignment (Mullaquana Station to Port Augusta)

River Catchment	Vegetation Associations[15]	Likelihood of perched or water table access	Likelihood of vegetation dependant on groundwater[16]	Further consideration required
Salt Creek (KP26) • Salt Creek	Broad drainage line with Weeping Emubush (*Eremophila longifolia* tall Shrubland over Silver Cassia (*Senna artemisiodes*) with sparse Pearl Bluebush (*Maireana sedifolia*).	• Unlikely to access water table aquifer • Likely to access perched groundwater system	Low	No further consideration
Myall Creek (KP64) • Myall Creek	Western Myall (*Acacia papyrocarpa*) open woodland over Blackbush (*Maireana pyramidata*) / Pearl Bluebush (*Maireana sedifolia*).	• Unlikely to access water table aquifer • Likely to access perched groundwater system	Low	No further consideration
Lincoln Gap pump station (KP78 - KP81) • Lincoln Gap Creek	Blackbush (*Maireana pyramidata*) low open shrubland +/- Pearl Bluebush (*Maireana sedifolia*) / Bladder Saltbush (*Atriplex vesicaria*).	• Unlikely to access water table aquifer • Unlikely to access perched groundwater system	Low	No further consideration
Lake Dempsey tributaries (KP96 - KP106)	• Elegant Wattle (*Acacia victoriae*) tall open shrubland over Blackbush (*Maireana pyramidata*) low chenopod shrubland. • Bladder Saltbush (*Atriplex vesicaria*), Samphire (*Tecticornia medullosa*), Blackbush (*Maireana pyramidata*) with or without Low Bluebush (*M. astrotricha*) and/or Woolly Bluebush (*M.eriantha*) low chenopod shrubland (stony tableland) • Western Myall (*Acacia papyrocarpa*), Umbrella Wattle (*A. oswaldii*) and Native Apricot (*Pittosporum angustifolium*) open woodland over chenopod shrubland	• Likely to access water table aquifer • Likely to access perched groundwater system	Medium	CEMP to include strategies and management to address the scenario of groundwater being identified during construction. Potential impact to native vegetation to be addressed as part of statutory requirements relating to clearance and provision of significant environmental benefit.

[15] Northern Water Baseline Ecological Survey (Jacobs 2026)

[16] Low = species is known to exist without access to groundwater, Medium = species is known to use groundwater but can survive without access for periods, High = species only occurs with groundwater, groundwater access is required for survival.

Table 5-3: Drainage lines with low to high sensitivity for groundwater dependence along the pipeline alignment (Port Augusta to Roxby Downs)

River Catchment	Vegetation Associations	Likelihood of water table groundwater dependence	Likelihood of vegetation dependent on groundwater	Further consideration required
Carriewerloo Station (KP111) • Braided stream tributaries	Blackbush (*Maireana pyramidata*) low open shrubland +/- Pearl Bluebush (*Maireana sedifolia*) / Bladder Saltbush (*Atriplex vesicaria*)	• Unlikely to be access water table aquifer • Likely to access perched groundwater system.	Low	No further consideration
Carriewerloo (KP129-KP130) • Illeroo Creek	Blackbush (*Maireana pyramidata*) low open shrubland +/- Pearl Bluebush (*Maireana sedifolia*) / Bladder Saltbush (*Atriplex vesicaria*)	• Likely to access water table aquifer • Likely to access perched groundwater	Low	No further consideration
Kells Swamp – Kells Camp Reservoir (KP146-150) • Kells Swamp tributaries (Hesso)	Blackbush (*Maireana pyramidata*) low open shrubland +/- Pearl Bluebush (*Maireana sedifolia*) / Bladder Saltbush (*Atriplex vesicaria*)	• Likely to access water table aquifer • Likely to access perched groundwater	Low	No further consideration
Kootaberra Dam (KP153) • Kootaberra drainage lines (Range View Rest Area)	Blackbush (*Maireana pyramidata*) low open shrubland +/- Pearl Bluebush (*Maireana sedifolia*) / Bladder Saltbush (*Atriplex vesicaria*)	• Unlikely to access watertable aquifer • Unlikely to access perched groundwater system	Low	No further consideration
Lake Dutton (KP195 – KP200) • Black Oak Creek	Stony tableland with Bladder Saltbush (*Atriplex vesicaria)* / Samphire *(Tecticornia medullosa)* / Cottonbush *(Maireana aphylla) /* Low Bluebush *(Maireana astrotricha)* low open shrubland	• Likely to access watertable aquifer • Unlikely to access perched groundwater system	Low	No further consideration
Lake Windabout (KP235 - KP240) • Mason Creek	• Low dunes with Slender Mulga (*Acacia aptaneura* tall open shrubland +/- Sandhill Wattle (*Acacia ligulata*) / Pinbush Wattle (*Acacia burkittii*).	• Unlikely to access watertable aquifer • Likely to access perched groundwater	Low	No further consideration

River Catchment	Vegetation Associations	Likelihood of water table groundwater dependence	Likelihood of vegetation dependent on groundwater	Further consideration required
	• Samphire (*Tecticornia spp*.) (*indica ssp. leiostachya / halocnemoides*) low open shrubland on salt lake margin.			
East of Red Lake (2km east of KP276 - KP277) • Wirra wirralu Creek and Phillip Ponds	• Drainage line with Sugarwood (*Myoporum montanum*) / Prickly Wattle (*Acacia victoriae*) closed shrubland +/- Blackbush (*Maireana pyramidata*) • Stony tableland with Bladder Saltbush (*Atriplex vesicaria*) / Samphire (*Tecticornia medullosa*) / Cottonbush (*Maireana aphylla*) / Low Bluebush (*Maireana astrotricha*) low open shrubland	• Likely to access watertable aquifer • Unlikely to access perched groundwater	Medium	CEMP to include strategies and management to address the scenario of groundwater being identified during construction. Potential impact to native vegetation to be addressed as part of statutory requirements relating to clearance and provision of significant environmental benefit.
West of Lake Richardson (KP290) • Saunders Creek	Stony tableland with Bladder Saltbush (*Atriplex vesicaria*) / Samphire (*Tecticornia medullosa*) / Cottonbush (*Maireana aphylla*) / Low Bluebush (*Maireana astrotricha*) low open shrubland	• Unlikely to access water table aquifer • Unlikely to access perched groundwater system	Low	No further consideration
West of Lake Mary (KP315) • Lake Mary drainage lines	Dune crest with Native Pine (*Callitris glaucophylla*) open woodland +/- tall shrubs Sandhill Wattle (*Acacia ligulata*) / Hopbush (*Dodonaea viscosa ssp.*)	• Unlikely to access water table aquifer • Likely to access perched groundwater	Low	No further consideration
West of Coorlay Lagoon (KP330) • Coorlay Lagoon drainage lines	• Minor drainage line with Prickly Wattle (*Acacia tetragonophylla*) / Native Apricot (*Pittosporum angustifolium*) tall shrubland • Low Bluebush (*Maireana astrotricha*) low open shrubland with emergent Senna spp. • Dune crest with Native Pine (*Callitris glaucophylla*) open woodland +/- tall shrubs Sandhill Wattle (*Acacia ligulata* / Hopbush (*Dodonaea viscosa ssp.)*	• Unlikely to access water table aquifer • Likely to access perched groundwater	Medium	CEMP to include strategies and management to address the scenario of groundwater being identified during construction. Potential impact to native vegetation to be addressed as part of statutory requirements relating to clearance and provision of significant environmental benefit.

Table 5-4: Drainage lines with low to high sensitivity for groundwater dependence along the lateral branch alignment

River Catchment	Vegetation Associations	Likelihood of water table groundwater dependence	Likelihood of vegetation dependent on groundwater	Further consideration required
North of Pernatty Lagoon (KPCA21) [The] Elizabeth Creek	• Sandhill Canegrass (*Zygochloa paradoxa*) grassland with emergent Sandhill Wattle (*Acacia ligulata*) and Western Rosewood (*Alectryon oleifolius*) on red sand dune. • Dune crest with Sandhill Wattle (*Acacia ligulata*) / Slender Hopbush (*Dodonaea viscosa ssp. angustissima*) tall open shrubland +/- Sandhill Canegrass (*Zygochloa paradoxa*). • Swale with Bladder Saltbush (*Atriplex vesicaria*) / Low Bluebush (*Maireana astrotricha*) low open shrubland. • Western Myall (*Acacia papyrocarpa*) low woodland over Blackbush (*Maireana pyramidata*) +/- Pearl Bluebush (*Maireana sedifolia*)	• Unlikely to access water table aquifer • Likely to access perched groundwater system	Low	No further consideration
East of Pernatty Lagoon (KPCA31 - KPCA33) Bonney Bluff drainage lines	• Dune crest with Sandhill Wattle (*Acacia ligulata*) / Slender Hopbush (*Dodonaea viscosa ssp. angustissima*) tall open shrubland +/- Sandhill Canegrass (*Zygochloa paradoxa*) • Bladder Saltbush (Atriplex vesicaria) / Samphire (*Tecticornia medullosa*) low open shrubland (stony tableland) • Samphire (*Tecticornia indica*) (*Tecticornia pergranulata*) +/- Tangled Lignum (*Duma florulenta*) open shrubland	• Unlikely to access water table aquifer • Unlikely to access perched groundwater system	Low	No further consideration
Pernatty Lagoon (KPCA34 - KPCA39) Yeltacowie Creek	• Cottonbush (Maireana aphylla) shrubland (clay depression) • River Red Gum (*Eucalyptus camaldulensis ssp. arida*) low woodland (in major drainage line)	• Likely to access water table aquifer • Likely to access perched groundwater	Medium	CEMP to include strategies and management to address the scenario of groundwater being identified during construction.

River Catchment	Vegetation Associations	Likelihood of water table groundwater dependence	Likelihood of vegetation dependent on groundwater	Further consideration required
	• Bladder Saltbush (*Atriplex vesicaria*) / Samphire (*Tecticornia medullosa*) low open shrubland (stony tableland) Dune crest with Sandhill Wattle (*Acacia ligulata*) / Slender Hopbush (*Dodonaea viscosa ssp. angustissima*) tall open shrubland +/- Sandhill Canegrass (*Zygochloa paradoxa*).			Potential impact to native vegetation to be addressed as part of statutory requirements relating to clearance and provision of significant environmental benefit.

6. Conclusions

There is potential for minor, localised changes in hydrogeological conditions due to trenching and underboring along the pipeline. Potential impacts would be temporary, occurring during the construction period only. It is recommended that the Project CEMP include strategies and management to address the scenario of groundwater being identified during construction along the pipeline alignment.

Potential impact to registered groundwater users along the pipeline alignment are not expected.

Potential impact to native vegetation and terrestrial GDEs (along the pipeline alignment) from groundwater drawdown are not expected (due to the shallow pipeline depth and temporary nature of drawdown). However, should minor impacts be necessary as a result of construction dewatering, they would be addressed as part of statutory requirements relating to clearance and provision of significant environmental benefit.

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8. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

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Appendix H-5:

Hydrogeological Investigation – Mullaquana Desalination Plant Site

Northern Water Project (Package 5)
Groundwater Model Update – June 2026

Mullaquana SA 5608

NWP-KLF-ONG-3000-GEO-RPT-0014_003

16 September 2026







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Northern Water Project (Package 5)
Groundwater Model Update – June 2026

Mullaquana SA 5608

NWP-KLF-ONG-3000-GEO-RPT-0014_003

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ABBREVIATIONS

Abbreviation	Definition
3D	Three-Dimensional
A	Cross-sectional Area
AMR	Absolute Residual Mean
CJ	Cooper-Jacob
CSM	Conceptual Site Model
DIT	Department for Infrastructure and Transport
EC	Electrical Conductivity
HFB	Horizontal Flow Boundary
i	Hydraulic Gradient
IPS	Intake Pump Station
K	Hydraulic Conductivity
Kleinfelder	Kleinfelder Australia Pty Ltd
L/day	Litres per Day
L/sec	Litres per Second
m	Metre
m/day	Metres per Day
m/m	Metre Change in Head per Metre Change in Distance
m^2/day	Square Metres per Day
m^3/day	Cubic Metres per Day
mAHD	Metres Australian Height Datum
mbgl	Metres Below Ground Level
mm	Millimetres
NWP	Northern Water Project
PCUG	Preconditioned Conjugate-Gradient for Unstructured grids
Q	Discharge Rate
RMS	Root Mean Square
RSS	Residual Sum of Squares
S	Storativity
SAQP	Sampling Analysis and Quality Plan
SSE	Sum of Squared Error
T	Transmissivity
TBM	Tunnel Boring Machine
TDS	Total Dissolved Solids
WP5	Work Package 5

1 INTRODUCTION

Kleinfelder Australia Pty Ltd (Kleinfelder) was engaged by the Department for Infrastructure and Transport (DIT) to undertake an update and refinement of the groundwater model developed as part of Work Package 5 (WP5) for the Northern Water Project (NWP). The groundwater model update and refinement were undertaken in accordance with the contract 'Provision of Geotechnical Investigations for the Northern Water Project (Work Package 5), Contract No. 24C378' executed 24 April 2025 and subsequent variation(s) to the contract.

This report presents the updates and refinements to the previously developed groundwater model for the proposed desalination plant at Mullaquana Station, as detailed in Kleinfelder, 2026a. The proposed desalination plant at Mullaquana Station is herein referred to as the 'site,' consistent with the previous hydrogeological investigation. The location of the site is presented on **Figure 1**. During previous reporting / investigations the site has also been referred to as 'Area F,' such as in the sampling analysis and quality plan (SAQP) (Kleinfelder, 2025a) and the *Area F Geotechnical and Environmental Investigation, Report Area F – Mullaquana Desalination Plant Site* (Kleinfelder, 2025b). As such the terms 'Area F' and 'site' are interchangeable when referring to Mullaquana Station; however, for consistency and clarity, this report has used the term 'site.' The overall purpose of undertaking the groundwater model update is to refine the groundwater model and scenario based on updated information provided by the DIT and as detailed in the *Northern Water Supply Project Reference Design Constructability Report* (SYSTRA, 2025); the model addresses proposed groundwater management during construction.

1.1 BACKGROUND AND OBJECTIVES

Kleinfelder has previously developed a groundwater model for the site that is presented in the Hydrogeological Investigation Report (Kleinfelder, 2026a). Since the development of the model and reporting, DIT has provided updated information on the proposed groundwater management during the excavation and construction of the tunnel boring machine (TBM) decline and launch box. Currently, the proposed design approach consists of a longitudinal launch box rather than a vertical shaft system. This longitudinal launch box design also allows for the complex and demanding elements of the intake/outlet structures and pumping station to be constructed during the tunnelling works (SYSTRA, 2025).

A schematic of the proposed TBM decline and launch box is presented below in **Figure 1.1**. The excavation is separated into two primary areas, a "drained" section (groundwater is able to flow into the excavation for draining) and "undrained" section (groundwater flow into the excavation is limited to low permeability features). The undrained section includes secant pile walls (yellow circles on **Figure 1.1**) to limit infiltration of groundwater into the excavation. The secant pile walls would be installed prior to any excavations to a maximum depth of 20 mbgl (SYSTRA, 2025). It is assumed that groundwater seepage into the excavation during construction can be managed through passive means (i.e., sumps/drains installed at low points to remove groundwater seeping into the excavation).

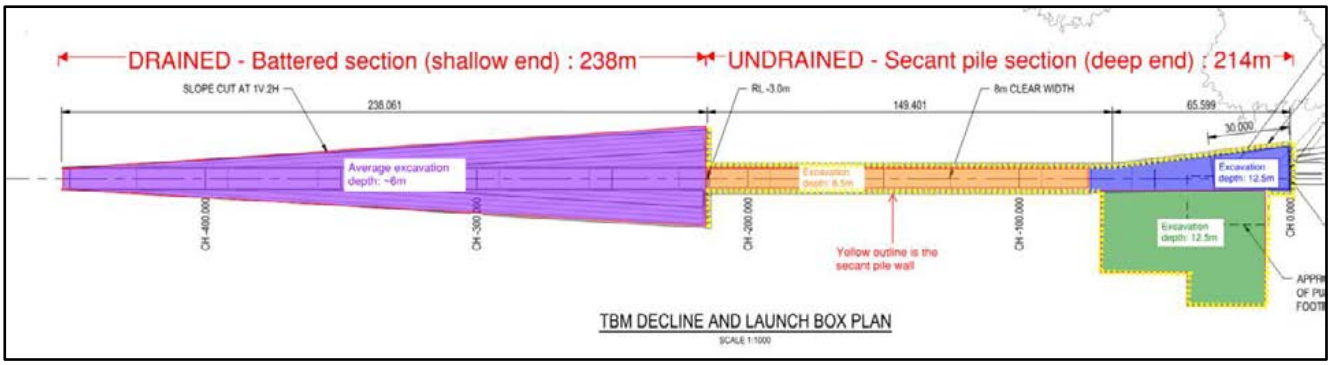


Figure 1.1: TBM decline and launch box plan (Source: SYSTRA, 2025)

Based on the current design approach, the following information is required to help inform feasibility of the proposed groundwater-management program:

- Volume of groundwater seepage into the excavation in both the drained and undrained sections
- Impacts of groundwater removal through passive means on groundwater levels immediately surrounding the TBM decline and launch box.

Given the above, the key objective of the groundwater model update and refinement is to obtain a further understanding of potential hydrogeological responses to the proposed construction approach, particularly within the area of interest around the TBM decline and launch box in relation to groundwater management during excavation. This objective can be further broken down as follows:

- Obtain an understanding of drawdown and groundwater elevations (at a screening level) in areas surrounding the TBM decline and launch box due to groundwater management at selected stages throughout the project (i.e., baseline conditions, during construction and post construction)
- Obtain an understanding of inflow rates (seepage) during the proposed excavation for the TBM decline and launch box at selected stages to inform groundwater-management options.

To meet the objectives outlined above, the following scope of work was proposed:

- Review and refine the groundwater model to obtain a more granular (i.e., finer) grid and information around the area of interest (i.e., reduce grid size from 20 x 20 metres [m] to 4 x 4 m)
- Calibrate and validate the groundwater model using transient data collected over the last 6 months at the site
- Simulate a new model scenario to obtain an understanding of potential hydrogeological responses from works associated with the proposed groundwater management during excavation and construction works for the TBM decline and launch box.

1.2 REPORT STRUCTURE

This report is focused on the refinement and update to the groundwater model. Previous background information has not been included. Detailed information on the overall project overview, site and environmental setting can be found in the *Hydrogeological Investigation – Proposed Mullaquana Desalination Plant Site* (Kleinfelder, 2026a).

In addition to the above, further intrusive works have been completed at the site since the development of the initial groundwater model. These additional works included the following scope relevant to the groundwater model update:

- Installation of six deep groundwater monitoring wells to a maximum depth of 35 metres below ground level (mbgl) within the area of the TBM decline and launch box
- Installation of six shallow groundwater monitoring wells to a maximum depth of 15mbgl throughout the desalination plant footprint
- Aquifer testing, consisting of rising- and falling-head (slug) tests in the 12 new groundwater monitoring wells, and two pumping tests completed in two existing wells within the TBM decline and launch box area.

Details of the completed scopes of works above can be found in the following reports:

- Kleinfelder, 2026b. Northern Water Project (Package 5) Supplementary Geotechnical Investigation – Mullaquana Station – TBM Launch Out and IPS, Document number ADL26R195197, Dated April 2026
- Kleinfelder, 2026c. Northern Water Project (Package 5) Mullaquana Station Desalination Plant Footprint Additional Geotechnical and Environmental Investigations (currently in production).

This report comprises three separate elements, as outlined below.

- Introductory information and background, aims and objectives of the groundwater model update, review of additional data and preliminary seepage calculations
  - **Section 1** – Introduction, background and objectives
  - **Section 2** – Data review, additional aquifer testing and long-term groundwater level monitoring
  - **Section 3** – Preliminary seepage calculations
- Refinement and update of the numerical three-dimensional (3D) groundwater model, including grid refinement methodology, calibration and validation with transient data, and development and simulation of updated groundwater management scenario and results
  - **Section 4** – Groundwater model update and refinement
- Summary of findings and conclusions of the refined and updated groundwater model.
  - **Section 5** – Summary of findings and conclusions.

2 DATA REVIEW

This section presents a review of additional data that have been obtained and are pertinent to the groundwater model update. This includes geology encountered in new boreholes, wells installed, aquifer testing, and long-term groundwater-level monitoring of the existing monitoring well network. The below subsections provide a summary of this new information and includes a brief summary of the scope of works, methodology and results presented in the following associated reports:

- Kleinfelder, 2026a. Northern Water Project (Package 5) Hydrogeological Investigation - Proposed Mullaquana Desalination Plant Site. Document number ADL25R189551, Dated 27 February 2026.
- Kleinfelder, 2026b. Northern Water Project (Package 5) Supplementary Geotechnical Investigation – Mullaquana Station – TBM Launch Pit and Intake Pump Station (IPS), Document number ADL26R195197, Dated April 2026
- Kleinfelder, 2026c. Northern Water Project (Package 5) Mullaquana Station Desalination Plant Footprint Additional Geotechnical and Environmental Investigations (currently in production)
- Kleinfelder, 2026d. Northern Water Project (Package 5) March 2026 Groundwater Monitoring Event – Proposed Mullaquana Desalination Plant Site. Document number ADL26R196141, Dated May 2026.

2.1 GEOLOGY ENCOUNTERED

A total of 14 new boreholes were drilled throughout the site, with 12 converted to groundwater monitoring wells. The locations of these boreholes and the groundwater monitoring wells are presented in **Figure 2**. Of the 12 new wells, 6 were drilled within the vicinity of the TBM decline and launch box to a maximum depth of 35.7 mbgl, and 6 were installed further inland, across the desalination-plant footprint. The geology observed is summarised in **Table 2.1** below.

Table 2.1: Summary of geology encountered in new boreholes

Area	Borehole IDs	Encountered Soil and profile	Geological unit
Plant footprint	DP-BH28 – DP-BH33	Generally consisted of a surface layer (0–3m) of clayey sand, silty sand, or sandy clay, overlying a clay layer or sandy gravelly clay layer extending from approximately 2 to 15m depth.	**Quaternary Sediments** Semaphore Sand Member (Qhcks)
TBM decline and launch box	DP-BH20 – DP-BH27 Note: DP-BH22 and DP-BH24 were geotechnical boreholes only and not completed as groundwater monitoring wells	Generally comprised a surface layer (0–1.5m) of clayey sand, silty sand, or sandy clay, overlying a clay or sandy gravelly clay layer extending from approximately 2 to 25m depth. A layer of granular material (sand and gravel) was encountered at some locations between approximately 6 and 10 mbgl. Bedrock was encountered between 20 and 24 mbgl, comprising predominantly limestone and siltstone, interbedded with thin soil layers, primarily clay.	**Quaternary Sediments** Pleistocene regolith/colluvial unit 4 (Qpr4) Holocene alluvial/fluvial sediments

The soil and profile encountered throughout the plant footprint is consistent with that from drilling previously completed as part of the initial intrusive investigations, with intercalated sandy clay and gravelly sandy clay to the maximum depth investigated (Kleinfelder, 2025b). Specifically, within the TBM decline and launch box area, the encountered geology was generally consistent with previous investigations, with intercalated sandy clay and gravelly sandy clay encountered to a depth of 25 mbgl. At each borehole, siltstone was encountered at depths between 20 and 25 mbgl to a maximum depth of 35.7 mbgl. The upper portions of the siltstone were highly weathered (residual soil) and interbedded with thin layers of clay.

2.2 AQUIFER TESTING RESULTS

Recent works have expanded the well network, with an additional 12 wells installed throughout the site. As further groundwater monitoring wells have been installed, additional aquifer testing has been completed. Aquifer testing completed throughout the site comprised both slug testing and pumping tests. Slug testing was completed in each of the 26 wells installed on the site. A pumping test was completed in each of three different groundwater wells within the vicinity of the TBM decline and launch box. The location of each groundwater well on the site is presented in **Figure 2**. Details of each groundwater well and its associated aquifer testing are presented in **Table 2.2** below.

Table 2.2: Summary of groundwater monitoring wells and aquifer testing completed

Well ID	Purpose	Location	Depth (mbgl)	Aquifer testing completed
DP-BH01	Monitoring / observation	TBM decline / launch box	15	Slug test
DP-BH02	Monitoring / observation	TBM decline / launch box	20	Slug test / pumping test
DP-BH03A	Monitoring / observation	TBM decline / launch box	25	Slug test / pumping test
DP-BH04	Monitoring / observation	TBM decline / launch box	25	Slug test
DP-BH05	Monitoring / observation	TBM decline / launch box	15	Slug test
DP-BH06	Monitoring / observation	Background / infill	15	Slug test
DP-BH07	Monitoring / observation	Background / infill	15	Slug test
DP-BH08	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH09	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH10	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH11	Monitoring / observation	TBM decline / launch box	25	Slug test
DP-BH12	Monitoring / observation	TBM decline / launch box	25	Slug test
DP-BH13	Monitoring / observation	Background / infill	25	Slug test
DP-BH20	Monitoring / observation	TBM decline / launch box	30	Slug test
DP-BH21	Monitoring / observation	TBM decline / launch box	30	Slug test
DP-BH23	Monitoring / observation	TBM decline / launch box	35.7	Slug test
DP-BH25	Monitoring / observation	TBM decline / launch box	30	Slug test
DP-BH26	Monitoring / observation	TBM decline / launch box	30	Slug test
DP-BH27	Monitoring / observation	TBM decline / launch box	30	Slug test
DP-BH28	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH29	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH30	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH31	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH32	Monitoring / observation	Desalination plant footprint	15	Slug test
DP-BH33	Monitoring / observation	Desalination plant footprint	15	Slug test
PW01	Monitoring / pumping	TBM decline / launch box	21	Slug test / pumping test

Notes: mbgl = metres below ground level

Tabulated results for the slug testing from all the works completed at the site are presented in **Appendix A**. A summary of the slug testing results is presented below in **Table 2.3**. with the results separated into two site areas: the Desalination plant footprint and the TBM decline / launch box.

Table 2.3: Summary of slug testing results by area

Area	Number of wells	Minimum K (m/day)	Maximum K (m/day)	Geometric mean K (m/day)
Desalination plant footprint*	10	0.07	2.05	0.26
TBM Decline and Launch Box**	16	0.71	4.48	1.61
All wells	26	0.07	4.48	0.82

Notes:
* DP-BH07 included in this designated area due to proximity
** DP-BH06 and DP-BH13 included in this designated area due to proximity
K = hydraulic conductivity (m/day)

Three 24-hour constant-rate tests, and associated step-drawdown tests, have been completed at the site in different wells. Results are presented in **Appendix B**. A summary of the results is presented below in **Table 2.4**, which represents more broad scale aquifer parameters within the area of interest at the TBM decline and launch box.

Table 2.4: Summary of constant-rate pumping test results

Pumped well	Observation well	Pumped rate (L/sec)	Analytical Solution	T (m^2/day)	S	K (m/day)
PW01	DP-BH11	1.0	CJ	18.95	0.057	0.45
			Thies	22.39	0.074	0.53
	DP-BH02		CJ	22.33	0.011	0.53
			Thies	42.47	0.051	1.01
	DP-BH03A		CJ	22.24	0.011	0.53
			Thies	40.86	0.098	0.97
DP-BH02	DP-BH11	0.9	CJ	24.11	0.010	0.57
			Thies	55.2	0.017	1.31
	PW01		CJ	24.26	0.010	0.58
			Thies	54.16	0.028	1.29
	DP-BH03A		CJ	49.69	0.007	1.18
			Thies	25.06	0.175	0.60
	DP-BH01		CJ	25.96	0.004	0.62
			Thies	49.03	0.217	1.17
DP-BH03A	DP-BH11	1.0	CJ	10.93	0.008	0.26
			Thies	20.08	0.056	0.48
	PW01		CJ	11.17	0.006	0.27
			Thies	20.11	0.055	0.48
	DP-BH02		CJ	11.47	0.005	0.27
			Thies	19.66	0.079	0.47

Notes:
L/sec = Litres per second
m^2/day = square metres per day
K = Hydraulic conductivity
CJ = Cooper-Jacob
T = Transmissivity
S = Storativity
m/day = metres per day

2.3 LONG-TERM WATER-LEVEL MONITORING

Following installation of groundwater wells, pressure transducers were installed to get a more thorough understanding of temporal variations in groundwater level. Pressure transducers were set to obtain a reading every three hours, with the recording period selected to allow identification of any tidal influences, given the proximity to the coast. The pressure transducer data was downloaded and provided to DIT following each groundwater monitoring event as part of the groundwater monitoring reporting. The data has been further reviewed during this groundwater model update, to be included for transient-model calibration.

From the detailed review of the pressure transducer data, the following are noted:

- Selected data from all groundwater monitoring wells have been adjusted to align with manual gauging and responses to weather observations
- Data from three wells, DP-BH05, DP-BH08 and DP-BH12, are unusable, due to errors in the pressure transducer reported values. Manual gauging data have been provided and used to understand groundwater levels over the monitoring period
- Overall, groundwater shows a rapid response to rainfall, particularly near the coast and in areas surrounding the TBM decline and launch box. This rapid response is likely influenced by shallow groundwater and increased infiltration rates at localised areas. Groundwater levels at wells further inland show a reduced response to rainfall.
- No tidal influence was observed in groundwater monitoring wells installed in areas surrounding the TBM decline and launch box.

Updated hydrographs are presented in **Appendix C**.

3 PRELIMINARY SEEPAGE CALCULATIONS

Groundwater seepage around the TBM decline and launch box during and following excavation was calculated to inform groundwater management options. As outlined in **Section 1.1**, the current design approach consists of a longitudinal launch box that is separated into two primary areas, a drained section and undrained section (refer to **Figure 1.1**). To inform groundwater management options the excavation works and construction of the TBM launch box have been divided into five key phases as follows:

- **Phase 1**: Baseline condition – prior to any excavation works
- **Phase 2:** Partial excavation of drained section – excavation of the TBM decline drained section to approximately 4 mbgl
- **Phase 3**: Complete excavation of drained and undrained sections – excavation of the entire TBM decline and launch box, including the approximate footprint of the IPS, to approximately 13 mbgl
- **Phase 4**: Sealing and construction of the intake and outfall tunnels – the base of the undrained section is to be sealed with a concrete slab for the tunnelling and construction works of the IPS
- **Phase 5**: Backfilling and completion of works.

Preliminary seepage calculations were completed for Phase 2 and Phase 3.

Groundwater seepage from Phase 4 would be limited due to the undrained section being contained within secant pile walls and a concrete slab on the base. The drained section would also be sealed on the base with a concrete slab, with any groundwater seepage occurring only through the battered walls.

3.1 APPROACH AND GENERAL ASSUMPTIONS

The overall approach for calculating seepage into any excavation is based on understanding the key elements of groundwater flow that are fundamental to Darcy's Law. These key elements include the horizontal hydraulic conductivity (K), hydraulic gradient (i), and the cross-sectional area (A) of the aquifer. If these elements are known, the discharge (seepage) rate can be calculated using Darcy's Law. A simplified form of Darcy's Law, used for the calculation is:

$$Q = KiA$$

where:
Q is the discharge rate
K is the horizontal hydraulic conductivity
i is the hydraulic gradient
A is the cross-sectional area

Using this simplified Darcy's Law equation, the seepage for Phase 2 and Phase 3 can be calculated based on the saturated surface area of the excavation. Site-specific criteria for each of the elements are provided below.

Hydraulic conductivity

From aquifer testing completed throughout the site the estimated K value is known (refer to **Section 2.2**). The area of interest is the TBM decline and launch box, therefore the estimated K values from slug testing and pumping tests in this area were considered. As K values can vary greatly over small distances, based primarily on geology, the geometric mean of the slug tests was considered appropriate, as this accounts for an inherent variability. The estimated K values used in the preliminary seepage calculations was 1.61m/day.

Vertical hydraulic conductivity has not been measured at the site, however given the geology and aquifer testing completed to date, it is assumed that the aquifer is generally isotropic. An isotropic aquifer would have the same K vertically and horizontally.

Hydraulic gradient

The groundwater gradient has been calculated from three different groundwater monitoring events and is summarised below in **Table 3.1**. The overall groundwater gradient is generally consistent with local gradients between groundwater wells installed throughout the drained section of the TBM decline and launch box (**Table 3.1**). The gradient used in preliminary seepage calculations was 0.0007 metres change in head per metre change in distance (m/m).

Table 3.1: Hydraulic gradient across the site

Groundwater monitoring event	Hydraulic Gradient (m/m)
Gradient between DP-BH09 and DP-BH06 across the site	
September 2025	0.00043
December 2025	0.00042
March 2026	0.00046
Gradient between DP-BH12 and DP-BH05 at the TBM decline and launch box	
September 2025	0.00052
December 2025	0.00042
March 2026	0.00069

Notes:
m/m – metre change in head per metre change in distance

Cross sectional area

The cross-sectional area of the excavation is calculated from its dimensions. Groundwater seepage would only occur through cross-sectional areas that are saturated (i.e.. below the groundwater level). Only excavated areas that extended beyond the current groundwater level were considered for inclusion in the cross-sectional area. The reported depth to groundwater, below ground level, in groundwater monitoring wells DP-BH05 and DP-12 was 2.786mbgl and 3.179mbgl respectively. To simplify the calculations, groundwater depth was set at 2.9mbgl.

The drained section areas are calculated based on the length and depth and width that extends below the groundwater level. The walls and the base of the excavation were considered during the preliminary seepage calculations for the drained section. Within the undrained section, secant pile walls will be installed. These would act as a semi-impermeable barrier limiting groundwater seepage horizontally into the excavation. For simplicity, the seepage through the secant pile walls has been assumed to be negligible, therefore seepage would only occur through the base of the excavation vertically.

3.2 PHASE 2 - PARTIAL EXCAVATION CALCULATIONS

To calculate the seepage of the partial excavation in the drained section, the cross-sectional area of the walls and the base is required. A plan and cross-sectional schematic of the partial excavation is presented in **Figure** 3.1 below.

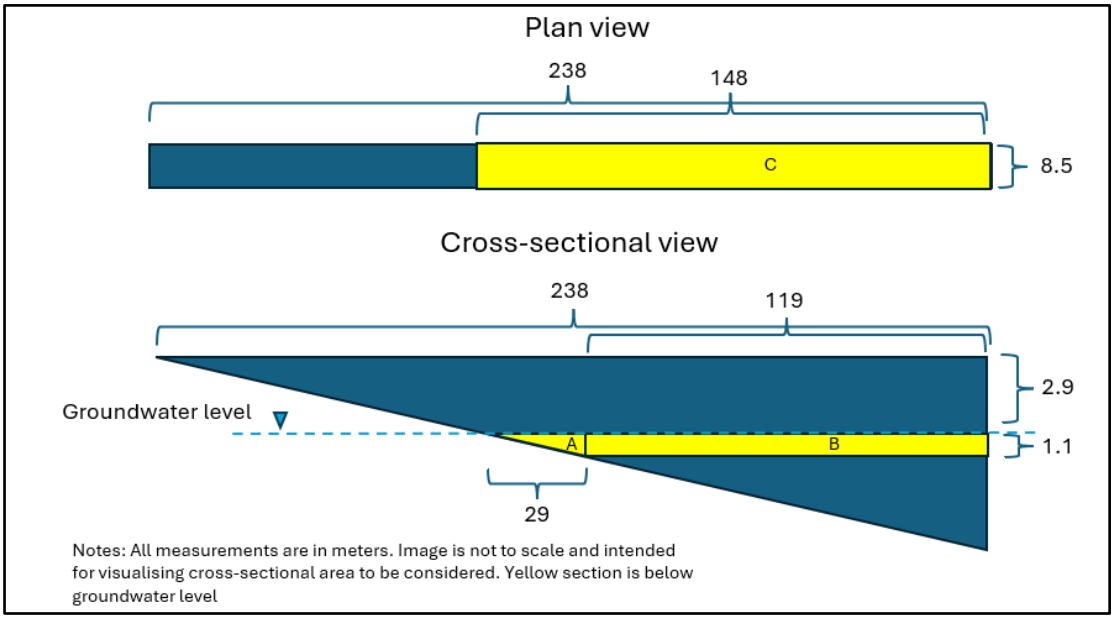


Figure 3.1: Schematic of cross-sectional area for partial excavation of drained section

The key elements and values used for the preliminary seepage calculation for the partial excavation are provided in **Table 3.2**.

Table 3.2: Variables for seepage calculation for partial excavation

Key element (variable)	Value
K	1.61 m/day
i	0.0007 m/m
A	1,561 m^2

Notes:
K – hydraulic conductivity i – hydraulic gradient
A – cross-sectional area m/day – metres per day
m/m – metre change in head per metre change in distance
m^2 – square metres

From the values in **Table 3.2**, the preliminary seepage calculated using Darcys Law is 1,800 litres per day (L/day), or 0.02L/sec.

3.3 PHASE 3 - COMPLETE EXCAVATION CALCULATIONS

To calculate the seepage of the complete excavation in the drained section and undrained section, the cross-sectional area has been separated into two parts. Part 1 is the cross-sectional area of the drained section, this is shown in the schematic in **Figure 3.2**. Part 2 is the base of the undrained section with the area provided in the Constructability report (SYSTRA, 2025) and summarised below in **Table 3.3**. The plan view is shown in **Figure 3.3**.

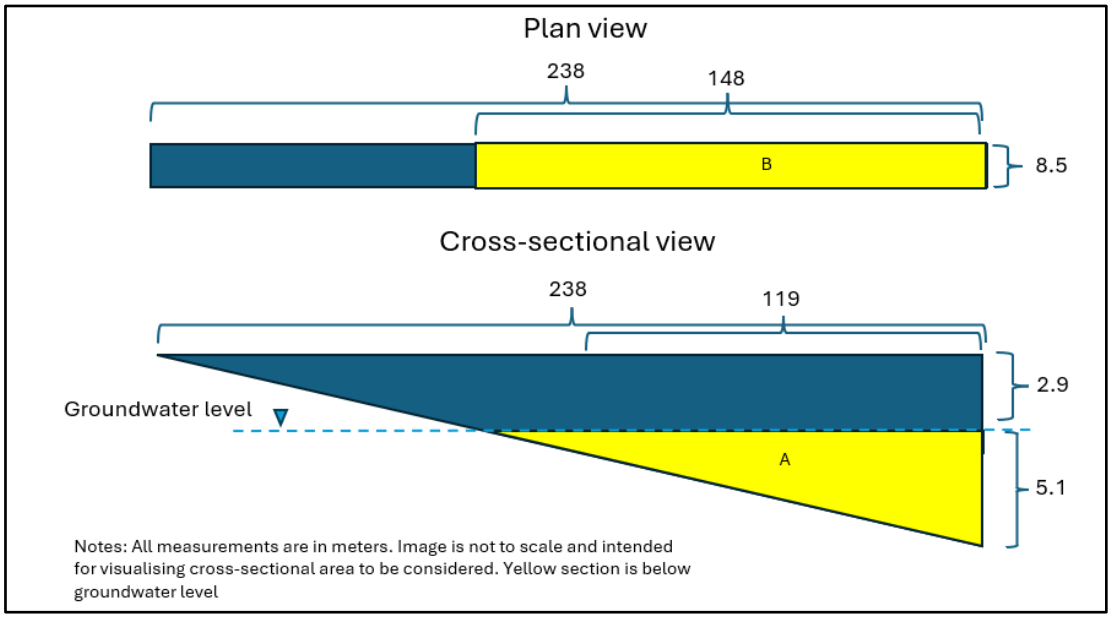


Figure 3.2: Schematic of cross-sectional area for complete excavation of drained section

Table 3.3: Area of undrained TBM decline and launch box

Location	Area (m^2)
Undrained TBM decline (sand coloured area)	1,038
Undrained TBM Launch box (blue coloured area)	859
Intake pumping station (green coloured area)	2,154

Notes:
m^2 – square metres

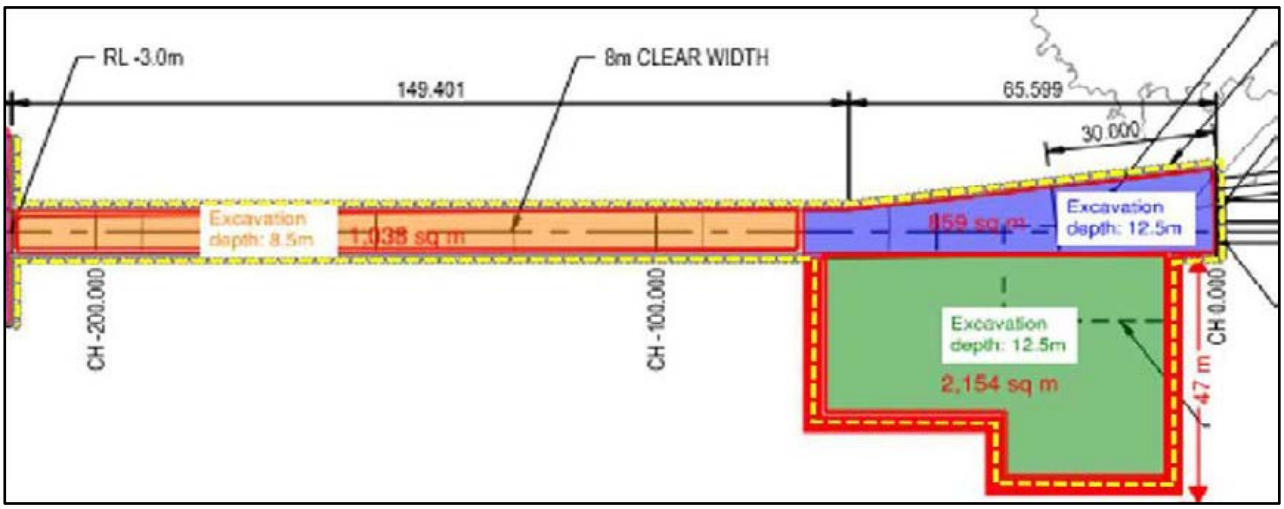


Figure 3.3: Plan view and are of TBM launch box and undrained area

The key elements and values used for the preliminary seepage calculation for the complete excavation are provided below in **Table 3.4**.

Table 3.4: Variables for seepage calculation for complete excavation

Key element (variable)	Value
K	1.61 m/day
i	0.0007 m/m
A	6,862 m^2

Notes:
K – hydraulic conductivity i – hydraulic gradient
A – cross-sectional area m/day – metres per day
m/m – metre change in head per metre change in distance
m^2 – square metres

Based on the values in **Table 3.4**, the preliminary seepage calculated using Darcys Law is 7,800L/day, or 0.09L/sec.

3.4 SUMMARY OF PRELIMINARY SEEPAGE CALCULATIONS

From the site-specific data, the preliminary seepage calculations for the TBM decline and launch box in Phase 2 and Phase 3 are summarised in **Table 3.5** below.

Table 3.5: Summary of preliminary seepage calculations

Phase	Preliminary discharge (seepage) calculation (L/day)
Phase 2	1,800
Phase 3	7,800

Notes:
L/day – litres per day

It should be noted that the preliminary seepage calculations presented above have used simplified site-specific data from a complex system. There is an inherent variability in geology and hydrogeological parameters that are not included in these calculations. This variability in aquifer and hydrogeological parameters can have significant impacts on groundwater discharge calculations, with estimated values potentially changing by an order of magnitude. The updated groundwater model (refer to **Section 4**) will be used to further evaluate the preliminary seepage calculations.

4 GROUNDWATER MODEL UPDATE AND REFINEMENT

This section describes the updates and refinement of the groundwater model, including refinement of the gird size, updated conceptualisation and design, transient groundwater levels for calibration, and results of the updated groundwater flow modelling.

The primary purpose of the model updates and refinement was to obtain insights into how the proposed groundwater management during construction would impact groundwater levels and flow surrounding the TBM decline and launch box. The subsections below include the modelling objectives and aim, refinement of the grid structure, model calibration with transient data, and simulated results based on the proposed groundwater management during construction.

The groundwater model update and refinement work presented within this report is built on previous work completed during the initial groundwater model. The initial model is presented in the *Hydrogeological Investigation - Proposed Mullaquana Desalination Plant Site* (Kleinfelder, 2026a). Given the model has been built on from this previous version, there are elements that remain unchanged. These elements are repeated within this report for completeness.

