Western Renewables Link

CHAPTER

24 Groundwater

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24 Groundwater

This chapter provides an overview of the potential groundwater impacts associated with the construction, operation and decommissioning of the Project. This chapter is based on **Technical Report S: Groundwater Impact Assessment**.

Groundwater refers to water found beneath the Earth's surface that has seeped through the ground and is stored in porous soils and rocks. Soils and rocks that store and transmit large quantities of groundwater are known as aquifers. The top of the saturated ground in an aquifer is called the watertable. Aquifers can be replenished by rainfall or through interaction with surface water.

The depth to groundwater varies; it can be shallow in low-lying areas with surface water recharge and deep in high topography areas with low recharge. Groundwater quality also varies; it can be naturally saline due to salts from rocks or become contaminated from industrial discharges, agricultural practices, landfills, and other processes.

Groundwater has associated environmental values that are protected under the *Environment Protection Act 2017* (Vic) (Environment Protection Act) and the Environment Reference Standard. These include its use as a crucial source of fresh water for drinking, irrigation and industrial use. In some areas, groundwater also plays an important role in sustaining aquatic and terrestrial ecosystems. These Groundwater Dependent Ecosystems (GDEs) rely on groundwater to support functions such as springs, rivers, wetlands, vegetation, irrigation, and industrial uses. Groundwater may sustain both aquatic and terrestrial biodiversity by supporting vegetation through deep root access, providing discharge to waterways as base flow or, in some cases, subterranean flow, and providing important inflows to sustain wetlands.

Environmental values

The environmental values of groundwater represent the uses, attributes, and functions of groundwater that are valued by the community for their ecological, social, cultural and economic benefits.

The Project has the potential to interact with groundwater where the depth of earthworks (such as levelling at terminal stations) or construction (such as tower footings) is below the watertable.

24.1 Evaluation objective

The scoping requirements identify the following evaluation objective relevant to groundwater:

Evaluation objective

Maintain the functions and values of aquatic environments, surface water and groundwater quality and stream flows and prevent adverse effects on protected beneficial uses.

In response to this evaluation objective, the impacts of the Project on groundwater were assessed, and measures to avoid, minimise or manage potential impacts have been identified. These measures are discussed throughout this chapter and have informed the development of Environmental Performance Requirements (EPRs). EPRs set out the environmental outcomes to be achieved through the implementation of mitigation measures during construction, operation and decommissioning to avoid, minimise and manage identified impacts. Cumulative impacts associated with relevant future projects were also assessed.

Further information on how the Project has been designed to avoid and minimise impacts is provided in **Chapter 5: Project development** and **Chapter 6: Project description**.

Other aspects covered in the Environment Effects Statement (EES) evaluation objective and relevant to groundwater are addressed in the following EES chapters:

- **Chapter 8: Biodiversity and habitat**
- **Chapter 22: Geology and soils**
- **Chapter 23: Contaminated land.**

24.2 Method

This section summarises the method adopted in **Technical Report S: Groundwater Impact Assessment**, which was informed by **Chapter 4: EES assessment framework and approach**. The key steps in assessing the impacts associated with groundwater included:

- Defining a study area appropriate for groundwater as presented in Figure 24.1. This included the Project Land, portioned into three geographical areas to align with areas of common groundwater conditions across the Project:
  - Western portion of the study area – from the existing Bulgana Terminal Station and the new 500kV terminal station near Bulgana to the most easterly extent of the Pyrenees Formation
  - Central portion of the study area – from the Pyrenees Formation to the eastern boundary of the Bungaree Groundwater Management Area
  - Eastern portion of the study area – from the eastern boundary of the Bungaree Groundwater Management Area to the Sydenham Terminal Station. The area includes the existing Elaine Terminal Station.

  Groundwater and groundwater receptors adjacent to the study area were considered where they are hydraulically connected, relevant and within the Project Land.
- Reviewing applicable Commonwealth and Victorian legislation, and relevant local, state and national standards, guidelines and policies.
- Conducting a desktop review to determine the existing groundwater conditions and groundwater environmental values including:
  - Geological and hydrogeological setting
  - Groundwater levels, flow and recharge
  - Groundwater quality
  - Groundwater use and GDEs.

  The following data sources and reference standards were reviewed:
  - Public databases for data related to depth to watertable, groundwater salinity, GDEs, spring locations, surface geology, groundwater users, water courses, and wetlands. A full list of public databases accessed are listed in Section 5.8 of **Technical Report S: Groundwater Impact Assessment**
  - Geological mapping
  - Licensed bore data through engagement with Southern Rural Water, Goulburn-Murray Water, and Grampians-Wimmera Mallee Water.

  Groundwater related fieldwork was not conducted as a desktop assessment of the Project design and known groundwater values were sufficient to identify potential groundwater impacts and develop EPRs. Other technical reports have included extensive field surveys (**Technical Report A: Biodiversity Impact Assessment**), or site visits (**Technical Report R: Contaminated Land Impact Assessment** and **Technical Report Q: Geology and Soils Impact Assessment**) that provided additional information to inform the groundwater impact assessment.

- Consulting with the relevant regulatory authorities and key stakeholders including the Department of Energy, Environment and Climate Action (DEECA), the Environment Protection Authority Victoria (EPA), Councils, Catchment Management Authorities (Wimmera, North Central, Corangamite, Glenelg Hopkins and Melbourne Water), Southern Rural Water, Goulburn-Murray Water, and Grampians-Wimmera Mallee Water, and reviewing the pins dropped by community members onto the Project's Social Pinpoint online mapping tool, which identified locations, features and values of importance.
- Developing a hydrogeological conceptual model to characterise the existing groundwater conditions within the study area, that describes:
  - Major aquifers present (with particular focus on those within 25m of the surface, as these have potential to be intersected by the Project), groundwater levels, groundwater flow directions, potential for groundwater-surface water interactions, groundwater salinity and associated environmental values
  - Local groundwater users (e.g., bores and groundwater fed dams)
  - Springs and GDEs.
- Conducting a risk screening process to identify the key issues during construction, operation and decommissioning for investigation within the technical report.
- Identifying and assessing the potential impact to the groundwater environmental values, namely groundwater levels, flow, recharge, quality, and availability to support receptors such as groundwater users (bores) and GDEs during construction, operation and decommissioning. These impacts were evaluated according to the following ratings, in relation to the extent, magnitude and duration of the impacts:
  - Negligible: No measurable change to groundwater level, groundwater quality, ecosystem function, or environmental value.
  - Minor: Localized, short-term changes (less than one month) in groundwater level or groundwater quality with no lasting impact on ecosystem function or environmental value.
  - Moderate: Extended changes (up to six months) in groundwater level or groundwater quality causing stress to ecosystems or groundwater users, but no change to environmental value.
  - Major: Long-term changes (up to one year) in groundwater level or groundwater quality affecting ecosystems or groundwater users beyond the Project Area, with impacts on environmental value.
  - Severe: Irreversible, long-term harm to ecosystems or permanent changes in groundwater quality or groundwater levels, causing regional impacts and loss of environmental value.

