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Edithvale and Bonbeach Groundwater Monitoring and Management Plan

VICTORIA'S BIG BUILD

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Version 5

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Copies of the current version of this Plan are to be provided to:

- Southern Rural Water
- Environment Protection Authority (EPA) Victoria
- Melbourne Water
- Kingston City Council
- Department of Energy, Environment and Climate Action (DEECA)

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1 Introduction

1.1 Background

The Victorian Government removed the dangerous and congested level crossings at Edithvale and Bonbeach in Victoria by lowering the rail line into trenches in November 2021. An Environment Effects Statement (EES) was undertaken for the Edithvale and Bonbeach Projects to assess potential impacts to groundwater levels, groundwater quality and the Edithvale-Seaford Wetlands. Due to the proximity of the projects to the Edithvale Wetland, which is one of two wetlands that form the Edithvale-Seaford Wetlands Ramsar Site, the projects also required approval under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act).

An Environmental Management Framework (EMF) has been prepared for the Edithvale and Bonbeach Projects in accordance with the project's planning approval under the Victorian *Planning and Environment Act 1987* (P&E Act). The EMF contains a number of Environmental Performance Requirements (EPRs) developed through the EES process, which have been approved by the Victorian Minister for Planning.

The EES and subsequent studies identified that groundwater levels and quality could be maintained for the Edithvale and Bonbeach Projects within acceptable thresholds through engineering controls and implementation of the EPRs. This Plan has been prepared to address the requirements of EPR_GW2 and Conditions 1-3 of Approval 2017/7906 (Appendix A: EPBC Act and EPR Condition requirements), granted for the projects under sections 130(1) and 133(1) of the EPBC Act.

1.2 Project status

As of August 2022, project construction has been completed and the project has entered the operational phase. As detailed in Section 1.3, there remains a comprehensive monitoring program that will alert the responsible entity (defined in Section 7) should an issue occur and contingency measures need to be enacted.

1.3 This Plan

This Plan responds to the requirements of EPR_GW2 (Appendix A: EPBC Act and EPR Condition requirements), which requires monitoring and management of predicted and potential impacts to groundwater as a result of the projects.

It requires the monitoring of groundwater levels and quality for environmental purposes, and the development of clear trigger events or levels for changes in groundwater level or quality, specifically to ensure:

- Edithvale Wetland is not impacted by the project and continues to provide habitat to migratory species
- Groundwater quality is not adversely affected by the project.

1.3.1 Document status

As detailed in Section 8.3, this Plan was reviewed annually during the first two years of implementation. This document represents version 5 of the Revised Action Management Plan (RAMP) relating to the Approval 2017/7906. Owing to the completion of project construction in 2022, this version of the Plan has been significantly reduced in terms of historic background and any construction-phase specific aspects. Refer to version 4[1] of the RAMP for a detailed summary of historical project and approvals context.

The reduction in monitoring scale adopted for this version 5 of the RAMP does not impact any of the related EPRs, as outlined below:

- EPR_GW1: The Groundwater Performance Outcomes outlined in EPR_GW1 will be monitored through this version 5 of the RAMP, to confirm that the project meets operation phase requirements through periodic review of groundwater level and quality data
- EPR_GW2: Each of the required triggers have been retained and the fundamental requirement in EPR_GW2 for a program of monitoring "for at least 10 years" is maintained
- EPR_CL5: This version 5 of the RAMP contains triggers which if met would instigate the Groundwater Quality Mitigation Plan, which focusses on groundwater quality risks while specifically referencing groundwater

[1] Level Crossing Removal Project (2021) Edithvale and Bonbeach Groundwater Monitoring and Management Plan, Version 4, 23 December 2021, State Government of Victoria, Melbourne.

performance outcomes (EPR_GW1) and related drawdown and mounding (i.e. the causal factors of the groundwater quality risks)
- EPR_FF7: This version 5 of the RAMP contains triggers which if met would instigate the Edithvale Wetlands Monitoring and Mitigation Plan.

1.3.2 Plan updates

Through the requirement for periodic compliance reporting and reviews, this Plan is intended to be a live document where elements may be updated in future, with the intention to incorporate updates to site conditions that cannot be anticipated during the preparation of this Plan or evolution of site conditions that require modification to the monitoring program.

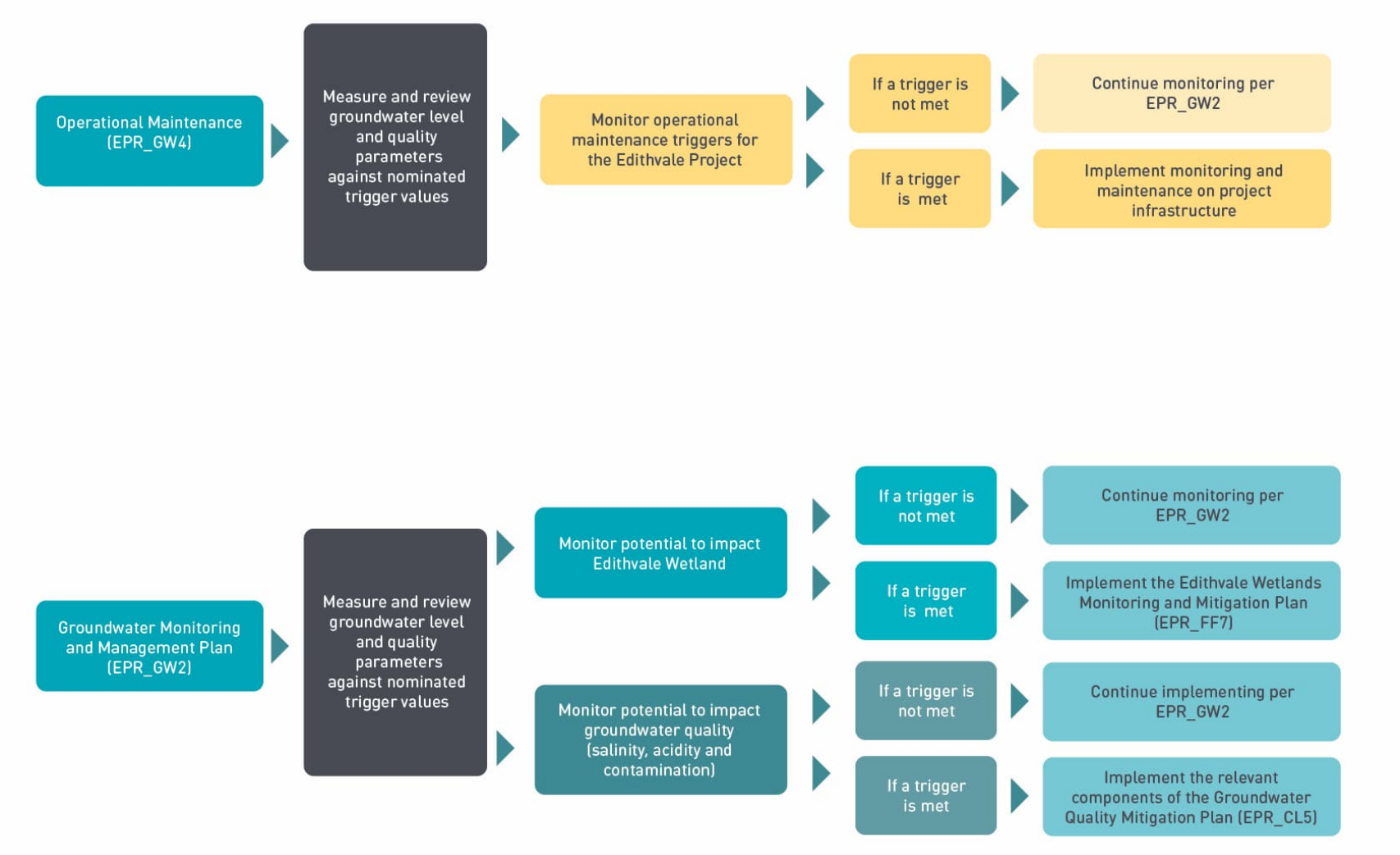
The objective of any update to this Plan is to better represent the project condition and/or provide a more relevant basis on which to inform project performance monitoring or the monitoring of potential project-related environmental impacts.

The next review of this Plan is required to be finalised within two years of the date of this Version 5 of the Plan (refer to Section 8.3).

In accordance with EPR_GW2, the duration of groundwater monitoring established by this Plan is for at least 10 years, noting that components of the Plan may cease earlier if considered appropriate.

An overview of the groundwater monitoring and mitigation framework is presented schematically in Figure 1. Changes to this Plan or its reporting and notification requirements may arise from related EPRs, specifically if the Edithvale Wetland Monitoring and Mitigation Plan (EPR_FF7) or the Groundwater Quality Mitigation Plan (EPR_CL5) are implemented. These additional mitigation plans may require on-going or additional monitoring in their implementation, which would be added to the monitoring outlined in this version of this Plan.

Figure 1 Approach to groundwater monitoring and implementation of mitigation measures



Note: Since this figure was prepared, EPR_GW4 has been considered no longer required, as outlined in Section 3 of this document. The step in this figure to *"implement monitoring and maintenance on project infrastructure"* should now read "Implement the Groundwater Quality Mitigation Plan (EPR_CL5)", as per the triggers in Table 4 and Table 5 and the related corrective actions outlined in Section 3 in this document.

1.4 Groundwater impact management measures

1.4.1 Project contingency

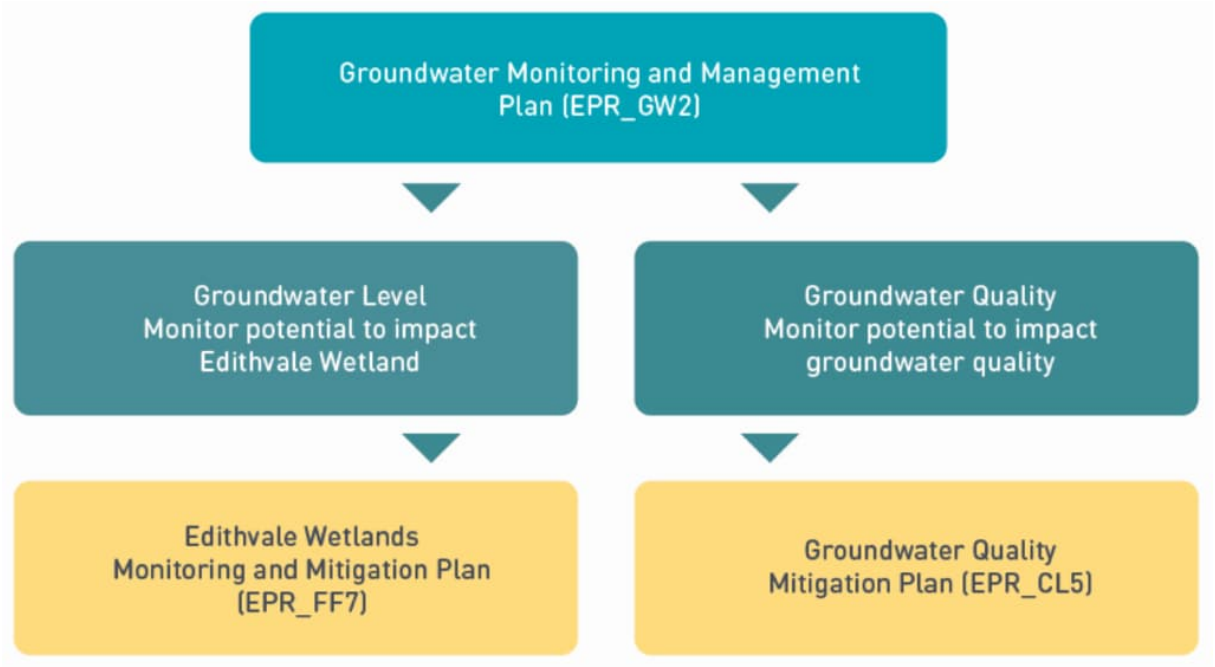
As a primary environment protection measure, a program of monitoring is required in this Plan to ensure acceptable project performance both during project construction and operation phases, in accordance with various EPRs for both the Edithvale and Bonbeach Projects (refer to Appendix A: EPBC Act and EPR Condition requirements). The operational monitoring requirements apply for the life of the project and are documented separately and summarised for information purposes only in Section 3.

As a secondary environment protection measure, this Plan defines certain groundwater level and quality parameters and thresholds as trigger levels for the implementation of the following mitigation plans:

- The Groundwater Quality Mitigation Plan (EPR_CL5) to protect groundwater quality; and
- The Edithvale Wetlands Monitoring and Mitigation Plan (EPR_FF7) to protect the Edithvale Wetlands.

The *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7) and the *Groundwater Quality Mitigation Plan* (EPR_CL5) present a staged monitoring and mitigation approach, firstly detailing steps to investigate whether the changes in the area are due to the projects and then describing mitigation measures that are to be implemented to rectify the situation.

Figure 2 EPR Hierarchy – Part 2



1.5 Objective and approach

The primary objective of this Plan is to ensure monitoring of groundwater levels and quality is conducted to confirm requirements specified in EPR_GW2, EPR_FF7 and EPR_CL5, and define trigger levels for the implementation of EPR_FF7 and EPR_CL5, whilst ensuring the EPBC Act condition requirements are met. The objectives of this Plan and commitments made by the proponent to ensure these objectives are achieved are provided in Table 1.