4.1 MODELLING UPDATE OBJECTIVES AND AIM

As outlined above in **Section 1.1**, the primary objectives of the groundwater model update and refinement are as follows:

- Understand groundwater elevations and drawdowns surrounding the TBM decline and launch box from groundwater management at selected stages throughout the project and excavation
- Understand inflow rates (seepage) throughout the proposed excavation for the TBM decline and launch box at selected stages throughout the project

4.1.1 Model selection

There are three different classes of models, as presented in the *Australian groundwater modelling guidelines* (Barnett et al., 2012) and outlined below in **Table 4.1**. The class of model determines the level of confidence and level of complexity that is involved in the model development and the modelling software to be used. Given the aim and objectives of the groundwater model outlined above, a Class 1/2 model is appropriate, i.e., screening level with the primary aims to understand groundwater flow processes under hypothetical conditions and to provide a guide to and/or inform groundwater management requirements for an excavation and associated impacts.

Table 4.1: Summary of different classes of models

Confidence level classification	Examples of specific uses[1]
Class 3	▪ Suitable for predicting groundwater responses to arbitrary changes in applied stress or hydrogeological conditions anywhere within the model domain ▪ Provide information for sustainable yield assessments for high value regional aquifer systems ▪ Evaluation and management of potentially high-risk impacts ▪ Can be used to design complex mine dewatering schemes ▪ Simulating the interaction between groundwater and surface water bodies.
Class 2	▪ Prediction of impacts of proposed developments in medium value aquifers ▪ Evaluation and management of medium risk impacts ▪ Providing estimates of dewatering requirements for mines and excavations and associated impacts ▪ Designing groundwater management schemes such as managed aquifer recharge, salinity management schemes and infiltration basins
Class 1	▪ Design observation bore array for pumping tests ▪ Predicting long-term impacts of proposed developments in low value aquifers ▪ Estimating impacts of low-risk developments ▪ Understanding groundwater flow processes under various hypothetical conditions ▪ Provide first-pass estimates of extraction volumes and rates required for mine dewatering

[1] examples sourced from Barnett et al., 2012

Given the selected class of model and the overall objective, modelling was completed using a combination of the following programs:

- **Leapfrog Works®** (Leapfrog) (Seequent Limited) – used to construct a 3D data visualization for input and visualization of geology throughout the assessment and study area. Both publicly available hydrogeological data and site-specific hydrogeological data collected in the field were used to inform the overall geological layers throughout the study area. Leapfrog was also used as a repository for collation of the associated data, both geological and hydrogeological, throughout the study area. The hydrogeological data were exported from Leapfrog as a grid and layer domain for importing into the groundwater modelling software.
- **Groundwater Vistas®** (v9.0) – for construction of both the steady-state and transient groundwater flow model using **MODFLOW-USG**. Further details on Groundwater Vistas® and MODFLOW are provided below in **Section 4.3**.

4.1.2 General approach to modelling

The general approach to groundwater modelling is to generate a simplified representation of a complex system to gain insights into the driving processes and how external factors (i.e., dewatering or groundwater management) may influence the system. The overall approach to a groundwater model design is development of a conceptual site model (CSM) that represents hydrostratigraphy and different aquifer parameters of the area of interest and the broader study area. Hypothetical scenarios can then be simulated to observe and predict the changes to groundwater levels and flows (i.e., predictive scenarios). The same process is applied for a groundwater model update and refinement, new information is reviewed and, where required, parameters are updated to reflect the new measured conditions at the site.

The overall objective of the model update and refinement is to gain further insights into groundwater responses to the proposed groundwater management during excavations and construction of the TBM decline and launch box. As presented in **Section 3** there is five key phases that are to be considered:

- **Phase 1**: Baseline condition – prior to any excavation works
- **Phase 2**: Partial excavation of drained section – excavation of the TBM decline drained section to approximately 4mbgl and installation of the secant walls
- **Phase 3**: Complete excavation of drained and undrained sections – excavation of the entire TBM decline and launch box, including the approximate footprint of the IPS to approximately 13mbgl
- **Phase 4**: Sealing and construction of the intake and outfall tunnels – the base of the undrained section is to be sealed with a concrete slab for the tunnelling and construction works of the IPS
- **Phase 5**: Backfilling and completion of works

4.2 CONCEPTUALISE MODEL

The CSM begins with the collation of data obtained from the hydrogeological investigation and the current understanding of hydrostratigraphy and groundwater of the study area. These data are then used to conceptualise geology and where aquifers are encountered/present and their characteristics. This is generally based on geological units for simplicity, with a layer to define each. As outlined above in **Section 4.1.1**, geology was conceptualised using Leapfrog before being exported to Groundwater Vistas® (v9.0). In addition to interpolation of 2D surfaces (e.g., groundwater potentiometric surface, planar geologic features), Leapfrog uses point data that are distributed in 3D space to build contact surfaces. The program works by interpolating points in 3D space using peer-reviewed 3D interpolation engine, Fast Radial Basis Function (FastRBF™) (Beatson et al., 2000, 2001; Cherrie et al., 2002). If the data are interval data (e.g., lithology), Leapfrog Works® converts the interval data to point values at either end of the interval. These points are interpolated to form surfaces, and a clipping 3D boundary is used to constrain the interpolation.

Since the initial groundwater model was developed, additional field work has been undertaken at the site, with a further 14 boreholes drilled and 12 groundwater wells installed. The geology was generally consistent with previous geology encountered and the initial CSM of the model remains appropriate. The three primary layers from the initial model remain the same, however given the level of detail required in the top 20 m of the TBM decline and launch box, Layer 1 has been further discretised into 10 sublayers. The updated layers are further discussed below.

4.2.1 Layer 1 to 10 – Differentiated and unconsolidated alluvial deposits

Layer 1 through to 10 consist of heterogeneous alluvial deposits of variable thickness. Field investigations completed throughout the site and area of interest have identified these deposits as fine-grained alluvial sediments, primarily clay with areas of intercalated sandy clay and gravelly sandy clay within the study area and site. Additionally, publicly available information for areas outside the area of interest indicates the thickness of these deposits varies, with a minimum thickness of 39.95m and maximum thickness of 83.13m in the broader area. The differentiated and unconsolidated alluvial deposits consist of 10 layers each between 3.9m to 8.3m thick, depending on location and elevation. The discretisation allows for increased level of detail within this geological unit, particularly in the top 20m which is the area of focus for the TBM decline and launch box.

4.2.2 Layer 11 – Confining unit

Layer 11 is an extensive confining unit that is present throughout the entire model domain. This confining unit ranges in thickness and is situated immediately above the weathered basement rock of granite (layer 12). The estimated thickness of layer 11 ranges from 4.95m in the west to 55.60m thick in the east, and is comprised of clay, silt, and lignite, based on publicly available data. No soil bores drilled during this hydrogeological investigation intersected the confining unit.

4.2.3 Layer 12 – Weathered basement rock

Layer 12 is the weathered basement rock, which represents the base of the model. Three boreholes throughout the initial model domain had publicly available data for the basement rock in layer 12. From the publicly available data, the basement rock is a granite that is highly weathered in the upper portions (what is included within this conceptualized model). The thickness of the basement rock varies, being thicker in the west, with a maximum thickness of 115.40m and thinner throughout the central and eastern portions, with a minimum thickness of 5.00 m. Layer 12 is characterised as a confined fractured rock aquifer throughout the model domain.

4.3 NUMERICAL MODEL UPDATE

The update and refinement of the groundwater flow model, both steady-state and transient, were constructed using the Groundwater Vistas® (v9.0) modelling platform developed by Environmental Simulations Inc. (ESI, 2024), consistent with the initial groundwater model developed. The program consists of a series of pre- and post-processors that transfer information to a groundwater modelling computer code. Groundwater flow modelling was performed using the United States Geological Survey (USGS) three-dimensional, finite-volume, computer code MODFLOW-USG (Panday et al., 2013). MODFLOW-USG consists of a main program that directs the execution of the simulation. It also contains a series of user-selectable packages or modules that simulate groundwater flow, control the solution of the finite-volume equations, and simulate boundary conditions. Length and time units of metres and days, respectively, were specified in the model, and the assigned parameter values were in consistent units.

The overall process for updating and refining the groundwater model is the same as construction of a model as outlined below:

- Refinement of model domain and discretisation, i.e., grid size, cell size(s), and number of layers
- Identification of new boundary conditions and input of boundary parameters
- Input/update of recharge and evapotranspiration
- Input/update of initial aquifer parameter estimates, including hydraulic conductivity, storage coefficient, and effective porosity
- Description of solver to simulate flow and movement of groundwater throughout the model domain

Each of these components is outlined below with the inputs and assumptions considered for the update and refinement of the groundwater model.

4.3.1 Model domain

The refined model domain and grid are represented in **Figure 4.1** below. To obtain the detail required around the area of interest the grid size was further refined from the initial model to focus on the TBM decline and launch box, covering an area of 0.28 square kilometres (km^2). The overall model grid consisted of 84 parent rows and 79 parent columns with 13 layers. Parent rows and columns are represented by the largest cells in **Figure 4.1**, with a grid spacing of 100m x 100m. The smaller cells represent the refined grid around the area of interest, the TBM decline and launch box, with a grid spacing of 2.5m x 2.5m. The gird was refined using a package within the modelling platform called the nested grid structure, or local grid refinement. It's a process of refining a selected area within the model domain for refined detail. The nested grid structure allows for the larger cells within the overall model domain while deploying a refined grid in the area of interest around the TBM decline and launch box.

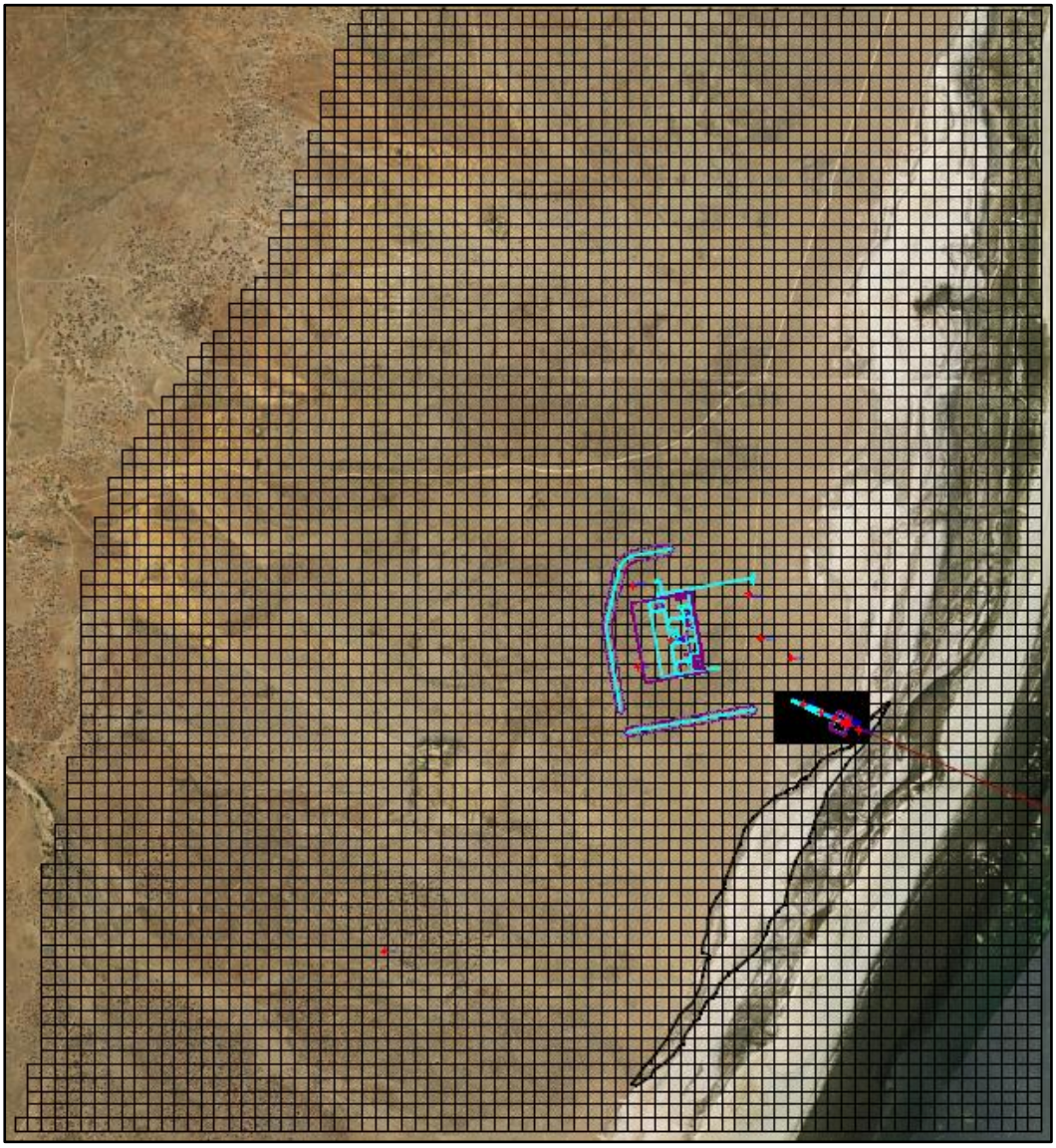


Figure 4.1: Model domain and grid

A total of 527,492 cells represent a total area of approximately 66.36km^2 within the model domain. Given the number of cells within the model domain, 8811 cells on the west of the model domain were set as inactive with no flow to improve model run times during calibration and simulations (refer to **Figure 4.3**). Inactive cells within layer one is not displayed in **Figure 4.1** above. The current desalination plant design footprint and TBM decline and launch box is also displayed in **Figure 4.1**. **Figure 4.2** shows a zoom in of the refined grid structure around the TBM decline and launch box.

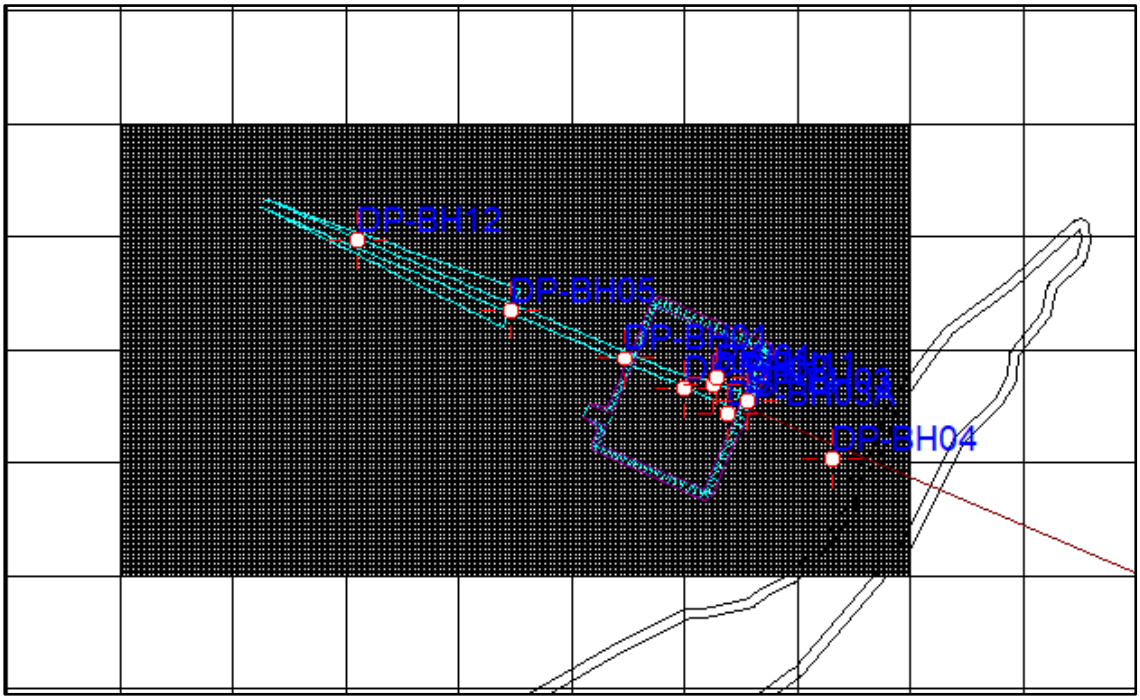


Figure 4.2: Refined grid structure within the TBM decline and launch box

4.3.2 Boundary conditions

Boundary conditions are elements that have defined limits/inputs in the model. There are three different types of boundary conditions as presented below (Barnett et al., 2012).

- Type 1, Dirichlet or specified-head (or constant-head) boundary condition: the head within a boundary or cell is specified, and the flow across the boundary section and/or cell is calculated.
- Type 2, Neumann or specified head-gradient boundary condition: the gradient of the hydraulic head is specified within a boundary section and/or cell, and flow rate across the boundary section and/or cell is specified.
- Type 3, Cauchy or specified-head gradient boundary condition: both the head and the gradient are specified in the boundary section and/or cell.

Details of the different boundary conditions designated for the study-area groundwater-flow model are detailed below.

4.3.2.1 Constant-head boundaries

A constant-head boundary, or specified-head boundary, is a Type 1 boundary condition. A constant-head boundary can represent features such as large lakes, water bodies, regional groundwater flow, or rivers where the water level remains at a fixed elevation (head). That is, water can flow freely in to or out of the boundary, to maintain a constant head, acting as an infinite source or sink. Within the model domain there are two different constant head boundaries:

- The western boundary of the model is defined as a constant-head boundary, with a head of 6 metres Australian height datum (mAHD) to simulate regional groundwater flow or base flow from the Middleback Ranges into the model domain.
- The eastern boundary was defined as a constant-head boundary due to the marine interface and no tidal influence observed on groundwater levels (refer to hydrographs in **Appendix C**). The head elevation for this boundary was defined as sea level (0mAHD) and is a natural boundary. This boundary was set based on the digital elevation model provided for the site and follows the inferred beach front along the coastline at 0mAHD.

The constant-head boundary conditions are presented on **Figure 4.3** below.

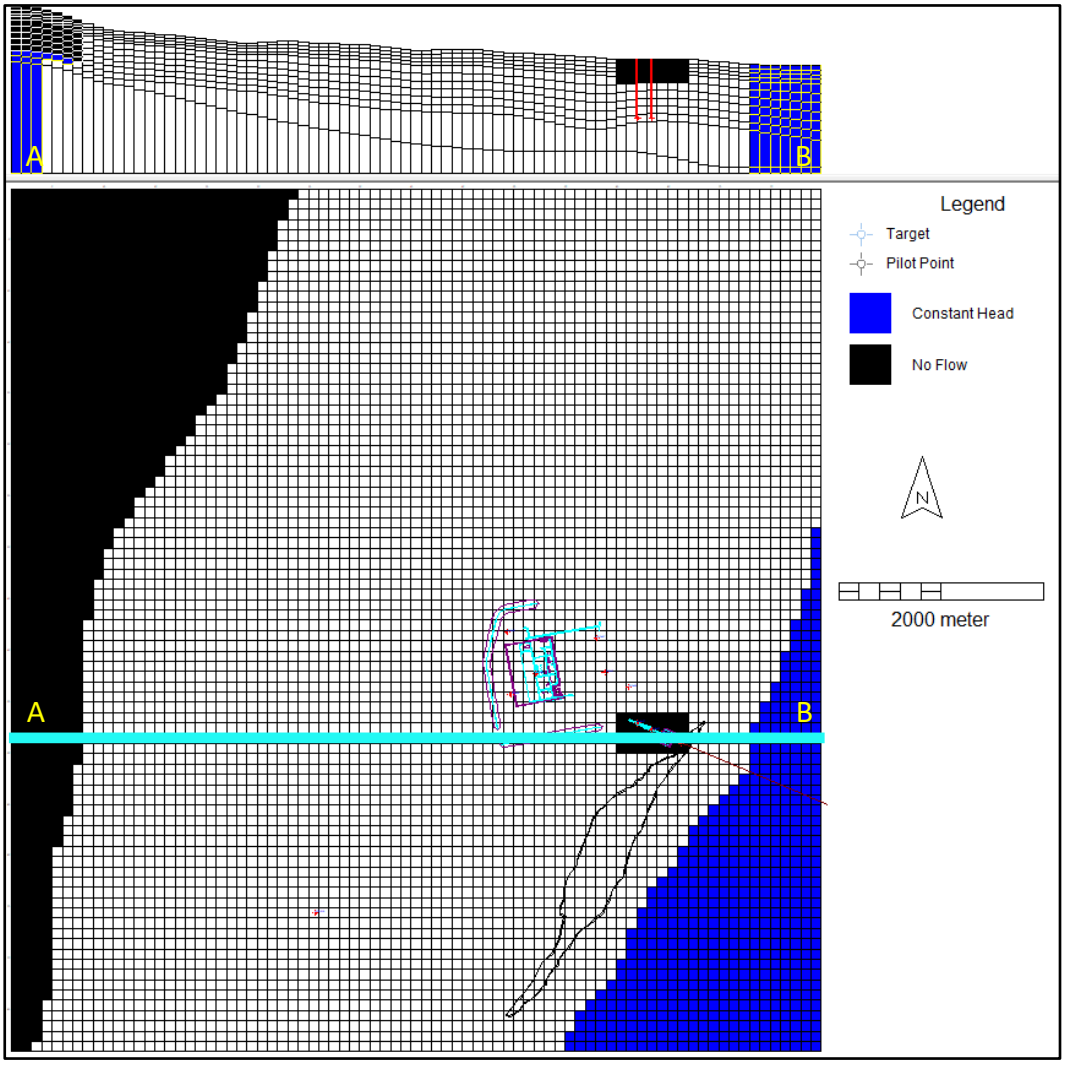


Figure 4.3: Model boundary conditions (vertical profile along row A-B is shown above)

4.3.2.2 Horizontal flow boundary condition

Certain features of the proposed TBM decline and launch box need to be captured within the model, the secant pile walls, which act as a semi-impermeable for the undrained section (refer to **Figure 1.1**). The secant pile walls are considered a boundary condition as this limit's groundwater movement through a certain area/cell within the model domain. The Horizontal Flow Boundary Package (HFB) was used to limit groundwater flow. The secant pile wall surrounding the undrained section of the TBM decline and launch box will be input in the model as an HFB. The HFB Package is a type 2 boundary condition as it limits the flow rate across the boundary section and/or cell. It operates between model cells, applying a resistance to the movement of flow between adjacent cells. The HFB will be input to a maximum depth of 20mbgl, which would extend a vertically through the first five layers surrounding the undrained section of the TBM decline and launch box.

4.3.2.3 Drain – sumps within excavation

A primary goal of the model update and refinement is to understand groundwater seepage into the excavation or void during certain phases. To simulate the proposed passive groundwater management of sumps within the excavation, the MODFLOW Drain (DRN) Package was used. A drain boundary condition removes water from the aquifer if the head in the model cell is above the prescribed drain elevation. From simulation of extraction rate over time, the groundwater seepage into the excavation can be evaluated. Discharge of groundwater through a drain from the excavation is a specified head or type 1 boundary condition. Further details on the groundwater discharge/seepage rates are provided in **Section 4.5**.

4.3.3 Recharge and evapotranspiration

Recharge and evapotranspiration are components of the model water-balance budget. These input parameters can have a significant impact on simulated results and require careful consideration. The climate of the study area is defined as warm mediterranean style, typically characterised by hot dry summers with cool wetter winters. The recharge and evapotranspiration within the model domain are discussed further below and have been based on 10 years of historical data obtained from Bureau of Meteorology which is outlined in detail in the *Hydrogeological Investigation* (Kleinfelder, 2026a).

4.3.3.1 Recharge

Recharge within the updated model domain was kept consistent with the initial model developed, assuming deep percolation of aerial recharge from precipitation. Studies undertaken for groundwater recharge in semiarid and arid regions identified a linear relationship between precipitation and recharge (Scanlon, et al., 2006). Based on the relationship identified, an annual rainfall of 300 to 400 millimetres (mm) per year would provide from 4 to 7mm of recharge per year. Given this relationship, a conservative estimate of between 1 - 4% of rainfall was assigned as recharge throughout the model domain.

4.3.3.2 Evapotranspiration

Evapotranspiration within the updated model domain was kept consistent with the initial model developed and kept extremely high within the study area. Potential total annual evapotranspiration exceeds annual precipitation within the study area. Where sufficiently shallow, the unconfined aquifer is likely to lose water to evapotranspiration as is evident through the groundwater type and water chemistry (elevated sodium and chloride, high total dissolved solids (TDS) and electrical conductivity (EC) classifying the groundwater as a brine). Given these factors, evapotranspiration was considered an important variable and included in the model, assuming deep, yet limited, evapotranspiration with an effective depth of up to 3mbgl.

4.3.4 Aquifer parameters

The following sections describe the updated initial hydraulic parameter estimates used during the update and refinement of the groundwater flow model. The updated hydraulic parameters include the initial aquifer testing results and the additional aquifer testing results, as presented in **Section 2.2**.

4.3.4.1 Hydraulic conductivity

Horizontal hydraulic conductivity values derived from aquifer tests (slug tests and pumping tests) of wells screened within layers 1 through to 7 were used to interpolate hydraulic conductivity values throughout the model domain. Derived values for hydraulic conductivity from aquifer testing were used for the differentiated and unconsolidated geology in layers 1 through 10. Horizontal hydraulic conductivity for layers 11 and 12 was assigned based on literature values for the hydrogeological units identified, and were kept consistent with the initial model values, which are presented in **Table 4.2** below. The hydraulic conductivity within all layers was assumed to be homogenous and isotropic in the horizontal and lateral directions (x and y directions). The hydraulic conductivity in the vertical (z) direction, was assigned an order of magnitude lower (i.e., vertical anisotropy). Further refinement of hydraulic conductivities was undertaken during model calibration using Parameter Estimation (PEST) inverse modelling (Doherty, 2004), as further discussed in **Section 4.4.1**. The initial hydraulic conductivity values presented in **Table 4.2** were used as pilot-point targets to direct and limit PEST parameter value optimization and interpolation of hydraulic conductivity in the model. **Figure 4.4** presents the refined hydraulic conductivities, after calibration is completed, for all layers.

Table 4.2: Initial vertical and horizontal conductivities

Layer – Unit	Kx=Ky	Kz
Layer 1-10 – Differentiated and unconsolidated alluvial deposits[1]	0.81 m/day	0.081 m/day
Layer 11 – Confining unit[2]	2.50×10^{-10} m/day	2.50×10^{-11} m/day
Layer 12 – Weathered basement rock[2]	1.00×10^{-8} m/day	1.00×10^{-9} m/day

Notes:
[1] indicates estimates from aquifer tests completed onsite
[2] indicates estimates from literature values – Domenico and Schwartz, 1990
Kx=Ky – hydraulic conductivity along the x and y axes (isotropic)
Kz – hydraulic conductivity along the z axis

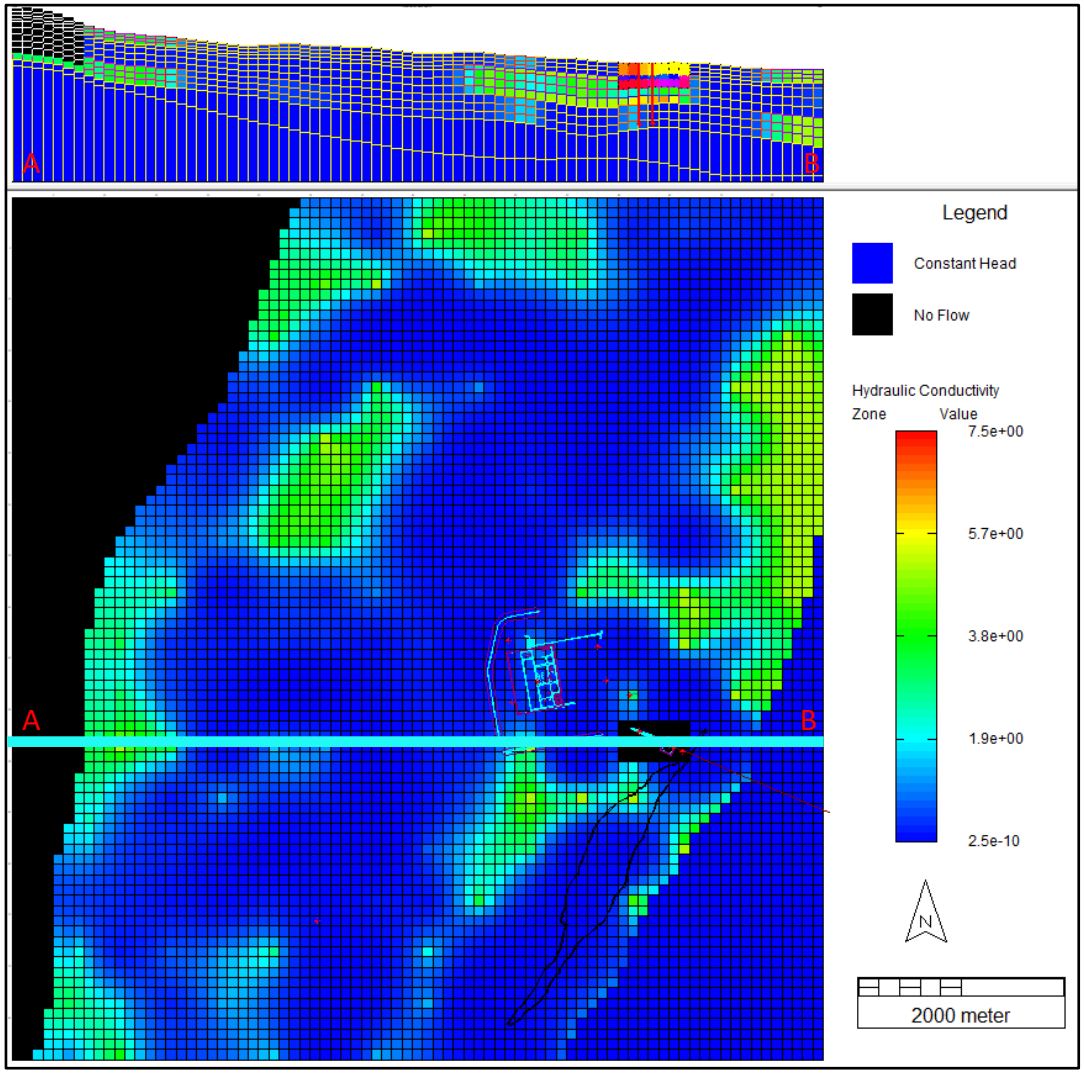


Figure 4.4: Calibrated horizontal hydraulic conductivity (vertical profile along row A-B shown above)

4.3.4.2 Storage coefficient

While only important for transient simulations, values of storage parameters (specific yield for unconfined layers, and specific storage for confined layers) were assigned for the groundwater flow modelling. Storage values are assigned in zones, which include layers within the model domain. The specific yield assigned to layer 1 through 10 was 0.03, derived from aquifer tests completed at the site. The specific storage value assigned to Layers 11 and 12 was 0.00065 and 0.00001, respectively, and based on literature values (Domenico and Schwartz, 1990)

4.3.5 Solver

The Preconditioned Conjugate-Gradient for Unstructured grids (PCGU) was used to solve the groundwater flow matrix equations for hydraulic head produced by MODFLOW-USG. The solver calculates the hydraulic-head distribution in the model domain by iteratively solving the flow equations. It efficiently solves large, sparse linear equations arising from complex (unstructured) grid systems, handling issues like flow residuals and convergence for large-scale hydrologic simulations. These equations are solved many times until certain criteria are met, indicating that a solution has been obtained. The model's solution has converged when the difference in calculated head values between one iteration and the next is below a set value (the convergence criterion, which in this case was 0.01m), indicating that additional iterations will provide only a marginal improvement in the flow field solution.

4.4 MODEL CALIBRATION

4.4.1 Transient flow calibration

Calibration of both the steady-state and transient flow model was completed using PEST. Calibration of the groundwater flow model involved adjustment of uncertain parameters, including hydraulic conductivity and

recharge, to obtain the best match between observed and simulated hydraulic head values. In general terms, the calibration is performed so that the results of simulations match measured head and flux values as closely as possible while maintaining hydraulic parameter values that are reasonable and consistent with the conceptual model (i.e., not significantly different than calculated/measured values). Calibration is thus an iterative process, whereby the model is run multiple times to find the optimum values and distribution of parameters.

Calibration was considered optimised when a statistically reasonable match between observed and model-calculated head values was obtained and the absolute residual mean (ARM, i.e., mean of the absolute value of target residuals) was less than 10% of the observed range in hydraulic head (Anderson and Woessner, 1992). The calculated scaled ARM of the calibrated model was 2.6 percent. The normalized root mean square (RMS) is expressed as a percentage scaled to the observed head range, and is a more representative measure of the fit than the scaled ARM. The calculated scaled RMS of the calibrated model was 4.1 percent. In addition, spatial bias for positive and/or negative residuals was not apparent (refer to **Figure 4.5**), further supporting acceptable model calibration The calibration statistics are plotted on a graph, presented below on **Figure 4.5**, that shows the calculated head compared to the observed head at monitoring wells in the study area.

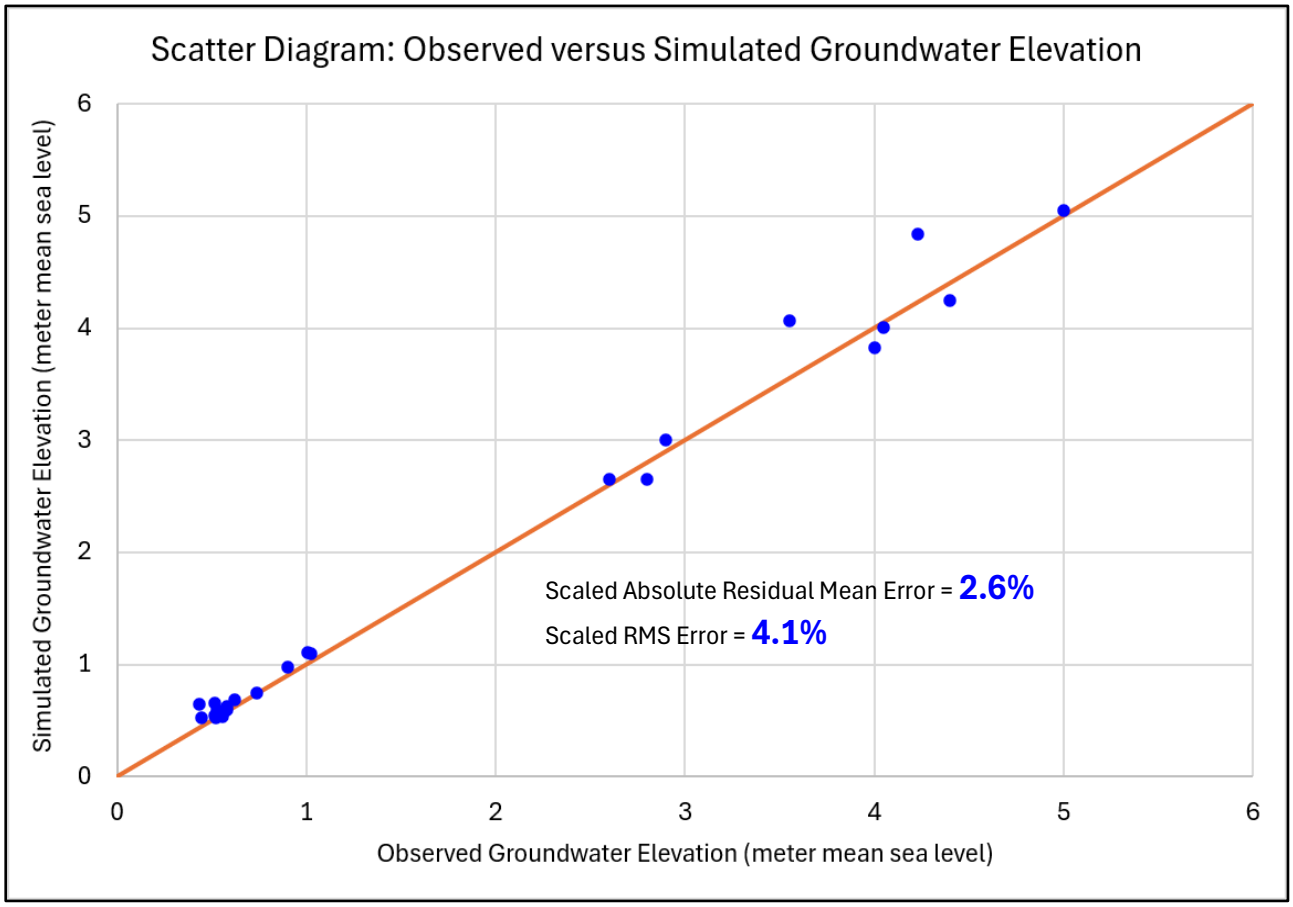


Figure 4.5: Scatter diagram – observed versus simulated groundwater elevation

Review of transient (time series) comparison between observed and simulated groundwater elevation at some selected groundwater monitoring wells indicated that the overall pattern, timing, magnitude, and calibration statistics appear to show that the model is calibrated transiently. Observed and simulated results for four selected wells, DP-BH04, DP-BH03A, DP-BH13 and DP-BH10, are presented in **Figure 4.6** below. The comparison shows a reasonable match of the modelled results to within 0.1m of the observed groundwater elevation data. An overall decreasing trend is present in the observed water levels from the 6 months of monitoring data. The modelled results also show an overall decreasing trend. Groundwater elevations near the coast and around the TBM decline and launch box show a rapid response to rainfall, as show in DP-BH04 and DP-BH03A. This rapid response can also be seen in the hydrographs in **Appendix C**. This rapid response to rainfall is likely an artefact of local changes in geology or ground cover giving rise to different recharge in isolated areas.

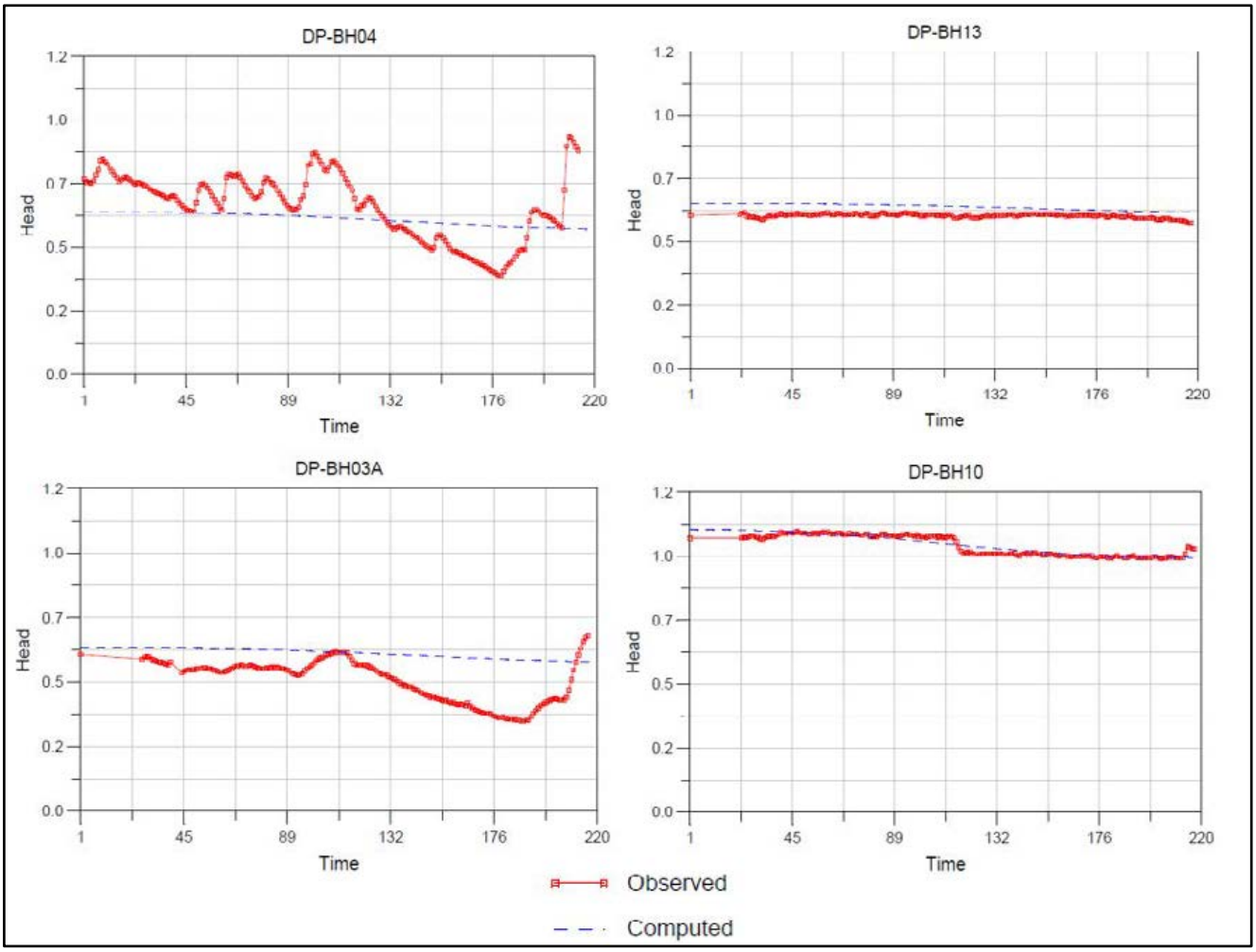


Figure 4.6: Simulated and measured groundwater elevation time series at selected groundwater monitoring wells

The simulated groundwater elevation contours from the unconfined aquifer are presented in **Figure 4.7**, and show groundwater flowing from the west, at the foot of the Middleback Range, to the marine interface at the Spencer Gulf in the east (both identified as constant-head boundary conditions (see **Section 4.3.2**). The simulated groundwater contours show a 0.5mAHD elevation around the TBM decline and launch box. This observed local groundwater high is likely resultant of the following:

- Increased density of measured data around the area of interest compared to areas more distal from the TBM decline and launch box
- Changes in local geology and hydraulic conductivity, which would impact groundwater movement and flow regime (refer to calibrated horizontal conductivity **Figure 4.4**).

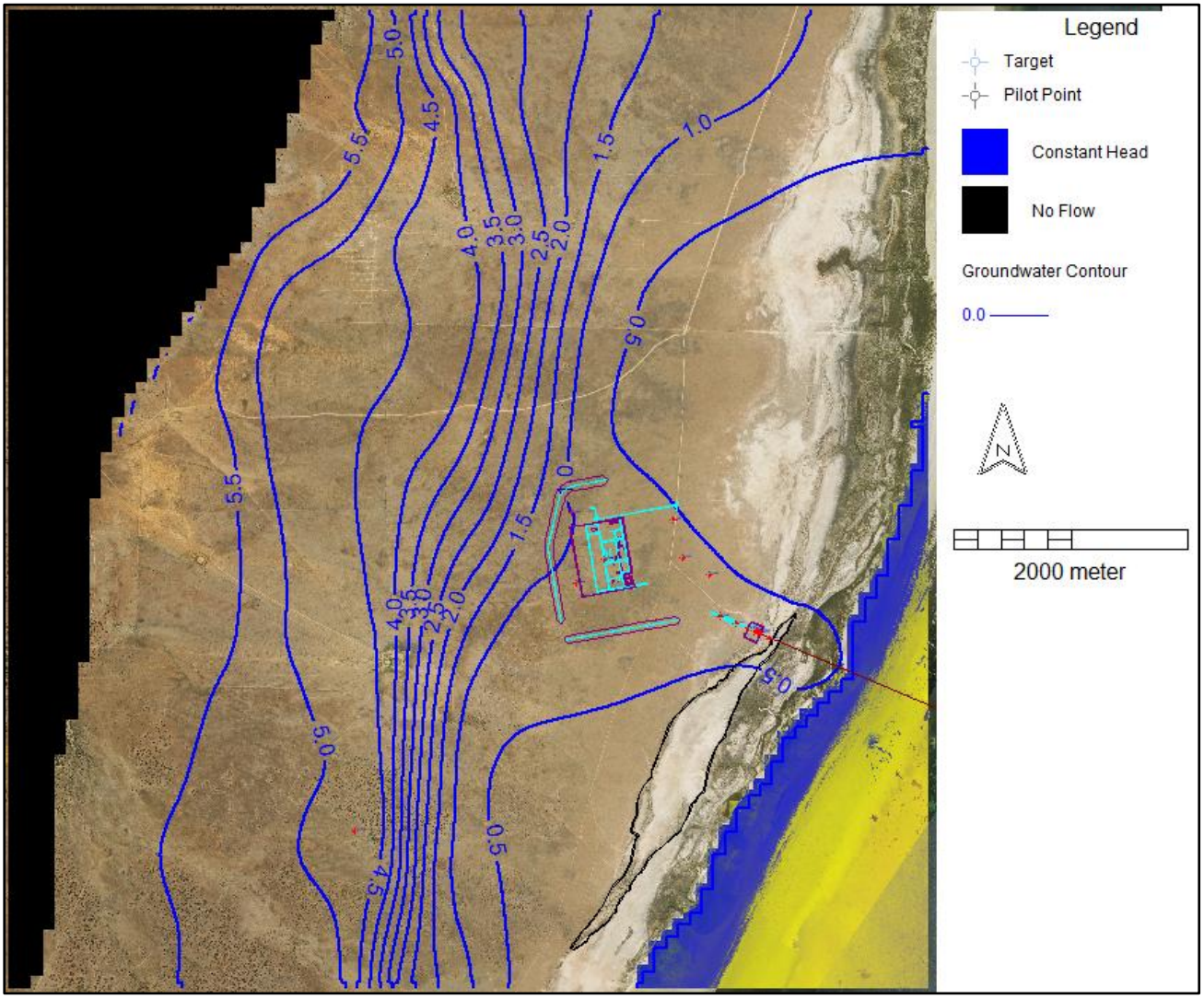


Figure 4.7: Simulated transient groundwater elevation contours

4.4.2 Model water balance

The mass balance of the groundwater model is generally considered to be acceptable when the difference between the incoming and outgoing groundwater fluxes is less than one percent, and ideal when the difference is less than 0.1 percent (Anderson and Woessner, 1992). The mass balance error for the final calibrated model was calculated as -0.04 percent (slightly more flux leaving than entering the model).