  Impact ratings considered the direct interaction or potential for interaction of the Project with groundwater, the conditions and sensitivity of environmental values, and the magnitude, duration and extent of Project impacts on identified values. The full definition of each rating is provided in Section 5.5 of **Technical Report S: Groundwater Impact Assessment.**
- Identifying relevant future projects that could lead to cumulative impacts when considered together with the Project (refer to **Chapter 4: EES assessment framework and approach** for the full cumulative impact assessment method).
- Developing EPRs in response to the impact assessment to define the required environmental outcomes that the Project must achieve through the implementation of mitigation measures during construction, operation and decommissioning. Measures to reduce the potential impacts were proposed in accordance with the mitigation hierarchy (avoid, minimise, manage, rehabilitate and offset) and have informed the development of EPRs. Alternative mitigation measures could be implemented to comply with the EPRs based on the specific site conditions, available resources, and the Principal Contractor's expertise.
- Following application of mitigation measures that would comply with the EPRs, determining residual impacts associated with the construction, operation and decommissioning of the Project, and evaluating their significance.

Figure 24.1 Groundwater study area

24.3 Existing conditions

This section summarises the existing conditions for groundwater according to the following key themes:

- Geological and hydrogeological setting
- Groundwater levels, flow direction and recharge processes
- Groundwater quality
- Groundwater receptors, consumptive use and GDEs.

Groundwater environmental values are dependent upon the level, flow, and quality of groundwater. Changes to these characteristics have the potential to limit the availability of accessible water to GDEs and bores. Environmental values identified in different geographic locations in the study area include:

- GDEs and species: groundwater quality that is suitable to protect the integrity and biodiversity of GDEs
- Potable water supply: groundwater quality that is suitable for raw or potable water supply
- Potable mineral water supply: groundwater quality that is suitable for drinking and, in its natural state, contains soluble minerals and natural gases causing effervescence
- Agriculture and irrigation: groundwater quality that is suitable for agricultural activities such as stock watering (water for consumption by livestock) and irrigation (water applied to land for the purpose of agricultural production)
- Industrial and commercial water uses: groundwater quality that is suitable for industrial and commercial use
- Water based recreation (primary contact): groundwater quality that is suitable for primary contact recreation, which means an activity in which the whole human body or face and trunk are frequently immersed, or the face is frequently wet by spray, and where it is likely that some water will be swallowed or inhaled, or come into contact with the body (for example, swimming, diving, water skiing, caving and spas)
- Traditional Owner cultural values: groundwater quality that supports ecosystems that are important for the cultural and physical well-being of Traditional Owners (e.g., the health of plants, animals, and other natural resources that are used in traditional practices).

Groundwater conditions were investigated across three main areas, as presented in Figure 24.1. Across all three areas, there is a high-degree of groundwater-surface water interaction and most major rivers, creeks, wetlands and riparian vegetation have a high or moderate potential for groundwater dependence.

24.3.1 Geological and hydrogeological setting

The geological setting for groundwater refers to the types of rocks and sediments present in an area, their arrangement, and their physical properties. This includes factors like the rock's porosity and permeability, which influence how water can move through them.

The hydrogeological setting involves the study of how groundwater interacts with these geological materials. It includes understanding the distribution and movement of groundwater within the soil and rocks, the recharge and discharge areas, and the overall behaviour of aquifers. Together, these settings help determine the availability and quality of groundwater in a region.

Across the study area, a number of aquifer types are present based on the geological and hydrogeological setting of groundwater. These range from shallow alluvial aquifers, which are typically found in valley regions and connected to surface water, to lower aquifers and bedrock, which are typically located much deeper below the surface.

Aquifer types

Aquifer types refer to the various kinds of underground layers that store and transmit groundwater.

Different aquifer types have unique characteristics, such as depth to the watertable, availability of groundwater for extraction, and connection to surface water.

Western portion of the study area

The geology of the western portion of the study area has surface deposits from the Quaternary period, predominantly associated with surface water features, that have incised (cut) into older Cambrian bedrock. Key features include the Shepparton Formation and White Hills Gravel, comprised of gravel, sand, silt and clay.

The groundwater in this area can be described by these aquifer types:

- Alluvial aquifers: These are found in valleys filled with sand, gravel and clay and are associated with creeks and rivers. They host the watertable and are usually connected to surface water
- Weathered zone aquifers (bedrock aquifer): The top layer of fractured rock aquifers that has been weather into silt, sand, or clay. These aquifers vary in thickness across the study area and have low water yield
- Fractured rock aquifers (bedrock aquifer): These aquifers are common across the study area. Their water yield depends on the number, sizing, spacing and interconnectivity of fractures and joints.

Central portion of the study area

The central portion of the study area has geological features shaped by surface water flow and lava from nearby volcanic eruptions, which have filled in the valleys formed by the bedrock. Aquifers in the study area are alluvial, weathered zone, and fractured rock aquifer types as outlined in Section 24.3.1 - Western portion of the study area.

Eastern portion of the study area

The eastern portion of the study area has geological features shaped by surface water flow and lava from nearby volcanic eruptions, which have filled and covered the valleys formed by the bedrock. Alluvial deposits can be encountered at surface water features.

The groundwater in this area can be described by these aquifer types:

- Upper aquifers: These include Quaternary alluvial units, White Hills Gravel and the Tertiary Newer Volcanics Basalt. They are located near the surface, unconfined and generally interact with each other and nearby surface water features
- Lower aquifers and bedrock: These aquifers are usually found deeper than 50m below surface; however, in the eastern portion of the study area they are present at the surface due to higher ground and the Rowsley Fault. This includes the Werribee Formation and Older Volcanics.