Table 1 Objectives of the Groundwater Monitoring and Management Plan and commitments

Objective	Commitments to achieve Objective	Relevant section of this Plan
Ensure monitoring of groundwater levels and quality is conducted to confirm requirements specified in EPR_GW2, EPR_FF7 and EPR_CL5, as well as the EPBC Act condition requirements (specified in Appendix A: EPBC Act and EPR Condition requirements)	Define location, monitoring parameters and associated methodology	Appendix A: EPBC Act and EPR Condition requirements Section 2
	Define roles and responsibilities for implementing, reviewing, and auditing this Plan.	Section 7
Ensure that the project does not adversely impact the ecological character of the Edithvale component of the Edithvale-Seaford Wetlands, as defined in the Edithvale-Seaford Wetland Ramsar Site Management Plan.	Define criteria for the magnitude and duration of project-induced changes to groundwater levels that trigger the implementation of the *Edithvale Wetland Management Plan.*	Section 4.1
	Undertake corrective measures if triggers are met.	Section 4.1.2
Ensure that the project does not adversely impact environmental values of groundwater (as defined by the Environment Reference Standard (ERS) 2021[2]).	Define criteria for the magnitude and duration of project-induced changes to groundwater quality that trigger the implementation of the *Groundwater Quality Mitigation Plan.*	Section 5.1 to 5.3
	Undertake corrective measures if triggers are met.	Section 5.4

[2] The EMF for the projects referred to 'Beneficial Use' (a use of the environment or any element or segment of the environment) to be protected, as defined in Section 4 of the Environment Protection Act 1970 and specified in the State Environment Protection Policy (Groundwaters of Victoria) 1997. Since the previous version (Version 3) of this Plan, the legislation and policy has been superseded by the Environment Protection Act 2017 and Environment Reference Standard 2021 respectively, which defines the 'Environmental Value' (a use, an attribute or a function of the environment) to be achieved or maintained. Reference to Environmental Values has been included throughout this Plan to ensure both the Plan and legislative objectives are met.

2 Methodology

The environmental monitoring program involves the measurement of groundwater levels and the sampling and testing of groundwater quality from groundwater monitoring bores located around the projects, for a period of at least 10 years (unless it is considered appropriate to cease monitoring for certain water quality parameters earlier).

The monitoring program stipulated in this Plan provides data that is used to assess and confirm that EPRs continue to be met and is designed to capture changes to groundwater levels and quality that indicate project related influences. General reference has been made to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG) 2018[3] during the development of the monitoring program.

2.1 Monitoring locations and parameters

A groundwater monitoring bore network has been established for the projects. Groundwater monitoring bores designated in this Plan are located either along the rail corridor or offset from the rail corridor, designed as either:

- Primary monitoring locations, which are typically located within or near to areas that could experience project induced groundwater level or quality variations.
- Control monitoring locations, which are located outside the modelled area of potential groundwater impact for comparative purposes to understand any non-project related changes to groundwater levels and quality.

Table 2 and Table 3 identify the 15 groundwater monitoring bores and the relevant monitoring parameters (i.e. the purpose) for each bore, at Edithvale and Bonbeach respectively. The procedures for groundwater data collection are defined in Appendix B: Monitoring procedure: groundwater levels and Appendix C: Monitoring procedure: groundwater quality.

The locations of the groundwater monitoring bores designated in this Plan are shown in Appendix D: Bore locations: Edithvale and Appendix E: Bore locations: Bonbeach.

Table 2 Monitoring locations and parameters - Edithvale

Bore ID	Levels (to inform operational performance and EPR_FF7)	Levels (to inform quality assessments)	Quality (Salinity)	Quality (Acid Sulfate Soils)	Quality (Contamination[4])
ID18-BH01 (control bore)	✓	✓	✓		
ID18-BH01A (control bore)			✓		
ID18-GWBH02			✓		
EPR-ID18-BH05	✓	✓	✓	✓	✓
EPR-ID18-BH06	✓	✓			
EPR-ID18-BH07	✓	✓			✓
EPR-ID18-BH08	✓	✓			

[3] ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

[4] Relevant parameters identified in Appendix C: Monitoring procedure: groundwater quality

Table 3 Monitoring locations and parameters - Bonbeach

Bore ID	Levels (to inform operational performance and EPR_FF7)	Levels (to inform quality assessments)	Quality (Salinity)	Quality (Acid Sulfate Soils	Quality (Contamination[5])
EPR-ID46-BH03R*	✓	✓			
ID46-BH03	✓	✓			
ID46-BH16	✓	✓		✓	✓
ID46-BH17	✓	✓	✓	✓	✓
ID46-BH20R*	✓	✓			
ID46-CASS23 (control bore)	✓	✓	✓		
ID46-GWBH03			✓		
ID46-GWBH04	✓	✓			

Notes:
* = Bores EPR-ID46-BH03R and ID46-BH20R are replacement bores for EPR-ID46-BH03 and ID46-BH20 respectively (refer to Appendix E: Bore locations: Bonbeach

). These bores were required to be replaced due to changes to project design that required removal of the bores after the bore monitoring network had been established.

[5] Relevant parameters identified in Appendix C: Monitoring procedure: groundwater quality

3 Monitoring performance of project infrastructure

This section provides a summary of the groundwater performance outcomes that ensure that the Edithvale and Bonbeach projects continue to operate effectively per the requirements of EPR_GW1 (refer to Appendix A).

The focus of this monitoring is the potential effect of project infrastructure including the tanked and intermediate pile walls on ambient groundwater conditions at both the Edithvale and Bonbeach Projects.

The project EPRs originally included EPR_GW4 (Operational maintenance), outlined in Appendix A. Due to design changes that came into effect after the EPRs were drafted, EPR_GW4 is no longer relevant/applicable, as the groundwater management system it relates to was ultimately not included in the Edithvale project design. The intent of EPR_GW4 is however, still monitored by way of the triggers outlined in Table 4 of this document, as the monitoring and assessment triggers stipulated therein effectively confirm that the Operational Maintenance (EPR_GW4) requirements are being met. If Table 4 triggers are met, it would instigate corrective actions as outlined below and in Section 3.3.

While EPR_GW4 only references Edithvale, triggers have also been provided for Bonbeach to measure impacts at this project and therefore the requirement for any mitigating action. The operational maintenance trigger level, presented for reference in Table 4 (Edithvale Project) and Table 5 (Bonbeach Project), is intentionally a more sensitive monitoring metric than any environmental trigger level included in this Plan, as it is intended to:

- Address the requirements of EPR_GW1, which specify the groundwater performance outcomes for both projects
- Provide an initial warning well before unacceptable environmental impacts are realised
- Require maintenance to be undertaken before environmental triggers are met relating to the implementation of either the:
    - *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7), or the
    - *Groundwater Quality Mitigation Plan* (EPR_CL5).

3.1 Adopted triggers – Edithvale Project

Table 4 outlines the monitoring locations relevant to operational maintenance and the staged criteria that must be sustained for a trigger to be met. Monitoring locations are shown for Edithvale in Appendix D: Bore locations: Edithvale. The trigger rationale is provided in Appendix G: Trigger rationale.

Table 4 Trigger level for the implementation of corrective actions at the Edithvale project

Monitoring locations	Trigger level
• Groundwater monitoring bores – EPR-ID18-BH05 – EPR-ID18-BH06 – EPR-ID18-BH07 – EPR-ID18-BH08 • Control bore – ID18-BH01	The difference in groundwater levels between any of the following bore pairs is on average greater than 0.5 metres (after correcting for baseline differences*), for a sustained period of 3 months: • EPR-ID18-BH05 and EPR-ID18-BH06 • EPR-ID18-BH07 and EPR-ID18-BH08. *OR* - Groundwater levels at any of the individual bores EPR-ID18-BH06 and EPR-ID18-BH08 are on average greater than the average groundwater level at control bore ID18-BH01 by more than 0.5 metres (after correcting for baseline differences*) for a sustained period of 3 months. The minimum frequency for measurement of groundwater level data is stipulated in Appendix B: Monitoring procedure: groundwater levels.

Source: Operation and Maintenance Plan
Note: The trigger rationale is outlined in Appendix G: Trigger rationale.
* A suggested method to correct for baseline differences is outlined in Appendix G: Trigger rationale.

3.2 Adopted triggers – Bonbeach Project

Table 5 outlines the monitoring locations relevant to operational maintenance and the staged criteria that must be sustained for a trigger to be met (i.e. the level of acceptability that defines the need to implement corrective action detailed in Section 3.3.2). Monitoring locations are shown for Bonbeach in Appendix E. The trigger rationale is provided in Appendix G: Trigger rationale.

Table 5 Trigger level for the implementation of corrective actions at the Bonbeach project

Monitoring locations	Trigger level
• Bores at trench – ID46-BH16 and ID46-BH03 – ID46-BH17 and EPR-ID46-BH03R – ID46-BH20R – ID46-GWBH04 • Control bore – ID46-CASS23	The difference in groundwater levels between any of the following bore pairs is on average greater than 2.1 metres (after correcting for baseline differences*) for a sustained period of 3 months: • ID46-BH16 and ID46-BH03 • ID46-BH17 and EPR-ID46-BH03R *AND* [#] - Groundwater levels at any of the individual bores ID46-BH03, EPR-ID46-BH03R, ID46-BH20R and ID46-GWBH04 are on average greater than the average groundwater level at control bore ID46-CASS23 by more than 1.3 metres (after correcting for baseline differences*) for a sustained period of 3 months. The minimum frequency for measurement of groundwater level data is stipulated in Appendix B: Monitoring procedure: groundwater levels.

Note: The trigger rationale is outlined in Appendix G: Trigger rationale.
* A suggested method to correct for baseline differences is outlined in Appendix G: Trigger rationale.
[#] The trigger adopted for the Bonbeach Project deliberately incorporates an "and" statement rather than an "or" statement as adopted for the Edithvale Project. The rationale is to provide a less sensitive trigger at Bonbeach since modelling undertaken indicates that even if either trigger component is met, unacceptable impacts would not be identified. The "and" incorporates both trigger components to provide verification that groundwater level changes are project induced.

3.3 Corrective action

3.3.1 Edithvale Project

If the trigger level in Table 4 is met, the following action must be taken:

1. A suitably qualified and experienced environmental consultant to undertake an initial logic / sense check to confirm that the trigger event aligns with the current conceptual model and represents a 'real' project induced event that could result in unacceptable impacts
2. Confirm that triggers established in Section 5 relating to potential to impact groundwater quality have been met and if this is the case, implement the Groundwater Quality Mitigation Plan (EPR_CL5).

3.3.2 Bonbeach Project

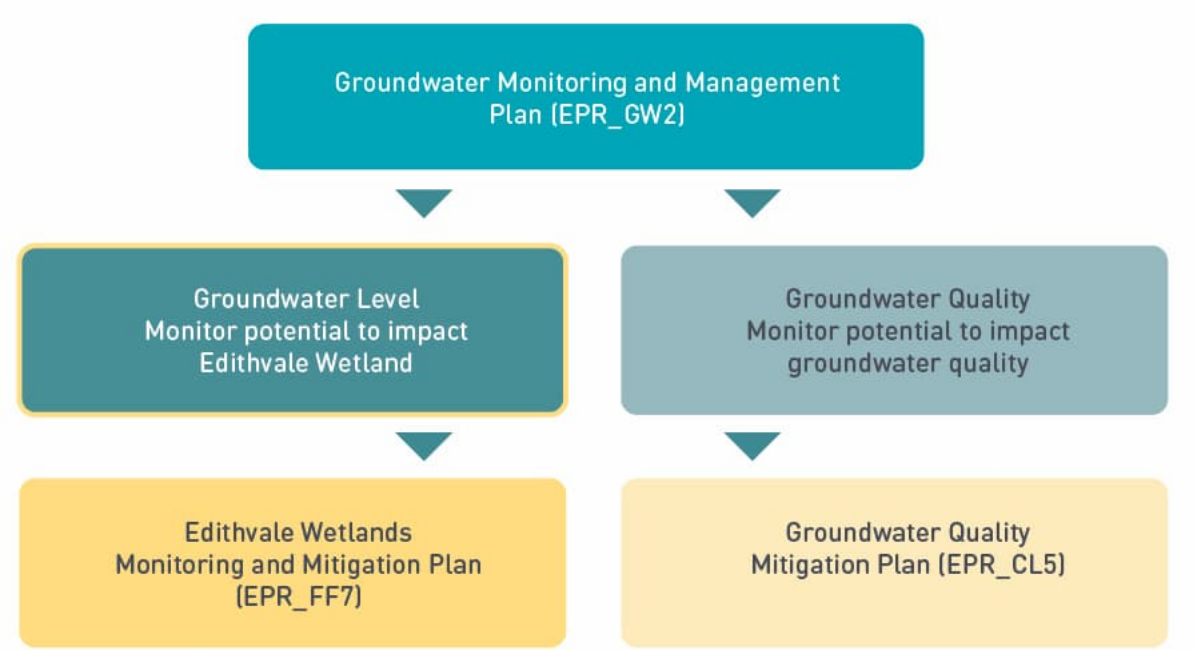
If the trigger level in Table 5 is met, the following action must be taken:

1. A suitably qualified and experienced environmental consultant to undertake an initial logic / sense check to confirm that the trigger event aligns with the current conceptual model and represents a 'real' project induced event that could result in unacceptable impacts
2. Confirm that triggers established in Section 5 relating to potential to impact groundwater quality have been met and if this is the case, implement the Groundwater Quality Mitigation Plan (EPR_CL5).