4.4.3 Model sensitivity analysis

A sensitivity analysis was conducted to identify which model input parameters have the most effect on model predictions. The sensitivity of simulated hydraulic heads was evaluated using changes in hydraulic conductivity, recharge, and evapotranspiration. Selected parameter values were varied around the calibrated value (base case) and the residual sum of squares (RSS) between simulated and target head for each simulation was compared to the RSS of the base case. The RSS is a statistical metric that measures the total discrepancy between observed values and the values predicted by a model. A lower RSS indicates a better fit, meaning the model's predictions are closer to the actual data.

A parameter was considered sensitive if changes in parameter value resulted in a significant increase in the base case RSS (i.e. 1.5 times the base case RSS). Results of the sensitivity analyses are presented in **Table 4.3**. The model appears to be sensitive to overall changes in horizontal hydraulic conductivity and increased recharge. The model exhibits no sensitivity to changes in vertical hydraulic conductivity.

Table 4.3: Sensitivity analysis

Multiplier	Sum of square residuals		
	Kx=Ky	Kz	Recharge
0.001	52,287.47	113.83	415.76
0.01	49,014.82	45.79	407.40
0.1	15,911.26	29.87	329.38
0.5	504.16	34.29	94.13
1	**34.33**	**34.33**	**33.90**
2	66.16	34.12	663.76
5	165.74	34.08	7,548.04
10	207.37	33.97	28,559.20
100	234.39	34.27	127,249.00

Notes:
Kx=Ky – hydraulic conductivity along the x and y axis (isotropic)
Kz – hydraulic conductivity along the z axis
Multiplier 1 shows the input data for the calibrated model

4.5 GROUNDWATER MANAGEMENT SIMULATION

The primary goal of the groundwater model update and refinement is to obtain insights into potential impacts on groundwater during excavation and construction of the TBM decline and launch box. Following the development and calibration of the steady-state and transient flow models, several predictive transient model scenarios were developed to simulate the different phases during the construction as outlined below:

- Phase 1: Baseline condition – prior to any excavation works (calibrated base model)
- Phase 2: Partial excavation of drained section – excavation of the TBM decline drained section to approximately 4mbgl and installation of the secant walls
- Phase 3: Complete excavation of drained and undrained sections – excavation of the entire TBM decline and launch box, including the approximate footprint of the IPS to approximately 13mbgl
- Phase 4: Sealing and construction of the intake and outfall tunnels – the base of the undrained section is to be sealed with a concrete slab for the tunnelling and construction works of the IPS
- Phase 5: Backfilling and completion of works

To simulate Phase 2 through Phase 5 of the TBM decline and launch box excavation, a predictive transient model was created for each phase. As the desalination plant is still currently in the design phase, the construction period and proposed methodology may change. However, the proposed excavation/construction time for each phase has been provided by DIT (**Table 4.4**). The number of stress periods (days) in each phase is also presented in **Table 4.4**.

Table 4.4: Phase of simulation and number of stress periods

Phase of simulation	Time period	Stress periods in model*
Phase 2	4 months	120
Phase 3	10 months	300
Phase 4	24 months	720
Phase 5^	24 months	-

Notes:
* indicates each stress period is a day.
^ indicates qualitative assessment completed

For clarity, throughout the remainder of this section, the following terms are used as defined below:

- Phase – is a predictive scenario that has been simulated to external stresses (such as excavation) to assess a response (e.g. Phase 2) in transient groundwater flow conditions
- Time period – is the period or time frame that a Phase is simulated (for e.g. 4 months)
- Stress period – is an individual time step within the Phase (in days)

4.5.1 Modelled phases

As outlined above, a total of five different phases, comprising the proposed excavation and construction of the TBM decline and launch box, were simulated. Each phase had different input parameters such as drain package, , HFB, time period, and number of stress periods to evaluate the proposed groundwater management. The detail simulated results of each phase are presented below Detail descriptions and the excavation depths within the TBM launch box, including ramping, and the pumping station and intake pumps are provided in **Appendix D**.

4.5.1.1 Phase 1 – baseline conditions

Phase 1 is the baseline conditions for the site. This phase is the calibrated model with no excavation or passive groundwater management. The simulated groundwater elevations across the site are shown in **Figure 4.7**. Simulated groundwater elevation contours within the area of interest around the TBM decline and launch box are shown in **Figure 4.8** below.

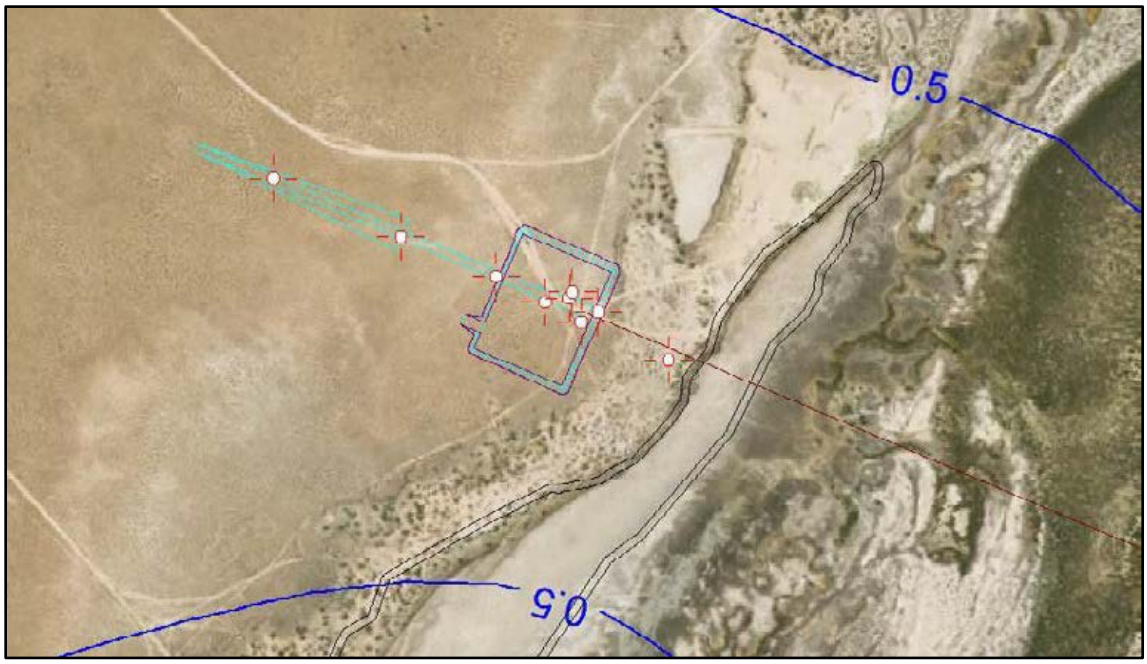


Figure 4.8: Baseline simulated groundwater flow conditions around the TBM decline and launch box

4.5.1.2 Phase 2 – Partial excavation of drained section

Phase 2 is the partial excavation of the TBM decline and launch box. The partial excavation or void was simulated by applying a drain boundary condition (purple color in Appendix D) with an elevation of approximately -0.1mAHD or 4.0mbgl depth. Phase 2 was simulated for four months (120 stress periods). To estimate groundwater seepage into the excavation zone, the total discharge from the drain boundary condition was reviewed. The seepage or flux was estimated to be approximately 0.02L/sec, with groundwater elevations at approximately -0.1mAHD. **Figure 4.9** shows simulated groundwater contours, or cone of depression, around the excavation zone.

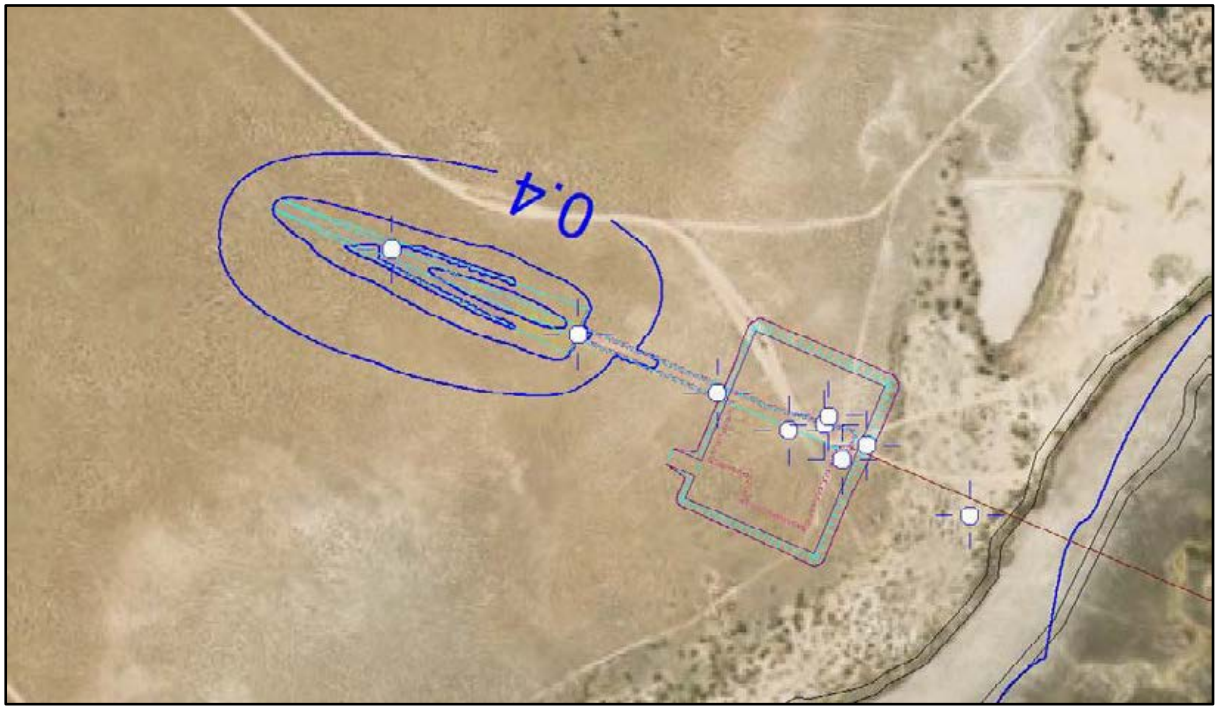


Figure 4.9: Simulated groundwater contours during partial excavation

4.5.1.3 Phase 3 – Complete excavation of drained and undrained sections

Phase 3 is the complete excavation of both the drained and undrained sections of the TBM decline and launch box. With the undrained section, a secant pile wall will be installed to the north, south, and east. As outlined in **Section 4.3.2.2**, the secant pile walls are depicted as HFB which serve to limit groundwater movement across adjacent cells. Phase 3 required the drained section and undrained section to be excavated to a maximum depth of 8mbgl (approximately -4.0mAHD) and 12.5mbgl (approximately -8.5mAHD), respectively. In Phase 3, the excavation and seepage were simulated using the drain and HFB packages. The groundwater elevations from the last stress period in Phase 2 were set as the initial groundwater elevations for Phase 3 as the work will be completed sequentially. The simulation was run for a time period of 10 months (300 stress periods in the groundwater flow model). The estimated seepage throughout this phase was approximately 6.2L/sec. **Figure 4.10** shows the cone of depression developed during Phase 3 groundwater flow simulation.

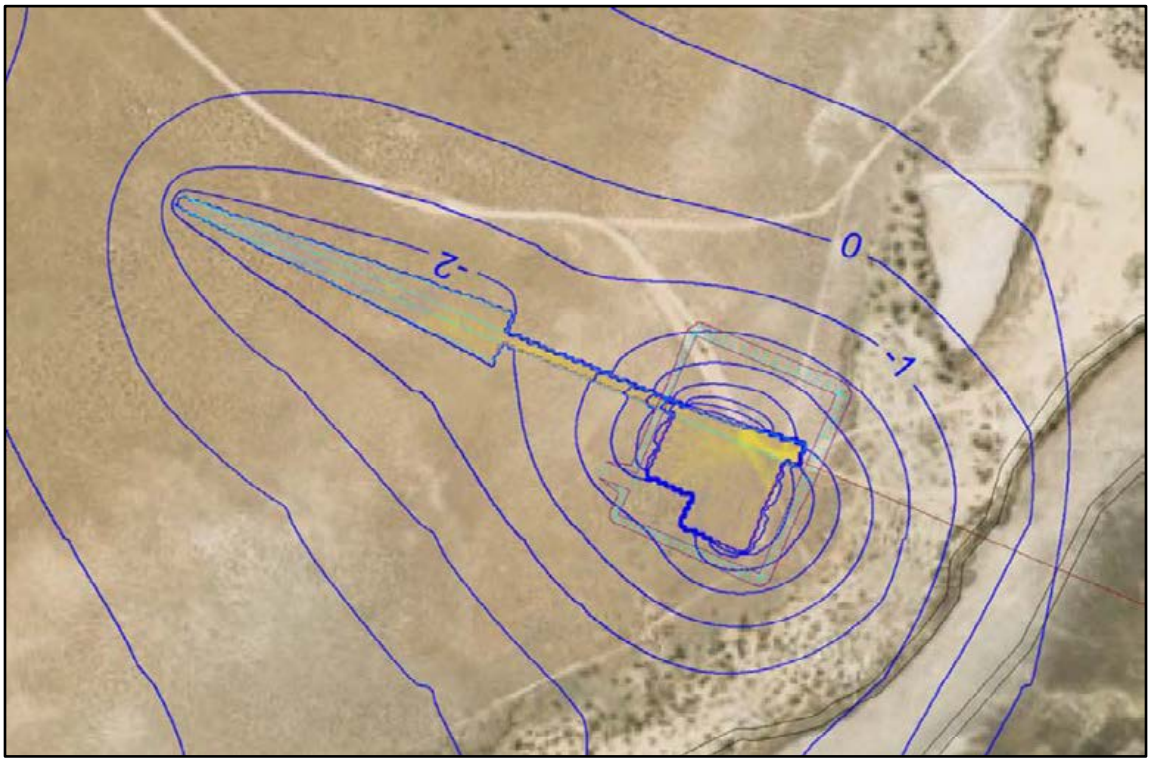


Figure 4.10: Simulated groundwater contours during complete excavation

4.5.1.4 Phase 4 – Sealing and construction of the intake and outfall tunnels

Phase 4 simulates the sealing and construction of the intake and outfall tunnels. This phase is similar to Phase 3 with the exception that a concrete slab is placed at the base to limit groundwater movement vertically (orange, blue, and green colors in Appendix D). The concrete slab is represented by low hydraulic conductivity (approximately 10^{-9} m/day). The same hydraulic conductivity was applied to the base of the excavation as the secant pile walls. The initial groundwater elevation for Phase 4 is set using the last stress period simulated in Phase 3. The simulation was run for a time period of 24 months (720 stress periods). The estimated seepage into the TBM decline and launch box was approximately 4.4L/sec and was from the battered walls of the drained section. **Figure 4.11** shows the cone of depression developed around the sealed TBM decline and launch box.

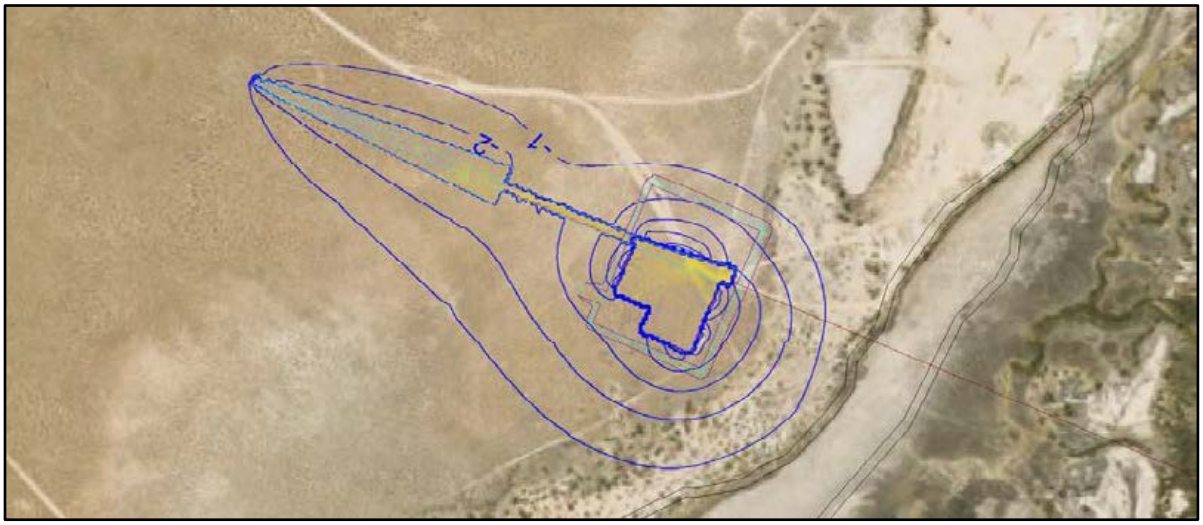


Figure 4.11: Simulated groundwater contours during the sealing and construction phase

4.5.1.5 Phase 5 – Backfilling and completion of works

Phase 5 is the backfilling of the TBM decline and launch box following the completion of the proposed tunnelling and IPS works. A qualitative assessment was undertaken for this phase of work. Simulated groundwater elevations and drawdown from Phase 4 would diminish over time as groundwater extraction is ceased and the excavation is backfilled. Groundwater surrounding the backfilled excavation would reestablish a new equilibrium over time similar to Phase 1. It is understood that the top two meters of the secant pile walls would be removed during the backfilling and completion of works. Pre-construction groundwater elevations within the TBM decline and launch box area were between 2.54 to 3.18 mbgl. Therefore, there may be local groundwater mounding and depressions due to the impermeable base and secant pile walls remaining in place which would limit groundwater movement locally.

5 REFINED MODELLING CONCLUSIONS

The initial groundwater numerical modelling was updated and refined to provide further insights and predictions on groundwater influences from the proposed excavation and groundwater management of the TBM decline and launch box. The refined model had a total of 12 layers, 10 within the first primary geologic unit identified, unconsolidated alluvial sediments, and one for a confining unit (layer 11), and the bottom one for a weathered basement rock (layer 12). Constant-head boundary conditions were established at the base of the Middleback Ranges at 6 mAHD to the west, and at the marine interface at 0 mAHD to the east. During calibration of the steady-state groundwater flow model, it was observed that the model is sensitive to horizontal hydraulic conductivity and recharge. Results of calibration indicated a good fit with measured data, with an ARM of 2.6% and RMS of 4.1%.

Following the groundwater numerical flow model development, five phases of the construction period (including initial existing condition) were simulated to predict shallow aquifer responses to groundwater management and excavations for the TBM decline and launch box. A key objective of the simulations of the five phases was to understand and estimate the seepage rates into the excavation zone. A summary of the findings from the five phases are presented below in **Table 5.1**.

Table 5.1: Summary of simulated scenarios

Scenario/segment	Discharge rate (seepage rate)	Number of stress periods (days)
Phase 1	N/A	Steady state/baseline conditions
Phase 2	0.02L/s	120
Phase 3	6.2L/s	300
Phase 4	4.4L/s	720
Phase 5^	N/A	-

Notes:
mAHD – metres Australian height datum
L/sec – Litres per second
N/A – not applicable
^ - qualitative assessment

Groundwater elevations in areas immediately surrounding the TBM decline and launch box are shown to be constrained to a limited area, with a small and narrow cone of depression.

The results presented in **Table 5.1** above are based on the current site understanding and site-specific information used to develop the model. These seepage rates presented and resultant cones of depression from the proposed groundwater management during the TBM decline and launch box excavation may change as new temporal information is obtained, and site-specific groundwater conditions are further understood. These results should be used with caution and may differ to conditions in the field during any excavation work, or as further groundwater information is obtained.

Given the temporal extent of the simulations, with a total simulated period of five years, it is recommended that further temporal data are used to validate the groundwater transient model. Data loggers are currently deployed in each groundwater monitoring well installed throughout the site with groundwater monitoring events and logger data collection due to be completed in March 2027. Following collection of further temporal groundwater levels, and associated rainfall data, the groundwater flow model should be updated and validated. Based on the results of validation work of the transient groundwater flow model (Phase 1), the remaining phases of the TBM decline and launch box excavation will be assed and evaluated.

6 REFERENCES

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7 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practising in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data known to date. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided. The science of climate change and translating climate risks into design criteria are new and evolving practices, involving many uncertainties. The projections made in this report only reflect the professional judgment of the Project Team applying a standard of care consistent with the level of care and skill of other professionals undertaking similar work in the same locality under similar conditions at the date the services are provided. For these reasons, the recommendations, predictions, and projections made within this report provide guidelines based on the knowledge available to Kleinfelder as of the date provided based on Kleinfelder's review of the resources [identified above]. Any predictions or projections made in this report are not guaranteed predictions or projections of future events. The nature and climate impacts may differ significantly from predictions based on currently available data. Kleinfelder recommends that the results of these evaluations be updated over time as science, data, and modelling techniques advance. Unless so engaged, Kleinfelder disclaims any undertaking to update these predictions in the future. Any reliance upon maps or data presented herein used to make decisions or conclusions is at the sole discretion and risk of the user. This information is provided with the understanding that the data is not guaranteed to be accurate, correct, or complete and assumes no responsibility for errors or omissions. This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report. The work performed was based on project information provided by Client. If Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

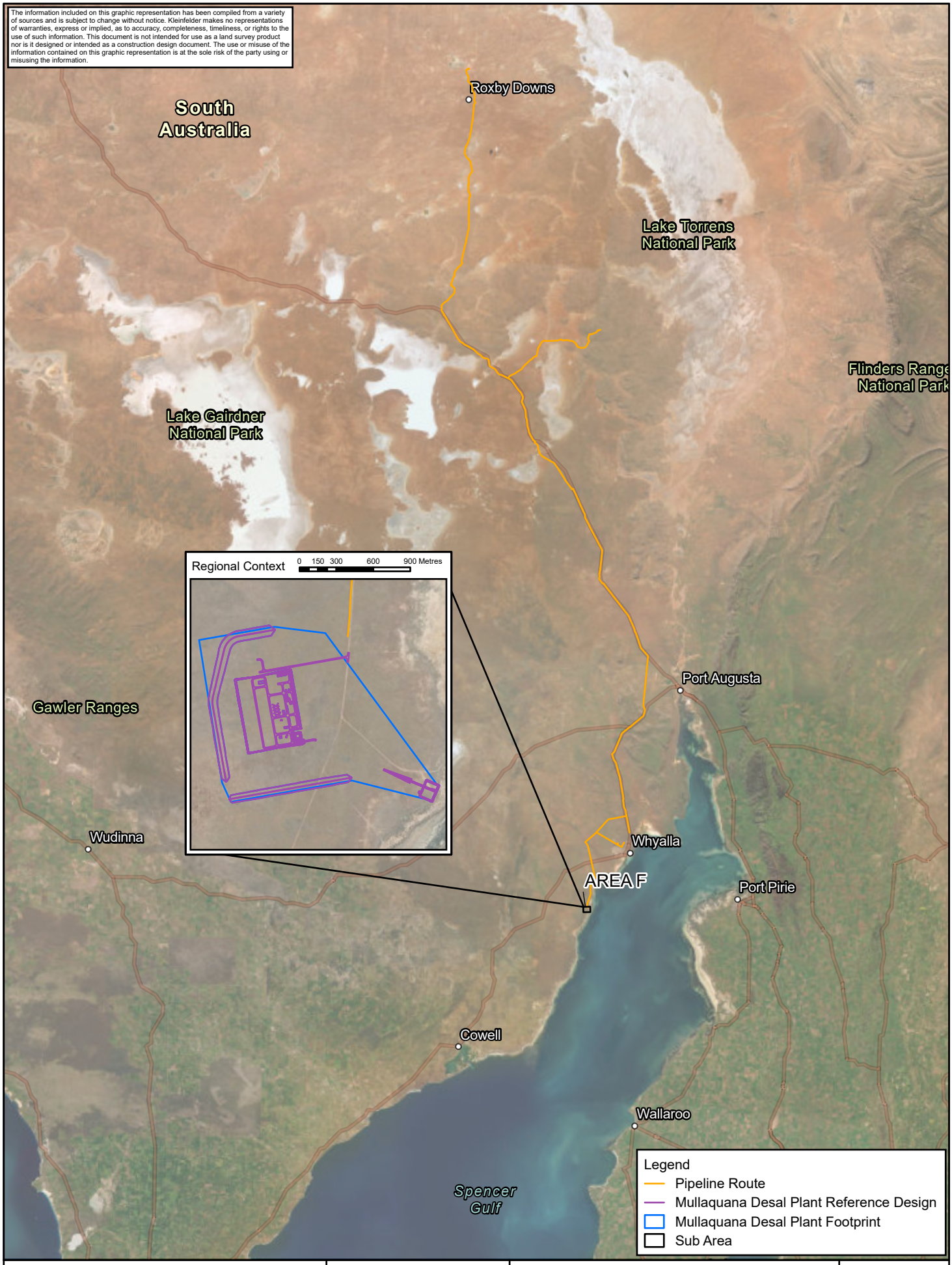
FIGURES







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Scale @ A4 1:1,800,000 Kilometres
GDA2020 MGA Zone 53

N

PROJECT REFERENCE:	26000324
DATE DRAWN: 12/06/2026	Version 1
DRAWN BY:	RHourigan

DATA SOURCE:
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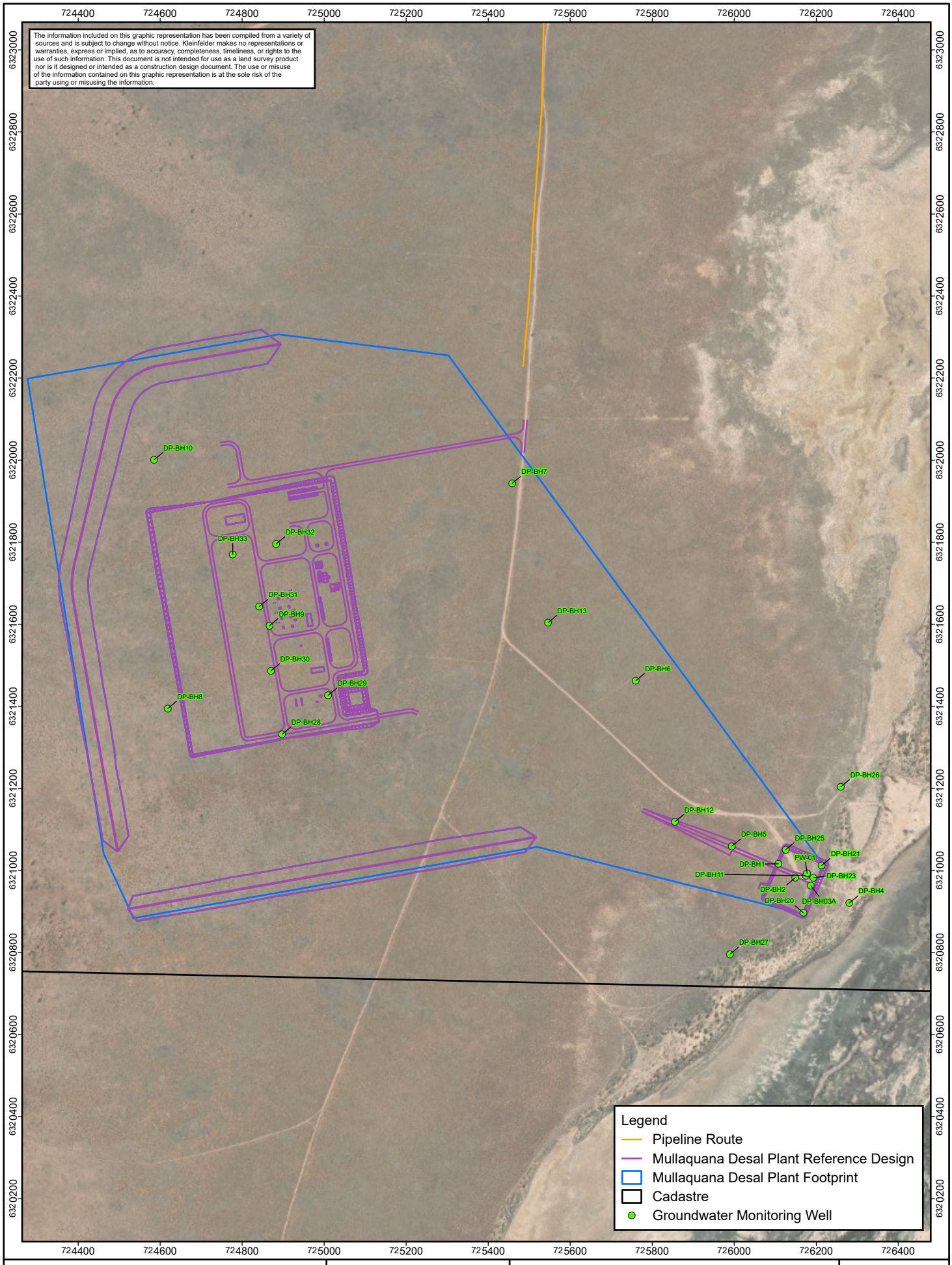
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SITE LOCATION AND PROJECT OVERVIEW

NORTHERN WATER GEOTECHNICAL INVESTIGATION
PROPOSED MULLAQUANA DESALINATION PLANT

FIGURE:
1

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GDA2020 MGA Zone 53

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WELL LOCATIONS

NORTHERN WATER GEOTECHNICAL INVESTIGATION
PROPOSED MULLAQUANA DESALINATION PLANT

FIGURE:

2

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APPENDIX A: SLUG TESTING RESULTS







Table 5
Slug Test Analysis and Results of Repeat Tests
Northern Water Project (Package 5)
Interim Hydrogological Investigation - Proposed Mullaquana Desalination Plant Site

WELL	Well Depth (mbgl)	Static Water Level (mbtoc)	Test		Δh	Depth d (m)	Length L (m)	Aquifer thickness - (b)	Anisotropy Ratio K_v/k_h	Submerged Screen? (Y/N)	Casing r(c) meters	Well r(w) meters	Aquifer Type	Expected Displacement Butler (1998) eq. (6.11b)	Analytical Approach	Transmissivity (T) (m^2/sec)	Transmissivity (T) (m^2/day)
KGS Solution																	
DP-BH01	15	3.520	Test 1**	Falling head	0.212	2.37	10.00	11.83	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	1.90E-04	16.37
			Test 2	Rising head	0.200									0.261		2.30E-04	19.83
			Test 3**	Falling head	0.204									0.261		1.88E-04	16.21
			Test 4	Rising head	0.193									0.261		2.69E-04	23.20
			Test 5	Falling head	0.190									0.261		2.64E-04	22.82
			Test 6	Rising head	0.193									0.261		3.11E-04	26.871
DP-BH02	20	3.306	Test 1	Falling head	0.157	2.35	15.00	17.24	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	3.65E-04	31.57
			Test 2	Rising head	0.158									0.261		3.45E-04	29.82
			Test 3	Falling head	0.160									0.261		3.74E-04	32.27
			Test 4	Rising head	0.154									0.261		3.37E-04	29.15
			Test 5	Falling head	0.159									0.261		3.80E-04	32.84
			Test 6	Rising head	0.152									0.261		3.45E-04	29.830
DP-BH03*	25	3.314	Test 1	Falling head	0.145	4.54	18.00	15.46	1.00	Yes	0.040	0.078	Unconfined	0.131	Category I	1.22E-04	10.51
			Test 2	Rising head	0.145									0.131		1.26E-04	10.86
			Test 3	Falling head	0.141									0.131		1.27E-04	10.98
			Test 4	Rising head	0.143									0.131		1.24E-04	10.71
			Test 5	Falling head	0.145									0.131		1.35E-04	11.64
			Test 6	Rising head	0.143									0.131		1.31E-04	11.316
DP-BH-03A	25	3.582	Test 1	Falling head	0.163	3.42	18.00	22.44	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	4.91E-04	42.44
			Test 2	Rising head	0.157									0.261		4.62E-04	39.88
			Test 3	Falling head	0.154									0.261		4.60E-04	39.75
			Test 4	Rising head	0.152									0.261		4.66E-04	40.29
			Test 5	Falling head	0.152									0.261		4.53E-04	39.13
			Test 6	Rising head	0.147									0.261		4.58E-04	39.532
DP-BH04	25	2.815	Test 1	Falling head	0.185	3.00	20.00	18.90	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	5.15E-04	44.47
			Test 2	Rising head	0.181									0.261		4.74E-04	40.91
			Test 3	Falling head	0.171									0.261		5.29E-04	45.73
			Test 4	Rising head	0.179									0.261		4.80E-04	41.48
			Test 5	Falling head	0.167									0.261		5.46E-04	47.20
			Test 6	Rising head	0.173									0.261		4.31E-04	37.254
DP-BH05	15	3.594	Test 1	Falling head	0.270	2.26	10.00	11.18	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	1.34E-04	11.59
			Test 2**	Rising head	0.314									0.261		8.82E-06	0.76
			Test 3**	Falling head	0.304									0.261		1.23E-05	1.06
			Test 4	Rising head	0.250									0.261		1.24E-04	10.69
			Test 5	Falling head	0.275									0.261		1.27E-04	10.94
			Test 6	Rising head	0.249									0.261		1.28E-04	11.037
DP-BH06	15	4.641	Test 1	Falling head	0.156	1.23	10.00	10.59	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	5.06E-04	43.75
			Test 2	Rising head	0.150									0.261		4.74E-04	41.00
			Test 3	Falling head	0.158									0.261		4.43E-04	38.28
			Test 4	Rising head	0.144									0.261		4.51E-04	38.93
			Test 5	Falling head	0.148									0.261		4.31E-04	37.25
			Test 6	Rising head	0.147									0.261		4.72E-04	40.822
DP-BH07	15	5.334	Test 1	Falling head	0.227	4.57	6.00	10.21	1.00	Yes	0.040	0.078	Unconfined	0.261	Category I	2.84E-04	24.53
			Test 2	Rising head	0.226									0.261		2.81E-04	24.30
			Test 3	Falling head	0.237									0.261		2.41E-04	20.85
			Test 4	Rising head	0.221									0.261		2.36E-04	20.42
			Test 5	Falling head	0.221									0.261		2.21E-04	19.06
			Test 6	Rising head	0.218									0.261		2.06E-04	17.795
DP-BH09	15	8.159	Test 1	Falling head	0.116	1.73	6.00	7.86	1.00	Yes	0.04	0.08	Unconfined	0.131	Category I	4.10E-05	3.55
			Test 2	Rising head	0.111									0.131		3.53E-05	3.05
			Test 3	Falling head	0.114									0.131		4.34E-05	3.75
			Test 4	Rising head	0.109									0.131		4.29E-05	3.70
			Test 5	Falling head	0.115									0.131		4.83E-05	4.17
			Test 6	Rising head	0.110									0.131		4.17E-05	3.601
DP-BH10	15	9.515	Test 1	Falling head	0.124	0.38	6.00	5.24	1.00	Yes	0.04	0.08	Unconfined	0.131	Category I	2.73E-05	2.36
			Test 2	Rising head	0.125									0.131		2.35E-05	2.03
			Test 3	Falling head	0.132									0.131		2.73E-05	2.36
			Test 4	Rising head	0.127									0.131		2.56E-05	2.21
			Test 5	Falling head	0.127									0.131		2.84E-05	2.45
			Test 6	Rising head	0.123									0.131		2.35E-05	2.031
DP-BH11	25	3.582	Test 1**	Falling head	0.114	4.27	18.00	22.26	1.00	Yes	0.04	0.08	Unconfined	0.131	Category I	6.51E-06	0.56
			Test 2	Rising head	0.113									0.131		1.26E-04	10.88
			Test 3**	Falling head	0.174									0.261		4.25E-05	3.67
			Test 4	Rising head	0.202									0.261		2.08E-04	17.97
			Test 5	Falling head	0.199									0.261		2.08E-04	17.97
			Test 6	Rising head	0.198									0.261		2.08E-04	17.969
DP-BH12	25	3.840	Test 1	Falling head	0.238	1.89	20.00	18.68	1.00	Yes	0.040	0.08	Unconfined	0.261	Category I	2.48E-04	21.47
			Test 2	Rising head	0.231									0.261		2.50E-04	21.58
			Test 3	Falling head	0.244									0.261		2.41E-04	20.85
			Test 4	Rising head	0.228									0.261		2.70E-04	23.35
			Test 5	Falling head	0.237									0.261		2.57E-04	22.18
			Test 6	Rising head	0.226									0.261		2.67E-04	23.096

Notes:
* well failed duing well installation with collapsed screen from 7.85 mbtoc.
** indicates test omitted following review of repeat tests and results

Table 5
Slug Test Analysis and Results of Repeat Tests
Northern Water Project (Package 5)
Interim Hydrogological Investigation - Proposed Mullaquana Desalination Plant Site

WELL	Well Depth (mbgl)	Static Water Level (mbtoc)	T MEAN (m/sec)	T GEO-MEAN (m/sec)	T MEAN (m/day)	T GEOMEAN (m/day)	Hydraulic Conductivity (K) (m/sec)	Hydraulic Conductivity (K) (m/day)	K MEAN (m/sec)	K GEOMEAN (m/sec)	K MEAN (m/day)	K GEOMEAN (m/day)	Stadard Deviation all tests	Standard Deviation with test/s ommited
DP-BH01	15	3.520	2.68E-04	2.67E-04	23.182	23.048	1.60E-05	1.38413	2.27E-05	2.25E-05	1.95955	1.94823	36%	24%
							1.94E-05	1.67616						
							1.59E-05	1.37030						
							2.27E-05	1.96128						
							2.23E-05	1.92931						
							2.63E-05	2.27146						
DP-BH02	20	3.306	3.58E-04	3.57E-04	30.912	30.882	2.12E-05	1.83168	2.08E-05	2.07E-05	1.79338	1.79158	9%	9%
							2.00E-05	1.72973						
							2.17E-05	1.87229						
							1.96E-05	1.69085						
							2.21E-05	1.90512						
							2.00E-05	1.73059						
DP-BH03*	25	3.314	1.27E-04	1.27E-04	11.005	10.998	7.87E-06	0.67988	8.24E-06	8.24E-06	0.71199	0.71158	3%	3%
							8.14E-06	0.70295						
							8.23E-06	0.71073						
							8.02E-06	0.69310						
							8.72E-06	0.75315						
							8.47E-06	0.73215						
DP-BH-03A	25	3.582	4.65E-04	4.65E-04	40.169	40.155	2.19E-05	1.89130	2.07E-05	2.07E-05	1.79006	1.78944	5%	5%
							2.06E-05	1.77725						
							2.05E-05	1.77120						
							2.08E-05	1.79539						
							2.02E-05	1.74355						
							2.04E-05	1.76170						
DP-BH04	25	2.815	4.96E-04	4.94E-04	42.840	42.708	2.72E-05	2.35354	2.62E-05	2.62E-05	2.26728	2.26026	19%	19%
							2.51E-05	2.16518						
							2.80E-05	2.42006						
							2.54E-05	2.19542						
							2.89E-05	2.49782						
							2.28E-05	1.97165						
DP-BH05	15	3.594	1.28E-04	1.28E-04	11.063	11.059	1.20E-05	1.03680	1.15E-05	1.15E-05	0.98993	0.98950	47%	3%
							7.89E-07	0.06820						
							1.10E-06	0.09478						
							1.11E-05	0.95645						
							1.13E-05	0.97891						
							1.14E-05	0.98755						
DP-BH06	15	4.641	4.63E-04	4.62E-04	40.005	39.949	4.78E-05	4.13165	4.37E-05	4.37E-05	3.77798	3.77267	22%	22%
							4.48E-05	3.87158						
							4.18E-05	3.61498						
							4.26E-05	3.67632						
							4.07E-05	3.51821						
							4.46E-05	3.85517						
DP-BH07	15	5.334	2.45E-04	2.43E-04	21.162	21.015	2.78E-05	2.40365	2.40E-05	2.38E-05	2.07346	2.05910	27%	27%
							2.76E-05	2.38118						
							2.37E-05	2.04336						
							2.32E-05	2.00102						
							2.16E-05	1.86797						
							2.02E-05	1.74355						
DP-BH09	15	8.159	4.21E-05	4.19E-05	3.637	3.622	5.22E-06	0.45109	5.36E-06	5.33E-06	0.46272	0.46073	5%	5%
							4.49E-06	0.38750						
							5.53E-06	0.47736						
							5.45E-06	0.47123						
							6.15E-06	0.53101						
							5.30E-06	0.45809						
DP-BH10	15	9.515	2.59E-05	2.58E-05	2.239	2.233	5.22E-06	0.45058	4.95E-06	4.94E-06	0.42778	0.42662	3%	3%
							4.49E-06	0.38759						
							5.22E-06	0.45066						
							4.88E-06	0.42189						
							5.42E-06	0.46803						
							4.49E-06	0.38794						
DP-BH11	25	3.582	1.87E-04	1.83E-04	16.196	15.850	2.93E-07	0.02529	8.42E-06	8.24E-06	0.72766	0.71212	35%	16%
							5.66E-06	0.48885						
							1.91E-06	0.16494						
							9.34E-06	0.80715						
							9.34E-06	0.80732						
							9.34E-06	0.80732						
DP-BH12	25	3.840	2.56E-04	2.55E-04	22.087	22.069	1.33E-05	1.14912	1.37E-05	1.37E-05	1.18238	1.18142	5%	5%
							1.34E-05	1.15517						
							1.29E-05	1.11629						
							1.45E-05	1.25021						
							1.37E-05	1.18714						
							1.43E-05	1.23638						

Notes:
* well failed duing well installation with collapsed screen from 7.85 mbtoc.
** indicates test omitted following review of repeat tests and results

Table 5
Slug Test Analysis and Results of Repeat Tests
Northern Water Project (Package 5)
Interim Hydrogological Investigation - Proposed Mullaquana Desalination Plant Site