24.3.2 Groundwater levels, flow and recharge

State-wide mapping shows the expected depth to the watertable across the study area varies from less than 5m to greater than 50m, with groundwater typically occurring 10 to 20m below the surface. Shallow watertables (less than 5m) are generally found in low-lying areas and valleys with surface water, while deeper watertables are in areas of high elevation with exposed bedrock. The construction of transmission towers typically requires earthworks to a depth of 9m, meaning that groundwater is likely to be encountered at some transmission tower locations during construction. Almost half of the study area is expected to have groundwater within 10m of the surface, including the location of the new 500kV terminal station near Bulgana, Sydenham Terminal Station, and Elaine Terminal Station.

Groundwater in the study area generally flows in the same direction as the land slope. Locally, groundwater flows towards the valleys and is discharged to creeks and rivers. Regionally, and in the western and central parts of the study area, groundwater crosses a ridgeline and flows in a northerly and southerly direction. In the eastern study area, regional groundwater flow is to the south-east.

The recharge process for aquifers present in the study area is through direct rainfall infiltration, a process that is described in Section 24.4.1. Natural discharge from aquifers is expected to be towards valleys and into creeks and rivers. In addition, groundwater is extracted from bores and wells across the study area as described in Section 24.3.4.

24.3.3 Groundwater quality

Groundwater quality within the study area is outlined in Table 24.1. Sources of groundwater contamination are described in detail in **Technical Report R: Contaminated Land Impact Assessment** and are summarised where relevant to groundwater existing conditions.

Table 24.1 Groundwater quality across the study area

Quality	Study area		
	WESTERN	CENTRAL	EASTERN
Expected groundwater salinity[1] (range)	Across portions of the western study area: less than 600 to 3,100mg/L total dissolved solids. At the new 500kV terminal station near Bulgana: 1,201 – 5,400mg/L total dissolved solids.	Less than 600 to 3,100mg/L total dissolved solids across the central study area.	Across the eastern portion of study area: Less than 600mg/L total dissolved solids at western boundary and increasing moving east, where it is expected to be above 10,000mg/L total dissolved solids. At the Elaine Terminal Station: 3,100 – 5,400 mg/L total dissolved solids.
Environmental values to be protected	• Water dependent ecosystems and species • Potable mineral water supply • Agriculture and irrigation – irrigation • Agriculture and irrigation – stock watering • Industrial and commercial • Water based recreation: primary contact • Traditional Owner cultural values • Buildings and structures • Geothermal properties.	• Water dependent ecosystems and species • Potable water supply – desirable[2] • Potable water supply – acceptable[3] • Potable mineral water supply • Agriculture and irrigation – irrigation • Agriculture and irrigation – stock watering • Industrial and commercial • Water based recreation – primary contact • Traditional Owner cultural values • Buildings and structures • Geothermal properties.	• Water dependent ecosystems and species • Potable mineral water supply • Agriculture and irrigation – stock watering • Industrial and commercial • Water based recreation – primary contact • Traditional Owner cultural values • Buildings and structures • Geothermal properties.
Acid sulfate soil potential	Low to extremely low probability of acid sulfate soils occurrence in the western study area	Most of the central area has low potential of acid sulfate soils low. Some isolated areas of high probability of occurrence have been identified surrounding established water bodies (e.g., reservoirs and wetlands), including Dean Reservoir, Hepburn Lagoon and Moorabool Reservoir.	Most of the eastern study area has low to extremely low potential for acid sulfate soils. Some isolated areas of high probability of occurrence have been identified surrounding established water bodies (e.g., reservoirs and wetlands), including Pykes Creek Reservoir and Merrimu Reservoir.

[1] Salinity influences the suitability of groundwater for various uses, and can impact related environmental values

[2] Desirable potable water supply means groundwater with a TDS between 0 and 600mg/L

[3] Acceptable potable water supply means groundwater with a TDS between 601 and 1200mg/L

24.3.4 Groundwater bores

Within the study area, local groundwater users include 789 registered groundwater bores. Registered bores are typically used for domestic and stock purposes, and do not require a licence if the extracted groundwater is being used solely for household needs, gardening, or watering livestock. **Technical Report S: Groundwater Impact Assessment** only considered registered bores; however, there may be unregistered bores or bores installed prior to accurate record keeping present in the study area.

Of these, 120 are licenced groundwater bores users. Licences are required for the extraction of groundwater for commercial, irrigation, or industrial purposes, and are managed by rural water corporations.

Western portion of the study area

There are limited groundwater users in the western portion of the study area as aquifers in this area have low yield potential and relatively high salinity. Registered groundwater bores are used for agricultural, commercial or industrial purposes, domestic and livestock needs, and groundwater observation. Some bores have an unknown use. There is only one licensed bore for extracting groundwater.

Central portion of the study area

In the central portion of the study area, groundwater is widely used for a range of purposes, particularly domestic and livestock needs. Bores mainly tap into the Newer Volcanics aquifer because it is shallow and has suitable potable (drinkable) quality. The Hepburn Shire includes several natural groundwater-sourced mineral springs of significant economic value (largely tourism). There are 106 licensed bores for extractive use.

Eastern portion of the study area

In the eastern portion of the study area, there are several registered groundwater bores used for agricultural, commercial or industrial purposes, domestic and livestock needs, and groundwater observation. There are 13 licensed bores for extracting groundwater. Groundwater is of poorer quality than along the central portion of the study area, and higher quality than along the western portion of the study area. Community feedback during the Project consultation identified important groundwater use sites, including an extensive groundwater-fed irrigated potato industry near Newlyn.

24.3.5 GDEs

GDEs are supported by groundwater aquifers in the western, central and eastern portions of the Project. These include:

- Aquatic ecosystems (including waterways, wetlands, and springs)
- Terrestrial ecosystems (located on land)
- Subterranean ecosystems (located below ground).

Groundwater may sustain both aquatic and terrestrial biodiversity by supporting vegetation through deep root access, providing discharge to waterways as base flow or in some cases subterranean flow and providing important inflows to sustain wetlands. Subterranean ecosystems are typically located in caves or aquifers and can depend on groundwater to support unique species of subterranean fauna (known as stygofauna). The presence of these GDEs is described in further detail in the following sections.