4 Monitor potential to impact Edithvale Wetland

This section defines the trigger levels, or the changes in groundwater levels which if observed, require the implementation of further investigations, corrective action, or mitigation of potential impacts, in accordance with the *Edithvale Wetland Monitoring and Mitigation Plan* (EPR_FF7; EPBC Approval condition 4), as outlined in Figure 3.

Figure 3 EPR Hierarchy – Monitor potential to impact Edithvale Wetland (groundwater levels)



The environment at each project site is different, and each project will interact with the environment differently. Therefore, the requirements for trigger levels have been defined separately. If trigger levels are met or exceeded at one project site only, the relevant measures of the corresponding mitigation plan specific to that trigger level and project site will require implementation.

4.1 Edithvale Project

4.1.1 Edithvale Wetland trigger levels

Groundwater level triggers have been established in this Plan for the Edithvale Project to monitor potential for impact to Edithvale Wetland. This section defines the trigger levels that, if met, require the implementation of the relevant components of the *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7). The trigger level is set out in Table 6.

Groundwater level monitoring methods and minimum data collection requirements are outlined in Appendix B: Monitoring procedure: groundwater levels.

Table 6 Edithvale Project triggers for the implementation of the Edithvale Wetlands Monitoring and Mitigation Plan

Monitoring locations	Trigger level
• Groundwater monitoring bores – EPR-ID18-BH05 – EPR-ID18-BH06 – EPR-ID18-BH07 – EPR-ID18-BH08 • Control bore – ID18-BH01	The difference in groundwater levels between any of the following bore pairs is on average greater than 3.0 metres (after correcting for baseline differences*) for a sustained period of 3 months: • EPR-ID18-BH05 and EPR-ID18-BH06 • EPR-ID18-BH07 and EPR-ID18-BH08. *OR* - Groundwater levels at any of the individual bores EPR-ID18-BH06 and EPR-ID18-BH08 are on average greater than the average groundwater level at control bore ID18-BH01 by more than 1.5 metres (after correcting for baseline differences*) for a sustained period of 3 months. The minimum frequency for measurement of groundwater level data is stipulated in Appendix B: Monitoring procedure: groundwater levels.

Note: The rationale for this trigger level is provided in Appendix G: Trigger rationale
*A suggested method to correct for baseline differences is outlined in Appendix G: Trigger rationale.

4.1.2 Corrective action

In the event that the trigger level in Table 6 is met, the following action must be taken:

1. A suitably qualified and experienced environmental consultant to undertake an initial logic / sense check to confirm that the trigger event aligns with the current conceptual model and represents a 'real' event that could result in unacceptable impacts
2. Notify Melbourne Water and the Commonwealth Department of Climate Change, Energy, the Environment and Water in accordance with Section 6.2.2
3. Implement the *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7)

4.2 Bonbeach Project

4.2.1 Edithvale Wetland trigger levels

The EES and subsequent assessments undertaken based on the updated project designs, concluded that the Bonbeach Project would not result in risk to the Edithvale Wetland associated with potential project induced changes to groundwater levels. The EES considered that management or mitigation measures would not be required at Bonbeach to maintain the risk level rating of Negligible. Because of this, Edithvale Wetland trigger levels are not proposed for the Bonbeach Project.

Groundwater level triggers have still been established in this Plan for the Bonbeach Project (outlined in Sections 3.2 and 5.3), for the purposes of verifying the EES (and subsequent) findings and monitoring potential to impact groundwater quality.

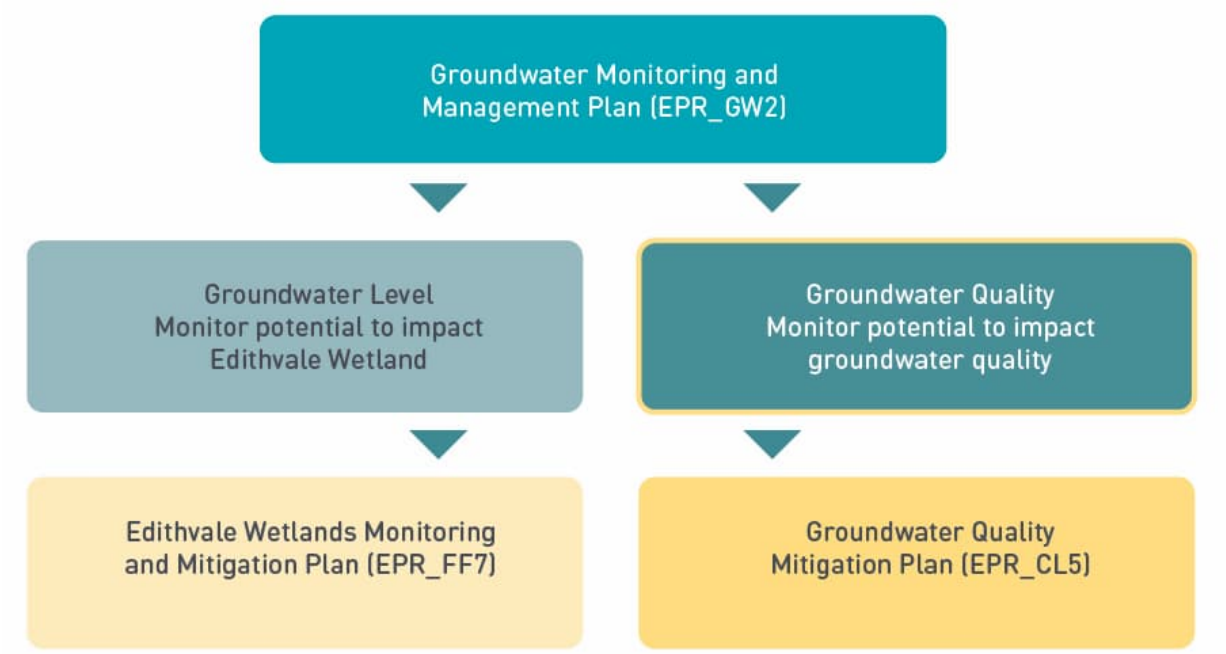
5 Monitor potential to impact groundwater quality

This section defines the trigger levels that if met, require the implementation of the *Groundwater Quality Mitigation Plan* (EPR_CL5). Trigger levels are documented separately for the different groundwater quality aspects, as follows and as outlined in Figure 4:

- Groundwater salinity (Section 5.1)
- Plume migration (Section 5.2)
- Acid sulfate soils (Section 5.3)

Corrective actions that must be implemented if any of these groundwater quality triggers are met, are outlined in Section 5.4.

Figure 4 EPR Hierarchy – Monitor potential to impact groundwater quality



5.1 Groundwater salinity trigger levels

There is potential for project induced impacts to the environmental values of groundwater due to potential changes in groundwater salinity. The effect of aquifer salinisation (pressure and density driven local upconing of the saltwater wedge), is likely to occur slowly, if at all - up to 100 years from construction of the pile walls.

Monitoring of potential groundwater salinity increases must distinguish potential project influences from the naturally variable salinity of the shallow water table. Natural variability in water table salinity occurs due to natural climatic changes such as seasonal variations in aquifer recharge and evaporation.

Table 7 defines the trigger levels that must be monitored in relation to potential impact to groundwater salinity that could result from the Edithvale and Bonbeach projects.

Table 7 Groundwater salinity trigger levels – Edithvale and Bonbeach

Project	Monitoring locations	Trigger level

Edithvale	• Bore near coast, mid trench
	  – EPR-D18-BH05
	  – ID18-GWBH02
	• Control bore
	  – ID18-BH01
	  – ID18-BH01A
		Initial criteria: Change in Total Dissolved Solids (TDS) at any of the individual bores EPR-ID18-BH05 and ID18-GWBH02 represents a statistically significant increasing trend (i.e. Confidence Factor (CF) > 90% using Mann-Kendall trend test) over a one year period that has resulted in, or is likely to result in, an exceedance of criteria for relevant environmental values; *or*
		
		TDS increases at bores EPR-ID18-BH05 or ID18-GWBH02 by more than 50% over the ambient levels calculated during baseline monitoring using the 80th percentile of concentration values
		
		Secondary Criterion: If either of the initial criteria are met, download and analyse the TDS results from control bores ID18-BH01 and ID18-BH01A and assess whether project induced impacts to the environmental values of groundwater have occurred.

Bonbeach	• Bore near coast, mid trench
	  – ID46-BH17
	  – ID46-GWBH03
	• Control bore
	  – ID46-CASS23
		Initial criteria: Change in Total Dissolved Solids (TDS) at any of the individual bores ID46-BH17 and ID46-GWBH03 represents a statistically significant increasing trend (i.e. Confidence Factor (CF) > 90% using Mann-Kendall trend test) over a one year period that has resulted in, or is likely to result in, an exceedance of criteria for relevant environmental values; or
		
		TDS increases at any of the individual bores ID46-BH17 and ID46-GWBH03 by more than 50% over the ambient levels calculated during baseline monitoring using the 80th percentile of concentration values
		
		Secondary Criterion: If either of the initial criteria are met, download and analyse the TDS results from control bore ID46-CASS23 and assess whether project induced impacts to the environmental values of groundwater have occurred.

The minimum frequency for collection of groundwater data is stipulated in Appendix B: Monitoring procedure: groundwater levels for groundwater levels and in Appendix C: Monitoring procedure: groundwater quality for groundwater quality.

5.2 Plume migration trigger levels

Table 8 defines the trigger levels that must be monitored in relation to potential project induced migration of existing contamination plumes, which could result from the Edithvale and Bonbeach projects. The groundwater environmental values, associated indicators and trigger guidance documents are detailed in Appendix C: Monitoring procedure: groundwater quality. Where these guidance documents and / or trigger values are updated over time, the updated documents should be referenced. Groundwater quality monitoring to assess for plume migration shall be completed for four years with monitoring to be completed annually, as detailed in Appendix C: Monitoring procedure: groundwater quality. The requirement for on-going monitoring should be assessed after that time as per Section 8.3.

Groundwater quality monitoring methods and minimum data collection requirements are outlined in Appendix C: Monitoring procedure: groundwater quality.

Trigger levels used to assess groundwater plume migration are based on the baseline conditions of groundwater quality and levels detailed in the *Baseline Groundwater Quality Assessment* (AECOM-GHD Joint Venture, 2020)[6], and the relevant criteria for the various environmental values specified in Appendix C: Monitoring procedure: groundwater quality. This report adopts the approach for protecting groundwater quality through achieving and maintaining the environmental values set out in the ERS 2021, with the aim of protecting human health and the environment from contamination of groundwater, whilst acknowledging that the project is not responsible for the presence of existing contamination if this is not mobilised by project activities and/or infrastructure and contaminates new locations.

Table 8 Plume migration trigger levels – Edithvale and Bonbeach

Criteria level	Monitoring locations	Trigger level
Note: A Plume Migration trigger is considered to have been met once either of the initial criteria have been met, AND one (or more) of the secondary criteria has/have been met.		
Initial Criteria	Edithvale • Groundwater monitoring bores – EPR-ID18-BH05 – EPR-ID18-BH06 – EPR-ID18-BH07 – EPR-ID18-BH08 • Control bore – ID18-BH01	The difference in groundwater levels between any of the following bore pairs is on average greater than 0.4 metres[7] (after correcting for baseline differences*) for a sustained period of 3 months: • EPR-ID18-BH05 and EPR-ID18-BH06 • EPR-ID18-BH07 and EPR-ID18-BH08. *OR* - Groundwater levels at any of the individual bores EPR-ID18-BH06 and EPR-ID18-BH08 is on average greater than the average groundwater level at control bore ID18-BH01 by more than 0.4 metres (after correcting for baseline differences*) for a sustained period of 3 months.

[6] AECOM-GHD Joint Venture (2020) *Level Crossing Removal Project. Southern Program 00 – Multiple Sites, Baseline Groundwater Quality Assessment – Edithvale (ID18) & Bonbeach (ID46)*, LXRA-LX31-00-HZ-RPT-0013. Revision: A

[7] This metric is based on the maximum groundwater level difference from baseline levels (DFB), through calculation of the deviation from Baseline (Oct 2020) for ID18-BH01 over time. This calculated a statistical DFB maximum of 0.358 m in November 2022 for project control bore ID18-BH01, rounded up to 0.4 m for the purpose of this trigger.