WELL	Well Depth (mbgl)	Static Water Level (mbtoc)	Test		Δh	Depth d (m)	Length L (m)	Aquifer thickness - (b)	Anisotropy Ratio K_v/k_h	Submerged Screen? (Y/N)	Casing r(c) meters	Well r(w) meters	Aquifer Type	Expected Displacement Butler (1998) eq. (6.11b)	Analytical Approach	Transmissivity (T) (m^2/sec)	Transmissivity (T) (m^2/day)
DP-BH13	25	5.328	Test 1	Falling head	0.197	1.55	19.00	19.62	1.00	Yes	0.040	0.08	Unconfined	0.261	Category I	2.69E-04	23.21
			Test 2	Rising head	0.186									0.261		2.72E-04	23.50
			Test 3	Falling head	0.185									0.261		2.64E-04	22.77
			Test 4	Rising head	0.185									0.261		2.81E-04	24.29
			Test 5	Falling head	0.183									0.261		2.87E-04	24.80
			Test 6	Rising head	0.183									0.261		2.70E-04	23.345
PW01	21	2.824	Test 1**	Falling head	0.100	4.45	18.00	5.24	1.00	Yes	0.08	0.10	Unconfined	0.111	Category I	6.97E-05	6.02
			Test 2	Rising head	0.091									0.111		1.37E-04	11.82
			Test 3	Falling head	0.086									0.111		1.25E-04	10.78
			Test 4	Rising head	0.095									0.111		1.22E-04	10.55
			Test 5	Falling head	0.086									0.111		1.16E-04	9.98
			Test 6	Rising head	0.093									0.111		1.15E-04	9.905
DP-BH20	29.79	4.425	Test 1	Falling head	0.259	19.58	6.00	25.37	1.00	Y	0.025	0.090	Unconfined	0.334	Category I	4.72E-04	40.81
			Test 2	Rising head	0.247									0.334		5.00E-04	43.22
			Test 3	Falling head	0.556									0.668		5.01E-04	43.26
			Test 4**	Rising head	0.587									0.668		1.59E-04	13.75
			Test 5**	Falling head	0.268									0.334		1.45E-04	12.56
			Test 6**	Rising head	0.286									0.334		1.88E-04	16.231
DP-BH21	30.083	3.686	Test 1	Falling head	0.190	20.31	6.00	26.40	1.00	Y	0.025	0.090	Unconfined	0.334	Category I	8.10E-04	69.99
			Test 2	Rising head	0.212									0.334		7.56E-04	65.32
			Test 3	Falling head	0.465									0.668		7.58E-04	65.48
			Test 4	Rising head	0.557									0.668		6.43E-04	55.56
			Test 5**	Falling head	0.586									0.668		4.71E-04	40.73
			Test 6	Rising head	0.524									0.668		8.36E-04	72.253
DP-BH23	34.273	3.892	Test 1	Falling head	0.319	25.86	6.00	30.38	1.00	Y	0.025	0.090	Unconfined	0.334	Category I	3.39E-04	29.27
			Test 2	Rising head	0.312									0.334		3.70E-04	32.00
			Test 3	Falling head	0.619									0.668		3.42E-04	29.58
			Test 4	Rising head	0.593									0.668		3.57E-04	30.87
			Test 5	Falling head	0.597									0.668		3.43E-04	29.66
			Test 6	Rising head	0.586									0.668		3.64E-04	31.420
DP-BH25	29.95	4.188	Test 1	Falling head	0.298	19.81	6.00	25.76	1.00	Y	0.025	0.090	Unconfined	0.334	Category I	2.98E-04	25.73
			Test 2	Rising head	0.257									0.334		2.57E-04	22.20
			Test 3	Falling head	0.557									0.668		2.51E-04	21.65
			Test 4	Rising head	0.552									0.668		3.01E-04	26.02
			Test 5	Falling head	0.605									0.668		2.44E-04	21.05
			Test 6	Rising head	0.559									0.668		2.98E-04	25.753
DP-BH26	29.851	3.030	Test 1	Falling head	0.190	20.97	6.00	26.82	1.00	Y	0.025	0.090	Unconfined	0.334	Category I	6.98E-04	60.32
			Test 2	Rising head	0.228									0.334		7.65E-04	66.07
			Test 3	Falling head	0.564									0.668		7.20E-04	62.20
			Test 4	Rising head	0.454									0.668		7.75E-04	66.95
			Test 5	Falling head	0.480									0.668		6.54E-04	56.52
			Test 6	Rising head	0.440									0.668		7.86E-04	67.875
DP-BH27	30.401	3.940	Test 1	Falling head	0.181	20.46	6.00	26.46	1.00	Y	0.025	0.090	Unconfined	0.334	Category I	1.71E-03	147.76
			Test 2	Rising head	0.181									0.334		1.42E-03	122.47
			Test 3**	Falling head	0.435									0.668		5.78E-04	49.98
			Test 4	Rising head	0.403									0.668		1.36E-03	117.19
			Test 5**	Falling head	0.450									0.668		7.20E-04	62.21
			Test 6	Rising head	0.392									0.668		1.35E-03	116.483
DP-BH28	15	8.373	Test 1	Falling head	0.404	0.63	6.00	7.70	1.00	Y	0.025	0.076	Unconfined	0.334	Category I	2.54E-05	2.19
			Test 2	Rising head	0.339									0.334		1.88E-05	1.62
			Test 3	Falling head	0.428									0.334		2.73E-05	2.36
			Test 4	Rising head	0.313									0.334		2.31E-05	2.00
			Test 5	Falling head	0.379									0.334		2.77E-05	2.40
			Test 6	Rising head	0.329									0.334		2.30E-05	1.984
DP-BH29	15	7.521	Test 1	Falling head	0.309	1.48	6.00	8.53	1.00	Y	0.025	0.076	Unconfined	0.334	Category I	1.39E-05	1.20
			Test 2	Rising head	0.176									0.334		7.48E-06	0.65
			Test 3	Falling head	0.345									0.334		1.63E-05	1.41
			Test 4	Rising head	0.317									0.334		1.26E-05	1.09
			Test 5	Falling head	0.361									0.334		1.15E-05	0.99
			Test 6	Rising head	0.325									0.334		1.31E-05	1.133
DP-BH30	15	8.050	Test 1	Falling head	0.388	0.95	6.00	8.18	1.00	Y	0.025	0.076	Unconfined	0.334	Category I	8.81E-06	0.76
			Test 2	Rising head	0.265									0.334		5.07E-06	0.44
			Test 3	Falling head	0.334									0.334		8.46E-06	0.73
			Test 4	Rising head	0.255									0.334		5.34E-06	0.46

Notes:
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** indicates test omitted following review of repeat tests and results

Table 5
Slug Test Analysis and Results of Repeat Tests
Northern Water Project (Package 5)
Interim Hydrogological Investigation - Proposed Mullaquana Desalination Plant Site

WELL	Well Depth (mbgl)	Static Water Level (mbtoc)	T MEAN (m/sec)	T GEO-MEAN (m/sec)	T MEAN (m/day)	T GEOMEAN (m/day)	Hydraulic Conductivity (K) (m/sec)	Hydraulic Conductivity (K) (m/day)	K MEAN (m/sec)	K GEOMEAN (m/sec)	K MEAN (m/day)	K GEOMEAN (m/day)	Stadard Deviation all tests	Standard Deviation with test/s ommited
DP-BH13	25	5.328	2.74E-04	2.74E-04	23.653	23.643	1.37E-05	1.18282	1.40E-05	1.39E-05	1.20542	1.20492	4%	4%
							1.39E-05	1.19750						
							1.34E-05	1.16035						
							1.43E-05	1.23811						
							1.46E-05	1.26403						
							1.38E-05	1.18973						
PW01	21	2.824	1.23E-04	1.23E-04	10.608	10.586	1.33E-05	1.15085	2.35E-05	2.34E-05	2.02643	2.02224	38%	15%
							2.61E-05	2.25850						
							2.38E-05	2.05891						
							2.33E-05	2.01571						
							2.21E-05	1.90685						
							2.19E-05	1.89216						
DP-BH20	29.79	4.425	4.91E-04	4.91E-04	42.428	42.412	1.86E-05	1.60877	1.94E-05	1.94E-05	1.67270	1.67208	61%	6%
							1.97E-05	1.70381						
							1.97E-05	1.70554						
							6.27E-06	0.54190						
							5.73E-06	0.49507						
							7.41E-06	0.63988						
DP-BH21	30.083	3.686	7.90E-04	7.89E-04	68.261	68.197	3.07E-05	2.65162	2.99E-05	2.99E-05	2.58595	2.58351	44%	24%
							2.86E-05	2.47450						
							2.87E-05	2.48054						
							2.44E-05	2.10470						
							1.79E-05	1.54310						
							3.17E-05	2.73715						
DP-BH23	34.273	3.892	3.53E-04	3.52E-04	30.467	30.449	1.12E-05	0.96336	1.16E-05	1.16E-05	1.00282	1.00225	4%	4%
							1.22E-05	1.05322						
							1.13E-05	0.97373						
							1.18E-05	1.01606						
							1.13E-05	0.97632						
							1.20E-05	1.03421						
DP-BH25	29.95	4.188	2.75E-04	2.74E-04	23.734	23.638	1.16E-05	0.99878	1.07E-05	1.06E-05	0.92128	0.91755	9%	9%
							9.97E-06	0.86167						
							9.73E-06	0.84050						
							1.17E-05	1.01002						
							9.46E-06	0.81708						
							1.16E-05	0.99965						
DP-BH26	29.851	3.030	7.33E-04	7.31E-04	63.321	63.189	2.60E-05	2.24899	2.73E-05	2.73E-05	2.36088	2.35597	17%	17%
							2.85E-05	2.46326						
							2.68E-05	2.31898						
							2.89E-05	2.49610						
							2.44E-05	2.10730						
							2.93E-05	2.53066						
DP-BH27	30.401	3.940	1.37E-03	1.37E-03	118.716	118.687	6.46E-05	5.58403	5.19E-05	5.19E-05	4.48646	4.48534	144%	12%
							5.36E-05	4.62845						
							2.19E-05	1.88870						
							5.13E-05	4.42886						
							2.72E-05	2.35094						
							5.10E-05	4.40208						
DP-BH28	15	8.373	2.38E-05	2.35E-05	2.058	2.032	3.30E-06	0.28469	3.10E-06	3.06E-06	0.27	0.26	4%	4%
							2.44E-06	0.21099						
							3.55E-06	0.30655						
							3.00E-06	0.25937						
							3.61E-06	0.31147						
							2.98E-06	0.25773						
DP-BH29	15	7.521	1.27E-05	1.22E-05	1.097	1.054	1.63E-06	0.14040	1.49E-06	1.43E-06	0.13	0.12	3%	3%
							8.77E-07	0.07576						
							1.91E-06	0.16528						
							1.48E-06	0.12813						
							1.35E-06	0.11664						
							1.54E-06	0.13288						
DP-BH30	15	8.050	6.92E-06	6.70E-06	0.598	0.579	1.08E-06	0.09305	8.46E-07	8.19E-07	0.07	0.07	2%	2%
							6.19E-07	0.05352						
							1.03E-06	0.08934						
							6.53E-07	0.05639						

Notes:
* well failed duing well installation with collapsed screen from 7.85 mbtoc.
** indicates test omitted following review of repeat tests and results

Table 5
Slug Test Analysis and Results of Repeat Tests
Northern Water Project (Package 5)
Interim Hydrogological Investigation - Proposed Mullaquana Desalination Plant Site

WELL	Well Depth (mbgl)	Static Water Level (mbtoc)	Test		Δh	Depth d (m)	Length L (m)	Aquifer thickness - (b)	Anisotropy Ratio K_v/k_h	Submerged Screen? (Y/N)	Casing r(c) meters	Well r(w) meters	Aquifer Type	Expected Displacement Butler (1998) eq. (6.11b)	Analytical Approach	Transmissivity (T) (m^2/sec)	Transmissivity (T) (m^2/day)
DP-BH31	15	8.106	Test 1	Falling head	0.31	0.89	6.00	7.98	1.00	Y	0.025	0.076	Unconfined	0.334	Category I	2.18E-05	1.88
			Test 2	Rising head	0.332									0.334		2.19E-05	1.89
			Test 3	Falling head	0.446									0.334		2.35E-05	2.03
			Test 4	Rising head	0.306									0.334		2.19E-05	1.89
			Test 5	Falling head	0.298									0.334		2.28E-05	1.97
			Test 6	Rising head	0.323									0.334		2.29E-05	1.980
DP-BH32	15	7.770	Test 1	Falling head	0.328	1.24	6.00	8.24	1.00	Y	0.025	0.076	Unconfined	0.334	Category I	1.63E-05	1.41
			Test 2	Rising head	0.335									0.334		1.65E-05	1.42
			Test 3	Falling head	0.324									0.334		1.61E-05	1.39
			Test 4	Rising head	0.338									0.334		1.88E-05	1.63
			Test 5	Falling head	0.329									0.334		1.48E-05	1.28
			Test 6	Rising head	0.339									0.334		1.72E-05	1.487
DP-BH33	15	8.458	Test 1	Falling head	0.324	0.55	6.00	7.68	1.00	Y	0.025	0.076	Unconfined	0.334	Category I	1.36E-05	1.17
			Test 2	Rising head	0.334									0.334		1.01E-05	0.87
			Test 3	Falling head	0.333									0.334		8.14E-06	0.70
			Test 4	Rising head	0.338									0.334		8.87E-06	0.77
			Test 5	Falling head	0.301									0.334		1.20E-05	1.04
			Test 6	Rising head	0.325									0.334		1.26E-05	1.087
Cooper et al. Solution																	
DP-BH21	30.083	3.686	Test 4	Rising head	0.557	20.31	6.00	26.40	1.00	Y	0.025	0.090	Unconfined	0.668	Category I	1.78E-04	15.35
			Test 5	Falling head	0.586									0.668		5.33E-05	4.60
DP-BH27	30.401	3.940	Test 3	Falling head	0.435	20.46	6.00	26.46	1.00	Y	0.025	0.090	Unconfined	0.668	Category I	1.65E-04	14.25
			Test 5	Falling head	0.450									0.668		3.05E-04	26.34
Bouwer and Rice Solution																	
DP-BH08	15	9.505	Test 1	Falling head	0.087	0.44	6.00	6.42	1.00	No	0.040	0.078	Unconfined	0.131	Category II	3.57E-05	3.08
			Test 2	Rising head	0.116									0.131		1.92E-05	1.66
			Test 3	Falling head	0.114									0.131		1.81E-05	1.57
			Test 4	Rising head	0.120									0.131		1.65E-05	1.42
			Test 5	Falling head	0.106									0.131		1.98E-05	1.71
			Test 6	Rising head	0.124									0.131		1.54E-05	1.328

Notes:
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** indicates test omitted following review of repeat tests and results

Table 5
Slug Test Analysis and Results of Repeat Tests
Northern Water Project (Package 5)
Interim Hydrogological Investigation - Proposed Mullaquana Desalination Plant Site

WELL	Well Depth (mbgl)	Static Water Level (mbtoc)	T MEAN (m/sec)	T GEO-MEAN (m/sec)	T MEAN (m/day)	T GEOMEAN (m/day)	Hydraulic Conductivity (K) (m/sec)	Hydraulic Conductivity (K) (m/day)	K MEAN (m/sec)	K GEOMEAN (m/sec)	K MEAN (m/day)	K GEOMEAN (m/day)	Stadard Deviation all tests	Standard Deviation with test/s ommited
DP-BH31	15	8.106	2.24E-05	2.24E-05	1.939	1.938	2.73E-06	0.23553	2.81E-06	2.81E-06	0.24	0.24	1%	1%
							2.74E-06	0.23691						
							2.94E-06	0.25384						
							2.74E-06	0.23656						
							2.85E-06	0.24624						
							2.87E-06	0.24805						
DP-BH32	15	7.770	1.66E-05	1.66E-05	1.435	1.432	1.98E-06	0.17081	2.02E-06	2.01E-06	0.17	0.17	1%	1%
							2.00E-06	0.17271						
							1.95E-06	0.16865						
							2.28E-06	0.19725						
							1.80E-06	0.15517						
							2.09E-06	0.18040						
DP-BH33	15	8.458	1.05E-05	1.04E-05	0.908	0.899	1.77E-06	0.15301	1.37E-06	1.36E-06	0.12	0.12	2%	2%
							1.32E-06	0.11362						
							1.06E-06	0.09158						
							1.16E-06	0.09979						
							1.57E-06	0.13548						
							1.64E-06	0.14161						
DP-BH21	30.083	3.686	1.15E-04	9.73E-05	9.977	8.405	6.73E-06	0.58163	4.37E-06	3.69E-06	0.37796	0.31839	29%	29%
							2.02E-06	0.17429						
DP-BH27	30.401	3.940	2.35E-04	2.24E-04	20.295	19.373	6.23E-06	0.53843	8.88E-06	8.47E-06	0.76699	0.73214	32%	32%
							1.15E-05	0.99555						
DP-BH08	15	9.505	2.08E-05	1.99E-05	1.794	1.720	5.56E-06	0.48021	3.24E-06	3.10E-06	0.27972	0.26806	10%	10%
							3.00E-06	0.25885						
							2.82E-06	0.24399						
							2.57E-06	0.22170						
							3.09E-06	0.26654						
							2.40E-06	0.20701						

Notes:
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** indicates test omitted following review of repeat tests and results

APPENDIX B: PUMPING TEST RESULTS







Aquifer thickness (b)	Wells included in analysis		Distance from pumped well	Depth d (m)	Length L (m)	r(c)	r(w)	Pumped Rate (L/s)				Model solution	Transmissivity (T) (m2/sec)	Hydraulic conductivity (K) (m/sec)	Transmissivity (T) (m2/day)	Hydraulic conductivity (K) (m/day)	Storativity (S) (unitless)	Specific Yield (Sy)	Comments
	Pumped well	Monitoring wells						Step 1	Step 2	Step 3	Constant Rate								
DP-BH02 test results																			
Step Drawdown Test																			
42.00	DP-BH02	-	-	1.71	15	0.04	0.0775	0.3	0.8	1.6/1.2	-	Thies	4.85E-03	1.15E-04	418.61	9.97	0.3*	0.3*	Storativity is implausibly low and unreliable
												Cooper -Jacob	3.28E-03	7.81E-05	283.31	6.75	0.3*	0.3*	
Constant Rate Test																			
42.00	DP-BH02	-	-	1.71	15	0.04	0.0775	-	-	-	0.9	Thies	5.67E-04	1.35E-05	48.95	1.17	0.222	0.222	Storativity is reasonable
												Cooper -Jacob	2.53E-04	6.01E-06	21.82	0.52	0.030	0.030	Storativity is implausibly low and unreliable
	DP-BH02	DP-BH01	58.6	1.58	10	0.04	0.0775					Thies	5.68E-04	1.35E-05	49.03	1.17	0.217	0.217	Storativity is reasonable
												Cooper -Jacob	3.01E-04	7.15E-06	25.96	0.62	0.004	0.004	Storativity is implausibly low and unreliable
	DP-BH02	DP-BH03A	44.3	3.513	18	0.04	0.0775					Thies	2.90E-04	6.90E-06	25.06	0.60	0.175	0.175	Storativity is reasonable
												Cooper -Jacob	5.75E-04	1.37E-05	49.69	1.18	0.007	0.007	Storativity is implausibly low and unreliable
	DP-BH02	DP-BH11	26.2	3.455	18	0.04	0.0775					Thies	6.39E-04	1.52E-05	55.20	1.31	0.017	0.017	Storativity is implausibly low and unreliable
												Cooper -Jacob	2.79E-04	6.65E-06	24.11	0.57	0.010	0.010	Storativity is implausibly low and unreliable
	DP-BH02	PW01	30.8	4.232	14	0.075	0.1					Thies	6.27E-04	1.49E-05	54.16	1.29	0.028	0.028	Storativity is implausibly low and unreliable
												Cooper -Jacob	2.81E-04	6.69E-06	24.26	0.58	0.010	0.010	Storativity is implausibly low and unreliable
DP-BH03A test results																			
Step Drawdown Test																			
42.00	DP-BH03A	-	-	3.14	18	0.04	0.0775	0.3	0.8	1.2/1.0		Thies	3.38E-03	8.05E-05	292.29	6.96	0.3*	0.3*	Storativity is implausibly low and unreliable
												Cooper -Jacob	2.50E-03	5.96E-05	216.35	5.15	0.3*	0.3*	
Constant Rate Test																			
42.00	DP-BH03A	-	-	3.14	18	0.04	0.0775	-	-	-	1	Thies	2.27E-04	5.41E-06	19.62	0.47	0.081	0.081	Storativity is implausibly low and unreliable
												Cooper -Jacob	8.41E-05	2.00E-06	7.27	0.17	0.316	0.316	Storativity is reasonable
	DP-BH03A	DP-BH02	44.3	1.74	15	0.04	0.0775					Thies	2.28E-04	5.42E-06	19.66	0.47	0.079	0.079	Storativity is implausibly low and unreliable
												Cooper -Jacob	1.33E-04	3.16E-06	11.47	0.27	0.005	0.005	Storativity is implausibly low and unreliable
	DP-BH03A	DP-BH11	28.9	3.43	18	0.025	0.0775					Thies	2.32E-04	5.53E-06	20.08	0.48	0.056	0.056	Storativity is implausibly low and unreliable
												Cooper -Jacob	1.27E-04	3.01E-06	10.93	0.26	0.008	0.008	Storativity is implausibly low and unreliable
	DP-BH03A	PW01	33.3	4.17	14	0.075	0.1					Thies	2.33E-04	5.54E-06	20.11	0.48	0.055	0.055	Storativity is implausibly low and unreliable
												Cooper -Jacob	1.29E-04	3.08E-06	11.17	0.27	0.006	0.006	Storativity is implausibly low and unreliable
PW01 test results																			
Step Drawdown Test																			
42.000	PW01	-	-	0.38	18	0.075	0.1	0.5	1.5	-	-	Thies	7.12E-04	1.70E-05	61.51	1.46	0.3*	0.3*	Storativity is implausibly low and unreliable
												Cooper-Jacob	3.95E-04	9.40E-06	34.11	0.81	0.3*	0.3*	
Constant Rate Test																			
42.000	PW01	-	-	0.38	18	0.075	0.1	-	-	-	1	Thies	4.53E-04	1.08E-05	39.15	0.93	0.180	0.18	-
												Cooper-Jacob	1.62E-04	3.86E-06	14.01	0.33	0.6	0.6	Storativity estimated is impausably high at 0.6. Storativity or specific yeild in an unconfined aquifer typically ranges between 0.1 and 0.3.
	PW01	DP-BH11	6.84	4.27	18	0.04	0.0775					Thies	2.59E-04	6.17E-06	22.39	0.53	0.074	0.074	Storativity is implausibly low and unreliable
												Cooper-Jacob	2.19E-04	5.22E-06	18.95	0.45	0.057	0.057	Storativity is implausibly low and unreliable
	PW01	DP-BH02	30.81	2.35	15	0.04	0.0775					Thies	4.92E-04	1.17E-05	42.47	1.01	0.051	0.051	Storativity is implausibly low and unreliable
												Cooper-Jacob	2.59E-04	6.15E-06	22.33	0.53	0.011	0.011	Storativity is implausibly low and unreliable
	PW01	DP-BH03A	33.33	3.42	18	0.04	0.0775					Thies	4.73E-04	1.13E-05	40.86	0.97	0.098	0.098	Storativity is implausibly low and unreliable
												Cooper-Jacob	2.57E-04	6.13E-06	22.24	0.53	0.011	0.011	Storativity is implausibly low and unreliable

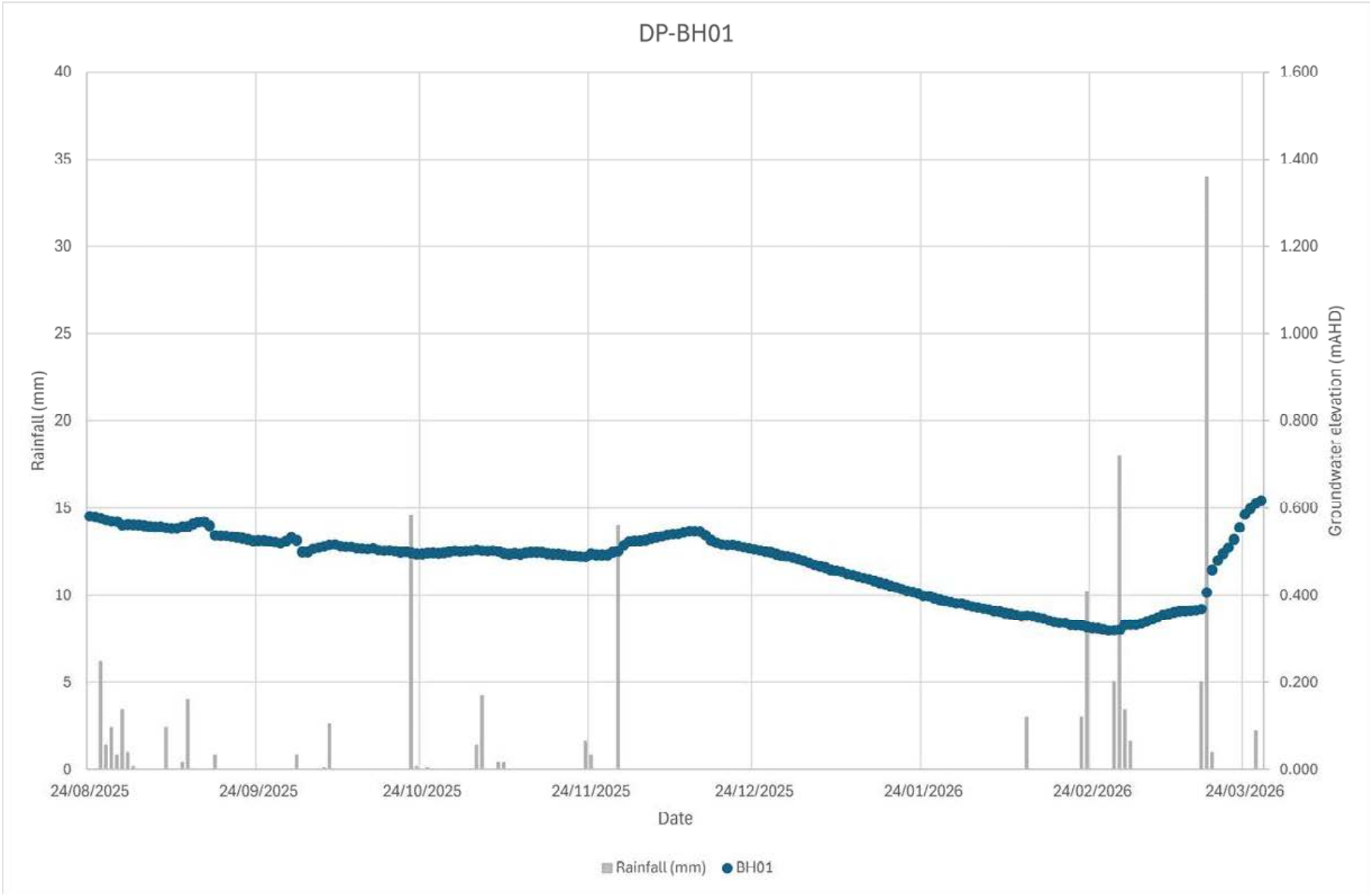
Notes:
* indicates value was unreliably low at 1X10^-10. S has been set to 0.3 for step drawdown test

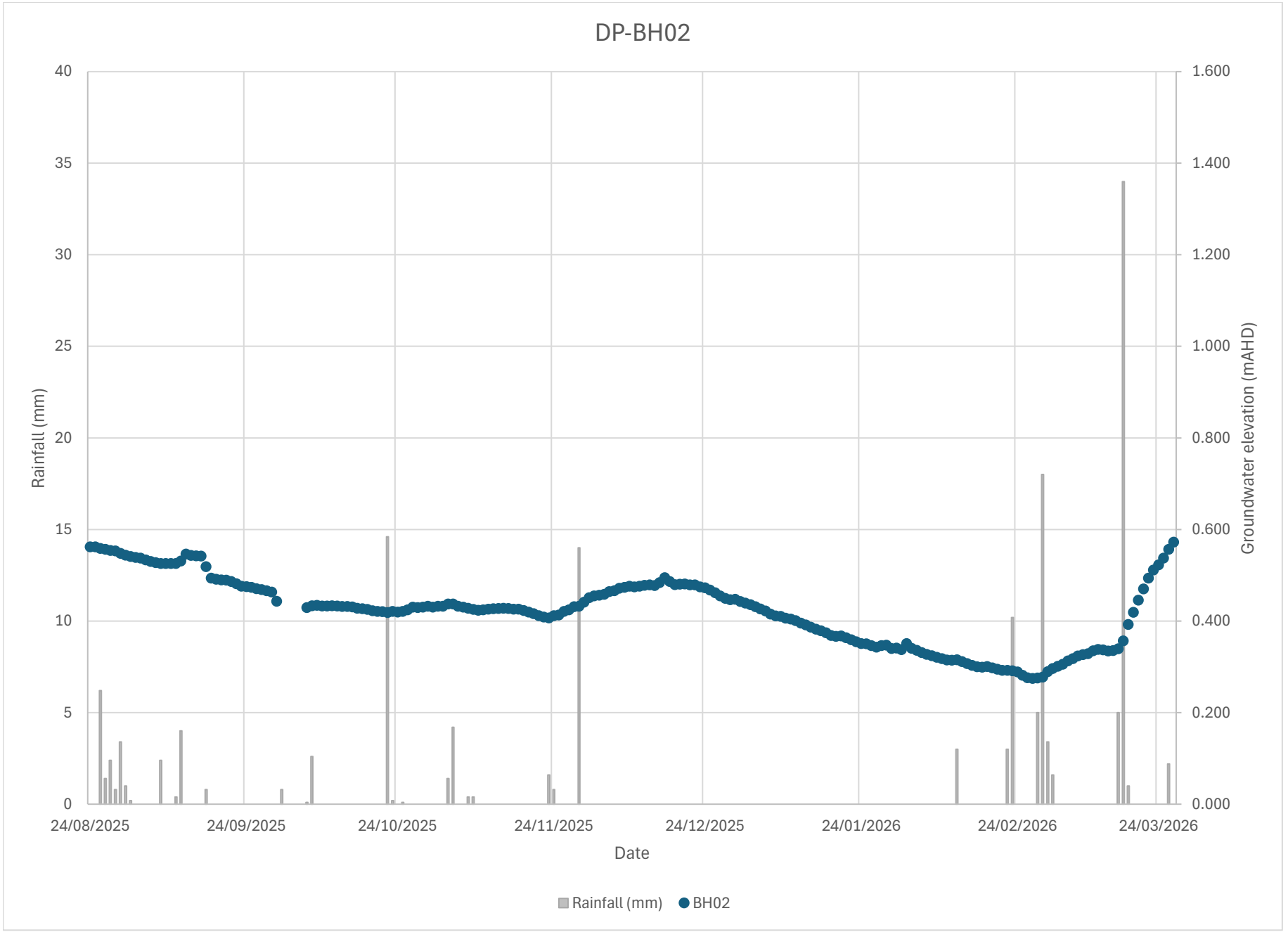
APPENDIX C: HYDROGRAPHS

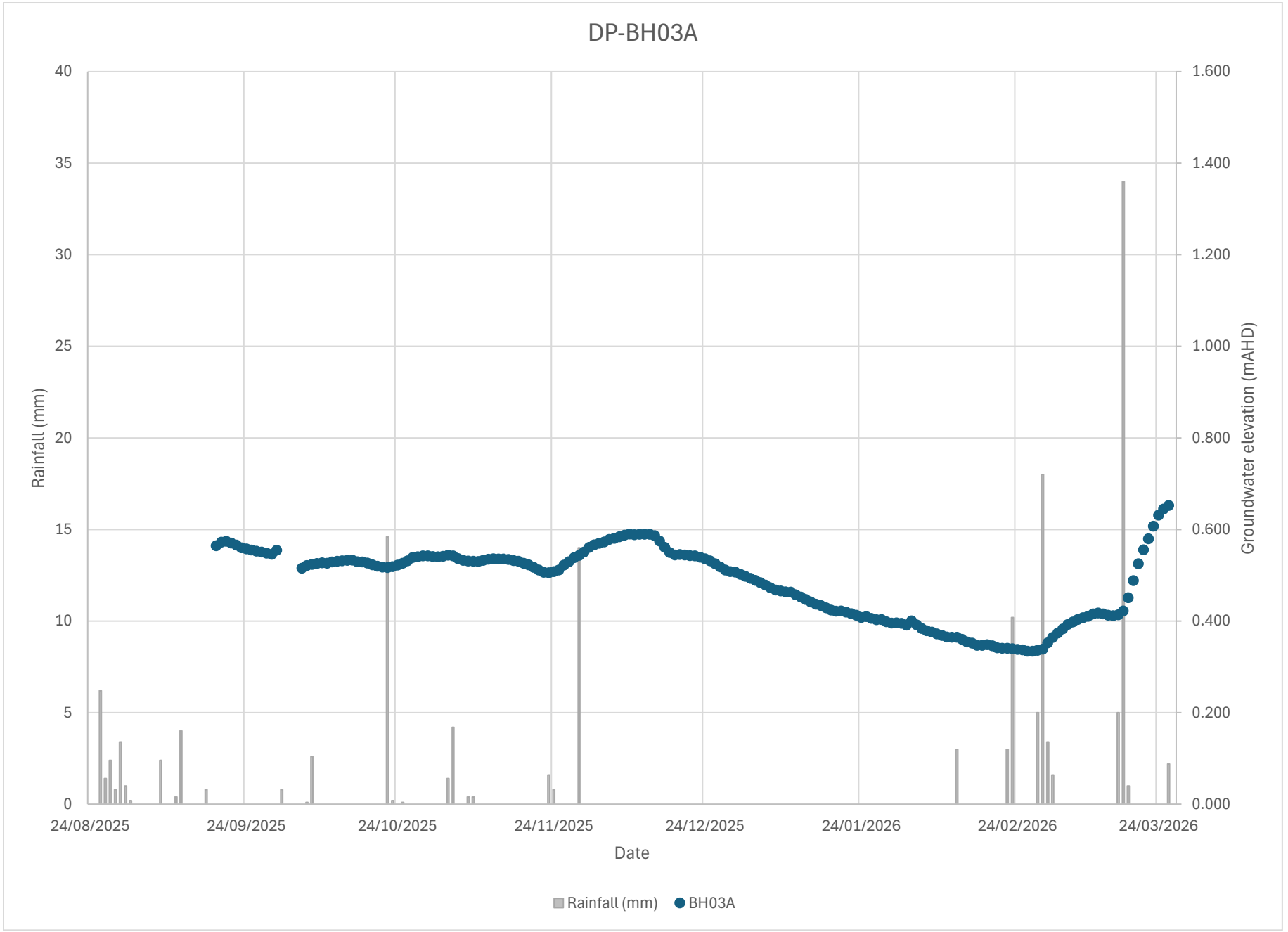


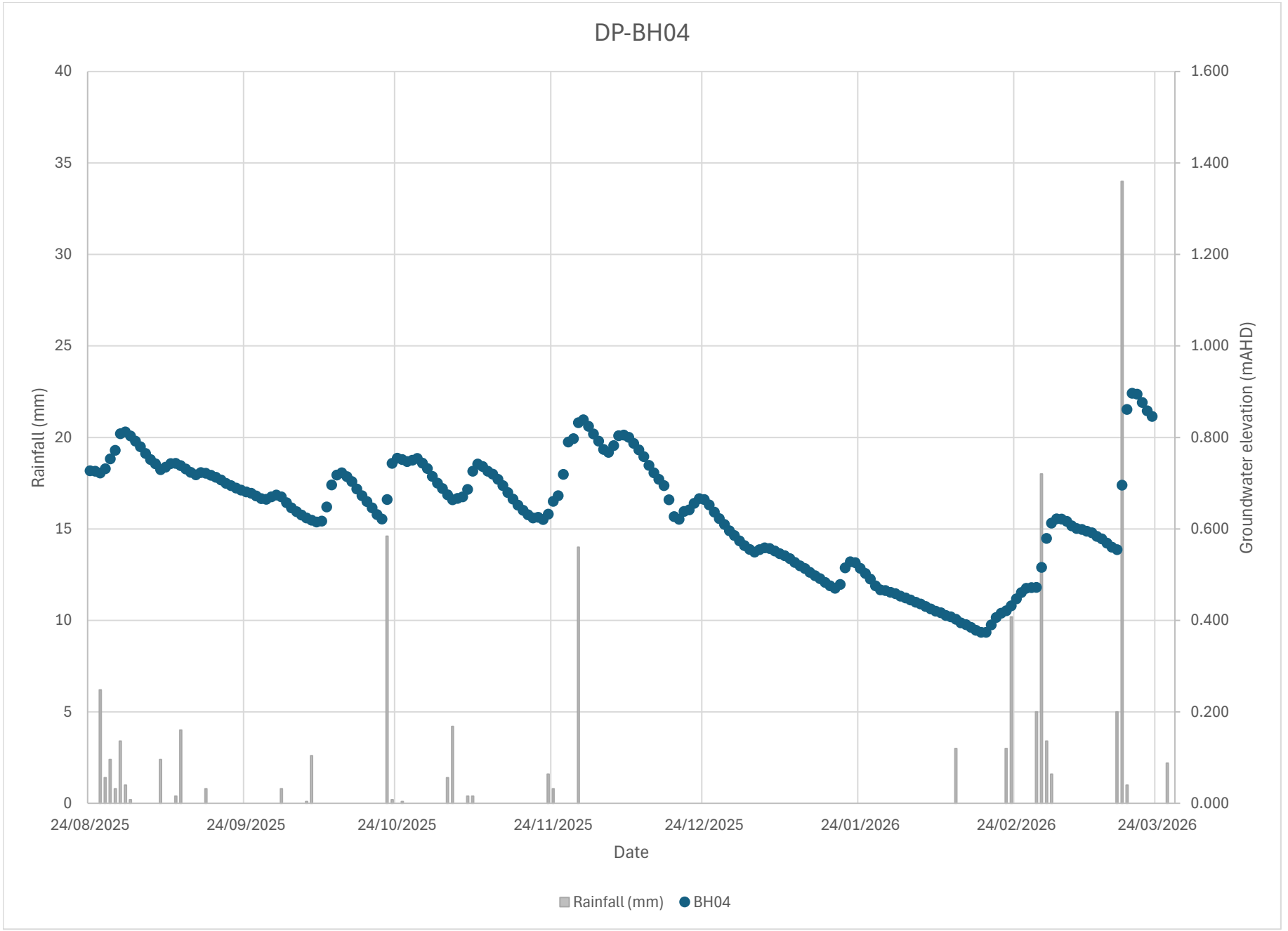


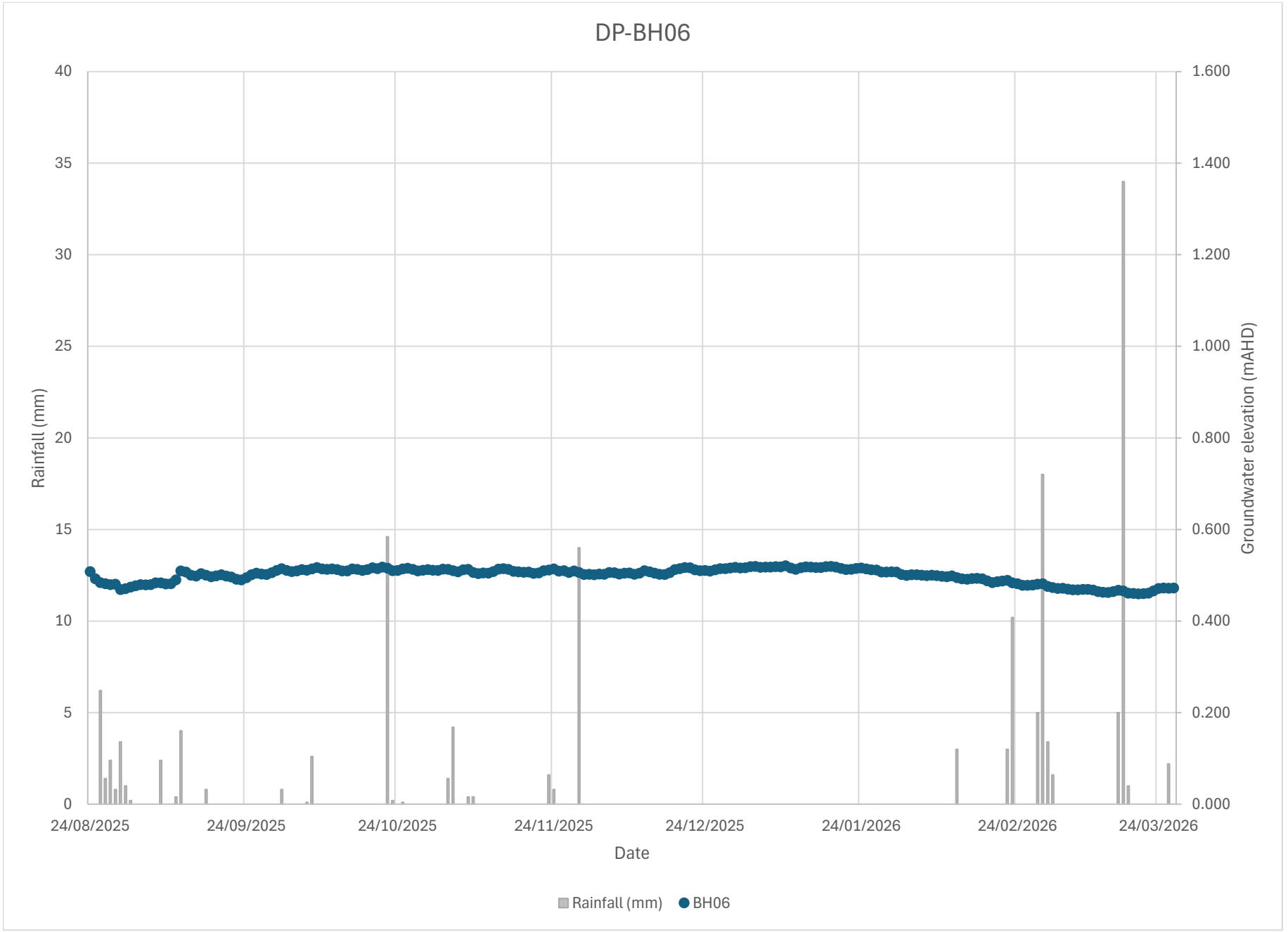


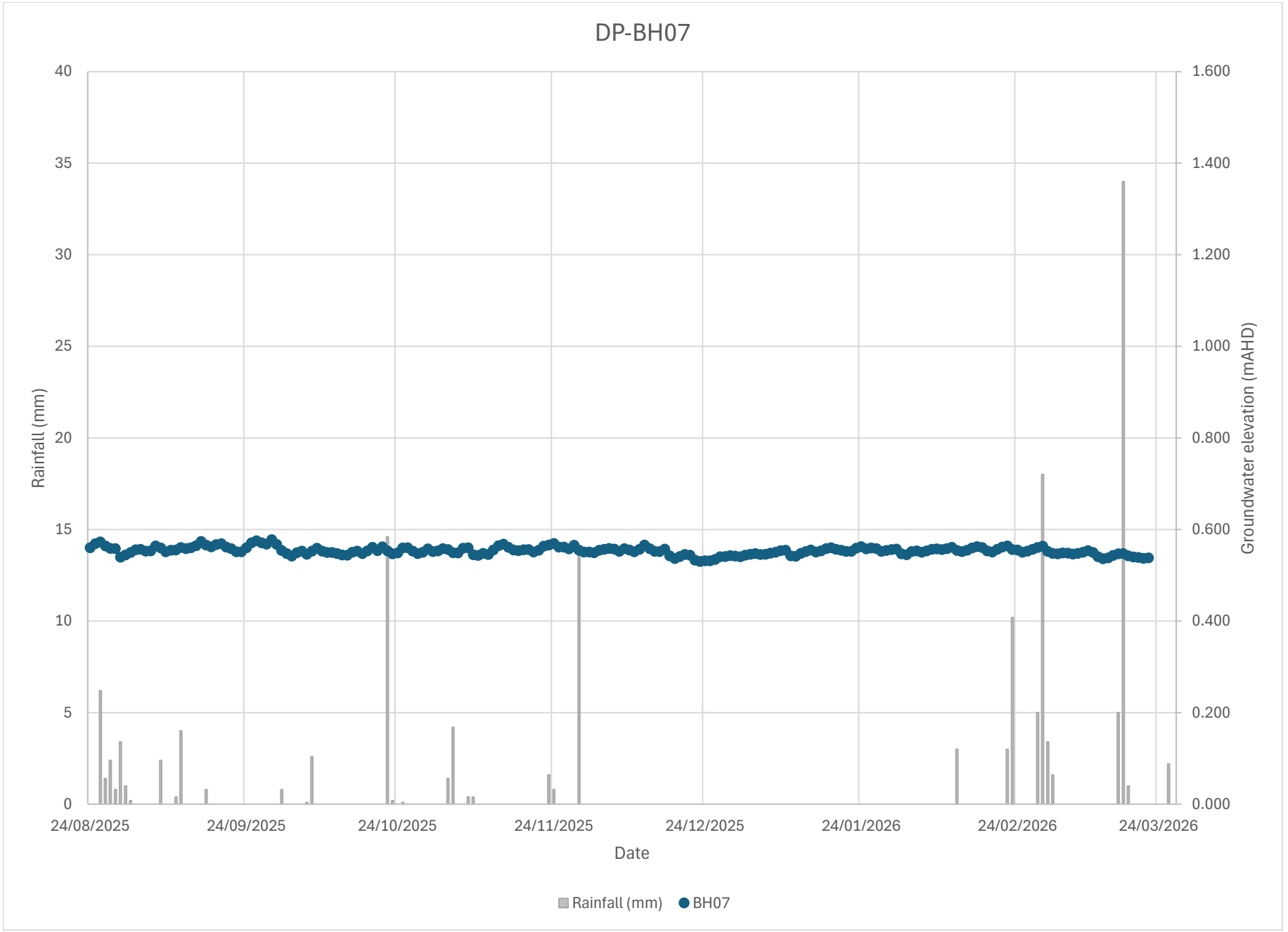

DP-BH01
Rainfall (mm)
Groundwater elevation (mAHD)
Date
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
0
5
10
15
20
25
30
35
40
0.000
0.200
0.400
0.600
0.800
1.000
1.200
1.400
1.600
Rainfall (mm)
BH01