Groundwater Dependent Ecosystems (GDEs)

GDEs are natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, to maintain their communities of plants and animals, ecosystem processes and ecosystem services[4].

[4] Richardson, S., et al., (2011). Australian groundwater-dependent ecosystem toolbox part 1: assessment framework, Waterlines report, National Water Commission, Canberra

Western portion of the study area

All major surface water features within the western section are classed as having a high or moderate potential for groundwater dependence. Waterways including the Wimmera River (in the vicinity of the new terminal station near Bulgana) and Glenlofty Creek in the Wimmera Catchment Management Authority (CMA), and Amphitheatre Creek and Avoca River in the North Central CMA are identified as having a high potential for groundwater dependence. Community feedback during Project consultation highlighted Glenlofty Creek also as a groundwater site of significance.

Vegetation along major waterways and scattered areas of vegetation is also recognised as having a high groundwater dependence. Shallow watertables (less than 5m below surface) are mainly found along drainage lines and waterways, supporting these aquatic and terrestrial GDEs. Aquifers within the study area may support subterranean (subsurface) GDEs.

Central portion of the study area

Almost all major surface water features within the central section are classed as having a high or moderate potential for groundwater dependence. A number of aquatic and terrestrial GDEs rely on the aquifers in this area. These include waterways including Birch Creek, Glendaruel Creek and Moorabool River West Branch, and scattered areas of vegetation, with a high or moderate potential for groundwater dependence. Community feedback collected during consultation on the Project highlighted significant groundwater use sites in the study area such as Kilkenny Creek and Birch Creek, and these have been considered for their potential groundwater dependence. Aquifers within the study area may support subterranean GDEs.

Eastern portion of the study area

All major surface water features within the eastern section are classed as having a high or moderate potential for groundwater dependence, with several aquatic and terrestrial ecosystems that depend on groundwater. Waterways including Arnolds Creek East Branch, Djerriwarrh Creek, Kororoit Creek, Lerderderg River, Toolern Creek and Werribee River and a wetland in vicinity of the study area all have a high potential for groundwater dependence. Vegetation along major waterways and scattered areas of vegetation are also recognised as having a high groundwater dependence. Aquifers within the study area may support subterranean GDEs.

24.4 Construction impacts

This section outlines the key issues identified through the risk screening process and associated potential impacts during the construction of the Project. The key issues and impacts identified for groundwater are discussed according to the following themes:

- Groundwater levels, flow and recharge: dewatering, reduction in groundwater recharge rates, reduction in aquifer storage capacity, change in groundwater flow direction and removal of vegetation.
- Groundwater quality: the potential for excavations below the watertable to create pathways for contaminants to enter groundwater, and contamination due to the storage and handling of fuels, as well as solid and liquid wastes.
- Groundwater bores: the siting of transmission towers and other below ground works, which could result in physical impacts to groundwater bores.
- GDEs: the siting of transmission towers and other below ground works, which could result in physical impacts to GDEs.

24.4.1 Groundwater levels, flow and recharge

Changes to groundwater levels could arise due to construction activities associated with transmission tower foundations, terminal stations, and the introduction of new impervious surfaces and potentially lead to a temporary reduction in water accessibility to GDEs and nearby bores. It is likely that the Project will intersect groundwater at some transmission tower locations. However, it is unlikely that groundwater will be encountered at terminal station locations as the proposed construction method and infrastructure requirements limit the potential to interact with groundwater.

Where groundwater is found during construction, such as the construction of tower foundations, works will be undertaken in 'wet' conditions by pumping concrete into the foundations. This may displace some groundwater; however, it will allow construction to occur without dewatering.

Across the Project, there may be some locations where dewatering may be required for a short duration. This could temporarily lower the groundwater level, affecting GDEs and sensitive groundwater users where they are close to a construction site. However, if dewatering is required, it will likely be brief (less than a day) at any location. The Principal Contractor will be required to develop and implement a Groundwater Management Plan (EPR GW2) that sets out specific protocols to minimise and manage impacts associated with dewatering should it be needed for excavations at tower assembly areas and terminal stations. The protocols will incorporate measures to manage potential impacts on groundwater users and GDEs, address the potential impact of acid sulfate soil exposure, and prevent the mobilisation of known groundwater contaminants. The application of these mitigation strategies will reduce the magnitude and duration of dewatering impacts, and the residual impacts will be negligible. Groundwater quality is discussed further in Section 24.4.2.

The Project may source water for use in construction from local sources, such as reservoirs or dams, in agreement with local stakeholders or landholders. It is not expected that groundwater will be extracted to facilitate construction of the Project. Additional water may be sourced from town supplies to support the needs of the workforce and workforce accommodation facilities.

The introduction of Project infrastructure and hardstand (impervious) surfaces could reduce groundwater recharge and compress underlying material, resulting in less aquifer storage capacity. However, the small area of these surfaces compared to the large regional aquifers means that any changes to the water level will be minor, localised, and short-term as the aquifer is expected to reach a new equilibrium. Similarly, any reductions to aquifer storage capacity are expected to be limited, being either highly localised or within the natural variability of groundwater, and to stabilise within the construction timeframe. Where Project infrastructure extends below the watertable, local groundwater flow and direction may be impacted. However, the comparatively small scale of the foundations relative to the scale of the individual aquifers is unlikely to measurably impact the rate or direction of groundwater flow. Based on this, the impacts are negligible, and no specific mitigation is recommended.

What is groundwater recharge and aquifer storage?

The **recharge process** for aquifers relevant to the Project (alluvial/colluvial aquifers and bedrock aquifer) is through direct rainfall infiltration. The physical presence of above ground infrastructure has the potential to reduce in rainfall infiltration to the aquifer. This reduction in recharge can result in a decline in groundwater level, impacting users and GDE health.

Above ground infrastructure can also cause compression of aquifers. This depends on the depth to watertable and whether the infrastructure is on consolidated or unconsolidated material. A reduction in **aquifer storage capacity** raises the watertable, which can impact GDEs and existing groundwater users.