Criteria level	Monitoring locations	Trigger level
OR -		
Initial Criteria	Bonbeach • Bores at trench – ID46-BH16 and ID46-BH03 – ID46-BH17 and EPR-ID46-BH03R – ID46-GWBH04 – ID46-BH20R • Control bore – ID46-CASS23	The difference in groundwater levels for any of the following bore pairs is on average greater than 0.5 metres[8] (after correcting for baseline differences*) for a sustained period of 3 months: • ID46-BH16 and ID46-BH03 • ID46-BH17 and EPR-ID46-BH03R. *Or -* Groundwater levels at any of the individual bores ID46-BH03, EPR-ID46-BH03R, ID46-BH20R and ID46-GWBH04 is on average greater than the average groundwater level at control bore ID46-CASS23 by more than 0.5 metres (after correcting for baseline differences*) for a sustained period of 3 months.
AND -		
Secondary Criterion	All bores listed in Appendix C	Occurrence of light non-aqueous phase liquid (LNAPL) in a bore that historically had not contained LNAPL
Secondary Criterion	All bores listed in Appendix C	Greater than 0.1 m increase in measured LNAPL thickness
Secondary Criterion	All bores listed in Appendix C	Occurrence of dense non-aqueous phase liquid (DNAPL) in a bore that historically had not contained DNAPL
Secondary Criterion	All bores listed in Appendix C	Greater than 0.1 m increase in measured DNAPL thickness
Secondary Criterion	All bores listed in Appendix C	Dissolved phase detection in a bore that historically had not detected potential contaminants of concern as listed in Appendix C: Monitoring procedure: groundwater quality
Secondary Criterion	All bores listed in Appendix C	Dissolved phase concentrations (excluding pH) exceed the 95% Upper Simulation Limit (USL95) of concentration values (including all monitoring data collected to date, including baseline).

[8] This metric is based on the maximum groundwater level DFB, through calculation of the deviation from Baseline (Oct 2020) for ID46-CASS23 over time. This calculated a statistical DFB maximum of 0.495 m in November 2022 for project control bore ID46-CASS23, rounded up to 0.5 m for the purpose of this trigger.

Criteria level	Monitoring locations	Trigger level
Secondary Criterion	All bores listed in Appendix C All bores in Table 9	A decrease in pH (field data) by more than one pH unit that is sustained for one year compared to ambient levels calculated during baseline monitoring using the 20th percentile of concentration values; or An increase in pH (field data) by more than two pH units that is sustained for one year compared to ambient levels calculated during baseline monitoring using the 80th percentile of concentration values.
Secondary Criterion	Projects	Identification of an unexpected Potential Source of Contamination (PSOC) with the potential to have caused existing contamination that may be mobilised in groundwater as a result of changes to the groundwater flow regime associated with the project.

Note: The rationale for the plume migration triggers outlined in Table 8 is provided in Appendix C: Monitoring procedure: groundwater quality and Appendix G: Trigger rationale.

5.3 Groundwater acidity trigger levels

Groundwater acidity trigger levels were developed to identify if the potential acid sulfate soils (PASS) identified in the area have been oxidised as a result of the operation of the Edithvale and Bonbeach projects, and whether potential oxidation of PASS could potentially give rise to groundwater acidity changes and impacts to environmental values.

Groundwater acidity trigger levels are based on the baseline conditions of groundwater quality detailed in the *Baseline Groundwater Quality Assessment* (AECOM-GHD Joint Venture, 2020), and the relevant environmental values criteria specified in Appendix C: Monitoring procedure: groundwater quality. Groundwater quality monitoring methods and minimum data collection requirements are outlined in Appendix C: Monitoring procedure: groundwater quality.

Table 9 defines the trigger levels that must be monitored in relation to potential impact to groundwater acidity that could result from the Edithvale and Bonbeach projects.

Table 9 Groundwater acidity trigger levels - Edithvale and Bonbeach

Monitoring locations	Trigger level
Edithvale: EPR-ID18-BH05 Bonbeach: ID46-BH16 ID46-BH17	• Initial criterion: Measurement of groundwater levels at each of the nominated monitoring locations and identification of groundwater drawdown that is greater than 0.5 metres at any individual monitoring bore, for a sustained period of 3 months; and • Secondary criteria: Decrease in groundwater pH for a sustained period of 3 months represents a statistically significant decreasing trend (i.e. CF > 90% using Mann-Kendall trend test) compared to ambient levels calculated during baseline monitoring using the 20th percentile of concentration values that has resulted in, or is likely to result in, an exceedance of protected environmental values criteria; or A decrease in pH by more than one pH unit for a sustained period of 3 months compared to ambient levels calculated during baseline monitoring using the 20th percentile of concentration values. • Tertiary criterion: If both the initial and secondary criteria are met, analyse samples for a broader suite of parameters (refer to Table 16, ASS Groundwater quality suite).

5.4 Corrective action

If any of the groundwater quality triggers are met, the following action must be taken:

1. A suitably qualified and experienced environmental consultant to undertake an initial logic / sense check to confirm that the trigger event aligns with the current conceptual model and represents a 'real' event that could result in unacceptable impacts
2. If required, implement the *Groundwater Quality Mitigation Plan* (EPR_CL5).

6 Reporting, notification, and audit

6.1 Data management

Data storage and analysis aspects of this Plan are the responsibility of the entity implementing this Plan. Responsibilities are defined in Section 7.

A groundwater database is to be maintained for the purposes of storing groundwater level and quality monitoring data required under this Plan. The database may be either desktop or web based, so long as it:

- can determine whether trigger levels have been met and producing a simple dashboard report, and
- represents value for money and can be made accessible to Victorian Government as requested.

As appropriate, monitoring data must be prepared in accordance with Condition 12 of EPBC Act Approval 2017/7906.

The data contained within this database will be provided to EPA Victoria, DEECA and Southern Rural Water either as requested or as part of annual compliance reporting. Backup and archiving of the database will be undertaken periodically. The data will be stored appropriately with all relevant metadata fields, including at a minimum:

- Bore construction details
- Bore locations
- Groundwater level data (referenced to measuring point, ground surface and reduced level)
- Groundwater quality parameters monitored
- Deployed monitoring equipment / telemetry devices

The input, storage and backup of the database are to be undertaken in accordance with the Quality Assurance (QA) and Quality Control (QC) measures outlined in Appendix F: Quality assurance and quality control.

6.2 Reporting

6.2.1 Annual compliance reporting

An annual compliance report must be prepared and made publicly available in accordance with Section 13 of EPBC Approval 2017/7906 and the Commonwealth Government reporting template. The compliance report is to be prepared by the responsible entity defined in Section 7 and must maintain accurate and complete compliance records.

The annual compliance report:

- Documents clearly and concisely whether:
  - each trigger level or event has, or has not, been met or exceeded
  - data is trending towards meeting or exceeding trigger events or levels.
- Appends the relevant groundwater level and quality data

The compliance report must include discussion regarding compliance with the requirements of this Plan and must comment on:

- The adequacy of the groundwater monitoring program
- The need for future groundwater monitoring
- The need for revision of established triggers, including proposed rationale and supporting data and discussion if changes are proposed
- The availability of project designs or project related modelling that may better represent the project condition and/or may provide a more relevant basis on which to inform elements of this Plan.

Results from the monitoring program will be reported to the public annually or as otherwise required by the Commonwealth EPBC Approval 2017/7906. Annual Compliance Reports must be made publicly available through the website of the entity implementing this Plan, as required by EPR_GW2.

6.2.2 Notifications and non-compliances

If any trigger event or level defined in Section 4 is met or exceeded for either project, an initial logic / sense check should be undertaken by a suitably qualified and experienced environmental consultant, to confirm that the trigger

event aligns with the current conceptual model and represents a 'real' event that could result in unacceptable impacts.

If the trigger event is considered 'real', notice is to be provided immediately by the responsible entity specified in Section 7 to the relevant authority (EPA Victoria, DEECA, Southern Rural Water, Melbourne Water or Kingston City Council). The responsible entity will implement any mitigation plans required in accordance with the requirements of the relevant mitigation plan. The Commonwealth Department of Climate Change, Energy, the Environment and Water are also to be notified of incidents or non-compliances in accordance with Conditions 14 and 15 of EPBC Approval 2017/7906.

All parties relevant to the implementation of this Plan and the mitigation plans are to be notified on termination of this Plan, or any part of this Plan. All relevant contact details are provided in Appendix H: Key personnel contact details.

6.3 Audits

The responsible entity specified in Section 7 will ensure independent audits of compliance with EPBC Act approval conditions are undertaken in accordance with Conditions 16-18 of EPBC Act Approval 2017/7906.

7 Roles and responsibilities

Roles and responsibilities associated with this Plan are set out in Table 10 for the project operational phase. Contact details for key personnel are provided in Appendix H: Key personnel contact details.

Table 10 Roles and responsibilities

Role	Responsible entity / authorities
Implementation of this Plan	Public Transport Victoria (PTV) and/or the Department of Transport and Planning (DTP) (as applicable), with responsibility for undertaking the environmental monitoring during the operation phase of the project for a 10-year period (or as otherwise determined through periodic review) delegated to the rail franchisee through an amendment to the franchisee agreement. Data storage and analysis aspects of this Plan during operation will be the responsibility of PTV / DTP (as applicable). The data contained within this database will be provided to EPA Victoria, DEECA (for upload to the Water Measurement Information System, WMIS) and Southern Rural Water either as requested or at a minimum, during annual compliance reporting. Monitoring results will be publicly available through the website of the PTV / DTP (as applicable) as required by EPR_GW2. Data storage and analysis requirements are detailed in Section 6.1.
Notification of trigger being met or other non-conformance identified	VicTrack Environment Manager, to notify: EPA Victoria DEECA Southern Rural Water Melbourne Water Kingston City Council Department of Climate Change, Energy, the Environment and Water
Review need for continued implementation	PTV / DTP (as applicable) EPA Victoria, as it relates to the *Groundwater Quality Mitigation Plan* Southern Rural Water, as it relates to groundwater resource management Melbourne Water, as it relates to the *Edithvale Wetlands Monitoring and Mitigation Plan*

Role	Responsible entity / authorities
Implementation of *Edithvale Wetlands Monitoring and Mitigation Plan* (if required)	PTV / DTP (as applicable) in conjunction with Melbourne Water.
Review of exceedances of trigger levels	Suitably qualified and experienced environmental consultant
Implementation of *Groundwater Quality Mitigation Plan* (if required)	PTV / DTP (as applicable)
Provision of results and annual monitoring reports to publicly available forum	PTV / DTP (as applicable)

8 Implementation of the Plan

8.1 Commencement and implementation

The Plan commenced two weeks prior to construction (defined as the commencement of the pre-occupation piling works), with implementation of the sampling programs detailed in Appendix B: Monitoring procedure: groundwater levels and Appendix C: Monitoring procedure: groundwater quality on 1 October 2020.

Monitoring for the following parameters shall continue for no less than 10 years from Plan implementation (unless it is considered appropriate to cease monitoring for certain water quality parameters earlier) as required by the EPRs/EPBC approval:

- Groundwater levels, as defined in Appendix B: Monitoring procedure: groundwater levels
- Groundwater quality (salinity), as defined in Appendix C: Monitoring procedure: groundwater quality
- Groundwater quality (contamination), as defined in Appendix C: Monitoring procedure: groundwater quality
- Groundwater quality (acidity), as defined in Appendix C: Monitoring procedure: groundwater quality

A suitably qualified and experienced environmental consultant will continue to be engaged to undertake the data analysis and reporting for the purpose of determining whether groundwater level or quality changes at the project area warrant the implementation of the mitigation plans.

If the relevant trigger levels pertaining to the *Groundwater Quality Mitigation Plan* are met and that plan is subsequently implemented, monitoring in accordance with this Plan will need to consider the findings of any investigation undertaken under the *Groundwater Quality Mitigation Plan*.

8.2 Risks to implementation of the Plan

Table 11 outlines the risks to achieving the environmental objectives of this Plan.

Table 11 Risks to implementation of the Plan

Risk	Risk description and management strategy
Cumulative impact to groundwater from other projects	Implementation of this Plan and review of Plan triggers should consider the potential for other projects to impact on groundwater in the Edithvale-Bonbeach area. Such projects may include the Groves Street, Aspendale level crossing removal project, which was proposed as a rail under road project in October 2022. Relevant to this Plan is the potential future validity of Edithvale control bore site (ID18-BH01), which is located in Aspendale and could be affected by future level crossing removal projects. Modelling undertaken for the Chelsea level crossing removal projects indicated no cumulative impacts to groundwater with the Edithvale-Bonbeach projects.
Catchment-related influences	Portions of the suburb of Edithvale are naturally prone to flooding from rain and shallow groundwater, owing to its flat topography and proximity to sea level. Edithvale Wetland itself is currently utilised by Melbourne Water for flood mitigation. While increased water logging is a relevant project risk, the potential occurrence of water logging, and its potential impacts to land use and water quality, will be considered in light of surface flooding impacts, which may occur due to factors that are not related to the project. Monitoring of groundwater levels at the trench will be used to determine if mounding is sufficiently great to result in water-logging potential. The trigger level for project infrastructure maintenance is designed to prevent project-induced water logging from occurring.
Climate change	Climate change has the potential to influence future groundwater conditions, including groundwater levels and quality. The susceptibility and adaptability of the groundwater systems that interact with

Risk	Risk description and management strategy
	the projects is unknown, and as such, their vulnerability to climate change remains uncertain, both at the project areas and at the Edithvale-Seaford Wetlands Ramsar Site. The most relevant climate change factors to the projects and Edithvale Wetlands include reduced rainfall, increased temperature, reduced groundwater recharge, sea level rise and storm surges. Variable groundwater level and salinity trends naturally occur in shallow water tables, due to natural climatic changes such as seasonal variations in recharge and evaporation. Climate change has the potential to exacerbate these trends. Over-arching climate change changes will be factored into the Project through the use of the control bore, which will be influenced by the same factors as the bore at the trench. As identified in EES Technical Report A (section 5.6), a suitably representative climate station is located near to the project area: Bureau of Meteorology Bonbeach (Carrum) (086210) climate station.
Co-operation of management authority/s	Agreement to provide access for monitoring in a timely manner if monitoring needs to be undertaken by a consultant and not Melbourne Water (i.e. in relation to Edithvale Wetland). Agreements between relevant agencies will be developed to ensure access will be granted.
Groundwater review and monitoring results not reliable	A suitably qualified and experienced environmental consultant will be engaged to undertake the data analysis and reporting for the purpose of determining whether groundwater level or quality changes at the project area warrant the implementation of the mitigation plans.