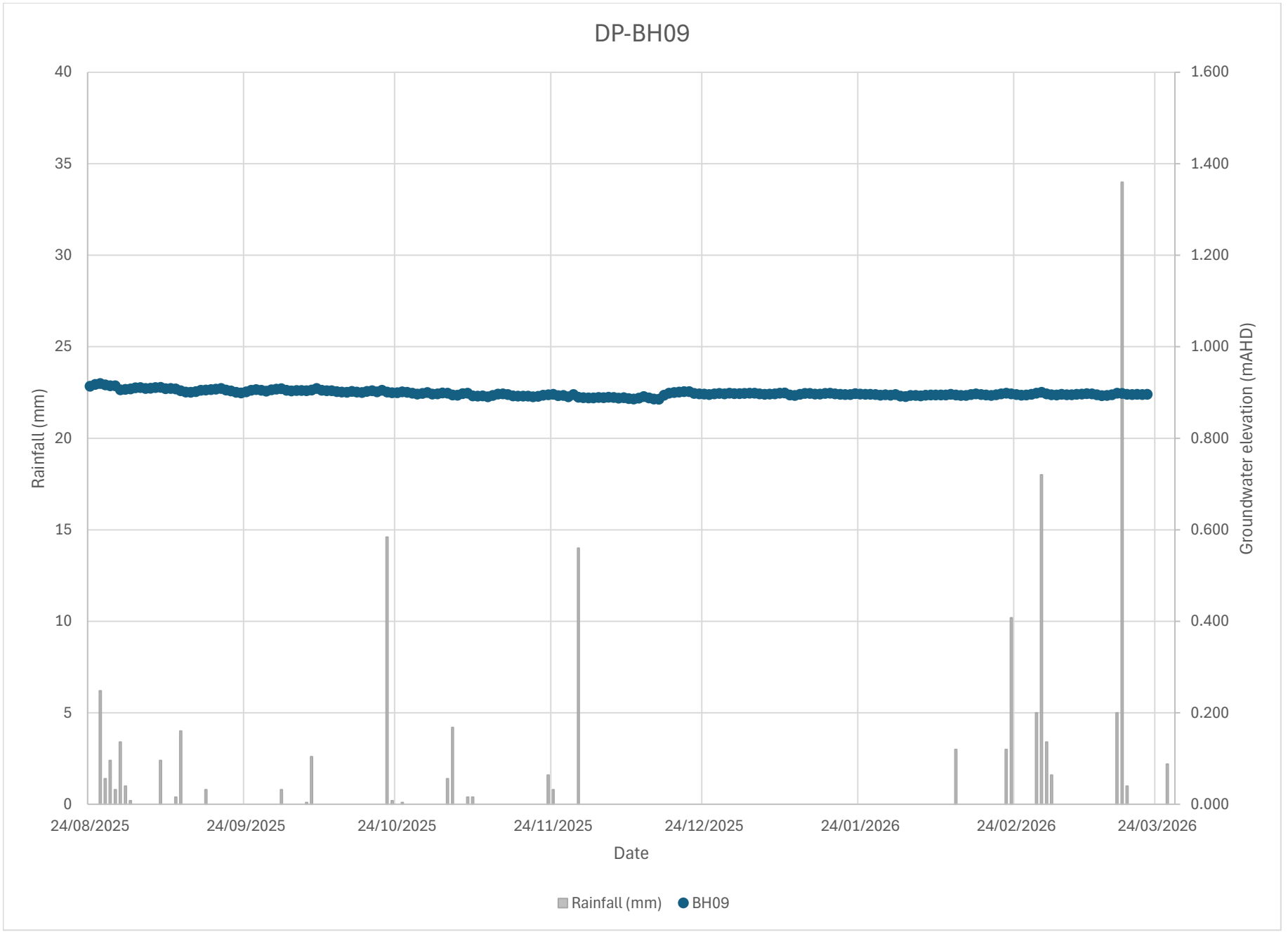

DP-BH02
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH02

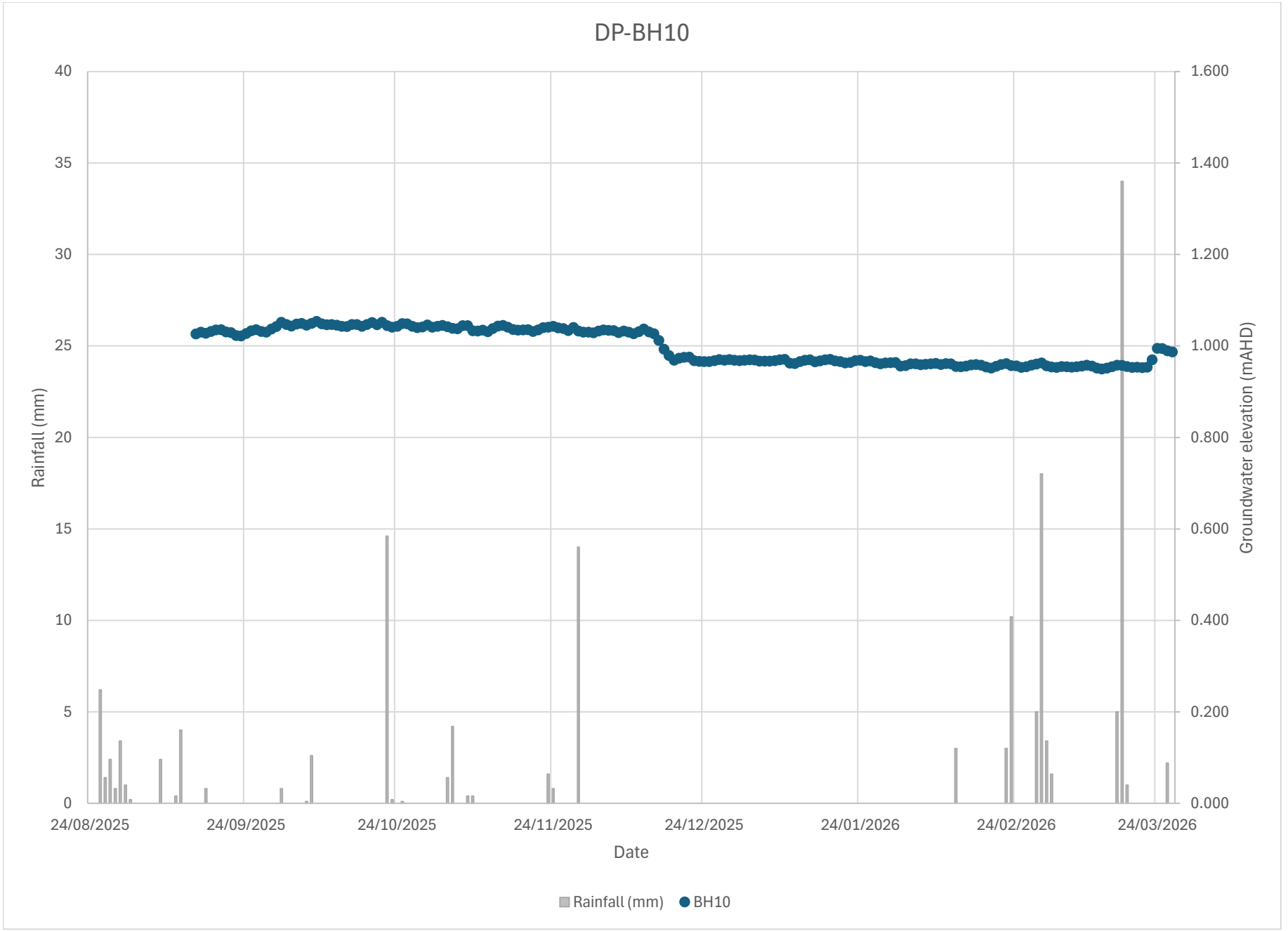

DP-BH03A
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH03A

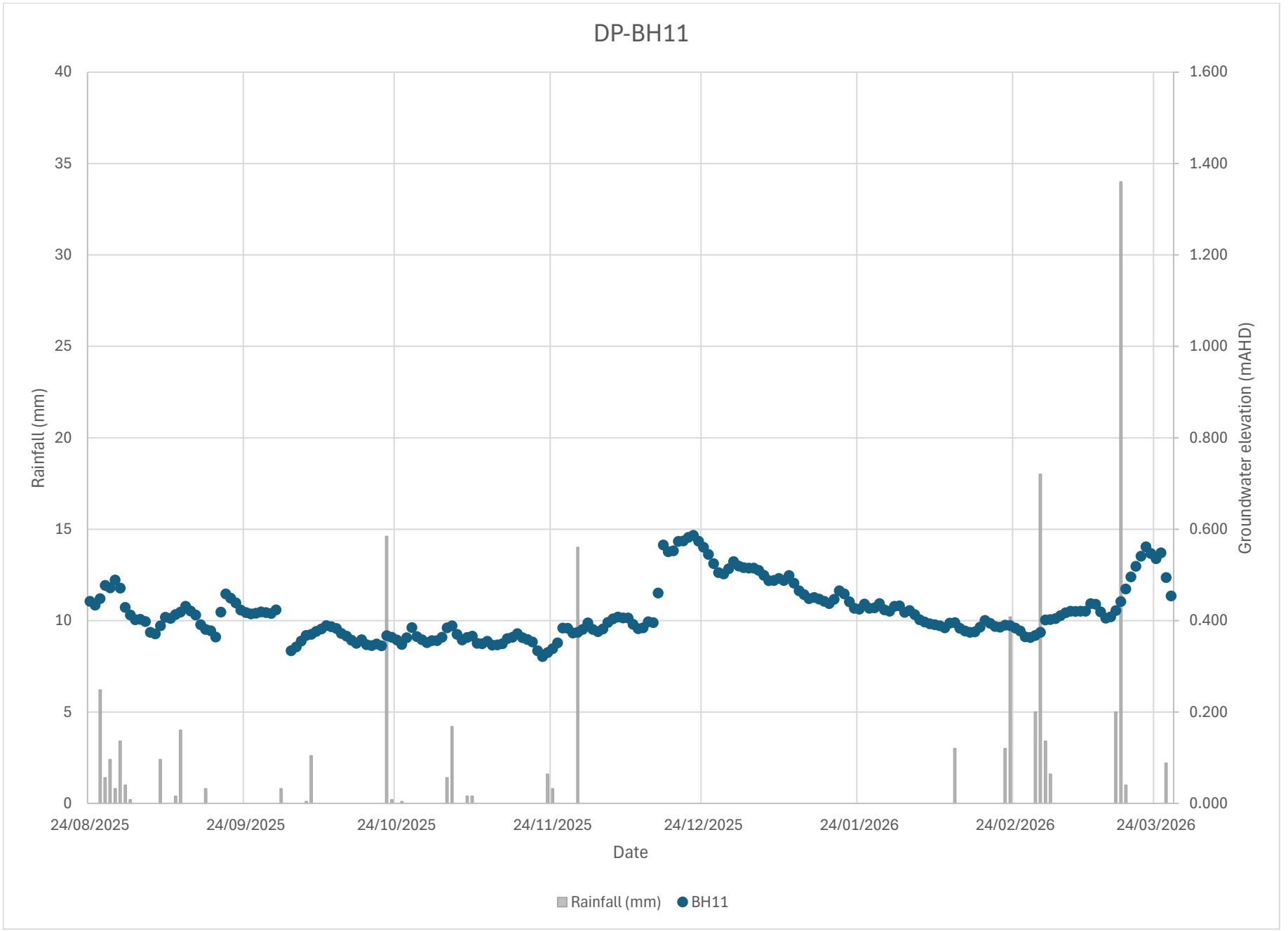

DP-BH04
Rainfall (mm)
Groundwater elevation (mAHD)
Date
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Rainfall (mm)
BH04

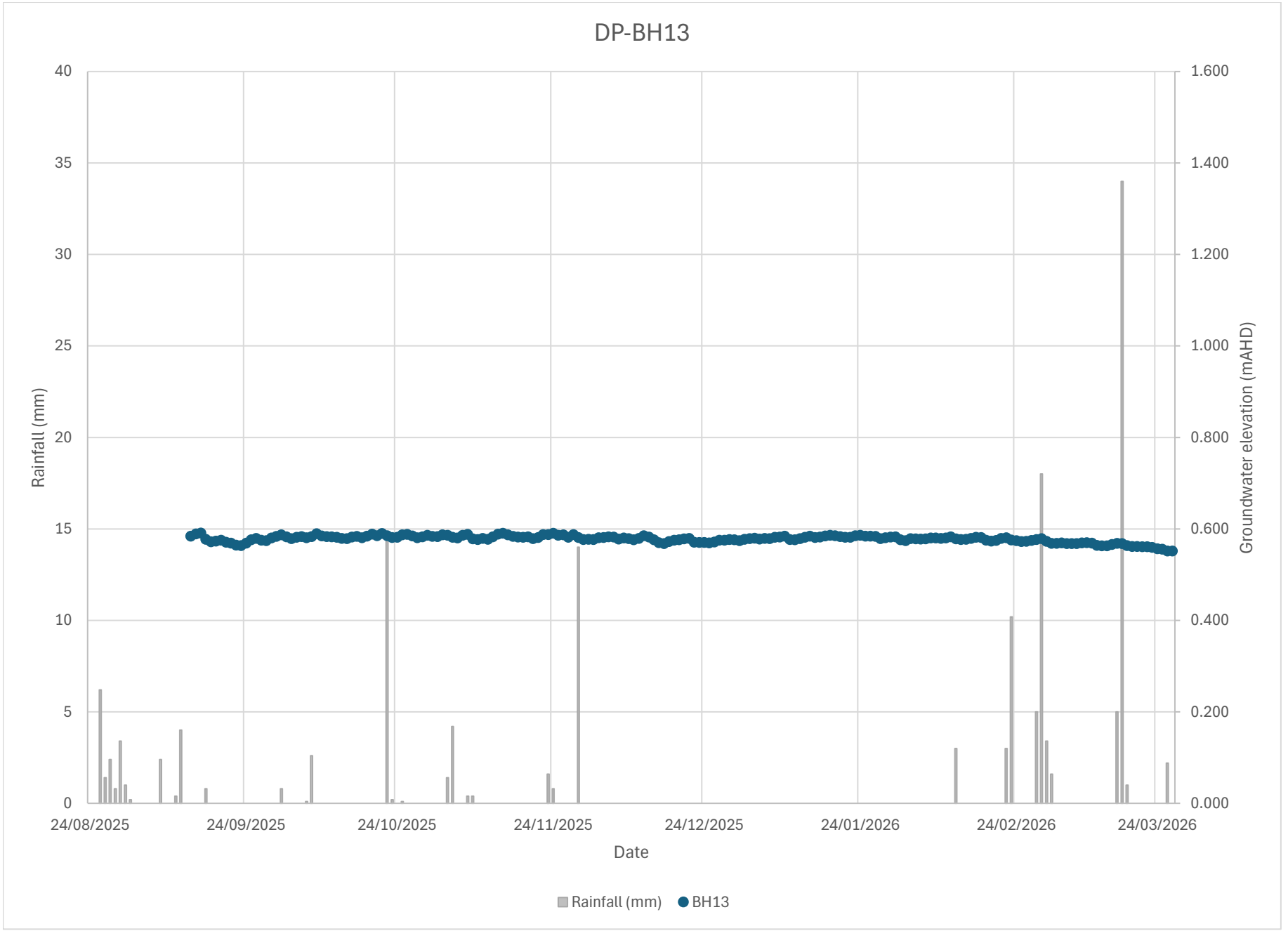

DP-BH06
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH06

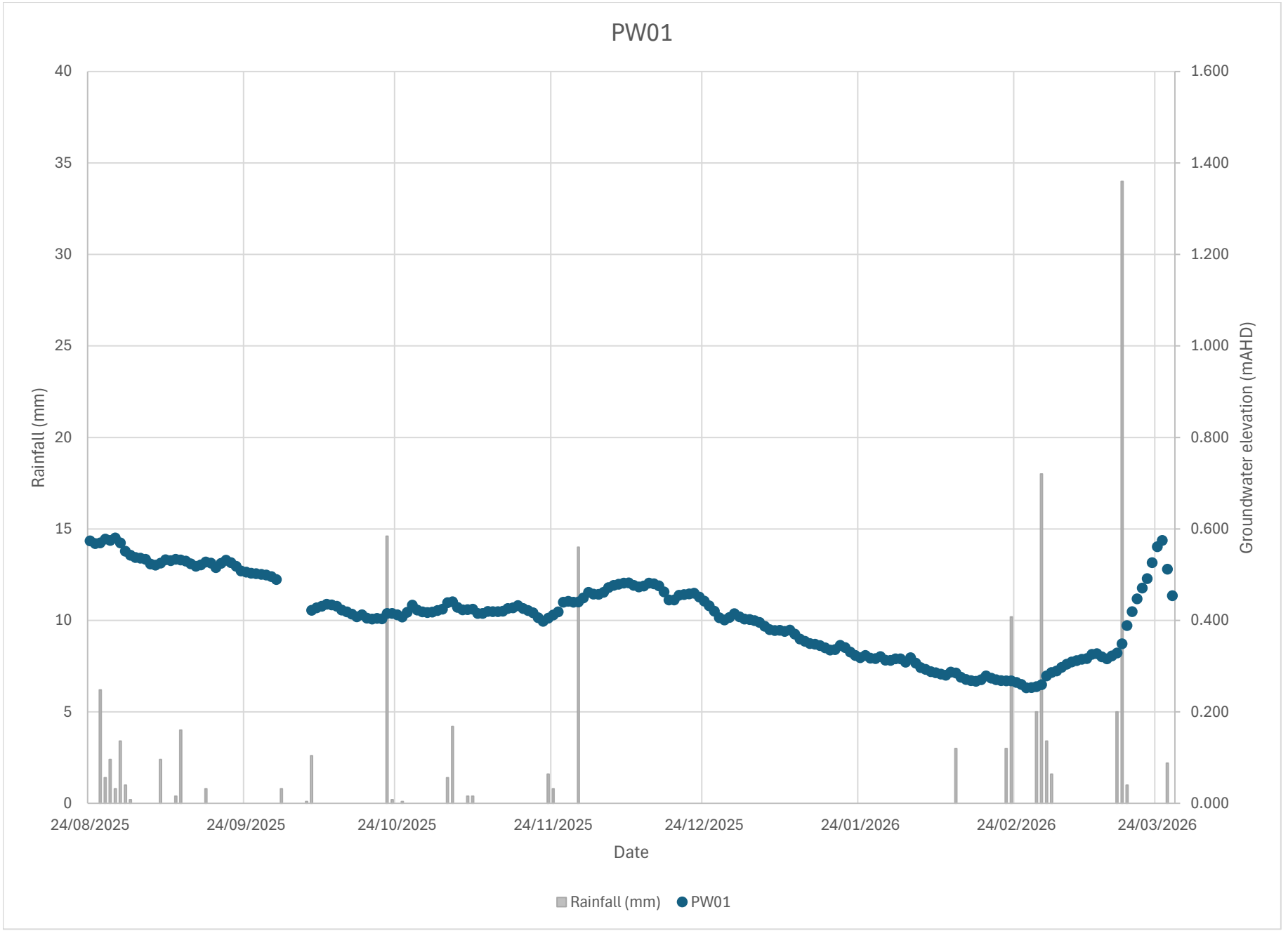

DP-BH07
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH07


DP-BH09
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH09


DP-BH10
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH10


DP-BH11
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH11


DP-BH13
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
BH13

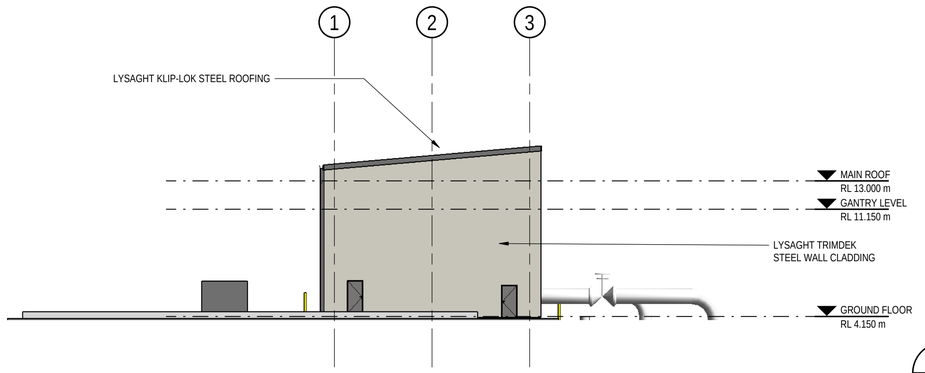

PW01
Rainfall (mm)
Groundwater elevation (mAHD)
40
35
30
25
20
15
10
5
0
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
24/08/2025
24/09/2025
24/10/2025
24/11/2025
24/12/2025
24/01/2026
24/02/2026
24/03/2026
Date
Rainfall (mm)
PW01

APPENDIX D: TUNNEL BORING MACHINE LAUNCH PIT AND PUMPING STATION/INTAKE PUMPS DESIGN DRAWINGS

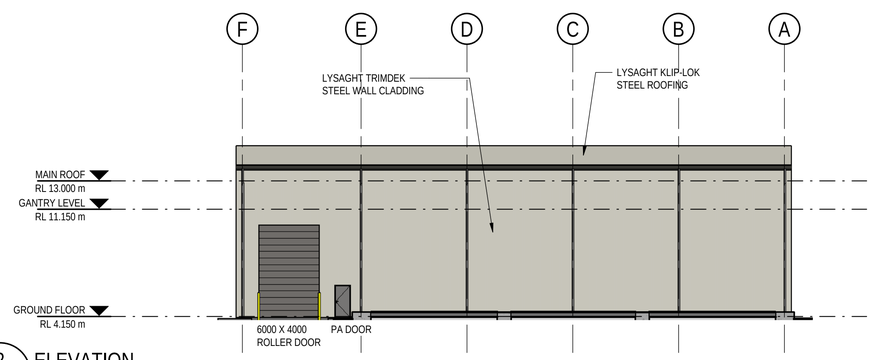




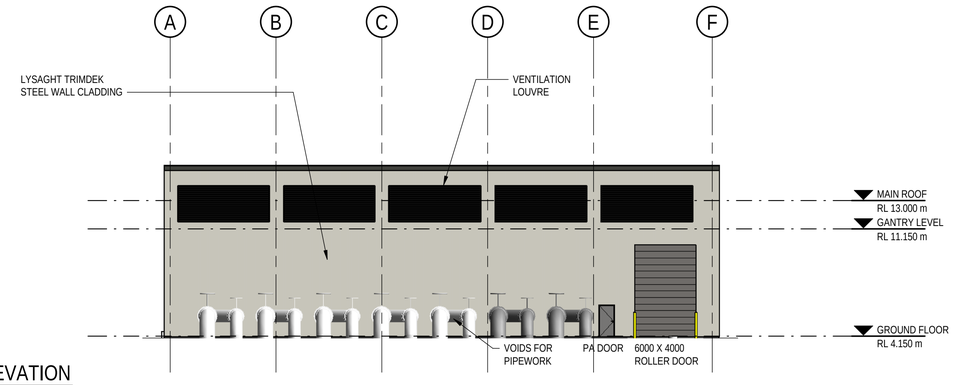




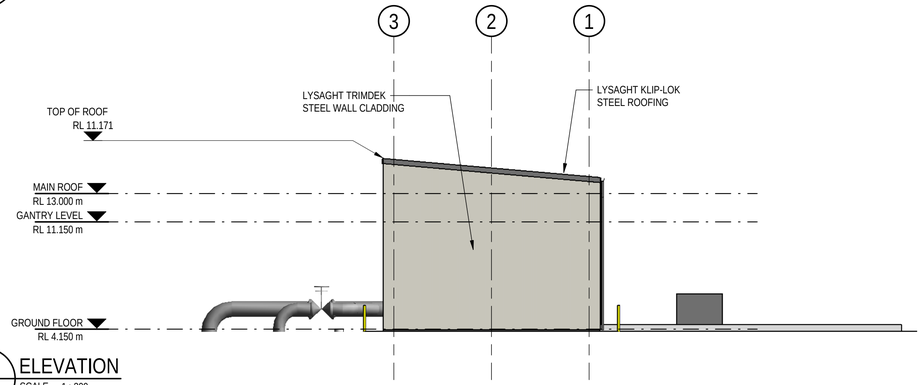
1 ELEVATION
0001 SCALE 1 : 200



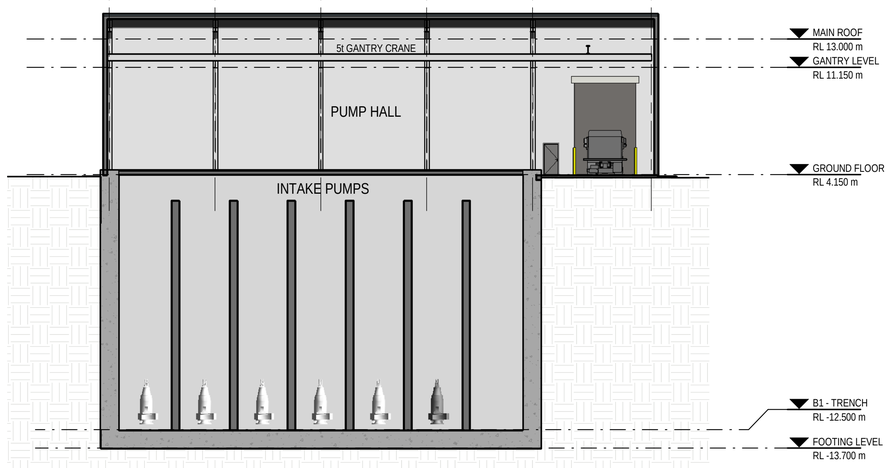
2 ELEVATION
0001 SCALE 1 : 200



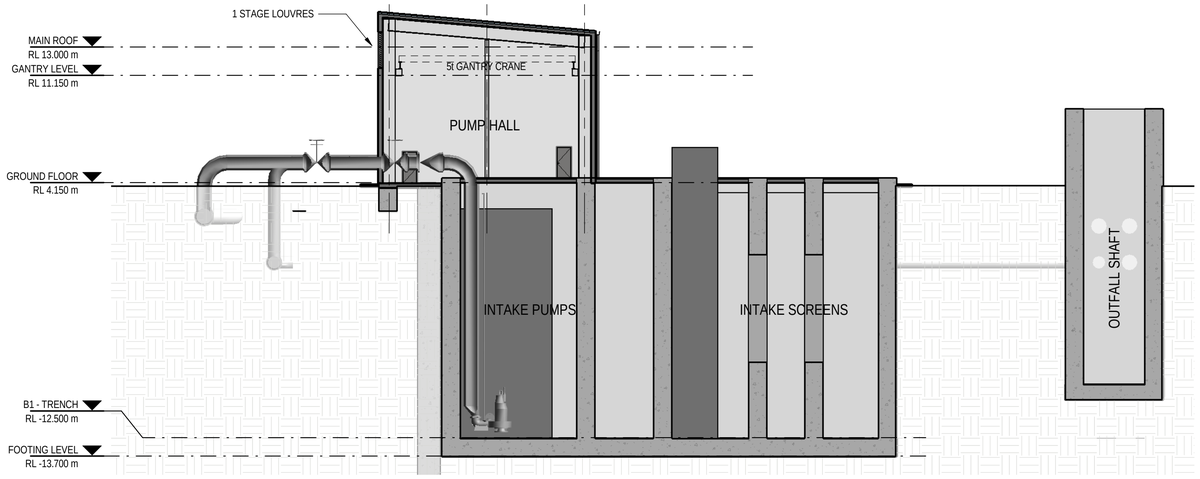
3 ELEVATION
0001 SCALE 1 : 200



4 ELEVATION
0001 SCALE 1 : 200



A SECTION
0001 SCALE 1 : 200



B SECTION
0001 SCALE 1 : 200

NOTES
ALL LYSAGHT STEEL CLADDING IS COLORBOND ULTRA STEEL.

COLORBOND STEEL COLOUR GUIDE:
SURFMIST: ROOF, WALLS
WALLABY: DOORS, FASCIAS AND GUTTERS

FOR INFORMATION ONLY

NOT FOR CONSTRUCTION

SCALES: 2000 0 2000 4000 6000 8000 10000 mm

No.	AMENDMENT DESCRIPTION	BY	DATE
B	FOR INFORMATION ONLY	AC	30.06.25
A	DRAFT FOR COMMENT	KR	23.05.25

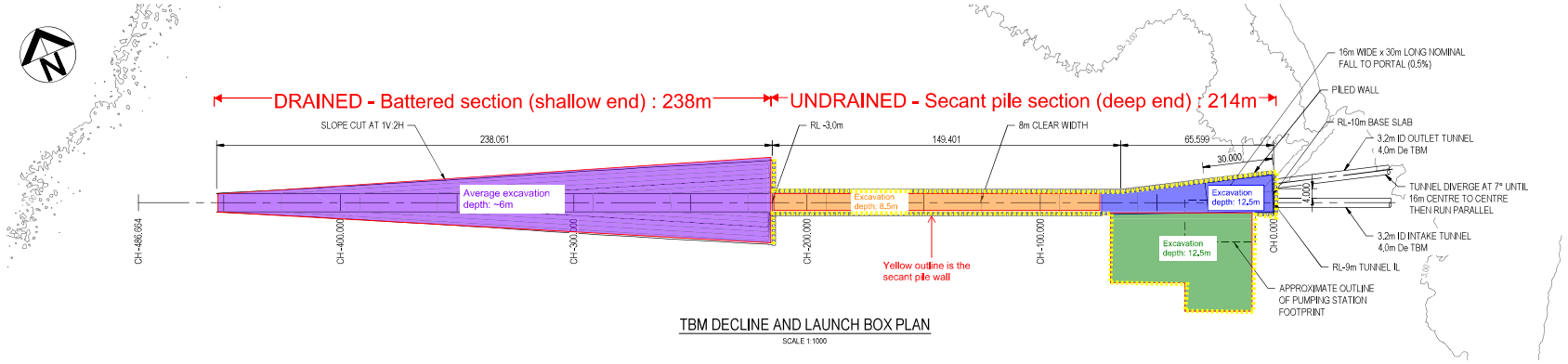
Government of South Australia
Department for Infrastructure and Transport

REFERENCE DESIGN
NORTHERN WATER
DESALINATION PLANT
INTAKE PUMP STATION BUILDING
ARCHITECTURE - ELEVATIONS & SECTIONS

DESIGNED	DRAFTED	CHECKED	PATCHS No.	SKETCH No.	AMEND No:
JW	KR	SZ	24C347	NW-DIT-BAS-2050-ARC-DRG -0002	B

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SHOWN OTHERWISE ◀ 1000 MILLIMETRES ON ORIGINAL DRAWING ▶ UNCONTROLLED COPY WHEN PRINTED

CAD FILE NAME: NW-DIT-BAS-2050-ARC-DRG-0002

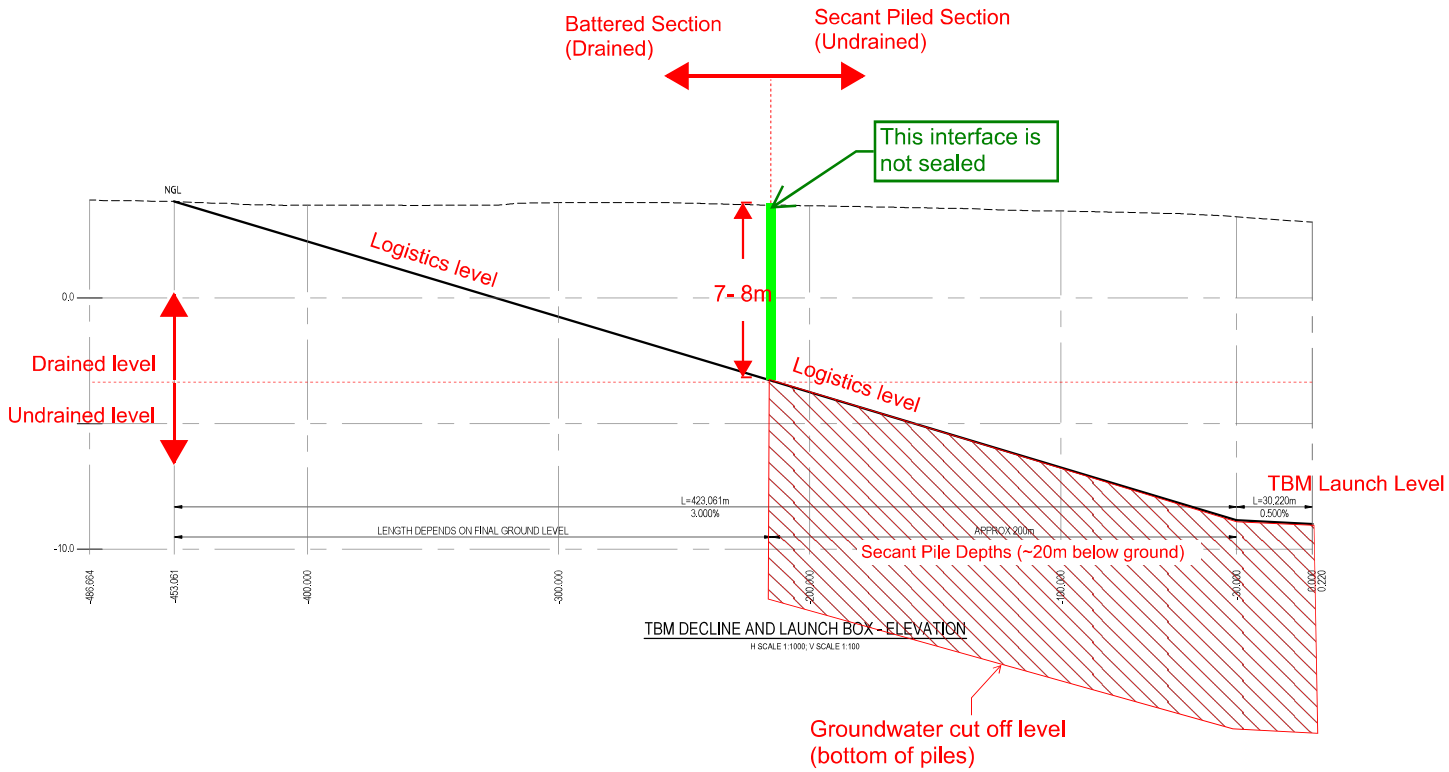


TBM DECLINE AND LAUNCH BOX PLAN

SCALE 1:1000

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING SHOWS PRELIMINARY INDICATIVE DIMENSIONS FOR A POSSIBLE BOX CUT AND ITS RELATIONSHIP TO OTHER PROPOSED INFRASTRUCTURE. THIS IS NOT A TEMPORARY WORKS DESIGN (TO BE COMPLETED AS PART OF DETAILED DESIGN).
3. THIS DRAWING HAS BEEN PREPARED FOR REFERENCE DESIGN PURPOSES ONLY AND IS BASED ON AN UNDERSTANDING OF THE PROJECT NEEDS AND CONSTRAINTS AT THE TIME OF ITS PREPARATION . IT THEREFORE DOES NOT REFLECT THE FINAL REQUIRED PROJECT SCOPE OR ANY PREFERENCE OF THE PRINCIPAL.
4. FOR OTHER NOTES, REFER TO DRAWINGS NW-DIT-BAS-1000-CIV-DRG-1001 AND 1002.



TBM DECLINE AND LAUNCH BOX - ELEVATION

H SCALE 1:1000, V SCALE 1:100

NOT FOR CONSTRUCTION

SCALES: V 2 0 1 2 3 4 — H 20 0 10 20 30 40

No.	AMENDMENT DESCRIPTION	BY	DATE
A	DRAFT FOR COMMENT	NA	16.05.25

Government of South Australia
Department for Infrastructure and Transport

ALL DIMENSIONS ARE IN METRES UNLESS SHOWN OTHERWISE — 100 MILLIMETRES ON ORIGINAL DRAWING — UNCONTROLLED COPY WHEN PRINTED

REFERENCE DESIGN
NORTHERN WATER
MARINE WORKS
TBM DECLINE AND LAUNCH BOX
PLAN AND ELEVATION

DESIGNED	DRAFTED	CHECKED	PATCHS No	SKETCH No.	AMEND No.
DO	NA		24C347	NW-DIT-BAS-1000-CIV-DRG-1003	A

CAD FILE NAME: NW-DIT-BAS-1000-CIV-DRG-1003.dwg

Appendix H-6:

Watercourses of Interest Table

Northern Water Pipeline –Watercourses of Interest

The Northern Water Project Area crosses over 200 identified drainage lines. The following list of watercourses has been developed to identify those of interest to stakeholders or with potential to be more sensitive to impacts. This list was compiled to include watercourses that:

- were identified in a technical report[1] as 'sensitive', 'major' or have a higher risk in a specific aspect than other watercourses crossed by the project.
- Identified as having sensitive environment which may necessitate alternative construction methods.
- had significant infrastructure proposed in close vicinity (for example a pump station adjacent to watercourse).

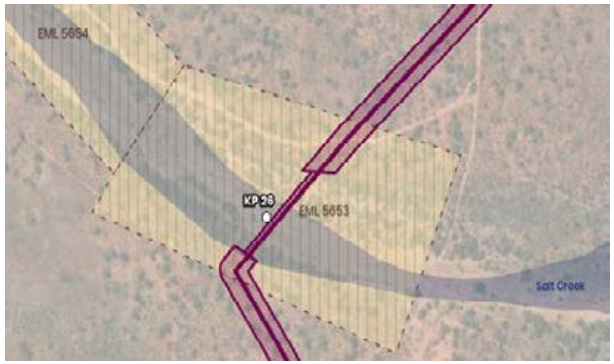
Each watercourse is described with location along the pipeline indicated by kilometre point from the desalination plant site (KP). Particular interest or risks for each watercourse have been highlighted to the right of the description (a tick indicates watercourse may be sensitive to the relevant aspect, cross indicates the risk from this aspect is the same as other watercourses).

[Unless otherwise stated all images are sourced from Google Earth (2026)].

Name[2] (ID)	KP	Description		Construct method	Ground water	Surface Water	Soils
Salt Creek (Nonowie Creek)	26	Ephemeral creek bed. Appendix H-4 identified regional aquifer is deep but there is potential for perched aquifers on the banks. Vegetation was assessed as being unlikely to depend upon groundwater. Pipeline crosses the creek at the same location as		Above ground	✓	✓	X

[1] Refer Appendix H Physical Environment: Topography, Geology and Soils Assessment (Jacobs 2026a) (Appendix H-1), Preliminary Site Investigation Report (JBS&G 2026d) (Appendix H-2), Surface Water Assessment (Jacobs 2026c) Appendix H-3) and Groundwater Impact Assessment (JBS&G 2026e) (Appendix H-4..

[2] Where a creek has multiple names, the name used in the EIS chapter is listed first with alternate names in brackets to allow cross-referencing with technical studies.

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
		Extractive Minerals Lease (EML) 5653 which is extracting gravel and sand within the creek bed to a similar depth as the proposed trench. Appendix H-3 identified risk for flooding within creek bed. *Image sources: Google Earth (2026) and JBS&G (2026)* 				
Myall Creek (Pine Creek) (Lincoln Gap Pump Station)	64, 74	Ephemeral, braided watercourse with multiple pipeline crossings. Disturbance will include a pipeline crossing, construction of a pump station between channels and upgrade of the existing substation adjacent to a channel. Appendix H-4 identified potential for a perched aquifer in southern crossings (KP 64).  Regional mapping identified a moderate potential GDE labelled *wetland lacustrine*, however, ecological assessment identified flora known to exist without access to groundwater. Site inspections identified large cobbles in bed load indicating high energy stream flow. Appendix H-3 indicated potential for floods within creek bed. *Image source: JBS&G (2026)*	Trenched	✓	✓	✓

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
Unnamed watercourse near Lincoln Gap	85	Ephemeral watercourse with trenched pipeline crossing. Existing infastructure at this crossing include a road, railway and pipe bridge as well as a fence. Photos of watercourse show large cobbles in bed load indicating high energy stream flow.  Disturbance will include a trenched pipeline crossing. Was identified in Appendix H-3 as having increased erosion risk from construction of a crossing and high flood risk. Appendix H-4 indicated water table below the disturbance area with geotechnical boreholes from this location identifying no groundwater to a depth of 10 m below ground level. 	Trenched	X	✓	✓

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
Tributaries of Lake Dempsey	96, 99, 102, 106 & 111	Ephemeral, braided watercourses feeding into Lake Dempsey. Review of groundwater records (well ID 6433-53) indicates shallow groundwater aquifer approximately 2.1m bgl.  Regional mapping has identified high potential aquatic GDE which was listed as *wetland seasonal streams*. Aerial imagery shows increased vegetation cover in this area supporting the assessment of groundwater supply for streambeds. As construction is proposed above ground, impacts from groundwater drawdown due to trenching or trenchless construction are reduced to support foundations only. Appendix H-2 indicated potential for PASS. Appendix H-3 identified increased risks associated with flooding, discharge or erosion.	Above Ground	✓	✓	✓
Kells Swamp Tributaries (Hesso Creek)	146 - 150	Ephemeral tributaries flowing to large Kelli Camp Reservoir.  Appendix H-4 concludes the likely presence of a shallow groundwater table in this region. No GDEs were located from regional mapping. Appendix H-1 identified risk of aggressive soils present in this area.	Trenched	✓	X	✓
Ranges View Creek (Kootaberra	153	Ephemeral tributaries flowing to large Kells Camp Reservoir.	Trenchless or trenching	X	✓	✓

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
Creek / Hesso Creek)		Appendix H-4 concludes unlikely for shallow groundwater. Review of mapping indicates deep confined operational well 335m bgl (6334-29). 7.5 km north of the Range View Creek crossing. No GDEs were located from regional mapping.  Appendix H-1 indicates risk of aggressive soils present in this area and potential for sediments to be unsuited to trenchless construction methodology. Appendix H-3 indicated above average risk of flooding.	with 25 m corridor			
Black Oak Creek	195 - 200	Ephemeral tributaries and channel connecting the salt lakes, Pernatty Lagoon and Lake Dutton. Appendix H-4 concluded likely shallow groundwater aquifer. Regional mapping has identified a high potential aquatic GDE (identified as *wetland palustrine*) and moderate potential aquatic GDE (Black Oak Creek). However, vegetation in this area is considered to have a low reliance on groundwater.  The Appendix H-3 identified potential for temporary restriction of fish passage at Pernatty Lagoon but not within Black Oak Creek. As the Project will only trench when the lagoon is dry this has not been considered further.	Trenched	✓	✓	✓

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
		Other risks identified in Appendix H-3 include flooding, discharge of groundwater, erosion and removal of vegetation. Appendix H-1 identified potential for aggressive soils and indurated materials.				
Unnamed watercourse	222	Was identified as potential area for trenchless construction due to sensitive environment. Identified as sediments being potentially weak and requiring additional supports for trenchless construction. No specific risks were identified in Appendices H-3 and H-4. 	Trenchless	X	X	✓
Lake Windabout	235 - 240	Pipeline will cross to the south of Lake Windabout salt lake. Groundwater well (6235-69) is measured at 6.5 m bgl and thus is not expected to be impacted by pipeline construction. Potential for perched groundwater in surrounding dune systems. Appendix H-3 identified potential risks for flooding, discharge or water or spoil, erosion, vegetation removal. Appendix H-1 has identified risk of aggressive soils and potential for additional engineering controls to be required for trenching. 	Trenched	✓	✓	✓

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
Wirra Wirralu Creek	276 - 277	Area of shallow groundwater table. Review of groundwater register indicates single shallow unconfined aquifer intersected (6235-30) adjacent to the waterways, water recorded at 0.61m bgl. Groundwater in this area has a medium likelihood of reliance on groundwater.  Potential for flooding within creekbed. Appendix H-1 indicated potential for aggressive soils at this location.	Trenched	✓	✓	✓
Lake Mary drainage line	315	Appendix H-4 concluded potential for perched groundwater, however, mapped vegetation has a low reliance on groundwater. Pipeline alignment is proposed adjacent to the Lake Mary lagoon and no direct impacts expected. 	Trenched	✓	X	X

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
Coorlay Lagoon drainage line	330	Potential for perched groundwater in surrounding sand dunes. Mapped vegetation communities have a medium likelihood of reliance on groundwater (intermittent use only). Was identified as potential area for trenchless construction due to sensitive environment.  Desktop assessment Identified sediments as being potentially weak and requiring additional supports for trenchless construction. Geotechnical test work undertaken in 2024 by CMW[3] identified this area has having indurated material which could not be excavated below 3 m with rock breakers.	Trenchless or trenching with 25 m corridor	✓	X	X
Elizabeth Creek	CA21	Ephemeral, braided creek flowing into the northern end of Lake Windabout (salt lake). Groundwater assessment in Carrapateena Project Mining Lease Application (OZ Minerals, 2017) identifies the shallowest aquifers being near salt lakes as 5 m bgl or deeper. Regional mapping has identified Elizabeth Creek itself to be a low potential aquatic GDE. Assessment of water quality and levels has identified vegetation dependent upon surface water and stored soil water (Oz Minerals 2017), indicating the potential for perched aquifers. Identified in Appendix H-1 as risk of PASS. Appendix H-3 rated this creek as increased risk for flooding, discharge of groundwater and erosion.	Trenched	✓	✓	✓

[3] CMW Geosciences (2024) Northern Water Project - Project Area A – Factual Report – Work Package 2 – Onshore Geotechnical, NWP-CMW-ONG-0000-GEO-RPT-OOO8_A.