Vegetation removal may increase groundwater levels. To assess the potential for impact of vegetation removal on groundwater, the areas of planned vegetation removal noted in **Technical Report A: Biodiversity Impact Assessment** were reviewed to identify areas that met a set of criteria including where removal is greater than 1ha (10,000m^2); densely vegetated (rather than sparse trees); expected depth to groundwater is less than 10m (overall) and less than 20m (areas of high permeability geology); and where the proportion of proposed vegetation removal with respect to the remaining adjacent vegetation is greater than 10 per cent. Three areas of vegetation removal, shown in Figure 24.2, met these criteria and have been assessed in terms of potential for groundwater impact:

- Vegetation between transmission towers F6119DL and F6116DL, in vicinity to Mile Creek Road and Forest Road, Lexton (Western portion of the study area).
- Vegetation between transmission towers F6260DL and F6259DL, south of Coutts Road, Waubra (Central Portion of the study area).
- Vegetation adjacent to transmission tower F4488DL in an area north of Wilson Reservoir.

In each area of vegetation removal, there is potential for groundwater levels to increase; however, given the wider area has a depth to groundwater between 10 to 20m below surface, and the controlling nature of adjacent watercourses, the overall significance of the impact on groundwater level is expected to be minor after vegetation removal is complete. Overall, the expected impact from vegetation removal for the Project is minor; however, in practice the impact could be classed negligible given the impact on groundwater level would not be measurable using conventional methods of groundwater monitoring.

As such, the residual impacts to groundwater levels, flow direction and recharge are minor to negligible for construction of the Project.

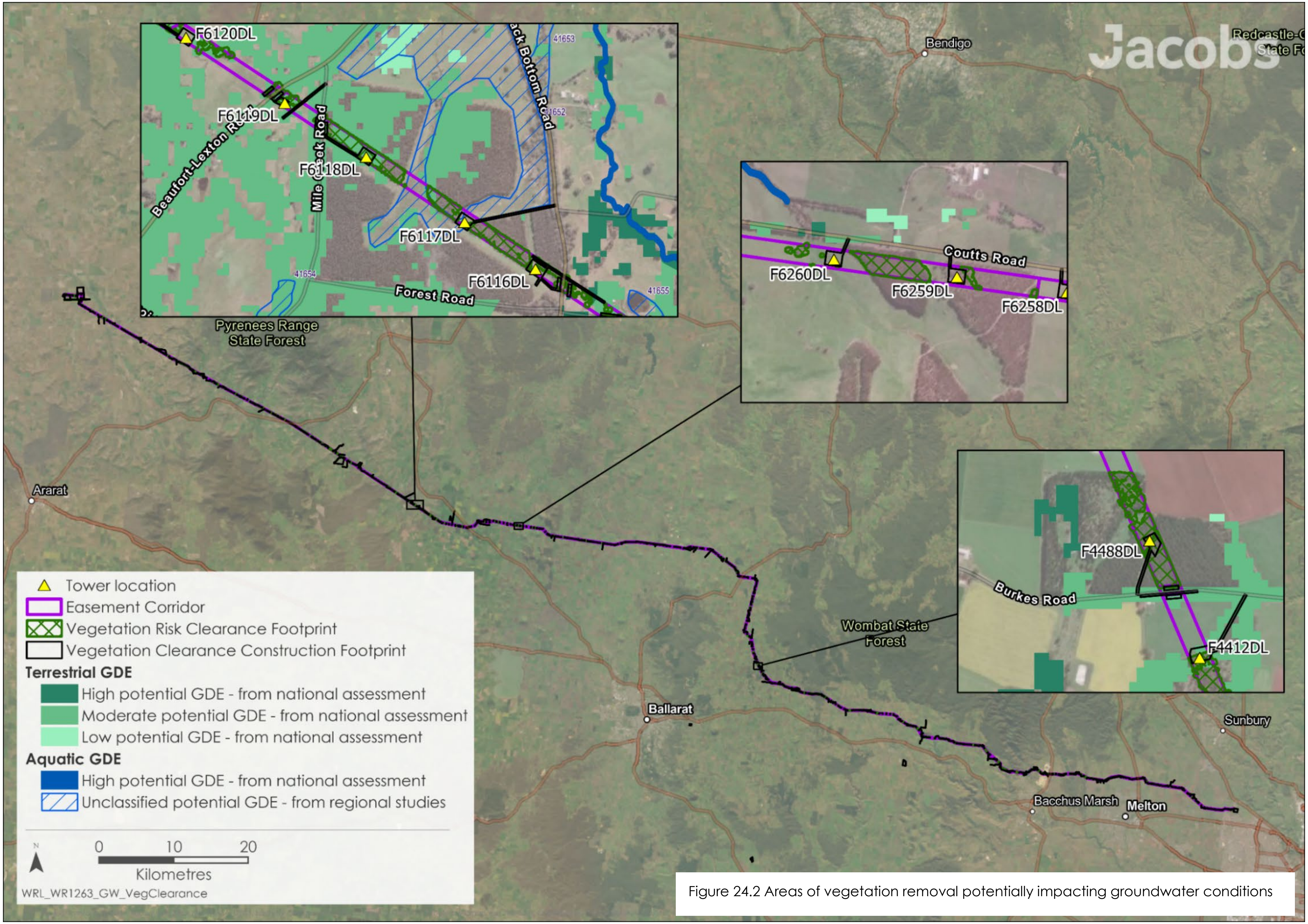

Figure 24.2 Areas of vegetation removal potentially impacting groundwater conditions

24.4.2 Groundwater quality

Construction of the Project may cause groundwater quality to degrade when excavations extend below the watertable or compromise surface seals, creating pathways that allow surface water or other pollutants to encounter groundwater. If acid sulfate soils or existing contaminants are present in excavations, dewatering could impact on groundwater quality by mobilising such contaminants. Excavations can also increase the permeability of the surrounding soil, making it easier for contaminants to enter groundwater through the groundwater recharge process (discussed in Section 24.4.1). Further, the handling of solid and liquid wastes during construction may lead to leaks and spills impacting groundwater quality and its environmental value.