8.3 Review of the Plan and need for continued implementation

The Plan has been reviewed annually for the first two years, and is to be reviewed not less than every second year to consider the adequacy of the groundwater monitoring program and the need for future groundwater monitoring beyond the minimum 10 year period[9]. The review shall consider all aspects of the Plan, including:

- whether it is appropriate to cease monitoring for certain water quality parameters earlier than the minimum 10 year monitoring period
- the data management and reporting requirements outlined in Section 6.2.

As noted in Section 6.2, additional data that may become available in future relating to the project designs, will be considered in updates to this Plan, with the objective of improving the relevance of this Plan.

If considered necessary, implementation of the Plan shall be extended by a duration agreed by relevant parties to this Plan. All revisions or amendments to the Plan following review shall be undertaken in accordance with Section 8.4 of this Plan. At these reviews, it may be considered appropriate to extend implementation of only a component of the Plan.

[9] For clarity, Plan reviews were completed in 2021 and 2022, and are still required in years 2024, 2026, 2028 and 2030.

8.4 Amending the Plan

Revisions to this Plan must be made in accordance with Conditions 19 to 24 of EPBC Act Approval 2017/7906.

If amendments to the Plan are proposed through periodic review, a suitably experienced and qualified environmental consultant is required to review and endorse the proposed amendments on behalf of the responsible entity specified in Section 7 before they will be taken into effect.

Sections of this Plan are specified as not requiring approval if revised (see Appendix H: Key personnel contact details).

Appendix A: EPBC Act and EPR Condition requirements

EPR_GW2 requirements

EPR_GW2 specifies the requirement for a *Groundwater Monitoring and Management Plan*, as follows:

Prior to construction (excluding preparatory works), prepare and fund the implementation of a Groundwater Monitoring and Management Plan in consultation with Southern Rural Water, EPA Victoria, Melbourne Water, Kingston Council, DELWP to monitor and manage predicted and potential impacts to groundwater as a result of the projects.[10]

The *Groundwater Monitoring and Management Plan* must include the requirements outlined in Table 12.

Table 12 EPR_GW2 requirements and document reference

	EPR_GW2 requirements	Location in Plan
a	detailed groundwater level monitoring parameters with timing and location of monitoring bores	Section 2.1 - Monitoring locations and parameters
b	parameters and timing for monitoring groundwater quality to identify any changes to contaminant transfer or plume migration (if present) caused by the projects	Section 5- Monitor potential to impact groundwater quality
c	duration of the groundwater monitoring program for at least 10 years, (components of the plan may cease earlier if considered appropriate following periodic reviews (refer point d))	Section 8 - Implementation of the Plan
d	provision for periodic review as required, and not less than every second year, to consider the adequacy of the groundwater monitoring program and the need for future groundwater monitoring	Section 7 – Roles and responsibilities Section 8.3 – Review of the Plan and need for continued implementation
e	the entity responsible for the implementation of the plan	Section 7 – Roles and responsibilities
f	the entity responsible for the ownership and management of monitoring network assets	Section 7 – Roles and responsibilities

[10] DELWP was the department name during EPR development; now the Department of Energy, Environment and Climate Action (DEECA)

	EPR_GW2 requirements	Location in Plan
g	clear trigger events or levels for changes in groundwater level or quality that require one or more of the following actions: i. implementation of the Groundwater Quality Mitigation Plan (EPR_CL5)	Section 5- Monitor potential to impact groundwater quality
	ii. implementation of the mitigation component of the Edithvale Wetlands Monitoring and Mitigation Plan (EPR_FF7)	Section 4.1 - Edithvale Project Edithvale Wetland trigger levels
	The Groundwater Monitoring and Management Plan must be publicly available.	Section 7 – Roles and responsibilities
	Results from the monitoring program must be reported to the public annually or as otherwise required by the Commonwealth EPBC Approval 2017/7906.	Section 6.2.1 – Annual compliance reporting Section 7 – Roles and responsibilities

EPBC Referral conditions

The projects were approved to proceed under the EPBC Act subject to meeting several conditions. Those conditions relevant to this Plan and the sections of this Plan which address the requirements of the conditions are provided in Table 13.

Table 13 EPBC Act approval conditions and document reference

Item	EPBC Act approval condition	Location
1	The approval holder must submit a Groundwater Monitoring and Management Plan for the Minister's approval that ensures predicted and potential impacts to groundwater as a result of the action are monitored, and corrective actions implemented if applicable trigger values are reached.	*Groundwater Monitoring and Management Plan* (this document)
2	The approval holder must not commence the action unless the Minister has approved the Groundwater Monitoring and Management Plan in writing. The approval holder must implement the Groundwater Monitoring and Management Plan approved by the Minister.	*Groundwater Monitoring and Management Plan* (this document)
3	The Groundwater Monitoring and Management Plan must be consistent with the relevant Environmental Performance Requirement approved by the Victorian Minister, and must include:	EPR_GW2 requirements (as above)
3a	The Groundwater Monitoring and Management Plan environmental objectives, relevant EPBC Act protected matter/s and a table setting out where it addresses the EPBC Act approval conditions applicable to the Groundwater Monitoring and Management Plan;	This Table

Item	EPBC Act approval condition	Location
3b	A table of commitments made in the Groundwater Monitoring and Management Plan to achieve the objectives, and reference to where each commitment is detailed in the Groundwater Monitoring and Management Plan;	Section 1.5 - Objectives
3c	Reporting and review mechanisms, and documentation standards to demonstrate compliance with the Groundwater Monitoring and Management Plan	Section 6 - Reporting, notification, and audit
3d	An assessment of risks to achieving Groundwater Monitoring and Management Plan environmental objectives and risk management strategies that will be applied;	Section 8.2 - Risks to implementation of the Plan
3e	Impact avoidance, mitigation and/or repair measures, and their timing;	Sections 3, 4 and 5
3f	A monitoring program, which must include: i. measurable performance indicators;	Section 2- Methodology
	ii. the timing and frequency of monitoring to detect changes in the performance indicators;	Section 2- Methodology
	iii. trigger values for corrective actions; and	Sections 4 and 5- Trigger levels and mitigation
	iv. corrective actions, and commitments to implement these actions if trigger values are reached.	Sections 4 and 5- Trigger levels and mitigation
4	The approval holder must submit an Edithvale Wetlands Monitoring and Mitigation Plan for the Minister's approval that ensures impacts to wetlands as a result of the action are monitored, and corrective actions implemented if applicable trigger values are reached.	*Edithvale Wetland Monitoring and Mitigation Plan*

Related EPRs

CL5 Groundwater Quality Mitigation Plan (operation)

Prior to the completion of the Projects, prepare and fund the implementation of a *Groundwater Quality Mitigation Plan* in consultation with the land manager of any affected land parcels to manage and mitigate any negative impacts from changes to groundwater quality as a result of the projects.

The *Groundwater Quality Mitigation Plan* shall be implemented following the completion of the projects if the relevant trigger level within the *Groundwater Monitoring and Mitigation Plan* (EPR_GW2) is met.

The Plan must include:

a. measures to manage any negative impacts on the beneficial use of groundwater caused by acidification that is attributable to the project(s) so as to maintain existing beneficial use of groundwater

b. measures to manage any negative impacts on the beneficial use of groundwater caused by contaminated groundwater transfer or plume migration that is attributable to the project(s) so as to maintain existing beneficial use of groundwater
c. measures to manage any negative impacts on the beneficial use of groundwater caused by changes to salinity that is attributable to the project(s) so as to maintain existing beneficial use of groundwater
d. the entity or entities responsible for implementation of any management and mitigation measures.

FF7 Edithvale Wetlands Monitoring and Mitigation Plan

Prior to the completion of the Projects, prepare and fund the implementation of the *Edithvale Wetlands Monitoring and Mitigation Plan* in consultation with the Commonwealth Department of Agriculture, Water and the Environment[11], DELWP and Melbourne Water.

The *Edithvale Wetlands Monitoring and Mitigation Plan* shall be implemented following the completion of the projects if the relevant trigger level within the *Groundwater Monitoring and Mitigation Plan* (refer EPR_GW2) is met.

The plan must:

a. identify a relevant entity or entities and the roles and responsibilities for monitoring and mitigation.
b. the plan must be made publicly available on a clearly identifiable website.
c. include a process to review monitoring data for groundwater levels at the Wetlands to determine if there is a change in water levels corresponding to the relevant trigger level (EPR_GW2)
d. include a process to review the existing ecology and hydrology monitoring data (if groundwater levels at the Wetlands are elevated corresponding with the trigger level) to determine whether a change at the Wetlands is attributable to the project(s) and requires mitigation

    i. include a requirement to continue and/or modify existing monitoring programs, if necessary, to determine whether impacts are attributable to the projects.

e. include monitoring criteria such as hydrology and ecology indicators, consistent with the *Edithvale-Seaford Wetland Ramsar Management Plan* to determine if impacts are due to the projects.
f. include contingency measures consistent with the Edithvale-Seaford Wetland Ramsar Management Plan to mitigate potential impacts attributable to the projects. Measures may include:

    i. ecological restoration measures developed by a suitably qualified ecologist that would be implemented to mitigate the effect of impacts attributable to the project(s)
    ii. engineering measures to reinstate the Wetlands to pre-impact conditions to the extent practicable.

GW1 Groundwater Performance Outcomes

The tanked rail trenches at Edithvale and Bonbeach must be designed and operated to ensure that project-derived changes to groundwater do not result in:

a. groundwater mounding that increases waterlogging at ground level
b. groundwater drawdown that could cause damage to buildings, structures and other assets as a result of ground subsidence or an adverse impact to sub-surface structures
c. degradation to groundwater quality (including as from acidification, changes to salinity, contaminant transfer or contaminant plume migration) that would have a negative effect on protected beneficial uses of groundwater (as defined by the State Environment Protection Policy (Groundwaters of Victoria) 1997)[12].
d. changes to groundwater that would have negative impacts on groundwater dependent ecosystems
e. changes to groundwater level that would have a significant negative impact to groundwater extraction from registered bores as a beneficial use.

Further mitigation measures must be implemented if a persistent change to groundwater level or quality is observed.

[11] Now the Commonwealth Department of Climate Change, Energy, the Environment and Water

[12] Since Version 3 of this Plan, the State Environment Protection Policy (Groundwaters of Victoria) 1997 has been superseded by the Environment Reference Standard 2021.

GW4 Operational Maintenance[13]

The Edithvale Project must be inspected and maintained to ensure that the groundwater management system continues to perform effectively.

[13] As outlined throughout this document, EPR_GW4 specifically considers the effective performance of a groundwater management system at the Edithvale Project, which, due to subsequent updates to the project designs, was no longer required and therefore, not installed. The intent of EPR_GW4 is however, still considered by way of the triggers outlined in Table 4 Trigger level for the implementation of corrective actions at the Edithvale project, within this document. The monitoring and assessment triggers stipulated in Table 4 of this Plan effectively confirm that the Operational Maintenance (EPR_GW4) requirements are being met.

Appendix B: Monitoring procedure: groundwater levels

Groundwater levels will be monitored in accordance with the procedure set out in Table 14.