Name[2] (ID)	KP	Description	Construct method	Ground water	Surface Water	Soils
Carra Creek	CA29	Ephemeral creek. Appendix H-4 concluded this creek was unlikely to access groundwater. Regional mapping has not located nearby GDEs. Identified in Appendix H-1 as risk of PASS. Appendix H-3 rated this creek as increased risk for flooding, discharge of groundwater and erosion.	Trenched	X	✓	✓
Yeltacowie Creek	CA34-CA39	Pipeline crosses multiple channels of this ephemeral, braided creek. Regional mapping has identified Yeltacowie creek to be a low to moderate potential aquatic GDE. Assessment of water quality and levels has identified vegetation is dependent upon surface water and stored soil water (Oz Minerals 2017). This could indicate potential for perched aquifers. Appendix H-3 identified above average risk for flooding, discharge or erosion. Identified in Appendix H-1 as having potential ASS. Creek was identified as potential area for trenchless construction due to sensitive environment. Identified as sediments being potentially weak and requiring additional supports for trenchless construction	Trenchless or Trenching (40 m corridor)	✓	✓	✓

Appendix H-7:

Stormwater Management Plan

Stormwater Management Plan

Northern Water Project – Desalination Plant

Department for Infrastructure and Transport

20 October 2025

→ **The Power of Commitment**



Project name		Northern Water Supply – Delivery Phase					
Document title		Stormwater Management Plan | Northern Water Project – Desalination Plant					
Project number		12601676					
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S4	0	S. Wijekoon/ S.Gianquitto	H.Sandland	**on file*	A.Chitty	**on file*	20/10/2025

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1. Introduction

1.1 Background

The Northern Water Project (NWP) is a priority initiative for South Australia and offers a unique opportunity for significant economic growth in the north of the State. The NWP is being delivered by the Department for Infrastructure and Transport (DIT). The NWP aims to provide a sustainable water supply to end-users, many of which currently source water from the Great Artesian Basin (GAB) and River Murray resources; water sources that hold significant environmental and cultural values.

DIT engaged GHD Pty Ltd to prepare a Reference Design for a proposed desalination plant and water transfer system. The scope of reference design completed by GHD was limited to a reverse osmosis desalination plant located near Mullaquana, in the northern Spencer Gulf region approximately 30 km southwest of Whyalla. The Desalination Plant comprises the intake pumping station, pre-treatment through reverse osmosis to post-treatment, and seawater concentrate return.

To support the environmental approval process associated with the NWP, DIT have requested GHD to prepare a Stormwater Management Plan (SMP) for the Reference Design desalination plant to align with the EPA requirements.

1.2 Purpose of this report

To support the environmental approval process a SMP has been prepared. The purpose of the SMP (this report) is to:

– Provide a summary of the terrestrial environment of the area covered by this SMP
– Perform hydrological estimates of design peak flows arriving to and discharging from the Desalination Plant site
– Nominate performance standards for site stormwater management
– Outline the flood management strategy to safely manage rainfall runoff both internal and external to the site.
– Assess the water quality impacts associated with the desalination plant site and recommended strategies to reduce stormwater pollutant discharges at the source, through Water Sensitive Design (WSD) principles.

1.3 Limitations

This report has been prepared by GHD for *Department for Infrastructure and Transport* and may only be used and relied on by *Department for Infrastructure and Transport* for the purpose agreed between GHD and *Department for Infrastructure and Transport* as set out in this report.

GHD otherwise disclaims responsibility to any person other than *Department for Infrastructure and Transport* arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.4 Assumptions and limitations

While care has been taken in the preparation of the model and the choice of the adopted parameter values, all hydrological and hydraulic modelling has an inherent level of uncertainty. This is due to several factors, including the following:

– The analysis to date has been undertaken at a conceptual level. Prior to the implementation of the strategies identified there will be a need for additional modelling and investigations. It is anticipated that additional modelling activities will be undertaken in the detailed design phases of the project where further refinement and optimisation will be undertaken.
– Estimation of input parameters for the model such as Manning's roughness, entry and exit losses, and time of concentration.
– Dynamic changes to topography due to erosion or deposition of soils during a flood event, which can lead to changes in the distribution of flow. These processes have not been included in the model.
– Uncertainty in the rainfall pattern and catchment conditions prior to a flood. Actual flood events are dependent on antecedent moisture conditions prior to rainfall, initial detention storage levels at the beginning of rainfall runoff and the intensity and uniformity of the rainfall event within the analysis area. The runoff modelled in this assessment are based on design storm bursts which attempt to reproduce the expected average temporal pattern of a storm burst within specified rainfall zones. As such, individual rainfall events may exhibit a differing temporal pattern that those modelled.

1.5 Existing information

This assessment has considered the following information:

– Catchment contours, surface level information derived from public Geoscience Australia digital elevation model datasets available at ELVIS website
– State Government watercourse, waterbody, drainage basin catchment data from Location SA
– Site climate and rainfall data from Bureau of Meteorology (BoM)
– Site geology data from South Australian Resources Information Gateway (SARIG)
– Aerial photography

2. Study Area

2.1 Site location

The pipeline supplying desalinated product water, will run north from the desalination plant to Olympic Dam, approximately 360 km, via Whyalla, Lincoln Gap, Woomera and Roxby Downs, with a major branch line from the pipeline to Carrapateena Mine. The design also includes for potential future offtakes at Whyalla North, Port Bonython, Woomera, Oak Dam Mine and Roxby Downs and various potential locations for connection to the Port Augusta-Woomera Pipeline (PAWP) along with a future pipeline expansion opportunity at Bosworth Road.

The locality of the desalination plant and transfer pipeline alignment are indicatively shown in Figure 1.

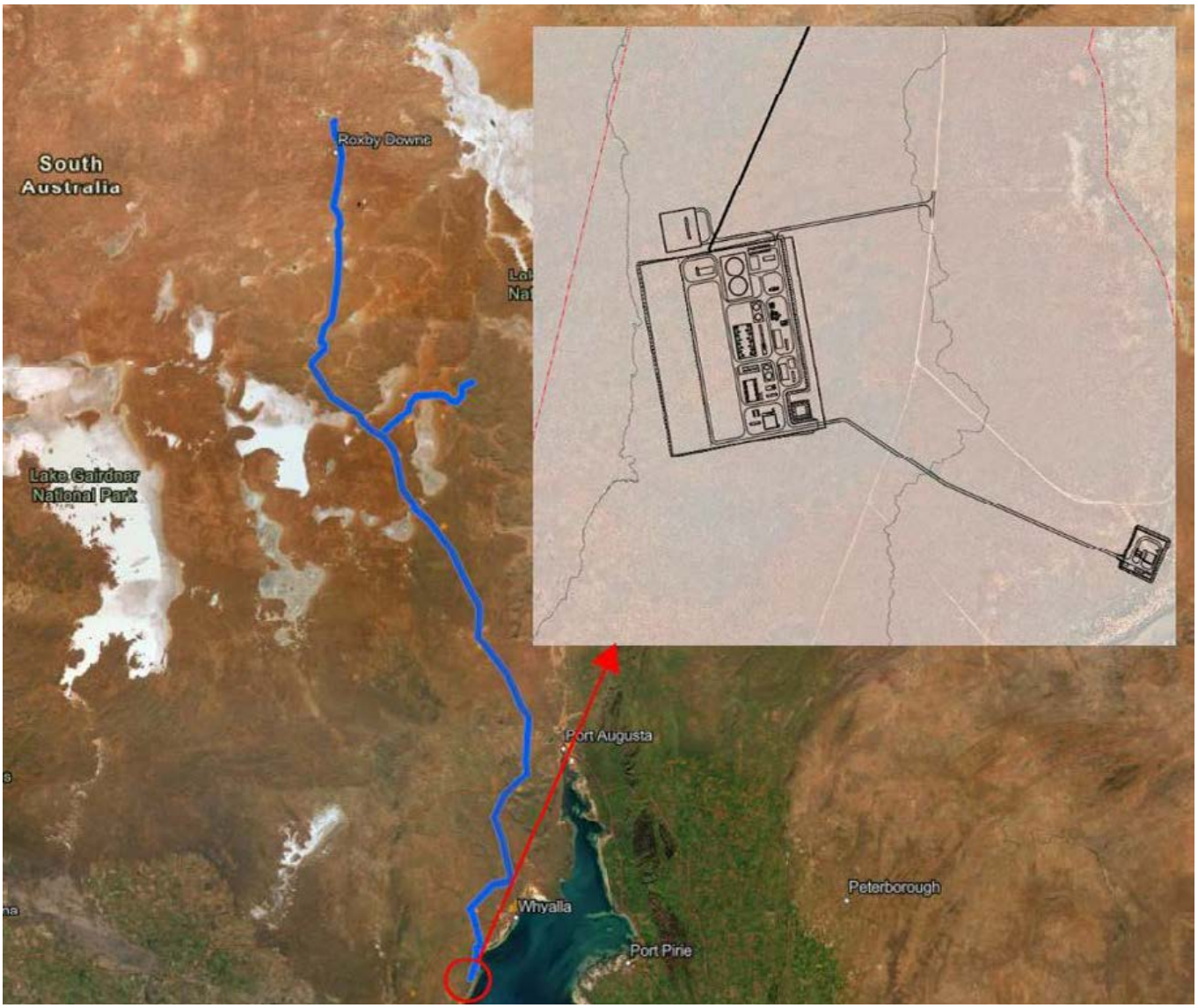


Figure 1 Site location with Mullaquana Desalination Plant site layout (inset) (Northern Water GIS, June 2025)

2.2 Desalination Plant

The nominated Desalination Plant site is near Mullaquana station, located approximately 30 km south of Whyalla, as identified by DIT. The site is required to encompass:

– the desalination plant

- high voltage switchyard
- intake and outlet pump station areas
- TBM launch facility
- construction activity and enabling/temporary works
- stormwater management systems; and
- future proofed land to support the potential development of additional treatment plant up to the Ultimate capacity of 200 ML/d.

For the purposes of the reference design, the plant is to be located in the south-eastern corner of the identified parcel (H560400 Section 53), which is Crown land with a lease currently held by Joyce Pastoral Pty Ltd. The site location is shown in Figure 2.

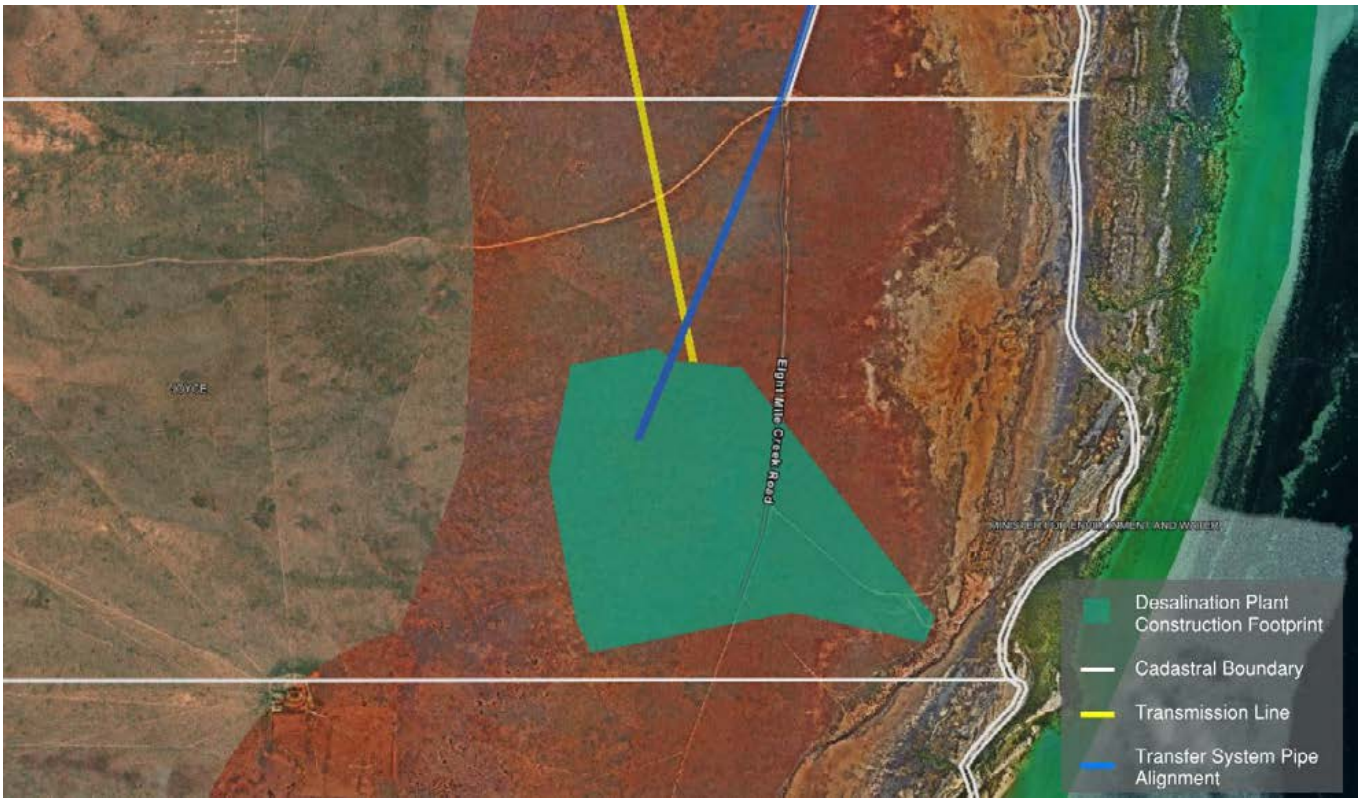


Figure 2 ***Proposed desalination plant site location and boundaries (Northern Water GIS, June 2025)***

2.2.1 Topography

The proposed desalination plant site features a predominantly flat and low-lying landscape, gently sloping from the western escarpment to the eastern coastline. To the west of the desalination plant site, the catchment has well defined topography and is drained by a network of ephemeral creeks and drainage lines. These drainage lines lose definition as they approach the desalination plant site to the east, where the terrain includes saline plains, low coastal dunes, and mangrove areas, gradually transitioning into sandy loam plains dominated by saltbush and bluebush vegetation.

The site itself does not fall within a major catchment, and there are no significant rivers or creeks flowing through or near the area. Nonetheless, the site is located within the broader Spencer Gulf drainage basin and ultimately drains into the Spencer Gulf.

There are no surface water features of formal conservation significance within the Project area (e.g. Great Artesian Basin (GAB) springs, Ramsar listed wetlands). The proposed desalination plant is not located within an area where the water resource is prescribed under the Landscape South Australia Act 2019 and is not within a water protection area.

Elevations within the catchment range from approximately 13 mAHD at the upstream most extent to less than 1 mAHD adjacent the coast. The coastal dunes nearest the site have an approximate elevation of 2 mAHD. The ground levels across the desalination plant site range from approximately 11 mAHD in the northwest to approximately 6 mAHD in the southwest. The intake pump station is at an elevation of approximately 4.2 mAHD.

The general topography and the water courses surrounding the project areas is shown in Figure 3.

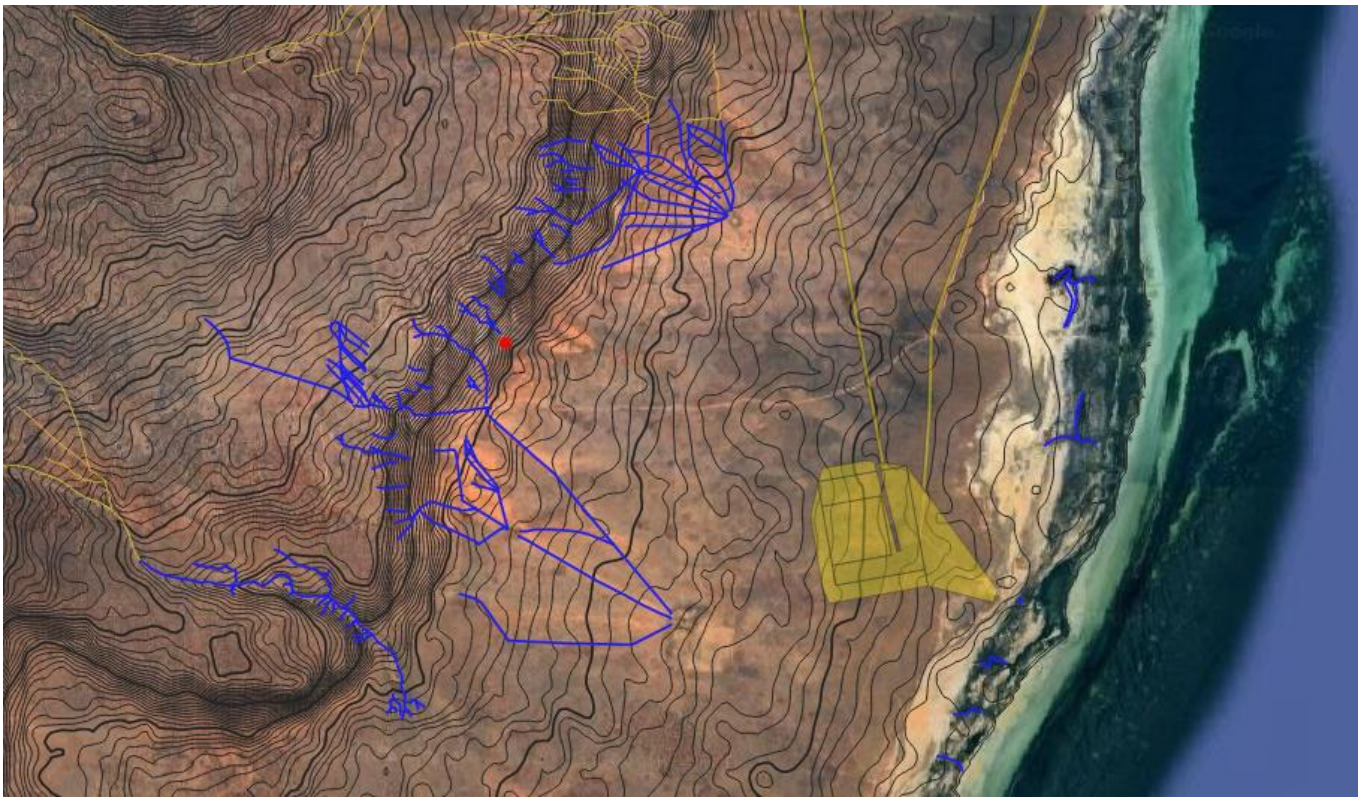


Figure 3 Site Topography and water courses

The LiDAR survey data acquired for the site only covers the coastal strip along the Spencer Gulf and is not suitable to determine the extent of external catchments flowing to the site. Publicly available LiDAR hydro-enforced data has been obtained from the ELVIS (Elevation Information System) platform to support the assessment of site topography beyond the extents of the provided LiDAR survey. The dataset is based on the Shuttle Radar Topography Mission (SRTM) and offers a spatial resolution of 30 metres.

2.2.2 Land use

The site is classified under the land use category Livestock and remains largely undeveloped. Existing features are minimal and include dirt access tracks, scattered scrub vegetation, several farm dams, and drainage ditches. To the east, the site is bordered by the coastline of the Spencer Gulf. This coastal area comprises an extensive swamp system that is subject to periodic inundation.

The Mullaquana Station area is sparsely populated and primarily used for sheep grazing. Two homesteads, Mullaquana Station and Nonowie Station, are situated within a 5-kilometre radius of the proposed Desalination Plant site. The surrounding coastal region near the site remains largely untouched and uninhabited, with only a few holiday homes located approximately 10.5 kilometres to the south at Murninnie Beach and 8 kilometres to the north at Cowleds Landing.

There are no areas reserved or managed for conservation purposes, or under Vegetation Heritage Agreements areas in the vicinity of the proposed Desalination Plant.

2.2.3 Soils

The Geological Survey of South Australia 1:100,000 scale Middleback (sheet 6331) and Whyalla (sheet 6431) maps indicate that the anticipated surface geology around the desalination plant consists of predominantly Holocene alluvial and fluvial deposits, Pleistocene regolith / Colluvial unit 4 and Saint Kilda Formation (Figure 4). Descriptions of the geological units underlying the site are as follows:

– Saint Kilda Formation (Qhck) – coastal marine sediment: calcareous, fossiliferous sand and mud of intertidal sand flats, beaches and tidal marshes; organic, gypseous clay of supratidal flats.
– Holocene alluvial and fluvial deposits (Qha) – undifferentiated alluvial/fluvial sediments.
– Pleistocene regolith / Colluvial unit 4 (Qpr4) – gravel, clay, silt and sand with soft carbonate, overlying nodular/tabular calcrete.
– Gibbon Beds (TpQag) – mottled clayey sand, sandy clay, conglomerate. Non marine.
– Melton Limestone (Tomm) – bryozoal limestone, sandy and gritty with lepidocyclina.

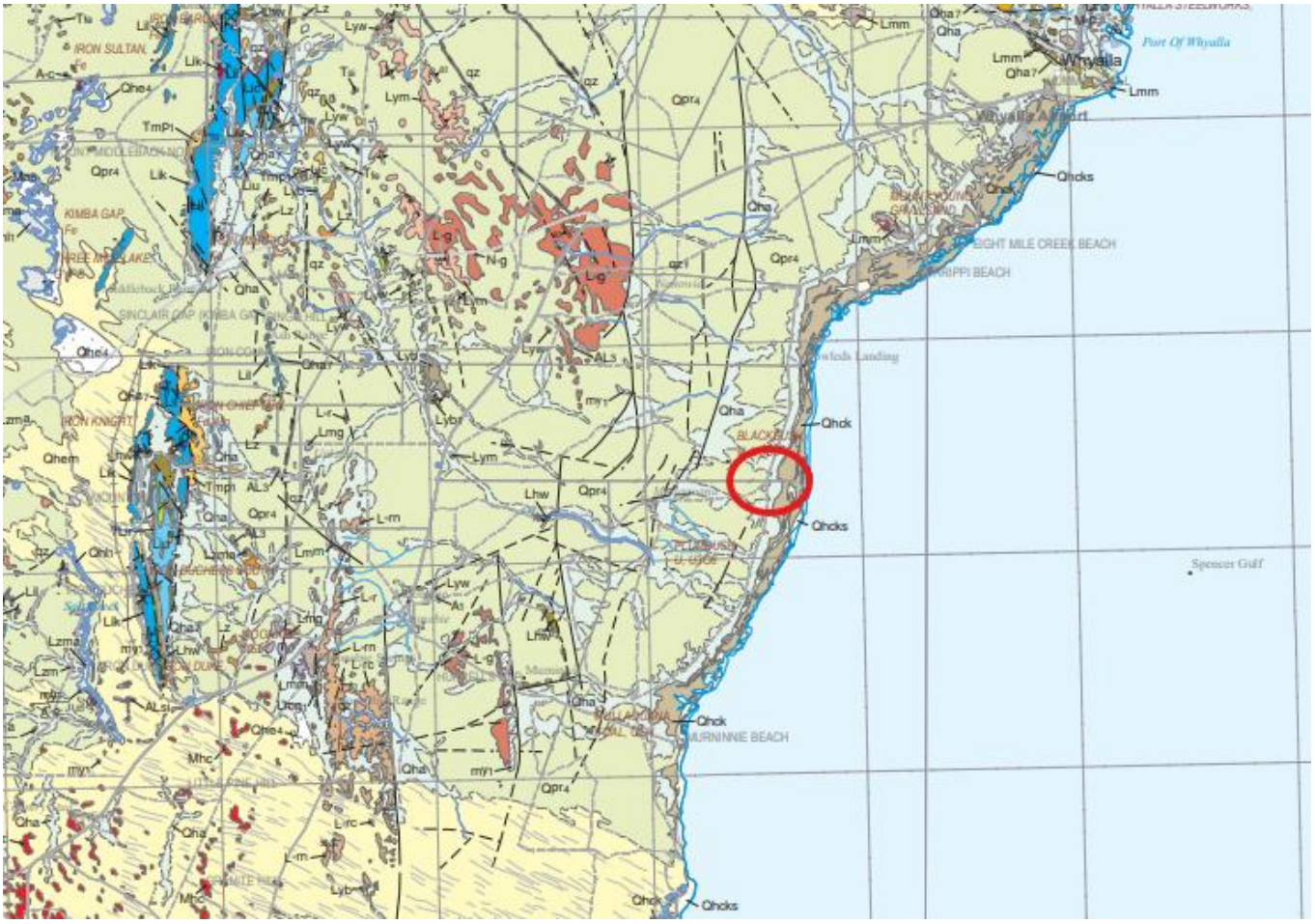


Figure 4 Site Geology (SARIG - Geological Survey of South Australia, July 2025)

Generally, the soils are likely to be clayey, with some sandier materials along the coast which is typical of the semi-arid regions of South Australia.

Based on the findings of the desktop study, the following geotechnical related risks and their potential consequences on achieving the desired stormwater management outcomes are as follows:

– The Pleistocene deposits, Holocene alluvial and fluvial sediments and Saint Kilda formations are generally poorly to very poorly drained due to high clay content, fine-grained sediments, and salinity; while localized

sand and gravel layers in Qpr4 may offer limited permeability, overall drainage across these units is restricted, especially in low-lying or coastal areas.

– Presence of calcrete at shallow depths across the desalination plant site may limit the feasibility of installing underground drainage systems and may have cost and constructability implications for other WSD features such as sedimentation ponds and detention/ retention basins which may require large earthmoving equipment with hydraulic breakers to construct excavations.
– The sand and clay layers with calcrete can have variable permeability which can limit the effectiveness of WSD treatments which rely on infiltration and filtration, particularly in areas of higher clay content or where possible perched water zones exist due to calcrete barriers.
– The near surface soils present a moderate to high potential to be dispersive. Dispersive soils are more prone to erosion and poor vegetation establishment which can affect the performance and sustainability of WSD treatments.

2.2.4 Groundwater

The closest groundwater well is located approximately 3.0 km to the west of the site. A groundwater level of 2.2 m AHD (approximately 11 m below ground level [bgl]) was recorded in November 2011. This suggests that the depths to groundwater across the desalination plant site could range from approximately 4 m to 10 m bgl. In the area of the intake / outlet pump stations the groundwater level is expected to be equivalent to mean sea level at approximately 0 - 1 m AHD, suggesting that the depths to groundwater would be in the order of 2 -3 m. Seasonal variations and rainfall events could lead to shallower groundwater levels, particularly closer to the ocean where ground levels are lowest.

Groundwater in the area is likely to be saline to hypersaline which will require careful consideration where WSD devices with vegetation such as grassed swales and bioretention devices are proposed.

2.2.5 Flood Risk

Waterbody mapping from State Government databases indicates an ephemeral waterbody to the east of the site, where surface runoff stores in the low-lying areas behind the coastal dunes. The coastal dunes, which act as a levee, have several breach points where informal channels are scattered along the coastline and would assist with controlling the floodplain extent in smaller, more frequent storm events.

Upstream surface runoff becoming trapped behind these coastal dunes is the main cause of flooding near the desalination plant site, in particular the intake pump station site. The extent of flooding along the coast has the potential to be large due to the relatively flat terrain which results in a broad and meandering floodplain. This is evident in Figure 5 which highlights the extent of areas subject to periodic inundation as defined in State Government water body mapping.

The extent of the floodplain is governed by the size of the corresponding storm event. However, the floodplain would reach a theoretical maximum that would correspond to a level at which the floodwaters would exceed the height of the coastal dunes, and discharge into the Spencer Gulf (assuming sea levels were below the dune spill height such that backwater effects were negligible). Levels obtained from the DEM suggest that the top of the dune has a level which ranges from 5 to 0.65 mAHD approximately 10 km north and south of the development site, respectively. The approximate location of the sand dune levee is depicted in Figure 6.

As the site is largely undeveloped, the current (pre-development) risk of personal danger and physical property damage caused by flooding in the low-lying areas is considered negligible. However, any facilities associated with the desalination plant, in particular the intake pump station which will likely reside closer to the coast, will need to be cognisant of the flood risk posed by this natural floodplain phenomena. As per State Government planning requirements, all floor levels should be constructed at least 300mm above the 1% AEP flood level.

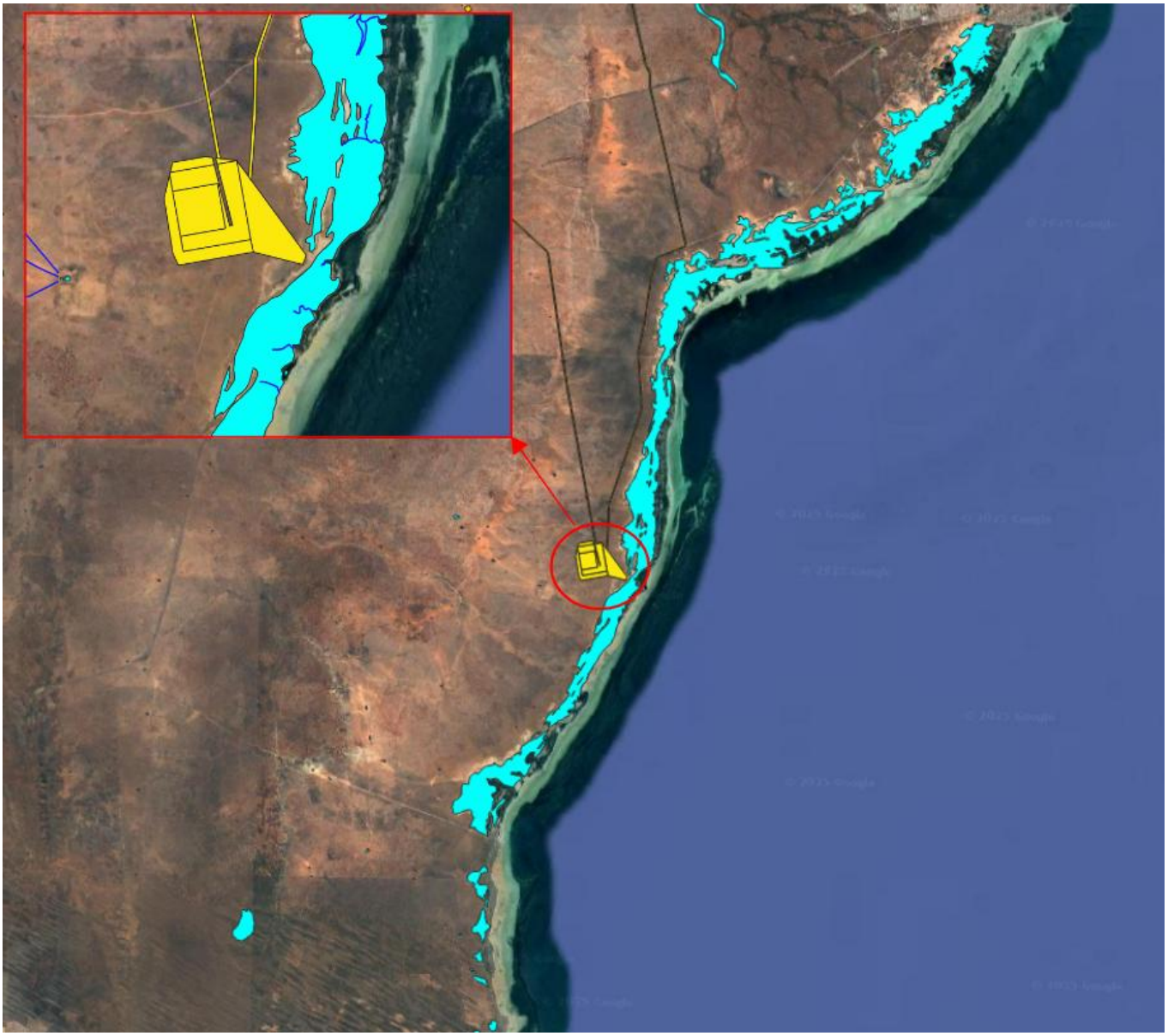


Figure 5 *Land subjected to inundation to the east of the project site (Location SA, August 2025)*

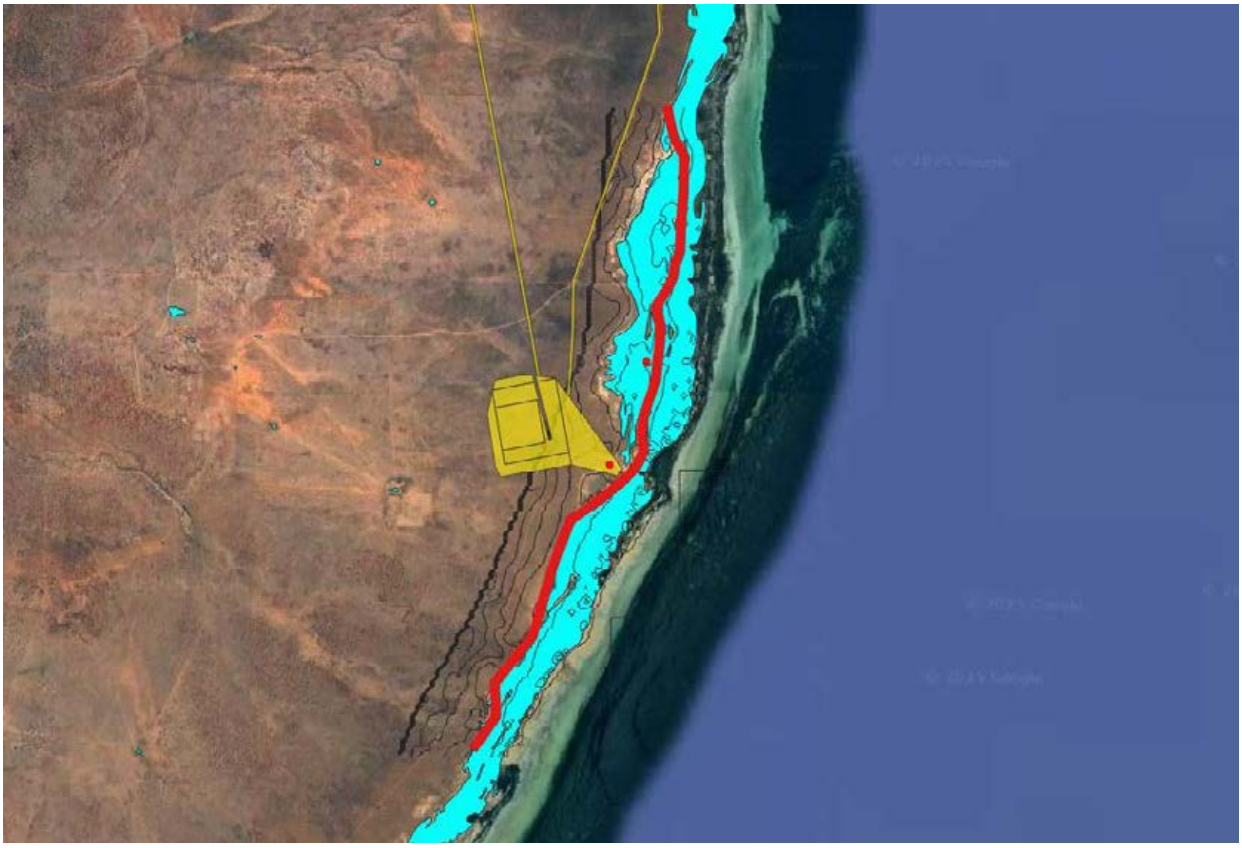


Figure 6 *Sand dune along the coast of the Spencer Gulf adjacent the proposal Desalination Plant site.*

2.3 Climate Context

2.3.1 Regional rainfall and evaporation

The closest daily rainfall gauges from the Bureau of Meteorology (BOM) climate data online for Whyalla has varying dates of operation and locations. These include:

– 018058 Whyalla (Mullaquana): Closed, 1910 to 2020 (Closest)
– 018120 Whyalla Aero: Open, 1945 to 2025
– 018006 Whyalla (Broadview Station): Open, 1932 to 2025

Table 1 *Annual mean rainfall statistics near Site*

Statistics	Annual Rainfall (mm)	% Difference to mean
018058 Whyalla (Mullaquana)		
Mean	253.3	-
Lowest	98.4	-61.15
10th %ile	152.4	-39.83
Median	240.2	-5.17
90th %ile	389.1	53.61
Highest	550.4	117.29
018120 Whyalla Aero		
Mean	262.5	-

Lowest	139.4	-46.90
10th %ile	155.9	-40.61
Median	253.7	-3.35
90th %ile	373	42.10
Highest	510.3	94.40
018006 Whyalla (Broadview Station)		
Mean	258.8	-
Lowest	3.2	-98.76
10th %ile	158.5	-38.76
Median	248.9	-3.83
90th %ile	366.4	41.58
Highest	553.1	113.72

Located within the arid zone of South Australia, the Whyalla region receives an average of 258.8 mm of rainfall per year. There are on average 50 rain days (>1mm) per year. The remaining days are, on average, clear and sunny which contribute to high evaporation rates. Rainfall is in deficit in every month of the year, with the mean annual evaporation being in the order of 2000 mm/ year.

Figure 7 illustrates the mean monthly rainfall recorded at Whyalla Broadview Station, highlighting June to September as the period with the highest precipitation. Rainfall levels begin to decline in October, with a noticeable drop in November, and continue a downward trend through the summer months. Historically, March has been recorded as the driest month.

On the contrary, evaporation data sourced from BOM Climate maps, illustrates that the mean monthly evaporation peaks in December and reaches its lowest point in June as shown in Figure 7.

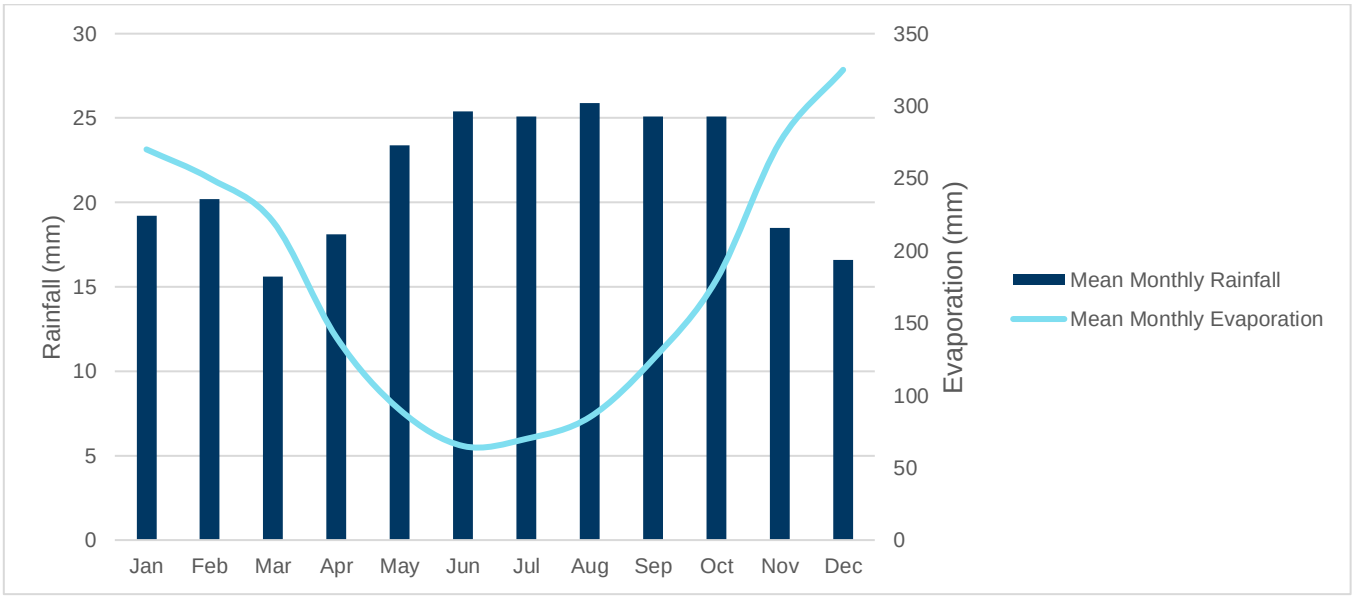


Figure 7 ***Mean monthly rainfall at Whyalla Broadview Station (018006) and mean monthly evaporation (BOM Climate maps)***

These climatic conditions suggests that antecedent soil moisture levels are likely to be elevated during winter, resulting in wetter ground conditions, particularly with the presence of any poorly draining soils. Higher antecedent moisture can potentially reduce the infiltration capacity and increase the surface runoff during rainfall events. The

opportunity for stormwater reuse within the site needs to be carefully considered. Based on the climate conditions in Whyalla, the reliability of supply from any detention basins is likely to be low.

2.3.2 Tidal Levels

The Australian Hydrographic Office software AusTides provides tidal data for over 80 primary and 600 secondary ports across Australia. The closest port to the Mullaquana desalination plant site is Whyalla (approximately 25km), and the tidal planes adopted for this reference design are summarised in Table 2.

Table 2 Tidal planes at Whyalla (AusTides 2025)

Parameter	Water Level (m CD)	Water Level (m AHD)
Highest Astronomical Tide (HAT)	3.30	1.53
Mean Sea Level (MSL)	1.60	-0.17
Lowest Astronomical Tide (LAT)	0.00	-1.77
Chart Datum (CD)	0.00*	-1.77

*** assumed to match LAT for Mullaquana location.**

2.3.3 Sea Level Rise

The Coast Protection Board Policy (DEW, 2022) includes a risk standard for coastal flooding which requires costal developments to account for sea level rise when setting site and building floor levels. As the project life exceeds 50 years, the project must consider a climate change horizon to at least the year 2100.

Advice regarding sea level rise at Cowleds Landing was obtained from the Coastal Protection Branch Department of Environment and Water, which is as follows:

– 1% AEP sea flood level to 2050 = 2.65 m AHD
– Sea level rise to 2050 = 0.30 m
– Sea Level rise to 2150 = 0.7 m additional to 2050.
– Wave Setup = 0.10 m
– Wave Runup = 0.15 m

Total 1% AEP sea level rise to 2050 = 3.20 m AHD

Total 1% AEP sea level rise to 2150 = 3.90 m AHD.

Finished floor levels are required to be a further 0.25 m above the minimum site level. For all Desalination Plant buildings, this would equate to at least 4.15m AHD to 2150. This estimate does not consider the influence of land subsidence or uplift in the area.