The potential for groundwater contamination will be minimised so far as reasonably practicable through the appropriate design of surface seals. The Principal Contractor will be required to develop and implement a Groundwater Management Plan (EPR GW2) that outlines the controls to avoid and minimise impacts to groundwater during construction. The Groundwater Management Plan will include, but is not limited to:

Soil permeability

Soil permeability refers to the ability of soil to allow water to pass through it and is dependent on the size of the soil particles and the spaces between them.

Highly permeable soils let water flow through easily, while less permeable soils restrict water movement.

- Controls outlined in EPA Publication 1834.1: Civil construction, building and demolition guide (EPA, 2023), as relevant to erosion, sediment, contaminated land and contaminated groundwater, chemicals and waste. Wastes will be classified, managed, and disposed in accordance with EPA Publication 1827.2: Waste classification assessment protocol (EPA, 2021a), EPA Publication 1968.1: Guide to classifying industrial waste (EPA, 2021b), and EPA Publication 1828.3: Waste disposal categories-characteristics and thresholds (EPA, 2024).
- Controls outlined in EPA Publication 1698: Liquid handling and storage guidelines (EPA, 2018a) and EPA Publication 1700: Preventing liquid leaks and spills from entering the environment (EPA, 2018b), to prevent leaks and spills, and measures to prevent any spills reaching the watertable.
- Controls to manage the collection, containment and transport of groundwater or slurry discharged from below ground construction (noting that groundwater displaced to the surface is 'waste' as defined by the *Environment Protection Act 2017* and will be managed in accordance with the Environment Protection Regulations).
- Controls as described in EPA Publication 655.1: Acid sulfate soil and rock, for management of acid sulfate soils (EPA, 2009).
- Installation of bunding during excavation works to prevent groundwater contamination during construction.
- Access arrangements to DEECA for any State Observation Bore Network (SOBN) bores located within the fenced construction area.
- Protocols for dewatering (i.e. a Dewatering Plan) to manage the potential impacts to groundwater users or GDEs, as well as the potential of exposing acid sulfate soils or mobilising known groundwater contaminants.

With the application of avoidance and mitigation measures as required by the Groundwater Management Plan (EPR GW2), the extent, duration and magnitude of impacts associated with groundwater contamination will be reduced, and residual construction impacts will be negligible.

24.4.3 Groundwater bores

Construction of the Project could have a direct physical impact on the environmental values and use of groundwater if transmission towers or other below ground works are conducted on, or in proximity to, existing groundwater bores.

There are nine groundwater bores located within 100m of a proposed transmission tower (five in the central portion of the study area, and four in the eastern portion of the study area). These bores have various uses and include five licensed bores (for irrigation and industrial / commercial use) and four registered bores (domestic and livestock and unknown uses). Based on depth to watertable information and the bore location with respect to the tower piling sites, three towers may encounter groundwater and five are unlikely to encounter groundwater except if piling exceeds approximately 9m depth. One site is not expected to encounter groundwater at all. Therefore, eight of the nine identified bores will require engagement with landholders to confirm presence of the bore, and if confirmed a site-specific assessment will be required to appropriately plan for and minimise and manage physical impacts from tower piling (EPR GW1).

An analysis of groundwater bores was also conducted in the vicinity of distribution line crossover locations. There are 15 groundwater bores located within 100m of crossover works (five are in the central portion of the study area and ten in the eastern portion of the study area). Of these, three are licensed bores (for irrigation and domestic and livestock needs), 11 are registered bores (domestic and livestock, observational and unknown uses) and one is a State Observation Bore Network (SOBN) bore. Based on depth to watertable information, seven distribution line crossover sites have the potential to intersect groundwater (groundwater is expected to be encountered at depths of less than 5m). The SOBN bore appears to be located within the easement designated for crossover works and there is potential for direct impact (damage) to the SOBN bore. Again, engagement with landholders and DEECA (for the SOBN bore) is needed to confirm the presence of these bores and if confirmed a site-specific assessment will be required to appropriately plan for and minimise and manage physical impacts as a result of crossover works (EPR GW1).

To reinforce the protection of existing groundwater bores and to minimise the potential for direct physical impacts of construction, Table 24.2 details the buffer zones to be considered for transmission towers, distribution line crossovers, and below ground works at terminal stations. If works will be within the specified buffers, a site-specific groundwater assessment will be conducted by the Principal Contractor to evaluate potential for physical impact. If impact is identified, site-specific monitoring and mitigation strategies will be implemented (EPR GW1). These buffer zones are for physical distancing only and do not consider dewatering impacts.

Table 24.2 Siting of works to minimise potential for direct physical impact of construction on groundwater receptors

Category	Siting of works
All registered or identified groundwater extraction bores	100m buffer zone from groundwater bores
SOBN bores	100m buffer zone from the bore

By siting works to reduce potential of direct physical impact to groundwater receptors (EPR GW1) and the implementation of mitigation measures required in the Groundwater Management Plan (EPR GW2), the extent and magnitude of impacts will be reduced, and the residual impact to bores identified within 100m of towers and distribution line crossovers is negligible. However, minor residual impacts are likely to be unavoidable only when mitigation measures cannot be fully implemented, for example where buffer zones cannot be implemented, and tower footings are located on top of existing bores. In these cases, groundwater bores may need to be abandoned and replaced in agreement with the landholder.

24.4.4 GDEs

Construction of the Project has the potential to cause a direct physical impact on the availability of groundwater to support GDEs if transmission towers, or other below ground works are undertaken in proximity. There are 15 aquatic GDEs located within 50m of a proposed transmission tower; these are dispersed across the study area. As referenced in **Technical Report T: Surface Water Impact Assessment**, the CMAs and Melbourne Water recommend construction setback distances from waterways (ranging from 20 to 50m depending on the type of waterway) which aim to minimise flow disruption and bank erosion.

In terms of groundwater impact, as the majority of the GDEs are located outside of the CMA and Melbourne Water setback distances, there is no significant physical impact expected from siting works within the recommended setback distances and the impact is minor. If dewatering is required for tower piling, the potential impacts to GDEs will be minimised and managed through specific protocols for dewatering which will form part of the Groundwater Management Plan (EPR GW2).

There are eight locations where distribution line crossovers within 50m of a GDE, which includes Wimmera River and Glenlofty Creek in the western portion of the study area; Birch Creek and Creswick Creek in the eastern section of the study area; Korkuperrimul Creek in the eastern section of the study area; and two wetlands (one in the eastern section and one in the central section of the study area). The management of the interaction will be dependent on the location and construction method proposed for crossover works. If dewatering is required, the potential impacts to GDEs will be managed through the Groundwater Management Plan (EPR GW2).