Table 14 Groundwater level monitoring procedure

Aspect	Procedure
Frequency	The minimum frequency of collection for groundwater level data is weekly. That is, groundwater levels must be recorded via automatic monitoring on a weekly basis.
Duration	The minimum period of collection for groundwater level data is no less than 10 years from the commencement of this Plan (refer Section 8.1).
Method	Groundwater level monitoring will be undertaken consistent with the National Industry Guidelines for hydrometric monitoring[14], particularly: • Part 2: Site establishment and operations (NI GL 100 02–2019) • Part 3: Instrument and measurement systems management (NI GL 100.03-2019) *Automatic monitoring is required at all groundwater level monitoring locations that inform 'Operational performance and EPR_FF7' as outlined in Table 2 and* Table 3, to minimise physical site access requirements and provide rapid review of data that facilitates timely management responses. While there is no relevant standard / guideline, dataloggers must be downloaded at regular frequencies: *At a minimum, groundwater level data to inform 'Operational performance and EPR_FF7' (as outlined in Table 2 and* • Table 3) will be measured on a weekly basis, and downloaded or otherwise backed-up every three months *At a minimum, automatically measured groundwater level data to inform 'Quality assessments' (as outlined in Table 2 and* • Table 3) will be measured on a weekly basis, and downloaded or otherwise backed-up annually, or as required by the staged triggers outlined in Table 8 • Periodic data download events and data reviews are required to report on whether the duration element of the trigger ("a sustained period of 3 months") has been exceeded - Dataloggers must be downloaded during each groundwater quality monitoring event, either through a physical download onsite or through remote download - Where possible, manual download events will coincide with other monitoring events to minimise mobilisations (e.g. groundwater sampling events) - Where relevant, battery life and storage capacity must be reviewed during each download event, along with calibration requirements; equipment is to be upgraded

[14] Bureau of Meteorology / Water Monitoring Standardisation Technical Committee, 2019, National Industry Guidelines for hydrometric monitoring, February 2019

Aspect	Procedure
	or replaced if either memory or storage are below 20%, and calibrated as per product manufacturer requirements • At a minimum, remotely collected data will be compared to physical/manual level data measurements on an annual basis. This is to verify datalogger accuracy, assess equipment 'drift' and consider recalibration requirements Manual groundwater level gauging shall occur at least annually to verify datalogger data accuracy and provide basis for recalibration if required. • Measurements must be obtained using a calibrated electronic water level / interface meter • Groundwater levels are to be measured opportunistically during each groundwater quality monitoring event • Calibration certificates are to be maintained and included within reports • Groundwater levels are to be measured both to the top of PVC casing and to the ground surface; both measurements must be reported relative to the Australian Height Datum (AHD) and as depth below ground level (bgl) • Bore integrity checks shall be undertaken during manual groundwater level monitoring events, to confirm that bore assets have not been damaged, destroyed, vandalised or otherwise deteriorated. At a minimum, bore integrity checks will include the following checks: - Bore security (locks, screw caps etc. in place and intact) - Bore cap present and functional - Datalogger and accessories in place (where relevant) and all components fastened tightly - Total bore depth is as expected - No visible pooling of surface water or ingress of surface contamination - Bore construction does not present a hazard to site personnel or general public If damage is observed, this will be reported and the issue rectified by A) Reinstatement works to repair damaged bores or B) Decommissioning of destroyed bore and installation of a replacement bore. All bores need to be constructed, repaired and decommissioned in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2020)[15].

[15] National Uniform Drillers Licencing Committee, Minimum Construction Requirements for Water Bores in Australia, 4th Edition, 2020

Appendix C: Monitoring procedure: groundwater quality

Groundwater quality will be monitored in accordance with the procedure set out in Table 15.

Table 15 Groundwater quality monitoring procedure

Aspect	Procedure
Frequency	The minimum frequency of collection for groundwater quality (salinity) data is monthly. That is, groundwater salinity must be recorded via the selected method (physical or remote) on a monthly basis. The minimum frequency of collection for groundwater quality (acidity) data is monthly. That is, groundwater acidity must be recorded via the selected method (physical or automatic) on a monthly basis through measurement of groundwater levels and pH. The data required for collection is based on the staged triggers outlined in Table 9, whereby only groundwater levels and pH are monitored (via remote techniques) through monthly measurements. If these triggers suggest a trend towards acidification, the physical groundwater sampling and analysis on selected bores listed in Table 16 would be required. The minimum frequency of collection for groundwater quality (contamination) data is annually, as detailed in Table 16. That is, groundwater contamination data must be collected via groundwater sampling and analysis every 12 months. Sampling events will occur within the month of November each year. Following year four of data collection (i.e. post 2024), the monitoring frequency and the practicability of managing groundwater impacts will be reviewed in accordance with EPA Victoria guidance for the clean-up and management of polluted groundwater (EPA Publication 2001).
Duration	The minimum period of collection for groundwater quality data is no less than 10 years from the commencement of this Plan (refer Section 8.1).
Method	Groundwater quality monitoring will be undertaken consistent with the National Industry Guidelines for hydrometric monitoring[16], particularly: • Part 2: Site establishment and operations (NI GL 100 02–2019) • Part 3: Instrument and measurement systems management (NI GL 100.03-2019) Groundwater quality monitoring is to be undertaken consistent with the following approaches: • Groundwater sampling procedures, including the measurement of non-aqueous phase liquids, must conform with the requirements of *EPA Victoria Publication 669.1: Groundwater Sampling Guidelines* (2022) • Groundwater samples must be issued to a National Association of Testing Authorities (NATA) accredited laboratory accredited for the testing program conducted • Quality control samples must be collected at a rate of 10%, consistent with Australian guidelines (*AS4482.1 Guide to the investigation and sampling of sites with*

[16] Bureau of Meteorology / Water Monitoring Standardisation Technical Committee, 2019, National Industry Guidelines for hydrometric monitoring, February 2019

Aspect	Procedure
	potentially contaminated soil) and best practice, and must incorporate the use of primary and secondary laboratories as per the quality control/quality procedures detailed in Appendix F. • In accordance with *EPA Victoria (2022)*, field parameter measurement of pH, Electrical Conductivity (EC), Dissolved Oxygen, Turbidity, Oxygen Reduction Potential (ORP) and Temperature is required to confirm field parameter stabilisation for all monitoring locations during all monitoring events. Measurement instrumentation will be calibrated per the manufacturer requirements, with evidence of calibration provided in the annual review reports. • At some monitoring locations, there is a requirement to automatically record downhole salinity, and pH via a downhole datalogger. In these cases, manual groundwater quality monitoring (and datalogger download) events must be undertaken periodically (annually at minimum) for datalogger calibration purposes and at times and locations where a broader suite of analysis is also required. Either field-measurements of parameters (using a calibrated water quality meter) or laboratory analytical data (obtained following sampling and analysis), may be used to inform the datalogger calibration.

Groundwater quality will be assessed at each bore by analysing groundwater samples collected for contaminants of concern listed in Table 16.

Table 16 Groundwater quality monitoring analysis

Bore ID	Analysis[1, 2, 3, 4]
EPR-ID18-BH07	Metals, Fe, TBT, BTEXN, TRHs, PAHs, Phenols, Ammonia, sVOC, VOC, pH, TDS, Major cations and anions, PFAS
ID46-BH16	Metals, Fe, TBT, BTEXN, TRHs, PAHs, Phenols, Ammonia, sVOC, VOC, pH, TDS, Major cations and anions, PFAS
ID46-BH17	Metals, Fe, BTEXN, TRHs, PAHs, Phenols, Ammonia, sVOC, VOC, pH, TDS, Major cations and anions, PFAS

Bore ID	Analysis[1, 2, 3, 4]

Note:

[1] Metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)

[2] PFAS (Perfluoroheptane sulfonic acid, N-Ethyl perfluorooctane sulfonamidoacetic acid, 10:2 Fluorotelomer sulfonic acid, Perfluorodecanesulfonic acid (PFDS), 4:2 Fluorotelomer sulfonic acid, Perfluorobutane sulfonic acid, N-Methyl perfluorooctane sulfonamidoacetic acid, Perfluorohexane sulfonic acid (PFHxS), Perfluoropentanoic acid, 8:2 Fluorotelomer sulfonic acid, N-Ethyl perfluorooctane sulphonamide, N-Ethyl perfluorooctane sulfonamidoethanol, N-Methyl perfluorooctane sulphonamide, N-Methyl perfluorooctane sulfonamidoethanol, 6:2 Fluorotelomer Sulfonate (6:2 FTS), Perfluorooctanoic acid (PFOA), Perfluoropentane sulfonic acid, Perfluorobutanoic acid, Perfluorodecanoic acid, Perfluorododecanoic acid, Perfluoroheptanoic acid, Perfluorohexanoic acid (PFHxA), Perfluorononanoic acid, Perfluorooctane sulfonic acid (PFOS), Perfluorooctane sulfonamide (FOSA), Perfluorotetradecanoic acid, Perfluorotridecanoic acid, Perfluoroundecanoic acid)

[3] ASS Groundwater Quality Suite only required to be analysed if either of the secondary criteria outlined in Table 9 are met.

[4] ASS Groundwater Quality Suite: Total Metals (Fe, Al)/ Dissolved Metals (Al, As, Cr, Cd, Fe, Mn, Ni, Se, Zn)/ pH/ EC/ Sulphate/ Chloride/ Total Acidity/ Total Alkalinity/ Sodium/ Ammonia/ TDS/ Total Nitrogen/ Total Phosphorous/ Filterable Reactive Phosphorous.

Environmental values of groundwater to be achieved or maintained

EPA Victoria (the Authority) will determine the segment to which groundwater in an aquifer belongs. The environmental values to be achieved or maintained for each of the groundwater segments are defined in Table 5.3 of the ERS 2021. Water of higher quality (lower salinity) has more environmental values than low quality (more saline) groundwater.

Environmental values to be achieved or maintained for each segment are marked by a tick in Table 17.

Table 17 Environmental values of groundwater segments to be achieved or maintained

Environmental Values	Segments (mg/L TDS)						
	A1 (0-600)	A2 (601-1200)	B (1201-3100)	C (3101-5400)	D (5401-7100)	E (7101-10,000)	F (>10,001)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

As stated in Clause 15 of the ERS, the Authority may determine that these environmental values do not apply to groundwater if any of the following apply:

- there is insufficient aquifer yield to sustain the environmental value, having regard to variations within the aquifer and reasonable bore development techniques to improve yield; or
- the application of that groundwater, such as for irrigation, may be a risk to the environmental values of land or the broader environment due to the soil properties; or
- the background water quality level exceeds (or is less than, in the case of indicators such as pH, dissolved oxygen and many biological indicators) the relevant objective specified in Table 5.4 (of the ERS) and as a result the environmental value cannot be achieved.

Clause 2 of the ERS also states, *"The purpose of this ERS is to support the protection of human health and the environment from pollution and waste by…..:*

- *identifying environmental values to be achieved or maintained in the whole or any part of Victoria; and*
- *specifying indicators and objectives to be used to measure, determine or assess whether those environmental values are being achieved, maintained or threatened".*

EPA Victoria guidance on the clean-up and management of contaminated groundwater (EPA Publication 2001) provides further explanation:

- Section 4.3 states, *"When considering the risks of harm from groundwater contamination, both existing and potential environmental values should be regarded:*
    - *'existing' environmental values are where there is an existing receptor (bore, spring or creek) in the vicinity of the site*
    - *'potential' environmental values are those that could be supported by the background groundwater quality. A potential environmental value is considered 'likely' in circumstances including, but not limited to, where:*
        - *groundwater is used for that environmental value in the same hydrogeological setting nearby*
        - *the existing and likely future land uses, both at the site and in the vicinity of the site, are compatible with the environmental value".*

In this case the Authority has not been consulted to determine the groundwater environmental values to be achieved or maintained, but these have been determined on the basis of the ERS for the purposes of this plan.

The Baseline Groundwater Quality Assessment (AECOM-GHD Joint Venture, 2020) reported the following total dissolved solids (TDS) results across the projects:

- TDS concentrations at Edithvale in bores screened across the water table ranged from 75 mg/L (EPR-ID18-BH08) to 590 mg/L (ID18-BH38).
- TDS concentrations at Bonbeach in bores screened across the water table ranged from 182 mg/L (ID46-BH20) to 578 mg/L (ID46-CASS23).

These boreholes are considered representative of the uppermost water bearing sequence of the Quaternary sands in the region. Therefore, the salinity of the groundwater in the Quaternary sands at the projects would be categorised as Segment A1, as defined in the ERS and shown in Table 18. It is noted that in some areas the groundwater in the Quaternary sands at the project areas may not be suitable for drinking. Further to this, the projects are not located in a recognised mineral water production area, therefore this environmental value is not considered relevant.

Table 18 Environmental values of groundwater segments to be maintained at the projects

Environmental Values	Segments (mg/L TDS)						
	A1 (0-600)	A2 (601-1200)	B (1201-3100)	C (3101-5400)	D (5401-7100)	E (7101-10,000)	F (>10,001)
Water dependent ecosystems and species	✓	✓	✓	✓	✓	✓	✓
Potable water supply (desirable)	✓						
Potable water supply (acceptable)		✓					
Potable mineral water supply	✓	✓	✓	✓			
Agriculture and irrigation (irrigation)	✓	✓	✓				
Agriculture and irrigation (stock watering)	✓	✓	✓	✓	✓	✓	
Industrial and commercial	✓	✓	✓	✓	✓		
Water-based recreation (primary contact recreation)	✓	✓	✓	✓	✓	✓	✓
Traditional Owner cultural values	✓	✓	✓	✓	✓	✓	✓
Buildings and structures	✓	✓	✓	✓	✓	✓	✓
Geothermal properties	✓	✓	✓	✓	✓	✓	✓

Adopted Groundwater Water Quality Criteria

Clause 16 of the ERS specifies the indicators and objectives (water quality investigation levels) required to maintain environmental values. The ERS generally refers to ANZG 2018 to determine the relevant environmental value criteria, which are specified in Table 19. Table 5.8 of the ERS specifies indicator values where groundwater discharges to surface water. Criteria are either based on river catchment / regional area or the level of protection for toxicants in water specified in ANZG 2018. Analyte specific criteria levels are based on the baseline conditions of groundwater quality detailed in Appendix L of the *Baseline Groundwater Quality Assessment* (AECOM-GHD Joint Venture, 2020), and the relevant environmental values criteria specified in Table 19. Published environmental values criteria and analyte specific criteria levels are subject to change over time and should be reviewed and updated accordingly as per the plan review process detailed in Section 8.3.