3. SMP Outcomes

3.1 Strategic Plans, Policies and Standards

There are a number of strategic plans, policies and standards of relevance to the proposed desalination plant development site which will influence stormwater management outcomes for the development. These are discussed below.

3.1.1 Eyre Peninsula Regional Landscape Plan 2021-2026 (EPLB, 2021)

The Eyre Peninsula Landscape Plan 2021–2026 builds on previous strategies, namely the Strategic Plan for the Eyre Peninsula Natural Resources Management Region – 2017-2027, with a sharper focus on landscape-scale resilience and integrated water management. Stormwater design for the desalination plant site should reflect the plan's priorities around safeguarding biodiversity, enhancing soil and water function, and mitigating the effects of extreme weather events. This includes designing systems that reduce erosion, support groundwater recharge, and prevent pollution of sensitive habitats. The plan also stresses the importance of aligning development with regional conservation goals and using nature-based solutions where feasible to strengthen ecological connectivity and long-term sustainability.

3.1.2 Eyre Peninsula Landscape Board's Water Affecting Activity Control Policy

The desalination plant site lies within the Eyre Peninsula Landscape Board region and is therefore subject to the *Water Affecting Activity Control Policy 2023* (EPLB, 2023) under the *Landscape South Australia Act 2019*. The main aim of the policy is to regulate water affecting activities. That is, any activities that may affect water resources, water dependent ecosystems, or water users. Such activities include constructing a dam or drainage channel, constructing or modifying a structure or building in a watercourse, lake or floodplain or drilling a well. The policy provides a permit framework for certain water affecting activities, with certain activities within priority surface water catchments triggering additional requirements.

In relation to the proposed development site, as there are no defined watercourses, surface water catchments, lakes or floodplains that the site resides within or directly interacts with, the provisions of the policy relating to these features do not apply. The relevant considerations for this site relate to runoff water quality, sedimentation and erosion management, reducing localised flood risk and the management of surface water and groundwater interactions.

Stormwater management measures for the site will need to be designed to protect the quality and hydraulic function of local water resources and to avoid adverse impacts on downstream ecosystems. This will involve ensuring runoff is treated at the source to remove sediments, hydrocarbons and other potential diffuse contaminates prior to discharge which is consistent with the policy's general principles for protection of water resources.

It is recommended that engagement with the Eyre Peninsula Landscape Board be undertaken during the detailed design phase to confirm any permit requirements for stormwater infrastructure that may be considered a Water Affecting Activity under the policy. This would also include temporary infrastructure needed to facilitate construction activities.

3.1.3 Environmental Protection (Water Quality) Policy 2015

Stormwater management for the desalination plant site has been developed with reference to the *Environment Protection (Water Quality) Policy 2015* under the *Environment Protection Act 1993* (EPA SA, 2015). While the Policy does not prescribe specific design standards for stormwater infrastructure, it establishes the statutory obligations to prevent pollution and to protect the environmental values of South Australian waters.

In accordance with the Policy:

- Site runoff will be managed to prevent the discharge of pollutants such as sediment, hydrocarbons, litter, and nutrients to the stormwater system and receiving waters.
- Segregate any plant process contacted water (including fuel and chemical storage and loading areas) to restrict Class 1 and Class 2 pollutants from interacting with stormwater runoff.
- Site stormwater systems will only contain runoff from car parks, roads, hardstand and landscaped areas and be designed to treat the pollutants commonly associated with these surfaces (e.g. gross pollutants, sediments and nutrients such as phosphorus and nitrogen).
- Erosion and sediment controls, spill containment measures, and treatment devices have been incorporated into the design to ensure stormwater leaving the site does not cause environmental harm.
- The stormwater management approach supports the protection of downstream water quality, consistent with the Policy's requirement to maintain environmental values of surface and marine waters.

3.1.4 Australian and New Zealand Water Quality Guidelines

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG,2018) provide nationally recognised, science-based benchmarks for protecting the environmental values of aquatic ecosystems, including coastal marine environments. While the Guidelines are not statutory in themselves, they support the implementation of the *Environment Protection (Water Quality) Policy 2015* by identifying water quality trigger values for key parameters such as turbidity, nutrients, salinity, pH, and metals.

In relation to the proposed development site, stormwater runoff generated from the site, in its pre-developed and post-developed forms do not discharge directly to marine waters. Instead, stormwater runoff flows overland for several kilometres before any potential connection with the coast. Hence, the majority of runoff is expected to infiltrate into the surrounding soils or be lost through evaporation, with significant attenuation of both flow and pollutant loads.

In this context, the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* are referenced as an overarching benchmark for the ultimate receiving environment being the marine waters. However, due to the absence of direct discharge pathways, the Guidelines are not taken to be applied as direct compliance targets at the site outlet. Instead, stormwater management measures should focus on preventing pollution at source and ensure that any runoff leaving the site is of a quality unlikely to adversely impact downstream waters, in alignment with the *Environment Protection (Water Quality) Policy 2015* and the Eyre Peninsula Landscape Board's *Water Affecting Activity Control Policy*.

3.1.5 State WSUD guidelines

The State Government document *Water sensitive urban design – creating more liveable and water sensitive cities in South Australia* (DEW, 2013), sets out the South Australian Government's position on Water Sensitive Urban Design (WSUD) in a local context, provides State-wide WSUD targets for new developments and details the role that Government will play in collaboration with other stakeholders to maximise the use of WSUD approaches.

Whilst the location of the proposed desalination plant is not classified as an urban environment, the WSUD framework provides a set of best-practice principles and technical measures for managing stormwater quality, quantity, and hydrological function in any developed site context, including industrial and regional projects.

In particular, the WSUD guidelines:

- Provide practical, technically tested design solutions for stormwater treatment (sediment control, gross pollutant traps, detention basins, vegetated swales, etc.) which are equally relevant to industrial precincts and greenfield sites such as Mullaquana.
- Align directly with the statutory obligations of the *Environment Protection (Water Quality) Policy 2015*, by offering design approaches that prevent pollutants from entering receiving waters.
- Complement the ANZECC/ARMCANZ Australian and New Zealand Water Quality Guidelines (2017) by providing practical means to meet the guideline water quality objectives.

– Support the intent of the *Eyre Peninsula Landscape Board's Water Affecting Activity Control Policy*, particularly in maintaining the hydraulic function of catchments and protecting downstream ecosystems.

A summary of the key performance principles, intents and targets as they relate to the stormwater management approach for the desalination plant development are given in Table 3.

Table 3 State-wide WSUD Performance Principles and Performance Targets (Source DEW, 2013)

Performance Principle	Performance principle intent	State-wide performance targets	Primary focus
Runoff Quality Positively manage the quality of urban runoff through implementing water-sensitive urban design	To help protect and where required, enhance, the quality of runoff entering the receiving water environments, in order to support environmental and other water management objectives	Achieve the following minimum reductions in total pollutant load, compared with that in untreated stormwater runoff, from the developed part of the site: • Total suspended solids by 80 per cent; • Total phosphorus by 60 per cent; • Total nitrogen by 45 per cent; • Litter/gross pollutants by 90 per cent.	Residential, commercial, industrial and institutional development, and roads, streets and thoroughfares.
Runoff Quantity Post-development hydrology should, as far as practical and appropriate, minimise the hydrological impacts of urban built environments on watercourses and their ecosystems	Help protect waterways and, where relevant, promote their restoration by seeking to limit flow from development to pre-development levels. Help to manage flood risk, by limiting the rate of runoff to downstream areas to appropriate levels	**For flood management**: For development and other relevant infrastructure that will drain runoff to an existing publicly managed drainage system or to a drainage system such as a creek or watercourse on privately-owned land: • the capacity of the existing drainage system is not exceeded; and • there is no increase in the 5 year ARI peak flow and no increase in flood risk for the 100 year ARI peak flow, compared to existing conditions.	Residential, commercial, industrial and institutional development, and roads, streets and thoroughfares.

3.1.6 Northern Water Functional and Operational Requirements

The Functional and Operational Requirements (Revision F- October 2025) for the Northern Water Project define stormwater management requirements for the development. These are listed in Table 4:

Table 4 Norther Water – Functional and Operational Requirements – Stormwater Management

Performance Principle	Requirement
Runoff Quantity	Stormwater Management design and estimation of flood flows must be in accordance with Master Specification Part RD-DK-D1. The stormwater system must ensure post development flows from the Desalination Plant do not exceed pre-development flows.
Flood Immunity and Resilience	Flood immunity and flood resilience of the facilities must as a minimum achieve the design standard below. – Chemical Storage facilities – 0.5% AEP flood immunity – Building works – 1% AEP flood immunity – Electrical Infrastructure – 1% AEP flood immunity – Facilities' internal site roadways – 1EY flood immunity/ 5% AEP flood resilience – Transfer Pumping Stations – 1% AEP Flood immunity – Above ground pipelines creek crossings – 0.5% AEP flood immunity

Performance Principle	Requirement
Water Quality	Water sensitive urban design elements must manage and treat stormwater flows for a 4 Exceedances per Year (4 EY event) design event. Stormwater management must be integrated with the landscape and the revegetation design to incorporate water sensitive urban design principles, maximising the opportunity for passive irrigation and re-use.

3.2 SMP Objectives

The purpose of the SMP is to identify a number of objectives which address the following themes:

– Flooding
– Runoff water quality
– Water reuse
– Environmental protection and enhancement

The objectives of this SMP have been informed by the various requirements identified in the strategic plans, policies and standards which apply to the development site. In alignment with these requirements, the following objectives and the corresponding approaches to achieving them are given in Table 5.

Table 5 SMP Objectives

No.	Objective	Approach
1	Reinforce existing major overland flow paths to minimise impacts to existing hydrological regimes	– The development site is to avoid construction over defined water courses. – Where overland runoff is diverted around the development site, implement measures to prevent soil erosion and maintain the integrity of the existing flow paths. – Leverage existing site topography to minimise earthworks for the new development.
2	Provide an acceptable level of flood protection to the development site through the management of internal and external catchment flows	– Adhere to the flood immunity and resilience requirements defined in the Functional and Operational Requirements for various site facilities, with due consideration of future climatic conditions. – Utilise an upstream diversion swale/ bund to redirect upstream catchment runoff around the site. – Raise site levels and building levels above 1% AEP flood event. – For areas at risk from sea level rise, ensure site and building floor levels are set above predicted future sea levels. – Provide minor and major drainage systems within the development site to safely manage surface runoff.
3	The stormwater system must ensure post development flows from the Desalination Plant do not exceed pre-development flows.	– Implement stormwater detention/ retention systems to ensure there is no increase in the 1 in 100 year ARI (1% AEP) and 5 year ARI (18.13% AEP) peak flow discharge from the development site, and no increase in flood risk for the 100 year ARI (1%AEP) peak flow, compared to existing conditions.
4	Improve water quality to meet the requirement for protection of the receiving environment	– Incorporate WSUD elements into the stormwater management systems such as vegetated swales and bioretention gardens. – Improve the quality of stormwater runoff discharging from the development site to achieve the following targets: • Total suspended solids – 80% • Total phosphorus – 60% • Total Nitrogen - 45% • Gross Pollutants - 90%

No.	Objective	Approach
		– Identify opportunities to achieve additional water quality improvement within proposed stormwater detention/ retention infrastructure. – Encourage revegetation of impacted areas with appropriate species. – Minimise the impacts of erosion and sedimentation by implementing erosion control measures within the stormwater drainage infrastructure.
5	Maximise the economic use of stormwater runoff	– Where economically feasible, maximise the opportunities for reuse of stormwater runoff within the development such as toilet flushing, landscape irrigation or dust suppression measures.

4. Hydrological Assessment

4.1 Rainfall-runoff modelling

4.1.1 Modelling approach

Design flood flow estimation for catchments can be performed using various methods, including rainfall-runoff routing models (e.g., RORB), loss models, and flood frequency analyses. The selection of an appropriate method depends on factors such as catchment type (urban or rural), size, topography, climate, and the availability of reliable hydrological data.

For rural catchments under 5 km², as is the case in this study, the Department Rational Method is considered applicable, as outlined in Master Specification Part RD-DK-D1 Road Drainage Design (2024). This method is based on the Rational Formula described in Section 6.6.3 of AGRD Part 5 – Drainage and was specifically developed for small rural catchments in South Australia.

Other methods such as RORB and flood frequency analysis are not considered appropriate in this context due to the absence of a defined watercourse and the lack of long-term streamflow data, which are essential for calibrating and applying these models effectively. Given these limitations, the Department Rational Method provides a practical and reliable solution. To meet specification requirements and enhance confidence in the results, this method was verified using the Initial Loss–Continuing Loss model, which is recommended by the ARR 2019 guidelines for estimating design flood flows from rural catchments.

ARR (2019) guidelines were also used in the hydrologic modelling exercise, specifically using the Ensemble Method to simulate 10 temporal patterns for each design storm duration for each Annual Exceedance Probability (AEP) event. This allowed for the selection of the critical duration (i.e., the highest peak discharge from the simulated storm durations for a given AEP event) for each catchment by analysing the median peak runoff result from the ensemble of temporal patterns for each AEP across all modelled durations.

4.1.2 Climate Change

The Department for Environment and Water (DEW, 2022) notes that South Australia's climate is undergoing significant changes in typical weather patterns, particularly in temperature and rainfall. These changes have led to longer, hotter, and more frequent heatwaves, increased incidence of dangerous fire weather, more intense heavy rainfall events, and rising sea levels along the coast. Of particular concern for stormwater management are the projected changes in rainfall patterns, which directly impact flood protection levels, drainage system performance, and the potential for stormwater harvesting and reuse.

To address these challenges, the approach to climate change modelling for the site has been developed in accordance with the methodology outlined in Australian Rainfall and Runoff 2019 (ARR 2019, V2, published 27 August 2024) and the Guide to Climate Projections for Risk Assessment and Planning in South Australia (DEW, 2022). This methodology involves selecting an appropriate Shared Socioeconomic Pathway (SSP) scenario based on the infrastructure's design life and the level of risk associated with climate impacts.

For this project, the following climate scenarios have been adopted:

– Existing Climate (Baseline): 2030 climate conditions under SSP2–RCP4.5.
– Future Climate (Design Scenario): 2100 climate conditions under SSP3–RCP7.0, representing a high emissions pathway over a 70-year horizon.

This future scenario (SSP3–7.0 for 2100) has been selected to assess the impact of increased rainfall intensity on stormwater infrastructure, ensuring resilience under projected climate extremes.

4.1.3 Design rainfall

Design rainfall Intensity-Frequency-Duration (IFD) has been sourced from the Bureau of Meteorology's (BOM) utilising the Australian Rainfall and Runoff online procedure. Design rainfall is based on:

– Latitude: 33.2125 (S)
– Longitude: 137.4125 (E)

4.2 External flood management

The external catchments located to the west of the desalination plant site have been assessed to determine the flood mitigation measures required to prevent runoff from entering the site. The upstream catchment runoff is expected to reach the site through a combination of overland flow and concentrated flow paths. The magnitude of these flows has been quantified using the DIT Rational Method. The external catchment extent is shown in Figure .

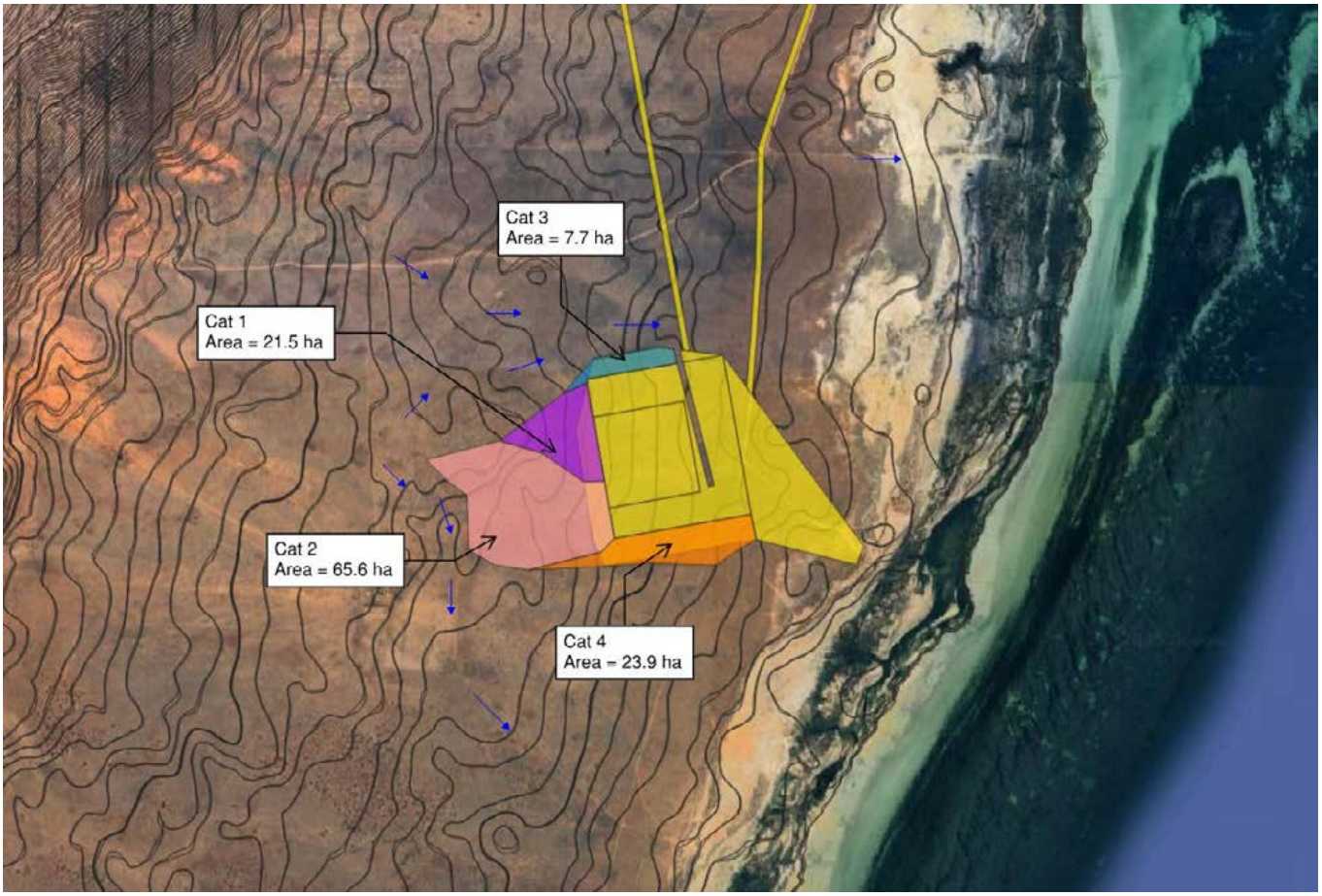


Figure 8 External catchments – Desalination Plant

4.2.1 DIT Rational Method

The DIT Rational Method is a simplified hydrological approach used to estimate peak design flood flows in small rural catchments (typically less than 5 km²). Developed specifically for South Australian conditions, the method is outlined in AGRD Part 5 – Drainage and adopted in Master Specification RD-DK-D1 (2024). It is particularly suitable where detailed hydrological data is limited and is verified using supplementary models such as the IL-CL method in accordance with ARR 2019 guidelines.

The parameters used for DIT Rational method are given in Table 6.

Table 6 DIT Rational method modelling parameters

Parameter	Value	Comment
Catchment Terrain Base coefficients	0.25	Native semi-arid grasslands
Slope Adjustment Factor	0 to -0.05	2 m/km ≤ Se, Equal area slope < 5 m/km
Catchment Area Adjustments	~ 1.6 to 2	Based on the catchment area
Location Adjustment Factor	0.5	Based on the nearest region
AEP/ EY Adjustment Factor	1.6 & 0.7	AEP 1% and 20% respectively
Climate change factor (SSP3-7.0 – 2100)	~1.42 to 1.5	Based on critical storm of catchments

Modelling Results

The following external catchment flows were obtained from the DIT rational method for the two climate scenarios under consideration as shown in Table 7.

Table 7 DIT Rational method modelling results for external catchments

Catchment	2030 SSP2–RCP4.5 Climate (Baseline)	2100 SSP3–RCP7.0 Climate (Design Scenario)
	1% AEP	1% AEP
C1	0.63	0.74
C2	0.90	1.02
C3	0.18	0.21
C4	0.44	0.51

4.2.2 Model Verification - Initial Loss- Continuing Loss (IL-CL) Model

As recommended by the DIT Master Specification RD-DK-D1, the DIT Rational Method must be verified using an alternative hydrological model to ensure reliability. For this study, surface water runoff across the project extent has been assessed using the Initial Loss–Continuing Loss (IL-CL) model in DRAINS software.

The initial loss and continuing loss values used in the model were derived from ARR recommendations. The ARR classifies the Mullaquana area within Region 2, which includes many coastal catchments. However, it is important to note that arid regions in Australia, including Mullaquana, suffer from a general lack of long-term hydrological data and specific guidance for rainfall-runoff routing. This presents challenges in accurately defining loss parameters, as the available data does not fully capture the variability and hydrological behaviour of such regions.

Furthermore, the range of initial loss and continuing loss values used for the deriving the losses in Region 2 is broad, reflecting the uncertainty and diversity of catchment conditions across the region. Given this variability and the absence of detailed local calibration data, representative values from within the ARR-recommended range were adopted. These values were selected to reflect the arid coastal nature of the project area, aiming to balance conservatism with realistic runoff response under design rainfall conditions.

Modelling Parameters

Based on ARR guidelines, the range of values used in developing the initial loss and continuing loss for Region 2 are outlined in Table 8. The initial loss and continuing loss values selected for this verification DRAINS model are 30 mm and 1 mm/hour respectively.

Table 8 IL-CL modelling parameters

Parameter	Minimum	Maximum	Median	Selected
Initial Loss, IL_s (mm)	20.0	60.0	37.5	**30**
Continuing Loss, CL (mm/hr)	1.4	8.3	2.7	**1**

Modelling Results

The model was run using the ensemble of 10 temporal patterns, with the median result taken in accordance with ARR guidance. The model was run up to an including the 6-hour duration, with the critical storms generally occurring for the 4.5 hour storm duration.

The external catchment flows (Table 9) were obtained from DRAINS IL-CL model for the two climate scenarios under consideration.

Table 9 IL-CL modelling results for external catchments

Catchment	2030 SSP2–RCP4.5 Climate (Baseline)	2100 SSP3–RCP7.0 Climate (Design Scenario)
	1% AEP	1% AEP
C1	1.04	1.56
C2	1.35	2.62
C3	0.34	0.52
C4	0.83	1.40

4.2.3 Hydrological Model Comparison

The predevelopment flows obtained for the catchment area using the two methods are summarised below in Table 10 for the two climate scenarios.

Table 10 Model Comparison

Catchment	DIT Rational Method Peak Flow (m^3/s)		IL-CL model Peak Flow (m^3/s)		% Difference	
	Climate Baseline	Design Scenario	Climate Baseline	Design Scenario	Climate Baseline	Design Scenario
C1	0.63	0.74	1.04	1.56	39.07	52.82
C2	0.90	1.02	1.35	2.62	33.06	60.89
C3	0.18	0.21	0.34	0.52	45.45	58.51
C4	0.44	0.51	0.83	1.40	47.36	63.91

The peak flow estimates derived from the IL–CL model differ from those obtained using the DIT Rational Method, with the IL–CL model generally producing higher flows across both climate scenarios. This variation highlights the uncertainties inherent in hydrological modelling, especially in data-sparse environments.

Given these limitations, assumptions were made to adopt representative loss values from within the ARR-recommended range, tailored to the arid coastal nature of the project area. Despite the uncertainties, the IL–CL model was selected as the final approach, as it provides more conservative peak flow estimates, which are preferable for design purposes in the absence of detailed local calibration data.

4.2.4 External flood management approach

The primary purpose of quantifying these external flows is to inform flood mitigation strategies that prevent runoff from entering the project site. Cut-off swales are recommended along the boundary of the desalination plant footprint to intercept and safely redirect external surface flows, thereby reducing the risk of flooding within the site. the layout is shown in Figure),

The indicative channel sizing required to safely convey the external flows for 1% AEP Climate Baseline is approximately a base width of 2 meters and a depth of 1.5 meters, with side slopes of 1V:4H and a longitudinal slope of approximately 0.2% to 0.4%. Due to the available space on the site, larger diversion swales can be easily accommodated in order to adapt to a different climate scenario in the future.

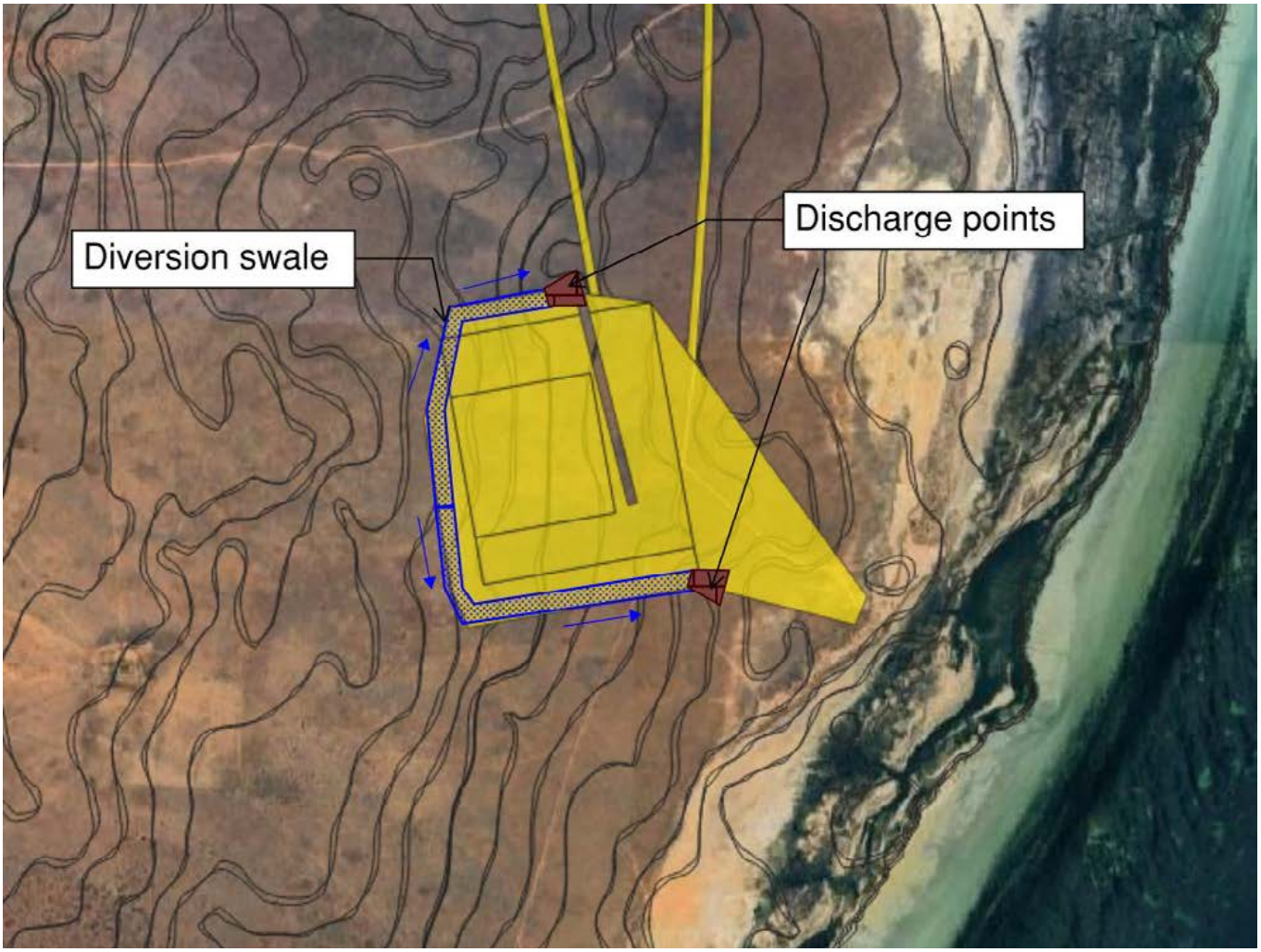


Figure 9 *Proposed diversion swales around the site*

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5. Site Stormwater Drainage

5.1 Introduction

The stormwater management strategies presented in this section are targeted towards achieving the SMP objectives defined in Section 3.2.

5.2 Pre-development Discharge

The Desalination Plant site occupies an area of approximately 28 hectares while the Substation located to the north occupies an area of 2.84 hectares. The project extent is shown in Figure 10.

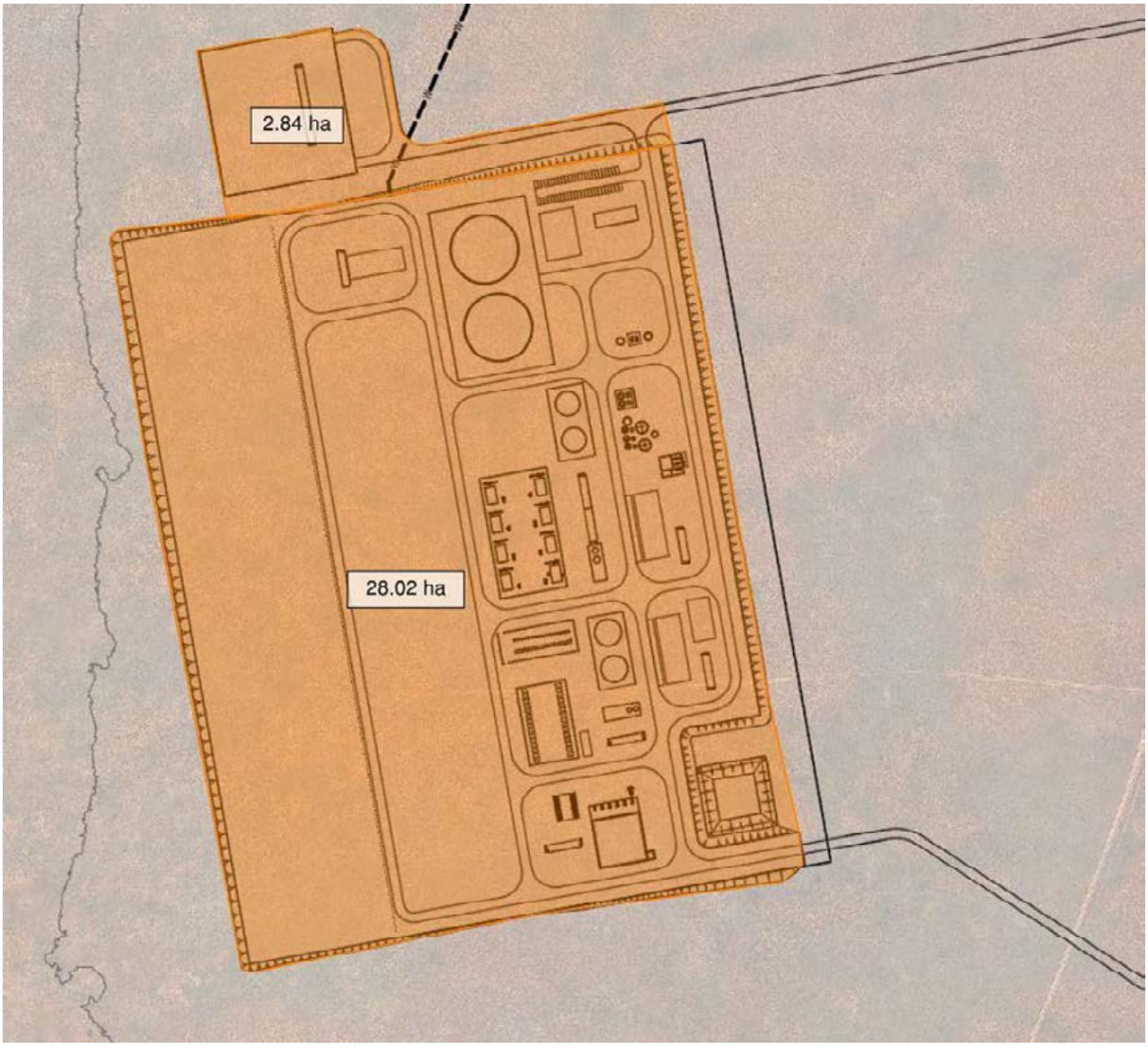


Figure 10 Desalination plant footprint

Pre-development peak flow rates have been estimated from this area, utilising the IL/CL hydrological model within DRAINS, adopting the following parameters in Table 11.

Table 11 Pre-development IL/CL modelling parameters

Parameter	Value
Pervious Area Initial Loss	30
Pervious Area Continuing Loss	1
Impervious Area Initial Loss	0
Impervious Area Continuing Loss	0
Impervious Fraction	0%
Time of Concentration	~ 3 hrs for both substation and desalination plant

The following pre-development flows (Table 12) were obtained for the two climate scenarios under consideration.

Table 12 IL-CL Pre-development modelling results

Event	Critical Storm	Peak Flow (m^3/s) 1% AEP	Peak Flow (m^3/s) 18.13% AEP
2030 SSP2–RCP4.5 Climate (Baseline)	4.5 hrs	1.40	0.28
2100 SSP3–RCP7.0 Climate (Design Scenario)	4.5 hrs	1.97	0.55

5.3 Post-development (unmitigated) Discharge

The site is proposed to be developed to comprise a mix of industrial buildings, sealed, compacted hardstand/ gravel areas, roadways and residual undeveloped land. At this conceptual stage, there is uncertainty around the proportion of effective versus non-effective impervious areas, as the final site layout and surface treatments are yet to be confirmed.

To adopt a conservative approach, the areas between buildings were assumed to be fully impervious, with direct connectivity to the site's drainage infrastructure. This assumption ensures that potential runoff contributions are not underestimated during stormwater modelling and design. Table 13 includes the impervious and pervious catchment delineation assumed for the post-development scenario.

Table 13 Increase in impervious area post development

Catchment	Pervious (%)	Effective Impervious (%)	Remaining Impervious (%)
Desalination Plant Catchment	34	66	0

Post-development (unmitigated) peak flow rates have been estimated from this area, utilising the IL/CL hydrological model within DRAINS, adopting the following parameters in Table 14.

Table 14 Pre-development IL/CL modelling parameters

Parameter	Value
Pervious Area Initial Loss	30
Pervious Area Continuing Loss	1
Impervious Area Initial Loss	0
Impervious Area Continuing Loss	0
Time of Concentration (pervious)	~10 to 30 mins
Time of Concentration (impervious)	~5 to 25 mins

The post development (unmitigated) flows generated from the site is as presented in Table 15 including the increase in flow as compared to the pre-development scenario.

Table 15 1% AEP peak flows under post development conditions

Event	Critical Storm	Peak Flow (m^3/s) 1% AEP	Increase in Flow (m^3/s)	Peak Flow (m^3/s) 18.13% AEP	Increase in Flow (m^3/s)
2030 SSP2–RCP4.5 Climate (Baseline)	2 hours	4.95	+3.55	1.62	+1.34
2100 SSP3–RCP7.0 Climate (Design Scenario)	2 hours	7.54	+5.57	2.67	+2.12

As shown, post-development peak flows show a significant increase compared to pre-development conditions. This is primarily attributed to the increase in impervious surfaces and a reduction in time of concentration, as runoff is now directed through more defined flow paths.

5.4 Internal stormwater management strategy

To manage the anticipated increase in runoff, the drainage strategy incorporates open channel systems, such as swales and culverts, which are well-suited to a rural setting. These systems are intended to convey flows efficiently while promoting infiltration and reducing peak discharge rates.

The existing site grading is expected to be largely maintained, with surface runoff continuing to flow in a northwest to southeast direction. This natural drainage pattern should be integrated into the final design layout to minimise earthworks and support passive flow conveyance across the site.

The swales would typically be lined with a combination of vegetation and rock rip-rap and are configured to direct post-development runoff toward the detention/ retention basin where flows are detained for high flow events to meet predevelopment discharge flow rates. A small permanent retention storage is also proposed to improve water quality through settlement of sediments within incoming flows.

The attenuated flows are then conveyed to a rock-lined outlet located near the eastern corner of the site, aligning with the natural drainage direction and supporting controlled release downstream. The runoff from the substation catchment discharges to a separate outlet, with flows treated and attenuated along its own drainage swale. The layout of the internal stormwater management strategy is shown in Figure .

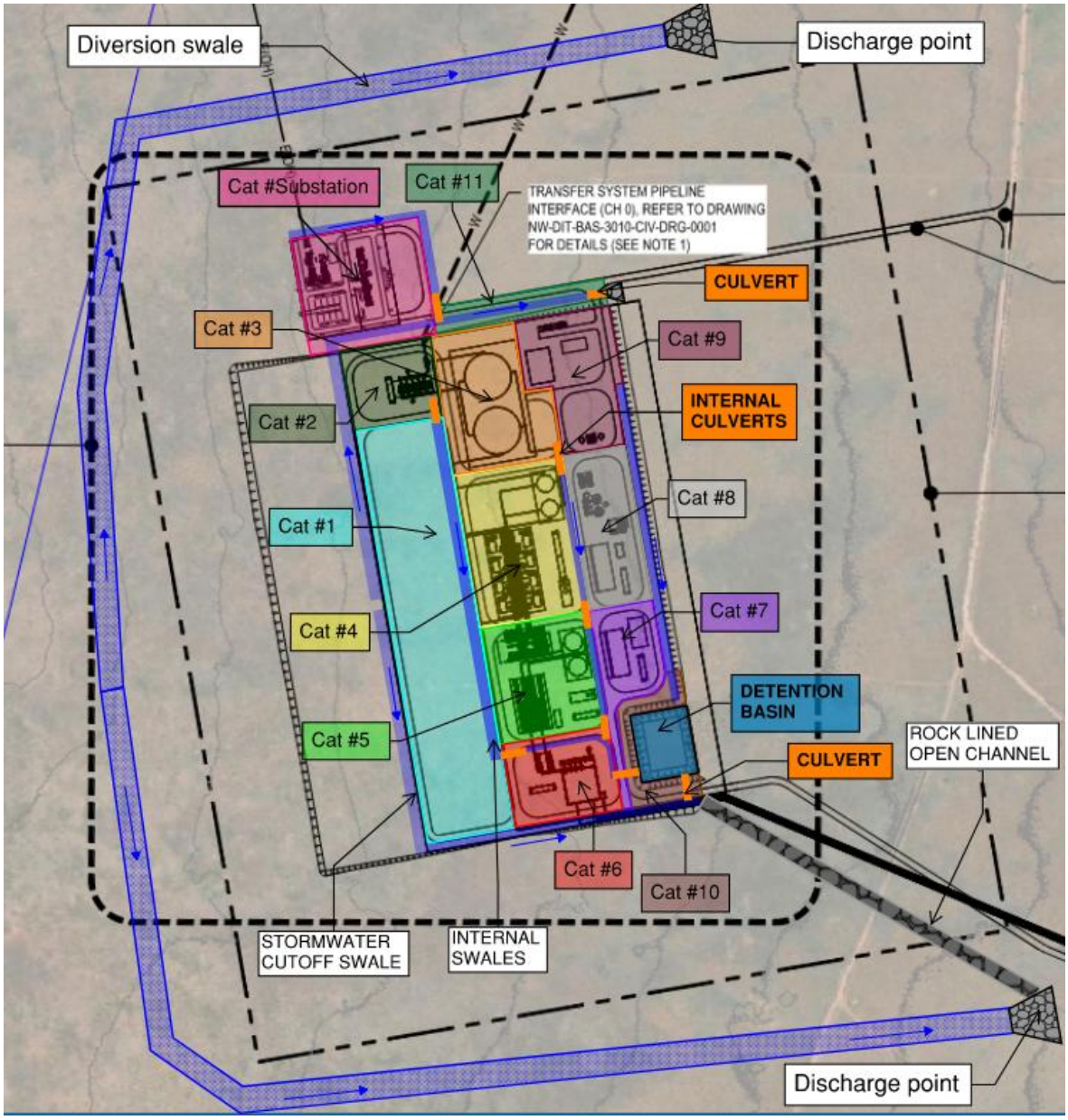


Figure 11 Strategy Layout

5.4.1 Post Development (mitigated) Discharge

To manage the increased peak flow for the 18.13% AEP and 1% AEP events, a detention basin in the south-eastern corner of the site is proposed. At a conceptual level, key basin levels and sizes are summarised in Table 16 below.

Table 16 Detention/ retention basin attributes

Parameter	Value
Invert of stormwater basin	4.58
Initial water level in basin at start of event	5.08 (0.5 m permanent pool depth)
Low level discharge invert level	5.6
Basin low flow outlet	0.45 x 0.45 culvert
High level (overflow) discharge level	6.38
Top of basin level	6.58

Parameter	Value
Surface area at top of basin level	6300 sq.m (70 m x 90 m)

The performance of the basin in mitigating peak flows discharged from the site, under both current and future climate scenarios is summarised in Table 17 below.

Table 17 Mitigated post-development discharge

	1% AEP peak flow (m3/s)	18.13% AEP peak flow (m3/s)
2030 SSP2–RCP4.5 Climate (Baseline)	1.13	0.25
2100 SSP3–RCP7.0 Climate (Design Scenario)	1.71	0.38

The 18.13% and 1% AEP basin peak discharge is less than the pre-development peak flow discharge and hence satisfies the nominated site discharge peak flow performance requirement.

It is important to note that seasonal fluctuations in groundwater levels may influence the size of the basin, necessitating a basin with a larger surface area. A detailed geotechnical and groundwater assessment will be necessary during the detailed design phase to ensure the basin functions effectively and to mitigate any potential adverse impacts.

5.5 Intake Pump Station

Figure 12 shows the catchment areas contributing runoff to the intake pump station from the west. This includes the external flows conveyed by the southern diversion swale and a portion of the Desalination Plant footprint which is sheltered by the external diversion swales. The peak flows arriving to the intake pump station are in Table 18.

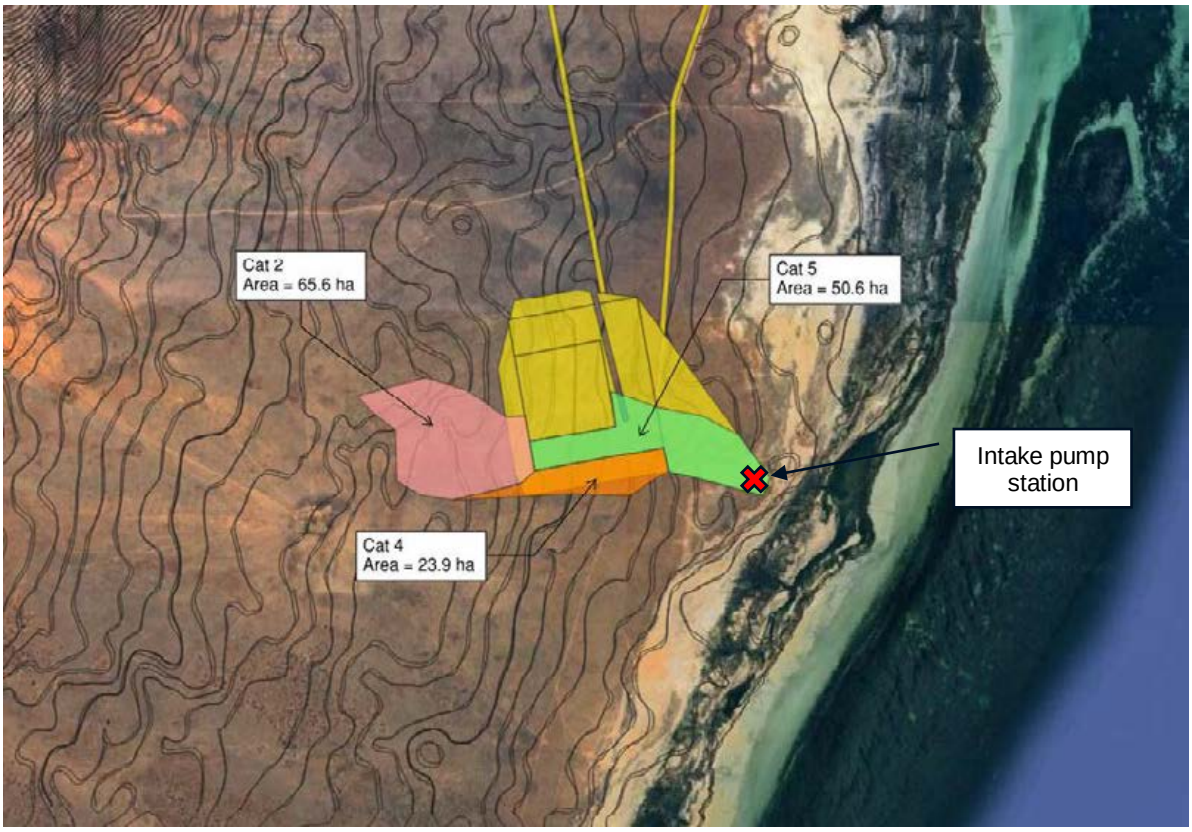


Figure 12 External catchments – Intake pump station

Table 18 External catchment flows – Intake pump station

Catchment	2030 SSP2–RCP4.5 Climate (Baseline)	2100 SSP3–RCP7.0 Climate (Design Scenario)
	1% AEP	1% AEP
C2	1.35	2.62
C4	0.83	1.4
C5	1.65	2.83

In order to intercept the external flows coming from the west, another diversion swale is proposed, similar to the arrangement adopted for the Desalination Plant. The indicative channel sizing required to safely convey the external flows for 1% AEP Climate Baseline which is approximately a base width of 5 meters and a height of 1 meters, with side slopes of 1V:4H and a longitudinal grade of approximately 0.1%. This will allow safe conveyance and discharge of upstream external catchments as well as the discharge from desalination plant open channel.