Similar to buffer zones discussed in 24.4.3, buffer zones to aquatic GDEs are to be considered for transmission towers, distribution line crossovers and below ground works at terminal stations (Table 24.3). Buffers will serve to protect GDEs, minimising the potential for physical impacts. If planned works will be within the specified buffers, a site-specific groundwater assessment will be conducted by the Principal Contractor to evaluate potential for physical impact. If an impact is identified, site-specific monitoring and mitigation strategies will be implemented (EPR GW1) to reduce the extent and magnitude of the impact. These buffer zones are for physical distancing only and do not consider dewatering impacts.

Table 24.3 Siting of works to minimise potential for direct physical impact of construction on GDEs

Category	Siting of works
Aquatic GDEs	50m (or the relevant waterway distance identified in EPR SW1, whichever is greater)

With the application of mitigations through EPR GW1 (site works to reduce potential of direct physical impact to groundwater receptors) and EPR GW2 (Groundwater Management Plan) the residual impact to GDEs is negligible.

24.5 Operation impacts

This section outlines the key issues identified through the risk screening process and associated potential impacts during the operation of the Project. The key issues and impacts identified for groundwater are discussed according to the following themes:

- Groundwater recharge: the addition of infrastructure and (impervious) surfaces, could reduce groundwater recharge rates.
- Groundwater quality: inappropriate herbicide application, and improper storage and handling of chemicals and wastes and chemicals has the potential to cause contamination at the terminal stations.

24.5.1 Groundwater recharge

As discussed in Section 24.4.1, the physical presence of above ground infrastructure that prevents rainfall infiltration to groundwater has the potential to cause a reduction in rainfall recharge to the aquifer. In the absence of mitigation, this could result in a decline in groundwater level impacting groundwater users, values, and the health of surrounding GDEs.

However, the small area of these surfaces compared to the regional scale of the aquifers means that any decrease in groundwater recharge is expected to have a negligible impact on broader groundwater recharge processes and groundwater values. As such, no specific mitigation strategies are required and residual impacts to the environmental value of groundwater are negligible.

24.5.2 Groundwater quality

During operation, vegetation growth at terminal station sites and within the transmission line easement will be managed using herbicides, which has the potential to introduce contaminants to groundwater. In addition, the storage of chemicals and management of onsite wastewater storages at terminal stations could result in groundwater contamination through leaks and spills.

Industry standard avoidance and mitigation measures for herbicide application, liquid storage and handling, and on-site wastewater storages will be used to prevent herbicides or effluent from onsite wastewater storages from entering groundwater, or to minimise the volume of a leak or spill that would enter groundwater if a leak or spill were to accidentally occur. Further, AusNet will operate the Project in accordance with existing AusNet operational procedures, which provide avoidance and mitigation measures to protect groundwater quality, covering the areas of vegetation management, storage and handling of waste and chemical spill management.

Residual impacts to groundwater quality from operational activities are expected to be negligible.

24.6 Decommissioning impacts

There are no activities described in the decommissioning stage of the Project that are considered to have potential for impact to groundwater level, flow, or quality. Tower and terminal station footings will typically be excavated to a maximum of 300mm below finished surface level, hence decommissioning work will not encounter or interact with groundwater.

Accordingly, the application of standard controls outlined in EPA Publication1834.1: Civil construction, building and demolition guide (EPA, 2023) would manage the potential for erosion, sedimentation and soil and groundwater contamination in accordance with the conditions of the time. This would also be managed by a Decommissioning Management Plan (EPR EM11) which would include mitigation measures for groundwater protection.

Based on this, residual impacts to groundwater from decommissioning are expected to be negligible.

24.7 Cumulative impacts

Cumulative impacts have been assessed by identifying relevant future projects that could contribute to cumulative impacts on groundwater values, considering their spatial and temporal relationships to the Western Renewables Link Project. The projects considered as potentially relevant to groundwater include:

- Elaine Battery Energy Storage System
- Elaine Solar Wind Farm
- Nyaninyuk Wind Farm
- Coimadai Sand Quarry
- Toolern Solar Farm
- Victoria to New South Wales Interconnector West.

Potential cumulative impacts to groundwater can arise from earthworks occurring across multiple projects that may collectively impact groundwater levels, flow, recharge and quality, and the availability of groundwater to bores and GDEs. The groundwater impacts from each project are expected to be localised and temporary in nature, similar to the magnitude and duration of impacts expected for Western Renewables Link. When considered cumulatively, impacts would be minor.

Cumulative impacts of the relevant future projects will be managed effectively through avoidance, engineering and administrative controls and the potential for significantly adverse cumulative impact is expected to be minor.

24.8 Environmental Performance Requirements

Potential impacts identified through **Technical Report S: Groundwater Impact Assessment** have informed the development of EPRs for the Project. EPRs set out the environmental outcomes to be achieved through the implementation of mitigation measures during construction, operation and decommissioning. While some EPRs are performance based to allow flexibility in how they will be achieved, others include more prescriptive measures that must be implemented. Compliance with the EPRs will be required as a condition of the Project's approval. Table 24.4 details the proposed EPRs developed for groundwater.

Table 24.4 Environmental Performance Requirements

EPR code	Requirement
EPR GW1	**Site works to reduce the potential of direct physical impact to groundwater receptors** 1. Prior to commencement of construction, apply buffers around known and identified groundwater receptors (where practicable) to minimise potential for direct physical impact of construction. These buffers are to apply to the construction of transmission towers, Powercor distribution line crossovers and below ground works at terminal stations. The buffer distances to be applied to groundwater receptors are as follows, noting they are for physical distancing only and do not consider dewatering impacts: a. Bores (i.e., all extractive bores and excluding bores for monitoring specific purposes): 100m b. SOBN bores: 100m c. Aquatic groundwater dependant ecosystems: 50m or related waterway buffer identified in EPR SW1. 2. If planned works for transmission towers, Powercor distribution line crossovers and below ground works at terminal stations are located within the buffers specified in item 1): a. Consult with the landholder and undertake a site walkover to inspect or identify groundwater bores or areas where sub-surface infrastructure is present (such as supply mains) within and adjacent the construction footprint. i. If additional bores or potential GDEs are discovered, these must be discussed with the landholder and the relevant water authority and considered against the nominated physical distancing buffers listed above in item 1. ii. If sub-surface infrastructure is identified (such as drains, mains), potential for physical impact must be discussed with the landholder. b. Conduct a site-specific groundwater risk assessment to evaluate potential for physical impact c. If potential impacts are identified, prepare and implement site-specific monitoring and mitigation strategies if necessary. These requirements must be incorporated into the Groundwater Management Plan as required by EPR GW2.