Table 19 Groundwater quality indicators

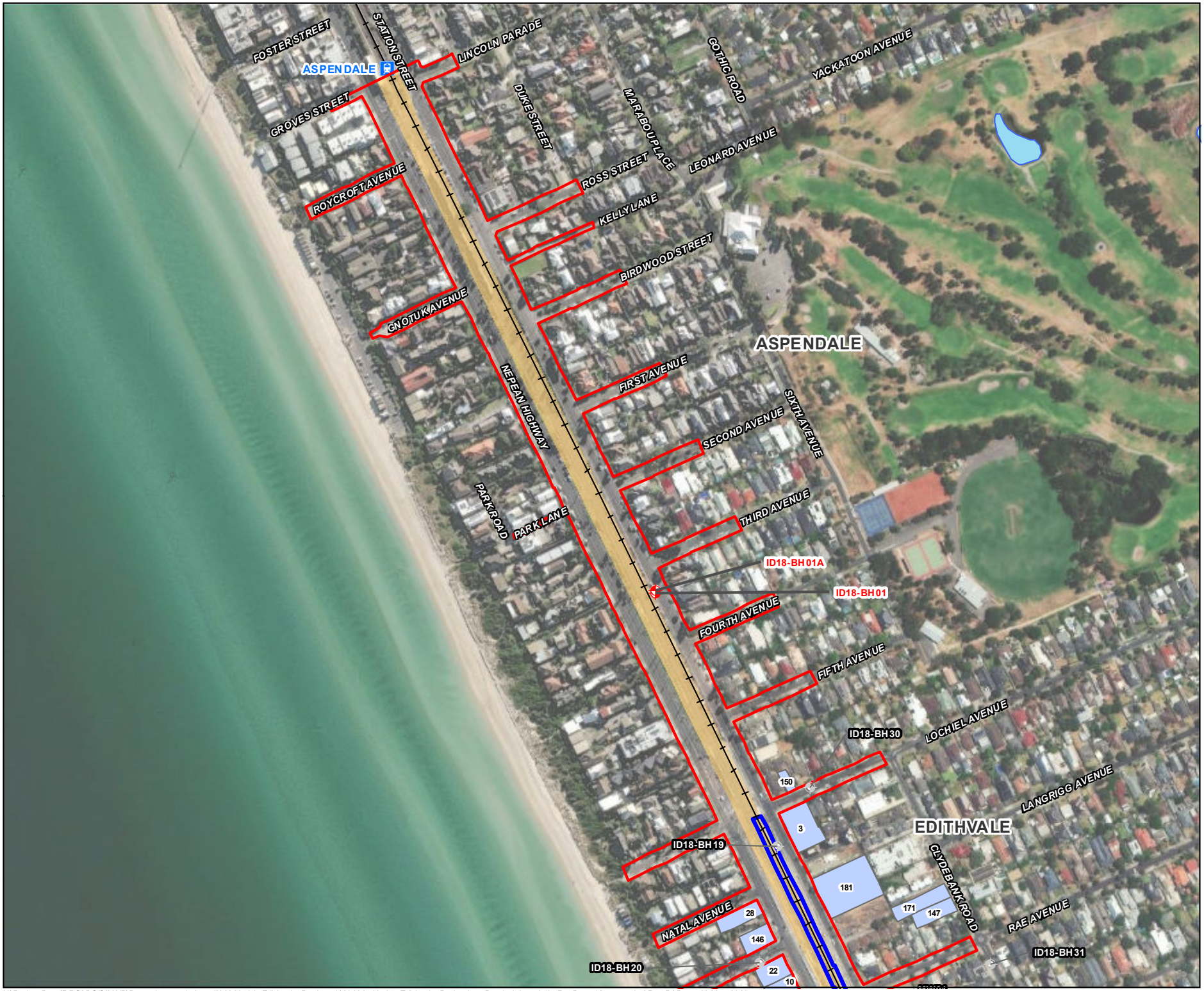
Environmental Values	Environmental Quality Indicators
Water dependent ecosystems and species	The project areas are located in an area covered by the ERS. The ERS lists the environmental values to be achieved or maintained for each segment of the water environment. Groundwater at the project areas is likely to discharge to Port Phillip Bay, the Patterson River in the southern section of the Bonbeach project area and the Edithvale-Seaford wetlands to the east. In accordance with Figure 1 of Clause 17, the Patterson River adjacent to the study area is included in the Central Foothills and Coastal Plains Segment, Port Philip Bay is included in the Central-East segment of the Port Phillip Bay marine segment and the wetlands are included in the Wetlands segment. The environmental quality objectives specified for this segment are those values specified in the ANZG 2018 guidelines, and the level of ecosystem protection for this Segment varies for each of the receiving water bodies as follows: • 90% for the highly modified ecosystems of the Patterson River • 95% for slightly to moderately modified ecosystems for the wetlands • 99% for the largely unmodified ecosystems of Central-East portion of Port Phillip Bay. For the purposes of this report, the 99% species protection criteria for largely unmodified ecosystems has been adopted as it is considered protective of all the relevant Segments adjacent to the project areas. For the assessment of PFAS, reference was made to the environmental guideline values in the National Chemicals Working Group (NCWG) of the Heads of EPAs Australia and New Zealand (HEPA). PFAS National Environmental Management Plan, Version 2.0, 2020. The 99% values were adopted.
Potable water supply (desirable and acceptable)	Table 5.4 of the ERS refers to the health-related and aesthetic guideline values specified in the Australian Drinking Water Guidelines. The current version of this guideline is the NHMRC, NRMMC (2011), Australian Drinking Water Guidelines Paper 6 version 3.6, updated March 2021. For the assessment of PFAS, reference was made to the drinking water quality values in the National Chemicals Working Group (NCWG) of the Heads of EPAs Australia and New Zealand (HEPA). PFAS National Environmental Management Plan, Version 2.0, 2020.
Potable mineral water supply	The projects are not located in a recognised mineral water production area; therefore this environmental value is not considered relevant.
Agriculture and irrigation (irrigation)	ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Environmental Values	Environmental Quality Indicators
Agriculture and irrigation (stock watering)	ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality
Industrial and commercial	No guideline specified, only that water quality is suitable for industrial and commercial use. ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, do not provide specific guidance for industrial water use, because industrial water requirements are so varied (both within and between industries) and sources of water for industry have other coincidental environmental values that tend to drive management of the resource. Industrial water use has been considered through regard for other environmental values.
Water-based recreation (primary contact recreation)	NHMRC (2008) Guidelines for Managing Risks in Recreational Water. To account for incidental ingestion during primary contact recreation activities, the NHMRC guideline values for inorganic compounds are multiplied by a factor of 10 based on consideration assuming a consumption rate of 100-200 mL per day. Refer to Section 9.3 of NHMRC (2008). For the purposes of short-term chemical hazard environmental quality indicators and objectives for water-based recreation – (a) waters must not be contaminated with chemicals that are either toxic or irritating to skin or mucous membrane; and (b) waters must have a pH range of – (i) 6.5–8.5; or (ii) 5–9 for recreational waters with a very low buffering capacity. For the purposes of short-term aesthetic indicators and objectives for water-based recreation – (c) are assessed against single samples or observations to determine if a public warning or other communication is needed; and (d) waters are observed as being free from the following – (i) visible materials that may settle to form objectionable deposits; (ii) floating debris, oil, scum and other matter; (iii) substances producing objectionable colour, odour, taste or turbidity; (iv) substances and conditions that produce undesirable aquatic life. Environmental quality indicator of E. coli is not greater than 10 E. coli/100 mL and when human faecal contamination sources (e.g. septic tanks) have been identified, no E. coli must be present.

Environmental Values	Environmental Quality Indicators
	For the assessment of PFAS, reference was made to the recreational water quality values in the National Health and Medical Research Council, *Guidance on Per and Polyfluoroalkyl (PFAS) in Recreational Water* (Recreational Guidelines 2019).
Traditional Owners cultural values	Water quality that protects the cultural values of Traditional Owners. Value may include traditional aquaculture, fishing, harvesting, cultivation of freshwater and marine foods, fish, grasses, medicines and filtration of water holes. The ERS states in table 5.7 that environmental quality objectives should be developed with the Traditional Owners and may be informed by ANZG (2018) to determine cultural values. However, in absence of any consultation, a conservative approach for the protection of ecosystem values from ANZG (2018) have been adopted and considered to protect environmental values.
Buildings and Structures	Introduced contaminants shall not cause groundwater to be corrosive to or otherwise adversely affecting the integrity of structures or building materials Indicators include pH, sulphate, chloride, redox potential salinity or any chemical substance or waste that may have a detrimental impact on the structural integrity of buildings or other structures. Investigation levels are not specified in ANZG (2018) therefore, best practice standards or guidelines are referenced, such as AS 2159-2009: Piling – Design and installation and the NEPM Management Limits that includes protection of "damage to buried infrastructure".
Geothermal properties	Water quality that must not affect the geothermal properties of groundwater. The temperature must sit between 30° and 70° Celsius. There are no known uses of the groundwater for this purpose within the vicinity of the projects and shallow groundwater is (naturally) less than the recommended range (30 to 70 degrees Celsius) for this use. It is unlikely that the drawdowns that could occur as a result of the projects would significantly impact the temperature of the groundwater.

Appendix D: Bore locations: Edithvale

Figure 5 Edithvale Project Area Borehole Locations



LEGEND

- Project Area
- Active bores
- Inactive bores
- Rail Station
- Railway

Trench extents (March 2021)

Flag

- Extent of intermediate piles

Potential sites of concern

- Rail Corridor
- Matched addresses identified from review of Lotsearch reports LS008945_EP, LS008949_EP and LS006546_EP

Edithvale Project Area
Borehole Locations
Figure 5 Page 1 of 2

LEVEL CROSSING REMOVAL AUTHORITY

AECOM GHD JOINT VENTURE

0 25 50 100
Metres

N

Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Data source: VicMap data, 2020; Created by: sacevedo.

X:\Project Data\PRGM\GIS\MXD\Bore_decommissioned\20230503_Edithvale_Bonbeach\20230508_05_Edithvale_ProjectAreaBoreholeLoc_A4L_RevD.mxd | sacevedo | Rev D | Date: 09 May 2023

LEGEND

- Project Area
- Level Crossing Site
- Active bores
- Inactive bores
- Rail Station
- Railway

Trench extents (March 2021)

Flag

- Extent of trench (tanked)
- Extent of intermediate piles

Potential sites of concern

- Rail Corridor
- Matched addresses identified from review of Lotsearch reports LS008945_EP, LS008949_EP and LS006546_EP

Model Year 5 (November 2019 model update) Mounding (m -ve)

- -0.1
- -0.2
- -0.3

Model Year 5 (November 2019 model update) Drawdown (m +ve)

- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6

Edithvale Project Area
Borehole Locations
Figure 5 Page 2 of 2

LEVEL CROSSING REMOVAL AUTHORITY

AECOM GHD JOINT VENTURE

0 25 50 100
Metres

N

Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Data source: VicMap data, 2020, Created by: sacevedo.

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Table 20 Monitoring bores - Edithvale

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
ID18-BH01	Actively monitored	333705.93	5788924.49	QA	9.1	6.1	9.1	Control monitoring location to provide groundwater level and quality information outside the area of predicted groundwater impact	Bore ID18-BH01 is screened below the water table within the Quaternary Aquifer
ID18-BH01A	Actively monitored	333704.55	5788927.19	UTAF	20.0	17.0	20.0	Control monitoring location to provide groundwater level and quality information outside the area of predicted groundwater impact	Bore ID18-BH01A is screened below the water table within the Upper Tertiary Aquifer
ID18-BH07	Not monitored	334105.95	5788246.20	UTAF	16.7	14.2	16.7	Trigger level monitoring location to provide groundwater level and quality information within the area of predicted groundwater impact	Bore ID18-BH07 is screened below the water table within the Upper Tertiary Aquifer
ID18-BH09	Not monitored	334199.09	5787923.56	QA	9.0	6.0	9.0	Background bore to provide groundwater level and quality information outside the area of predicted groundwater impact	Bore ID18-BH09 is screened below the water table within the Quaternary Aquifer
ID18-BH19	Not monitored	333830.15	5788661.59	QA	7.3	4.3	7.3	Targeting multiple sites including: • The service station located at 190-192	Bore ID18-BH19 is screened across the water table targeting top of the Quaternary Aquifer

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								Station Street, Edithvale (Figure 8, site 3) • The former motor garage and engineers at 187 Station Street, Edithvale (Figure 8, site 150) Bore ID18-BH19 is located down hydraulic gradient of the service station.	Bore ID18-BH19 is located approximately 15 m west and inferred down hydraulic gradient from the closest boundary of the service station
ID18-BH20	Not monitored	333812.18	5788543.20	QA	6.0	3.0	6.0	Targeting the mechanics at 222 Nepean Highway Edithvale (Figure 8, site 22)	Bore ID18-BH20 is screened across the water table targeting top of the Quaternary Aquifer Bore ID18-BH20 is located approximately 4 m north and inferred cross hydraulic gradient from closest boundary of the mechanics
ID18-BH22	Not monitored	333888.58	5788366.15	QA	12.0	9.0	12.0	Targeting the dry cleaners at 244 Nepean Highway Edithvale (Figure 8, site 78)	Bore ID18-BH22 is screened below the water table targeting the base of the Quaternary Aquifer Bore ID18-BH22 is located approximately 2 m north-west and inferred cross hydraulic gradient from closest boundary of the dry cleaners