6. Stormwater Quality Management

WSD principles, which promote the collection, treatment, and reuse of stormwater within the catchment, are strongly encouraged as part of the site's stormwater strategy. In addition to managing the volume and flow of post-development runoff, stormwater quality has also been considered to ensure environmentally responsible discharge.

6.1 Pollutant sources

The are two main sources of pollutants within the site which present risks to stormwater runoff quality.

1. **Process contacted water and fuel/ chemical loading and storage areas**

   A range of chemical dosing systems are required for the desalination plant to function. Consequently, there is the potential for these chemicals, some which are toxic, to enter the natural environment if proper controls aren't implemented. All areas where chemicals will be delivered, handled and stored on site are to be covered and bunded. This limits the interaction of stormwater runoff and potentially hazardous chemicals and greatly reduces the likelihood of discharge to the environment.

   Furthermore, the bunded areas are intended to drain to on-site storage tanks with the ability to be pumped out for off-site disposal, if testing deems it is unsuitable to discharge into the site stormwater network.

   Any chemical storage areas or areas where chemicals are utilised must also have a higher flood immunity standard to further minimise the likelihood of hazardous chemical discharge to the environment.

2. **Roofs, car parks, roads, hardstand and landscaped areas**

   When rainfall reaches the ground, it is typical for it to become polluted as it flows across various surfaces within the site. Runoff generated over roads, carparks and hardstand areas can collect oil, grease and litter. Similarly, runoff generated over landscaped areas can collect, organic material, fertilizers and sediment. These pollutants are then washing into the site stormwater systems where they can degrade water quality.

   The WSD water quality improvement performance targets (DEW, 2013) as defined in Table 19 have been adopted as the pollutant reduction goal for the site.

Table 19 Pollutant reduction targets

Pollutant	Reduction Target (%)
Total Nitrogen	45
Total Phosphorus	60
Total Suspended Solids	80
Gross Pollutants	90

6.2 MUSIC Modelling

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) is a widely used tool for simulating and assessing stormwater quality treatment performance. A MUSIC model was established in accordance with the drainage strategy proposed for the site to estimate the treatment efficiency of the proposed WSD measures.

6.2.1 MUSIC Modelling Parameters

Water Sensitive SA (2021) SA MUSIC Guideline is the standard for water quality modelling in South Australia and therefore have guided the input of parameters for MUSIC model, as outlined in Table 20.

Table 20 MUSIC Modelling parameters

Parameter	Value
Climate Data Source	Whyalla Aero - 0018120
Climate Data Range	2011–2021
Source Node Soil Type	Sandy Clay
Lumped Land Use Catchment Parameter	Urban Industrial
Swale Vegetation Height (m)	0.1 (assume native planting)

6.2.2 Treatment Train Layout

To identify a suitable stormwater treatment system within the constraints of the site, several key factors were evaluated, including available space, site grading, expected pollutant loads, and compatibility with low-maintenance rural infrastructure. These considerations informed the selection of appropriate treatment measures aimed at improving water quality prior to discharge.

The treatment train layout as shown in Figure 13 supports effective water quality management while aligning with WSD principles and accommodating the site's climatic and spatial constraints.

While the majority of surface runoff will continue to be managed through natural infiltration and sediment control measures, such as vegetated swales, these systems are primarily effective at capturing and filtering particulate pollutants. Due to the arid climate of the project site, maintaining vegetation within swales may be challenging. To ensure long-term performance, drought-tolerant native species should be selected to withstand extended dry periods and minimise maintenance requirements.

The proposed stormwater treatment train consists of primary treatment via internal vegetated swales and secondary and tertiary treatment through the bioretention swale and detention basin, which can incorporate a sedimentation zone to allow fine sediments to settle out.

The use of bioretention basins in arid environments must be carefully considered due to challenges in maintaining vegetation and filter media under dry conditions. Resultantly, a conservative approach regarding the effective vegetation height has been adopted for both bioretention basin and vegetated swales so as to not overestimate the water quality improvement offered by vegetation in arid regions.

It is important to also apply a suitable lining treatment (e.g. rock rip rap lining) in high velocity zones of the stormwater system, such as at bends, outlets or where there is a high proportion of concentrated flow contribution. Such treatments will prevent erosion of the swale bed and limit sedimentation.

Although not modelled in MUSIC, oil water separators are to be provided upstream of any stormwater connection point from car parks or loading or unloading areas.

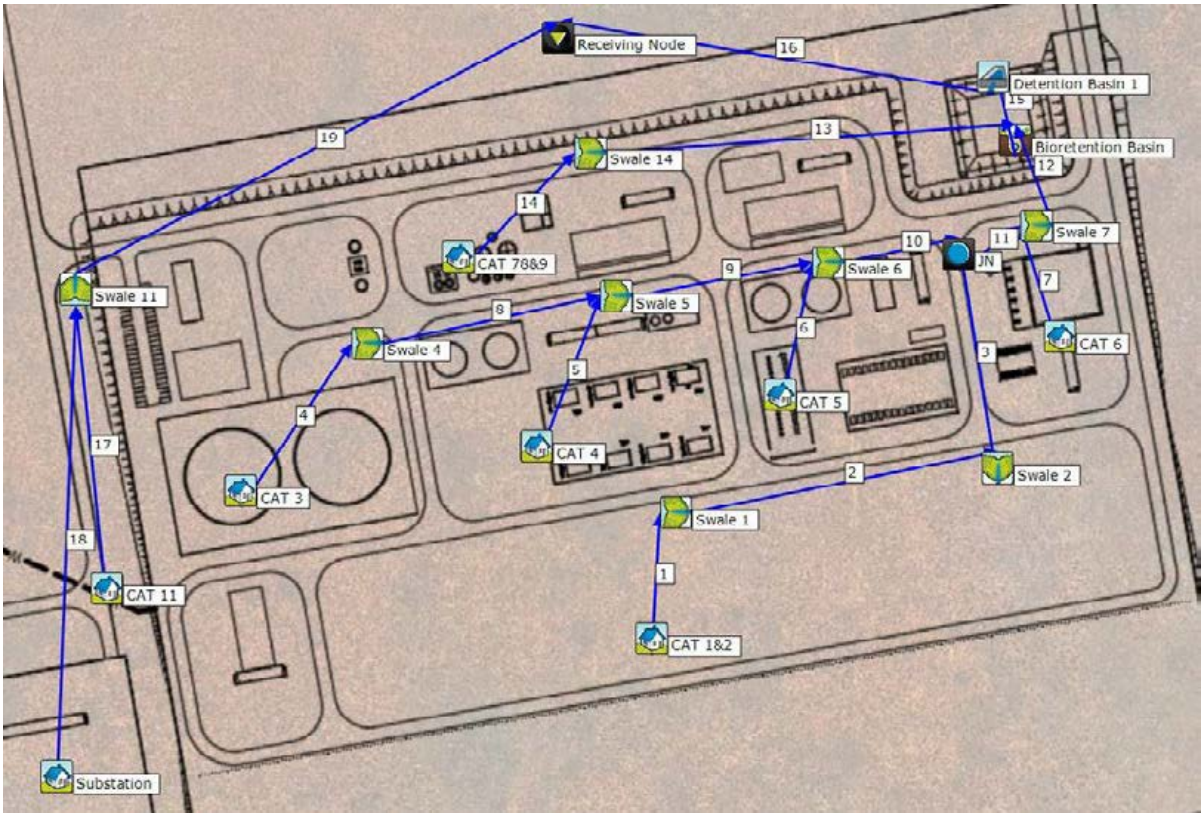


Figure 13 Treatment Train Layout

6.3 MUSIC Modelling Results

The MUSIC modelling results for the site is provided below in Table 21. Analysis of the result show that the proposed treatment train is effective and result in all water quality targets being achieved. As would be expected added impervious area has increased the pollutant load present from storm events, however due to added water treatment asset (such as swales) and spare capacity in the current system this rise in pollutants have been effectively treated.

Table 21 Post Development MUSIC modelling results for Desalination plant

	Post Development Source Load	Post Development Residual Load	Pollutant Reduction (%)	Target Achieved
Total Suspended Solids (kg/yr)	8503	1168	86	YES
Total Phosphorus (kg/yr)	20	7	64	YES
Total Nitrogen (kg/yr)	169	91	46	YES
Gross Pollutants (kg/yr)	1529	0	100	YES

6.4 Stormwater Reuse

Opportunities to reuse stormwater within this development to achieve the SMP objectives have been assessed and are listed below:

– Installation of rainwater tanks to capture roof runoff which could be reused for toilet flushing and the like.
– The stormwater detention/ basins could be augmented to include a permanent retention zone that could allow water to be drawn for the purposes of irrigated vegetated landscapes and swales as well as a means of dust suppression or hardscape areas. It is noted that the reliability of supply from the basin is likely to be low, due to the infrequent nature of rainfall in the region and high evaporation rates.

Opportunities to utilise groundwater have not been formally assessed. However, it is envisaged that due to the likely saline composition of the groundwater, its applicability as an alternative water supply would be limited.

The viability of these stormwater reuse opportunities would need to be further explored as part of a yield assessment.

6.5 Water Quality Risk Assessment

A preliminary water quality risk assessment (WQRA) has been undertaken in accordance with DIT's Environmental and Heritage Technical Manual Attachment 6A Protecting Waterways Guideline. The WQRA can be found in Appendix A.

7. Conclusion

This stormwater management plan has been developed to provide a framework for stormwater runoff generated from the desalination plant to be sustainably managed to minimise adverse impacts to the receiving environment. The implementation of the strategies outlined in this stormwater management plan will reduce the impacts of flooding to the Desalination Plant site and minimise detrimental impacts to water quality for receiving environments. This is a preliminary plan and will be further developed and refined based on site specific data and detailed design to be completed in future stages of the project.

The key outcomes and recommendations from this stormwater management plan are to:

– Ensure existing external overland flow paths do not impact the desalination plant development and are safety diverted around the site via diversions swales.
– Manage surface flows for the site's infrastructure and buildings during the design rainfall events to meet pre-development conditions.
– Incorporation of WSD principles within the stormwater system to reduce the potential pollutant loading exiting the site and adversely impacting on the downstream environment.
– Set site levels and finished floor levels above predicted future sea and flood levels.

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Appendices

Appendix A

Preliminary Water Quality Risk Assessment

Technical Memorandum

October 17, 2025

To	Colin Bolden	**Contact No.**	08 8111 67015
Copy to	Heath Sandland, Neil Tooley	**Email**	Stefan.gianquitto@ghd.com
From	Stefan Gianquitto	**Project No.**	12601676
Project Name	Northern Water Supply Project – Technical Advisor PREM053427		
Subject	Preliminary Water Quality Risk Assessment		

1. Introduction

The Technical Memorandum serves as the Preliminary Water Quality Impact Assessment for the Northern Water Supply Project Desalination Plant site at Mullaquana Station, South Australia (the Project). As part of this impact assessment, a preliminary Water Quality Risk Assessment (WQRA) has been undertaken in accordance with Section 2.2 of the Protecting Waterways Guideline (2021) The main steps in the risk assessment process are:

1. Establish the context
2. Identify risks
3. Analyse risks
4. Evaluate risks
5. Treat risks

A more detailed impact assessment shall be undertaken during the detailed design phases of the project.

1.1 Purpose of this Memorandum

The purpose of this Technical Memorandum is to determine the potential nature, scale and likelihood of any impacts on water quality during both the construction and operational phases of the Project and to assist in identifying appropriate management measures to manage the project impacts. This document summarises the preliminary WQRA undertaken during the Proving phase of the project.

This Preliminary WQRA does not address risks associated with the construction or operation of tunnelling elements or intake/ outfall structures that interact directly with the marine environment, nor does it consider potential process water discharges to the marine environment from the desalination plant during its operational phase. The scope of this assessment is limited to evaluating the impacts of stormwater runoff within the site and its interactions with construction activities and site operations that occur on land.

1.2 Scope and limitations

This technical memorandum has been prepared by GHD for the Department of Infrastructure and Transport. It is not prepared as, and is not represented to be, a deliverable suitable for reliance by any person for any purpose. It is not intended for circulation or incorporation into other documents. The matters discussed in this memorandum are limited to those specifically detailed in the memorandum and are subject to any limitations or assumptions specially set out.

This Technical Memorandum is provided as an interim output under our agreement with the Department of Infrastructure and Transport. It is provided to foster discussion in relation to technical matters associated with the project and should not be relied upon in any way.

2. Context Setting

2.1 Purpose and nature of the project

The Northern Water Project (NWP) aims to provide a sustainable water supply to users in northern South Australia through the staged delivery of a desalination plant and transfer system. The proposed plant location is near Mullaquana, in the northern Spencer Gulf region, approximately 30 km southwest of Whyalla as shown in Figure 1.

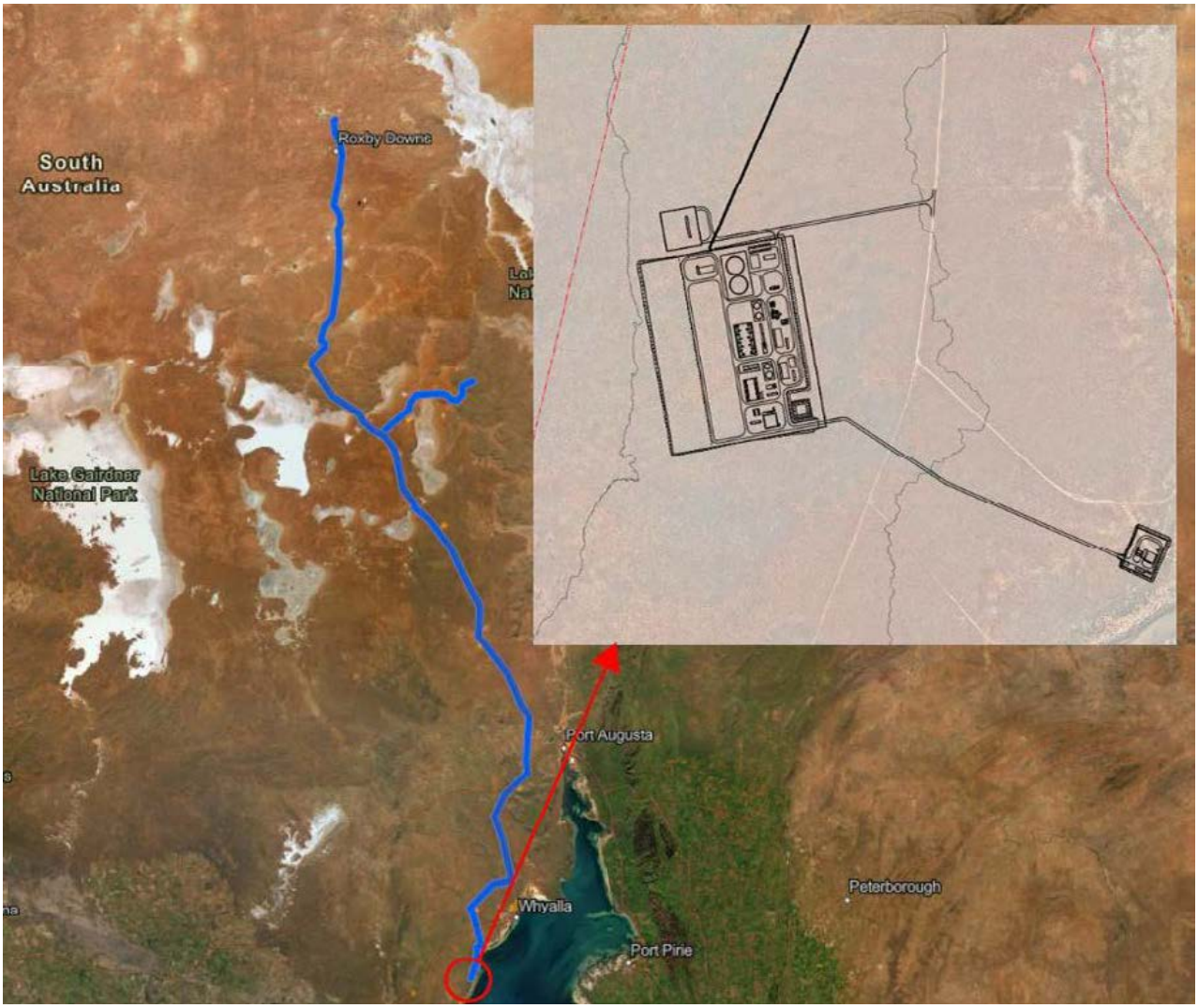


Figure 1 ***Site location with Mullaquana Desalination Plant site layout (inset) (Northern Water GIS, June 2025)***

As with all new development, there is a risk of environmental impact during both construction and operational phases which need to be properly identified and managed to minimise water quality impacts

2.2 Legislative compliance requirements

Relevant legislation to water quality impacts associated with the project includes:

- *The Landscape South Australia Act 2019 (*which repealed the *Natural Resources Management Act 2004)* on 1 July 2020
- *The Local Government (Stormwater Management) Amendment Act 2007*
- *Environmental Protection Act 1993*
- *Environmental Protection (Water Quality) Policy 2015*
- *Eyre Peninsula Landscape Boards Water Affecting Activity Control Policy 2023*
- *Native Vegetation Act 1991 (NV Act) and Native Vegetation Regulations 2017*

- *Commonwealth Environment, Protection and Biodiversity Conservation Act 1999*
- *South Australia's Water Sensitive Urban Design (WSUD) Policy 2013*

2.3 Relevant plans including Natural Resource Management Plans

The Landscape South Australia Act 2019 has resulted in 'landscape regions' replacing Natural Resource Management (NRM) regions. This change came into effect on 1 July 2020. Eight regional landscape boards were formed, with Mullaquana located within the Eyre Peninsula board region.

The desalination plant site lies within the Eyre Peninsula Landscape Board region and is therefore subject to the *Water Affecting Activity Control Policy 2023* under the *Landscape South Australia Act 2019*. The main aim of the policy is to regulate water affecting activities. That is, any activities that may affect water resources, water dependent ecosystems, or water users.

In relation to the proposed development site, as there are no defined watercourses, surface water catchments, lakes or floodplains that the site resides within or directly interacts with, the provisions of the policy relating to these features do not apply. The relevant considerations for this site relate to runoff water quality, sedimentation and erosion management, reducing localised flood risk and the management of surface water and groundwater interactions.

Stormwater management measures for the site will need to be designed to protect the quality and hydraulic function of local water resources and to avoid adverse impacts on downstream ecosystems. This will involve ensuring runoff is treated at the source to remove sediments, hydrocarbons and other potential diffuse contaminates prior to discharge which is consistent with the policy's general principles for protection of water resources.

3. Risk identification

3.1 Site Characteristics

3.1.1 Site topography and features

The proposed site is located within a rural area. The surrounding land comprises a combination of public land managed by the Department of Environment and Water, as well as privately owned pastoral land. The site itself is generally low-lying, with a gentle gradient falling from approximately 11 m AHD in the northwest to 6 m AHD in the southwest, spanning a width of around 600 m. The existing topography directs surface water flow eastwards across the proposed site towards the coast, refer to Figure 2 Surface water flow patterns at proposed siteFigure 2 below. There are no major rivers or defined creeks, though ephemeral drainage lines exist to the west that dissipate toward the coast.

3.1.2 Soils

Soils comprise Holocene alluvial and fluvial deposits, Saint Kilda Formation clays, and Pleistocene colluvium with calcrete. These are generally clayey, poorly drained, and moderately to highly dispersive, presenting erosion risks and challenges for infiltration-based water-sensitive design. Coastal soils may contain organic and gypseous clays with potential for acid sulfate conditions in saline or tidal zones.

3.1.3 Climate and rainfall patterns

The Whyalla region is semi-arid, with an average annual rainfall of 259 mm and 50 rain days per year. Rainfall peaks from June to September, with high evaporation (2000 mm/year). Conditions are typically dry, with limited rainfall reliability and low potential for stormwater reuse.

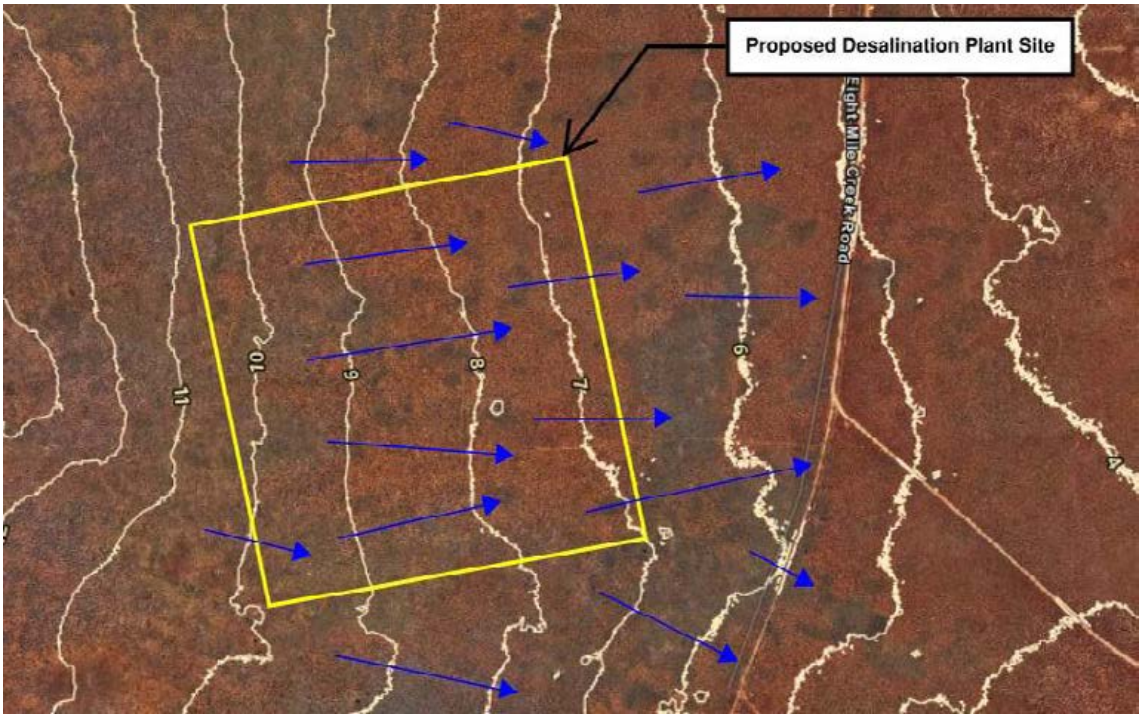


Figure 2 *Surface water flow patterns at proposed site*

3.1.4 Drainage pattern and size of catchments

The site lies within the Spencer Gulf drainage basin but outside any major surface water catchment. Local drainage occurs via minor ephemeral channels that terminate in saline coastal flats. The low gradient results in limited surface runoff conveyance and localised ponding in depressions behind coastal dunes. There are four main sub-catchment areas upstream if the site as shown in Figure 3.

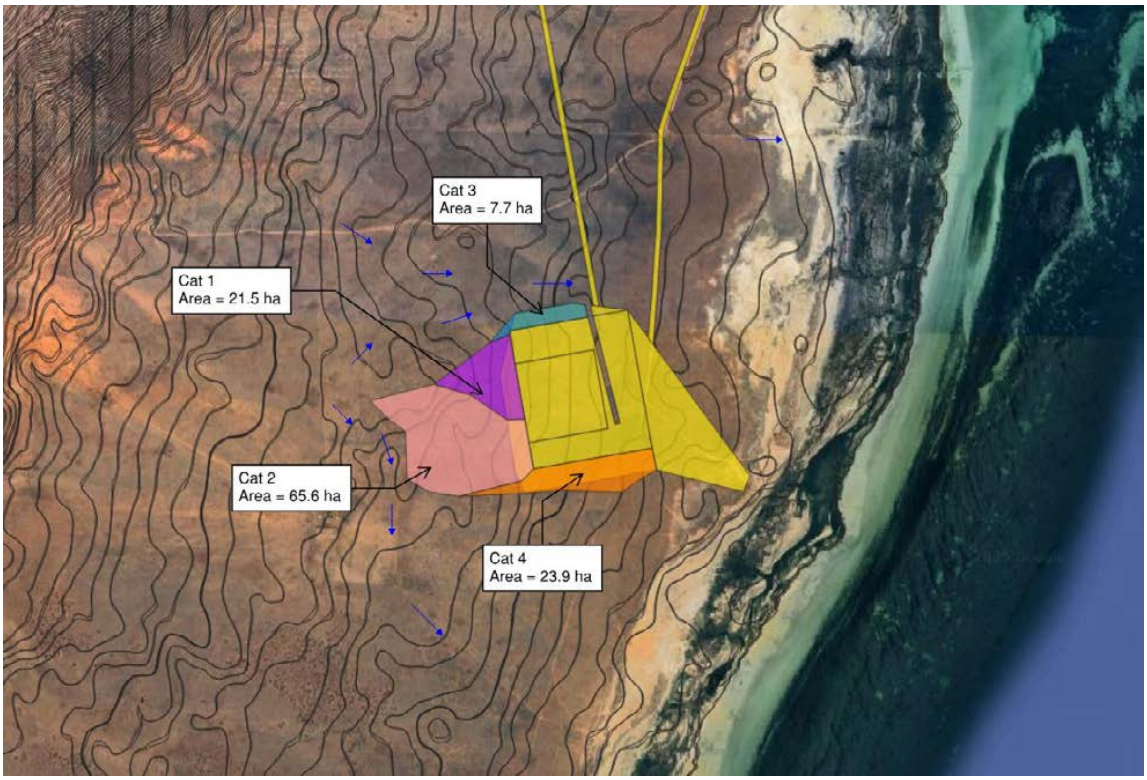


Figure 3 *External sub-catchments*

3.1.5 Quality and nature of receiving waters

The receiving environment is the Spencer Gulf which is a marine ecosystem of regional ecological significance, supporting mangroves and tidal flats.

3.1.6 Quality and depth to groundwater and pollution transport mechanisms

Groundwater depth varies from ~4 m to 10 m bgl, becoming shallower (2–3 m bgl) near the coast. Groundwater is saline to hypersaline, limiting infiltration potential. In relation to the proposed development site, stormwater runoff generated from the site, in its pre-developed and post-developed forms do not discharge directly to marine waters. Instead, stormwater runoff flows overland for several kilometres before any potential connection with the coastal waters. Hence, pollutant transport mechanisms are primarily through surface runoff and potential shallow subsurface flow toward the coast.

3.1.7 Vegetation and ecology of the site and surrounding area

Vegetation comprises low saltbush and bluebush shrubland typical of arid coastal plains, with mangroves and saline wetland vegetation along the coast. No areas of conservation significance or known threatened species habitats occur within the site, though downstream marine and intertidal habitats are ecologically sensitive.

3.1.8 Land use of adjacent and downstream areas (including sensitive uses)

Surrounding land is used for livestock grazing (Mullaquana Station), with minimal development. The coast to the east features swamps subject to tidal inundation. No sensitive downstream land uses (e.g., drinking water supply) are present, but marine ecosystems may be sensitive to sediment or salinity changes.

3.1.9 Nature and capability of downstream water quality treatment measures

No formal water quality treatment infrastructure exists within the catchment. Rainfall runoff from the site area is largely treated via infiltration, with any excess runoff captured and stored in the coastal wetland area which is subject to periodic tidal flushing. The developed site will require dedicated water treatment devices to ensure runoff quality is better than, or at the very least, no worse than existing.

3.1.10 Presence of contaminated soil/groundwater/surface water

No known contamination identified within or surrounding the site. The area is largely undeveloped pastoral land.

3.1.11 Presence of potential acid sulfate soil material

As part of the initial screening for the potential of acid sulfate soils (ASS) around the project site, a review of the publicly available data on SA NatureMaps was undertaken- refer Figure 4. It is also important to note that the site is adjacent to areas with an increasing probability of acid sulfate soils, particularly the mangrove areas near the coastal dunes. Accordingly, the design will need to consider how modifications to the hydrological regime could impact these soils.

The risk increases where excavation or dewatering exposes these soils to oxygen which is more likely to occur for the construction of the marine intake and pump station which are located in high ASS potential regions.



Figure 4 ***Acid sulfate soils in vicinity of site area***

3.2 Project Characteristics

The purpose of this section is to describe the characteristics of the Northern Water Project within the context of water quality impacts. This section is limited to the project works relating to the desalination plant at Mullaquana.

3.2.1 Timing and scale of the project

The Northern Water Supply Project comprises a large-scale infrastructure initiative including the construction of a desalination plant at Mullaquana, associated marine intake and outfall tunnels, and a transfer pipeline system extending north to Olympic Dam and Carrapateena.

The project area covers approximately 280,000 m² at the desalination site and a pipeline corridor extending over 400 km through Eyre Peninsula and northern South Australia. Construction will occur over multiple years, with activities sequenced across marine, desalination, and transfer system packages to manage environmental risk and logistical complexity.

3.2.2 Project staging and areas under construction

Construction will be staged to limit the footprint of active works. The transfer pipeline will be constructed progressively within a 40 m wide corridor, identified as the minimum practical width required for trenching and access. Staging of works will also be influenced by seasonal weather constraints to minimise exposure of disturbed soils during high rainfall periods.

At the desalination site, it is envisaged that major civil works including earthworks, foundations, tanks, and buildings will be staged to ensure drainage infrastructure and sediment controls are installed early. Temporary drainage, erosion control, and sediment basins should be implemented before large-scale site clearing.

Concrete may be supplied from local facilities around Whyalla and/or a mobile batching plant located either onsite or at a suitable local industrial area. A batching plant will require an approved environmental protection licence prior to mobilisation in accordance with EPA SA requirements.

3.2.3 Extent of cut and fill

Earthworks at the desalination plant site will primarily involve grading and levelling across a gently sloping terrain that ranges from approximately 11 mAHD in the northwest to 6 mAHD in the southwest.

Cut and fill operations are envisaged to be balanced on site as far as practicable to reduce haulage and erosion risk. Areas of exposed fill and embankments shall be stabilised through revegetation and appropriate erosion protection treatments (e.g. geotextile lining)

3.2.4 Volume and nature of traffic

Construction traffic will include light vehicles, haulage trucks, and heavy machinery associated with earthworks, pipe transport, tunnelling, and concrete deliveries. At the Mullaquana site, traffic will include delivery of construction materials and equipment for the desalination plant and tunnelling works. Hazardous loads (e.g. fuels, lubricants, chemicals) will be limited to standard construction and plant operational needs and must be managed in accordance with Dangerous Goods legislation and EPA SA guidelines.

Internal roads and tracks will likely be developed to accommodate the requirements of the construction phase. it is anticipated that the tracks will be left unsealed until just prior to handover. Redundant tracks will need to be rehabilitated and returned to existing conditions. Water carts will likely be used for dust suppression.

3.2.5 Potential traffic accident characteristics

Traffic movements will be managed under a project-specific Traffic Management Plan. Controlled access points, defined haul routes, and separation of light and heavy vehicles will minimise collision risk. Spill response kits should be maintained on site, and all operators will undergo induction and competency verification.

During operation, the likelihood of traffic accidents occurring near the desalination plant, is very low as there are minimal traffic volumes due to the rural nature of the area. The main access to the site is through Eight Mile Creek Road. Based on traffic volume data of other major roads in the area (e.g. Lincoly Hwy and Middleback Road), it is anticipated that traffic volumes for Eight Mile Creek Road would not exceed 100 vehicles per day. Similarly, in the event of a spill, standard operating procedures for spill containment are anticipated to come into effect to minimise the risk of environmental contamination.

3.2.6 Stormwater concentration, dispersion, and flow impacts

The development will alter existing surface flow patterns due to new impervious areas, regrading, and the construction of stormwater infrastructure. The Northern Water Project Stormwater Management Plan (SMP) includes measures to maintain pre-development hydrology, with flow diversion swales to safely redirect overland flow around the site and a treatment train comprising vegetated swales, bioretention systems, and a detention basin to minimise water quality risks.

These systems are designed to meet Water Sensitive Design (WSD) pollutant reduction targets:

– 80% reduction in Total Suspended Solids
– 60% reduction in Total Phosphorus
– 45% reduction in Total Nitrogen
– 90% reduction in Gross Pollutants

The detention basin also provides attenuation of peak flows, thereby reducing potential downstream flooding and erosion risks.

3.2.7 Avoidance of risks through management measures

Risk mitigation measures include:

– Staged earthworks and early installation of sediment controls
– Progressive stabilisation of disturbed areas
– Bunded and roofed chemical and fuel storage areas
– Spill containment and response systems
– Implementation of erosion and sediment control plans (silt fences, check dams, and sediment basins)
– Regular monitoring of stormwater discharge quality during construction

These measures will significantly reduce the likelihood of sediment-laden or contaminated runoff entering downstream systems.

3.2.8 Effects on downstream water quality treatment measures

The desalination site does not discharge directly to marine waters. Runoff travels several kilometres overland before potential coastal interaction. Consequently, pollutant loads are naturally attenuated through infiltration and evaporation prior to reaching the coast. The proposed stormwater infrastructure will ensure discharges meet or exceed the pollutant reduction targets, thereby protecting downstream sensitive environments.

3.2.9 Impediments to achieving water quality and WSD objectives

The semi-arid climate, high evaporation rates (2000 mm/year) and low annual rainfall (259 mm/year) present challenges for vegetation establishment and maintenance of water quality treatment systems. However, these have been addressed in the reference design through the selection of hardy native vegetation, conservative design parameters, and allowance for low-maintenance systems.

No significant impediments are anticipated in meeting catchment water quality objectives or WSD principles, provided the management measures are implemented and maintained.

3.2.10 Impacts from Erosion, Scouring, and Other Risks

Potential construction-phase impacts include:

– Localised erosion and sedimentation of downstream drainage lines
– Temporary increases in turbidity during heavy rainfall events
– Contamination from hydrocarbons or chemicals if spills occur
– Changes in flow regime from temporary diversions or exposed soil surfaces

Erosion protection (e.g. rock rip-rap at high velocity zones) and stormwater treatment measures will mitigate these risks. Post-construction, the stabilised site and WSD systems are expected to maintain or improve downstream water quality relative to existing conditions.

The implementation of the detention basin to attenuate peak flows to the pre-development equivalent will also ensure erosive flow velocities are managed and flow regimes from the area are closely matching existing. A perimeter swale drain has also been incorporated, designed to follow existing stormwater flow paths, with riprap installed to prevent erosion and scouring.

4. Risk analysis and evaluation

The Risks arising from the site and project characteristics identified in Section 3 were examined in regard to the likelihood and consequences of the risk occurring. The following questions were considered:

– How likely is it to happen?
– What could be the consequence if it does happen?

4.1 Construction Phase

A qualitative risk analysis matrix (refer Table 2-2 of the *Protecting Waterways Guideline*) was used to evaluate the level of risk for the Construction Phase. The results are documented in Table 1. The Operational Phase risks are examined in the next section.

Table 1 Construction Phase risk assessment

Risk	Likelihood	Consequence	Risk	Proposed Management Measures	Reassessed Risk
Accidental spills affecting groundwater and waterbodies	L	M	M	CEMP, SEDMP and Emergency Response Plan (Spill kits, bunding) Regular inspection and maintenance of construction vehicles and chemical storage areas	L
Contamination of the groundwater and the Spencer Gulf because of poor site management practices	L	M	M	Worksite to be maintained in a clean state with all wastes appropriately managed. Construction materials (particularly liquids) to be stored in bunding or secondary containment at least 10 m from drain inlets and the Gulf. Spill kits to be available as part of the emergency response preparations. Have emergency procedures and equipment to appropriately manage all liquid spills. Stop work if contaminated soils/groundwater are encountered. Contaminated material to be stored separately and disposed of according to the appropriate waste management procedures. Water Quality Monitoring to be undertaken during construction works	L
Soil disturbance during construction results in erosion and sedimentation	H	M	H	Construction contractor to adhere to SEDMP and CEMP. Soils to be stockpiled a sufficient distance away from designated drainage paths Stormwater systems have been designed to retain existing surface water flow regimes as far as reasonable practicable. Minimise disturbance to shoreline. Separate topsoil during initial excavation to use in rehabilitation. Progressive stabilisation of soil and areas disturbed by earthworks using vegetation, matting and various other techniques.	M
Tunneling spoil and spoil water infiltrating the watertable and contaminating soils and the Gulf	H	H	H	Water to be stored in a sealed/ lined basin or storage tank to prevent discharge to the environment.	M
Unexpected find of contaminated soils resulting in mobilisation of polluted soils/ water	M	M	M	Stop work authority to be enacted to enable site drainage strategy to be reassessed to ensure sediments from contaminated materials are contained.	L
Disturbance/ oxidation of acid sulfate soils (if present)	L	H	M	Conduct acid sulfate soil (ASS) investigation in design phase.	L

Risk	Likelihood	Consequence	Risk	Proposed Management Measures	Reassessed Risk
				Avoid unnecessary excavation below water table. Isolate / treat any acidic leachate before discharge. Monitor pH and metal concentrations in effluent.	
Change in hydrodynamics/ flow regime leading to localised flooding	M	M	M	Stormwater system has been designed to retain existing surface water flow regime.	L
Discharge of dewatering water or groundwater containing sediment	L	H	M	Minimise works at or near water table Route dewatering discharge to separate lined/ isolated basin or tank to prevent infiltration into soils. Monitor water quality of dewatering effluent	L

Detailed consideration of specific treatment measures to address the risks will be undertaken during subsequent stages of the project design.

4.2 Operational Phase

The same qualitative risk analysis matrix was applied to assess risks associated with the Operational Phase. The results are presented in Table 2.

Table 2 Operational Phase risk assessment

Risk	Likelihood	Consequence	Risk	Proposed Management Measures	Reassessed Risk (following implementation of Management Measures)
Industrial pollutants being deposited on road surface, to be later washed off	M	H	H	Industrial chemicals are to be loaded/ unloaded in designated areas, which are undercover (reducing rainwater interaction) and bunded. Chemical storage areas are to be designed to a higher flood immunity standard to further reduce the risk of environmental contamination during flood	M
Hydrocarbons from vehicles creating significant Biochemical Oxygen Demand (BOD) in the downstream environment.	L	M	L	Oil water seperators are proposed to be implemented in all vehicle car park areas. All runoff from roads and hardstands within the site are directed to the site stormwater drainage system which contains water treatment devices designed to achieve the pollution reduction requirements specified.	L
Sediment export causing increased turbidity, decreased light penetration and	M	L	L	No significant changes to sediment load in the Gulf	L

Risk	Likelihood	Consequence	Risk	Proposed Management Measures	Reassessed Risk (following implementation of Management Measures)
smothering of aquatic vegetation.					
Nutrient export creating impact on water bodies	L	M	L	The site stormwater drainage system is to be designed adopting WSD principles in which stormwater runoff adheres to pollutant reduction requirements	L
Vegetative matter washed into waterways, and creating BOD	L	L	L	The site stormwater drainage system is to be designed adopting WSD principles in which stormwater runoff adheres to pollutant reduction requirements. No significant change in vegetative matter expected post-development due to the semi-arid environment	L
Significant litter export having a visual impact	L	L	L	No significant changes are expected on litter export. Site stormwater drainage system to incorporate litter traps to intercept gross pollutants	L
Runoff volume change causing erosion or saturation downstream	H	M	H	Stormwater system has been designed to retain existing surface water flow regime. Erosion control measures specified at outlets	M
Runoff temperature change having an impact on biota	L	L	L	Minimal change in runoff temperature expected	L
Decrease groundwater infiltration due to increased sealed area	L	L	L	Increase in impervious site coverage in local region resulting from the project is no significant and is unlikely to have a material impact	L

Detailed consideration of specific treatment measures to address the risks will be undertaken during subsequent stages of the project design.

5. Permits, Licences and Authorisations

As the project progresses through design, consultation between the Department of Infrastructure and Transport (DIT) and the Environmental Protection Agency (EPA) will determine any requirements for permits, licences, or other authorisations.

6. Soil Erosion Drainage Management Plan

The Soil Erosion and Drainage Management Plan (SEDMP) will be the principal document for managing erosion, sedimentation, and water quality impacts during construction. It must identify drainage flow paths within the project area and the specific treatment measures required to manage them. The level of detail in the SEDMP will correspond to the scale and risk of the proposed works.

An initial site erosion risk assessment has been conducted to inform the required level of detail for the SEDMP (refer Table 2-4 of the *Protecting Waterways Guideline*). The scoring outcome for this project is presented in Table 3.

Table 3 Initial site erosion risk assessment

Parameter	Score
Location (for determining erosivity)	Area less than 500 mm annual rainfall = 1
Average slope before construction works	Not greater than 2% = 1
Soil type	Clay soil = 3
Expected duration of risk undertaken at any one time	Longer than 12 months = 8
Expected area disturbed at any one time	More than 2500 m^2 = 8
Sensitivity of receiving area	High conservation or ecological value system = 4
Total score = 25	

A score over 20 results in an 'extreme' level of risk (refer Table 2-5 in the *Protecting Waterways Guideline*). For an extreme level of risk, the site assessment requirements involve:

- Detailed SEDMP
- High level of site management
- Third part auditing with regular (e.g. fortnightly or monthly) reporting to demonstrate compliance
- A detailed Water Quality Monitoring Plan for construction

Accordingly, a detailed SEDMP will be prepared during later stages of the project design. Refer to Section 2.4.3 of the *Protecting Waterways Guideline* for full details of these requirements. Importantly, the requirement for a Water Quality Monitoring Plan, discussed in the following section, forms part of this response framework.

7. Water Quality Monitoring Plan for Construction

As identified in the SEDMP, a Water Quality Monitoring Plan (WQMP) is to be developed for the project to ensure that monitoring will be undertaken in accordance with legislative requirements and relevant guidelines, achieve the required objectives and that collected data will be of good quality. The plan must include details of the following:

– The monitoring objective
– A description of the receiving environment
– Details of the legislative framework relevant to the monitoring plan
– The approach and methodology of the monitoring works including sampling frequency

A detailed description of the WQMP requirements can be found in Section 2.5 of the *Protecting Waterways Guideline*.

8. Outcomes from this WQRA

This WQRA has identified that all assessed water quality risks for both the Construction and Operational Phases. As a result, the following key outcomes have been identified:

– A detailed Soil Erosion and Drainage Management Plan (SEDMP) is required, addressing site-specific drainage, erosion, and sediment controls.
– A Water Quality Monitoring Plan (WQMP) must be developed to ensure compliance with water quality objectives during construction.
– Further refinement of preventive and mitigating measures for chemical handling and storage will be required as design progresses.

These outcomes will be further developed in subsequent project design stages, alongside the resolution of outstanding investigations outlined in Section 9.

9. Further Investigation

Due to the early stage of project development, several areas relevant to water quality risks require further investigation, including but not limited to:

– Environmental concerns raised during community consultation
– Hydrological modelling to quantify runoff changes due to site development
– Identification of impediments to achieving water quality and Water Sensitive Design (WSD) objectives
– It is recommended that engagement with the Eyre Peninsula Landscape Board be undertaken during the detailed design phase to confirm any permit requirements for stormwater infrastructure that may be considered a Water Affecting Activity under the policy. This would also include temporary infrastructure needed to facilitate construction activities.

These matters will be addressed in the updated WQRA as the project progresses through future stages of design.

Regards

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