EPR code	Requirement
EPR GW2	**Develop and implement a Groundwater Management Plan** 1. Prior to commencement of Project construction and as part of the CEMP (EPR EM2), develop, implement and maintain a Groundwater Management Plan in consultation with EPA and relevant water authorities that details the specific controls that would avoid or minimise risks to the environmental value of groundwater. 2. The Groundwater Management Plan must include the following, as a minimum: a. Controls outlined in EPA Publication1834.1 Civil construction, building and demolition guide (EPA, 2023), as relevant to erosion, sediment, contaminated land and contaminated groundwater, chemicals and waste. This includes controls for management measures of the collection, containment and transport of groundwater or slurry discharged or displacement displaced from below ground construction. Groundwater displaced to the surface will be "waste" as defined by the *Environment Protection Act 2017*. Wastes will be classified, managed, and disposed in accordance with EPA Publication 1827.2: Waste classification assessment protocol (EPA, 2021a), EPA Publication 1968.1: Guide to classifying industrial waste (EPA, 2021b), and EPA Publication 1828.3: Waste disposal categories-characteristics and thresholds (EPA, 2024). Waste will be managed in accordance with the Environment Protection Regulations 2021. These measures should be implemented to prevent any waste reaching waterways, as well as ensuring open holes are bunded to prevent preferential pathways during construction (refer to EPR CL3). b. Controls outlined in EPA Publication 1698 Liquid handling and storage guidelines (EPA, 2018a) and EPA Publication 1700 Preventing liquid leaks and spills from entering the environment (EPA, 2018b). This includes controls such as using secondary containment (bunded) areas to store or transfer liquids, safe pouring and decanting methods, and spill kits to prevent migration of liquid. These measures should be implemented to prevent any onsite spills reaching the watertable. c. Controls as described in EPA Publication 655.1: Acid sulfate soil and rock, for management of acid sulfate soils (EPA, 2009). d. Provision of access arrangements to DEECA in the event that State Observation Bore Network bores are located within a fenced construction area. e. Protocols in the event of dewatering for towers and terminal stations. The dewatering protocols must include, but not be limited to: i. Review of geotechnical survey data to determine sub-surface conditions. ii. Estimation of drawdown and cone of depression based on planned dewatering duration and conditions encountered. iii. Estimation of extraction volume. If the activity is within a Groundwater Management Area, the volume should be communicated to the relevant Water Authority. iv. Identification of receptors (GDEs, waterways, users) or sensitive sites (acid sulfate soils, contamination sources as identified through EPR CL1) within the expected cone of depression. If potential for impact to receptors is identified, consider the proposed construction method and timing to minimise or eliminate impacts. v. If there is high uncertainty, high risk, or if impacts cannot be mitigated through design, construction methodology, and timing, install a groundwater bore and undertake investigations to determine groundwater level, groundwater quality and hydraulic conductivity. vi. Design and implement a field monitoring program before, during and after dewatering to monitor and manage impacts. vii. Develop site-specific mitigation strategies to mitigate potential impacts. viii. Groundwater inflow management planning. ix. Groundwater discharge options assessment and management planning.

Other EPRs contribute to a reduction in the magnitude, extent and duration of impacts for groundwater values. Additional EPRs related to groundwater include:

- EPR EM2 – Develop and implement a Construction Environmental Management Plan
- EPR EM11 – Develop and implement a Decommissioning Management Plan.

Refer to **Chapter 29: Environmental Management Framework** for full detail of these EPRs.

Groundwater monitoring will be undertaken on a site-specific basis where buffer distances to groundwater receptors (as specified in EPR GW1) cannot be achieved and there is potential for impact. Further field monitoring will be undertaken before, during and after dewatering in the event that it is required, in accordance with the Groundwater Management Plan (EPR GW2).

The objectives of proposed monitoring programs for the Project required by the EPRs are outlined in **Chapter 29: Environmental Management Framework.**

24.9 Summary of residual impacts

With the application of the EPRs, residual impacts associated with groundwater are considered to be minor to negligible:

- Residual impacts to groundwater levels, flow and recharge during construction are minor to negligible. The removal of patches of vegetation in three areas of the Project may result in an increase in groundwater levels; however, the expected impact from vegetation removal for the Project overall is minor. Planned protocols will be followed in the event that dewatering is required, managing potential adverse impacts (EPR GW2).
- Residual impacts to groundwater quality (including salinity) during construction are negligible. The Groundwater Management Plan will include standard controls to manage potential groundwater contamination, and all surface seals will be designed to minimise the potential for contaminants to enter the groundwater (EPR GW2).
- Residual impacts to groundwater bores or GDEs during construction are minor to negligible. Where buffer distances cannot be achieved to groundwater receptors, site-specific assessments will be undertaken, and monitoring and mitigation strategies will be implemented where impacts are identified (EPR GW1, EPR GW2).
- Residual impacts to groundwater recharge and quality during operation are negligible. The assessment of the potential for impact to groundwater recharge rates concluded that the Project is expected to have negligible effect on groundwater recharge processes and no specific mitigation strategies are required. The potential impacts to groundwater quality from herbicide application will be managed in accordance with existing AusNet operational procedures, resulting in a negligible residual impact.
- Residual impacts to groundwater during decommissioning are considered to be negligible, as decommissioning activities will not interact with groundwater. The Decommissioning Management Plan (EPR EM11) will include standard controls that will manage potential groundwater impacts.

With the implementation of measures to comply with EPRs, it is considered that the Project meets the groundwater aspects of the evaluation objective *"Maintain the functions and values of aquatic environments, surface water and groundwater quality and stream flows and prevent adverse effects on protected beneficial uses."*

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