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
ID18-BH23	Not monitored	333906.74	5788322.93	QA	7.0	4.0	7.0	Targeting the mower sales/service centre at 246 Nepean Highway Edithvale (Figure 8, site 18)	Bore ID18-BH23 is screened across the water table targeting the top of the Quaternary Aquifer Bore ID18-BH23 is located approximately 26 m south-south-west and inferred cross hydraulic gradient from closest boundary of the mower sales/service centre
ID18-BH30	Not monitored	333864.70	5788722.91	QA	7.0	4.0	7.0	Targeting multiple sites including: • The service station at 190 Station Street, Edithvale (Figure 8, site 3) • The former motor garage and engineers at 187 Station Street, Edithvale (Figure 8, site 150) Bore ID18-BH30 is located up hydraulic gradient of the service station.	Bore ID18-BH30 is screened across the water table targeting the top of the Quaternary Aquifer Bore ID18-BH30 is located approximately 15 m north-east and inferred up hydraulic gradient from closest boundary of the service station.
ID18-BH31	Not monitored	334051.39	5788540.76	QA	7.0	4.0	7.0	Targeting the Edithvale Fire Station at 206 Station Street, Edithvale (Figure 8, site 180)	Bore ID18-BH31 is screened across the water table targeting the top of the Quaternary Aquifer Bore ID18-BH31 is located approximately 75 m north-east and

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								Bore ID18-BH31 is located up hydraulic gradient of the fire station	inferred up hydraulic gradient from closest boundary of the Fire Station
MW01	Not monitored	333954.95	5788458.96	QA	8	5	8	Targeting the Edithvale Fire Station at 206 Station Street, Edithvale (Figure 8, site 180) Bore MW01 is located on the Edithvale Fire Station forecourt between the sub-surface project infrastructure the fire station Targeting the northeast section of the intermediate pile structure Bore MW01 replaces bore ID18-BH32 which was decommissioned due to project design changes resulting in the original bore location (ID18-BH32) being located within excavation zone of the project	Bore MW01 is screened across the water table targeting the top of the Quaternary Aquifer Bore MW01 is located on the Fire Station site near the inferred down hydraulic gradient boundary
ID18-BH32	Decommissioned 2020	333934.020	5788449.710	QA	7.50	4.5	7.5		
ID18-BH33R	Not monitored	333953.74	5788458.27	UTAF	18.1	14.6	17.6	Targeting the Edithvale Fire Station at 206 Station Street, Edithvale (Figure 8, site 180) Bore ID18-BH33R is located on the Edithvale Fire Station forecourt between the sub-	Bore ID18-BH33R is screened across the water table targeting the Upper Tertiary Aquifer (UTAF)
ID18-BH33	Decommissioned 2020	333938.910	5788448.480	UTAF	18.50	15	18		

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								surface project infrastructure the fire station Bore ID18-BH33R replaces bore ID18-BH33 which was decommissioned due to project design changes resulting in the original bore location (ID18-BH33) being located within the project excavation zone	Bore ID18-BH33R is located on the Fire Station site towards the inferred down hydraulic gradient boundary
ID18-BH34R*	Not monitored	334030.99	5788268.744	QA	10.7	7.7	10.7	Targeting multiple sites including: • The former surfboard manufacturers and former motor car radio specialists at 223 Station Street, Edithvale (Figure 8, site 86) • The former air conditioning specialists/engineers at 5 Edithvale Road, Edithvale (Figure 8, site 74) • The Former Fuel Merchants at 10 Edithvale Road, Edithvale (Figure 8, site 169)	Bore ID18-BH34 is screened across the top of the Quaternary Aquifer Bore ID18-BH34 is located: • approximately 5 m west and inferred down hydraulic gradient from closest boundary of the Former surfboard manufacturers and former motor car radio specialists • approximately 90 m west and inferred down hydraulic gradient from closest boundary of the former air conditioning specialists/engineers • approximately 150 m west and inferred down hydraulic gradient from closest
ID18-BH34	Decommissioned 2020	334039.19	788247.59	QA	7.0	4.0	7.0		

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								Bore ID18-BH34 is located between the sub-surface project infrastructure and the site listed above.	boundary of the Former Fuel Merchants
ID18-BH35	Not monitored	334107.63	5788246.78	QA	7.5	4.5	7.5	Targeting multiple sites including: • Former Surfboard Manufacturers and former Motor Car Radio Specialists at 223 Station Street, Edithvale (Figure 8, site 86) • Former Air Conditioning Specialists/Engineers at 5 Edithvale Road, Edithvale (Figure 8, site 74) • Former Fuel Merchants at 10 Edithvale Road, Edithvale (Figure 8, site 169) Bore ID18-BH35 is located between the sub-surface project infrastructure and the sites listed above.	Bore ID18-BH35 is screened across the water table targeting the top of the Quaternary Aquifer Bore ID18-BH35 is located: • Approximately 540 m east and inferred up hydraulic gradient from closest boundary of the Former Surfboard Manufacturers and former Motor Car Radio Specialists • Approximately 30 m south west and inferred down hydraulic gradient from closest boundary of the Former Air Conditioning Specialists/Engineers • Approximately 80 m west and inferred down hydraulic gradient from closest boundary of the Former Fuel Merchants

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
ID18-BH38	Not monitored	333876.48	5788480.97	QA	7.5	4.5	7.5	Targeting multiple sites including: • Current Motor Garage &/Or Panel Beaters and Former Motor Service Station / Abrasive Blasting/Welding Equipment Manufacturers at 221-222 Nepean Highway, Edithvale (Figure 8, site 22) • Former Dry Cleaners, Dyers & Pressers at 225 Nepean Highway, Edithvale (Figure 8, site 10) • Former Motor Garages & Engineers at 229-232 Nepean Highway, Edithvale (Figure 8, site 155) Bore ID18-BH38 is located between the sub-surface project infrastructure and the sites listed above.	Bore ID18-BH38 is screened across the water table targeting the top of the Quaternary Aquifer Bore ID18-BH38 is located: • approximately 80 m south-east and inferred cross hydraulic gradient from closest boundary of the Motor Garage &/Or Panel Beaters and Former Motor Service Station / Abrasive Blasting/Welding Equipment Manufacturers • approximately 50 m south-east and inferred cross hydraulic gradient from closest boundary of the Former Dry Cleaners, Dyers & Pressers • approximately 30 m south east and inferred cross hydraulic gradient from closest boundary of the Former Motor Garages & Engineers
ID18-BH39	Not monitored	333877.58	5788478.68	QA	13.1	10.5	13.1	Targeting multiple sites including:	Bore ID18-BH39 is screened below the water table targeting the base of the Quaternary Aquifer.

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								• Current Motor Garage &/Or Panel Beaters and Former Motor Service Station / Abrasive Blasting/Welding Equipment Manufacturers at 221-222 Nepean Highway, Edithvale (Figure 8, site 22) • Former Dry Cleaners, Dyers & Pressers at 225 Nepean Highway, Edithvale (Figure 8, site 10) • Former Motor Garages & Engineers at 229-232 Nepean Highway, Edithvale (Figure 8, site 155) Bore ID18-BH39 is located between the sub-surface project infrastructure and the sites listed above.	Bore ID18-BH39 is located approximately 80 m south east and inferred cross hydraulic gradient from closest boundary of the Motor Garage &/Or Panel Beaters and Former Motor Service Station / Abrasive Blasting/Welding Equipment Manufacturers • approximately 50 m south east and inferred cross hydraulic gradient from closest boundary of the Former Dry Cleaners, Dyers & Pressers • approximately 30 m south east and inferred cross hydraulic gradient from closest boundary of the Former Motor Garages & Engineers
ID18-BH40	Not monitored	333966.65	5788297.22	QA	10.3	7.9	10.9	Targeting multiple sites including: • Former Motor Cycle Dealers &/Or Repairers at 238 Nepean Highway,	Bore ID18-BH40 is screened below the water table targeting the base of the Quaternary Aquifer. Bore ID18-BH40 is located:

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								Edithvale (Figure 8, sites 6 & 7) • Former Dry Cleaners, Dyers & Pressers at 244 Nepean Highway, Edithvale (Figure 8, site 78) • Mower sales/service centre at 246 Nepean Highway, Edithvale (Figure 8, site 18) Bore ID18-BH40 is located between the sub-surface project infrastructure and the sites listed above.	• approximately 140 m south east and inferred cross hydraulic gradient from closest boundary of the Former Motor Cycle Dealers &/Or Repairers • approximately 90 m south east and inferred cross hydraulic gradient from closest boundary of the Former Dry Cleaners, Dyers & Pressers • approximately 80 m south east and inferred cross hydraulic gradient from closest boundary of the Mower sales/service centre
ID18-BH42	Not monitored	334005.08	5788218.00	QA	10.8	7.8	10.8	Targeting multiple sites including: • Former Boot & Shoe Repairs at 262 Nepean Highway Edithvale (Figure 8, site 178) • Former Dry Cleaners, Dyers & Pressers at 268 Nepean Highway, Edithvale (Figure 8, site 168)	Bore ID18-BH42 is screened below the water table targeting the base of the Quaternary Aquifer Bore ID18-BH42 is located: • approximately 20 m south east and inferred cross hydraulic gradient from closest boundary of the Former Boot & Shoe Repairs • approximately 20 m north and inferred cross hydraulic gradient from closest boundary of the Former Dry Cleaners, Dyers & Pressers

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								• Former Boot & Shoe Repairs at 274 Nepean Highway, Edithvale (Figure 8, site 116) Bore ID18-BH42 is located between the sub-surface project infrastructure and the sites listed above.	• approximately 50m north and inferred cross hydraulic gradient from closest boundary of the Former Boot & Shoe Repairs
ID18-BH44	Not monitored	334132.45	5787959.48	QA	10.8	7.8	10.8	Targeting multiple sites including: • Former upholsterers at 294 Nepean Highway, Edithvale (Figure 8, site 153) • Former Builders & Building Contractors at 296 Nepean Highway, Edithvale (Figure 8, site 117) • Former Boat & Yacht Builders at 298 Nepean Highway, Edithvale (Figure 8, site 118) Bore ID18-BH44 is located between the sub-surface project infrastructure and the sites listed above.	Bore ID18-BH44 is screened across the water table targeting the base of the Quaternary Aquifer Bore ID18-BH44 is located: • approximately 40 m east and inferred up hydraulic gradient from closest boundary of the Former upholsterers • approximately 20 m east and inferred up hydraulic gradient from closest boundary of the Former Builders & Building Contractors • approximately 30 m north and inferred cross hydraulic gradient from closest boundary of the Former Boat & Yacht Builders.

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								Bore ID18-BH44 is also targeting the southwest section of the intermediate pile structure	
ID18-BH45	Not monitored	334197.05	5787928.27	UTAF	14.5	11.5	14.5	Background bore to provide groundwater level and quality information outside the area of predicted groundwater impact.	Bore to be screened below the water table targeting top of the Upper Tertiary Aquifer
ID18-BH46	Not monitored	333905.41	5788422.76	QA	7.0	4.0	7.0	Targeting the northwest section of the intermediate pile structure	Bore ID18-BH46 screened across the water table targeting the top of the Quaternary Aquifer
ID18-BH48	Not monitored	334174.70	5787985.76	QA	7.0	4.0	7.0	Targeting the southeast section of the intermediate pile structure	Bore ID18-BH48 screened across the water table targeting the top of the Quaternary Aquifer
ID18-CASS22	Not monitored	333812.83	5788426.76	QA	6.5	2.5	6.5	Targeting the presence of Potential Acid Sulfate Soils (PASS) in Edithvale between Nepean Highway, Port Phillip Bay, Carrington Street and Derrybeg Lane, and the Edithvale fire station located at 206 Station Street, Edithvale (Figure 8, site 180)	Bore ID18-CASS22 is screened across the water table targeting the top of the Quaternary Aquifer

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
ID18-CASS23	Not monitored	333903.25	5788220.07	QA	6.0	3.0	6.0	Targeting the presence of PASS in Edithvale between Nepean Highway, Port Phillip Bay, Carrington Street and Derrybeg Lane	Bore ID18-CASS23 is screened across the water table targeting the top of the Quaternary Aquifer
ID18-CASS24	Not monitored	333969.47	5788086.65	QA	5.5	2.5	5.5	Targeting the presence of PASS in Edithvale between Nepean Highway, Port Phillip Bay, Carrington Street and Derrybeg Lane	Bore ID18-CASS24 is screened across the water table targeting the top of the Quaternary Aquifer
ID18-GWBH01	Not monitored	333949.80	5788226.72	QA	8.0	5.0	8.0	Trigger level monitoring location to provide groundwater level and quality information within the area of predicted groundwater impact	Bore ID18-GWBH01 is screened below the water table within the Quaternary Aquifer
ID18-GWBH02	Actively monitored	333904.32	5788204.68	UMTD	28.0	21.0	28.0	Trigger level monitoring location to provide groundwater level and quality information within the area of predicted groundwater impact	Bore ID18-GWBH02 is screened below the water table across the Upper-Mid Tertiary Aquitard
ID18-GWBH04	Not monitored	334376.33	5788332.92	QA	4.5	1.0	4.5	Monitoring for groundwater change between trench and Edithvale Wetland, as per section 5.1.1 of the Edithvale	N/A

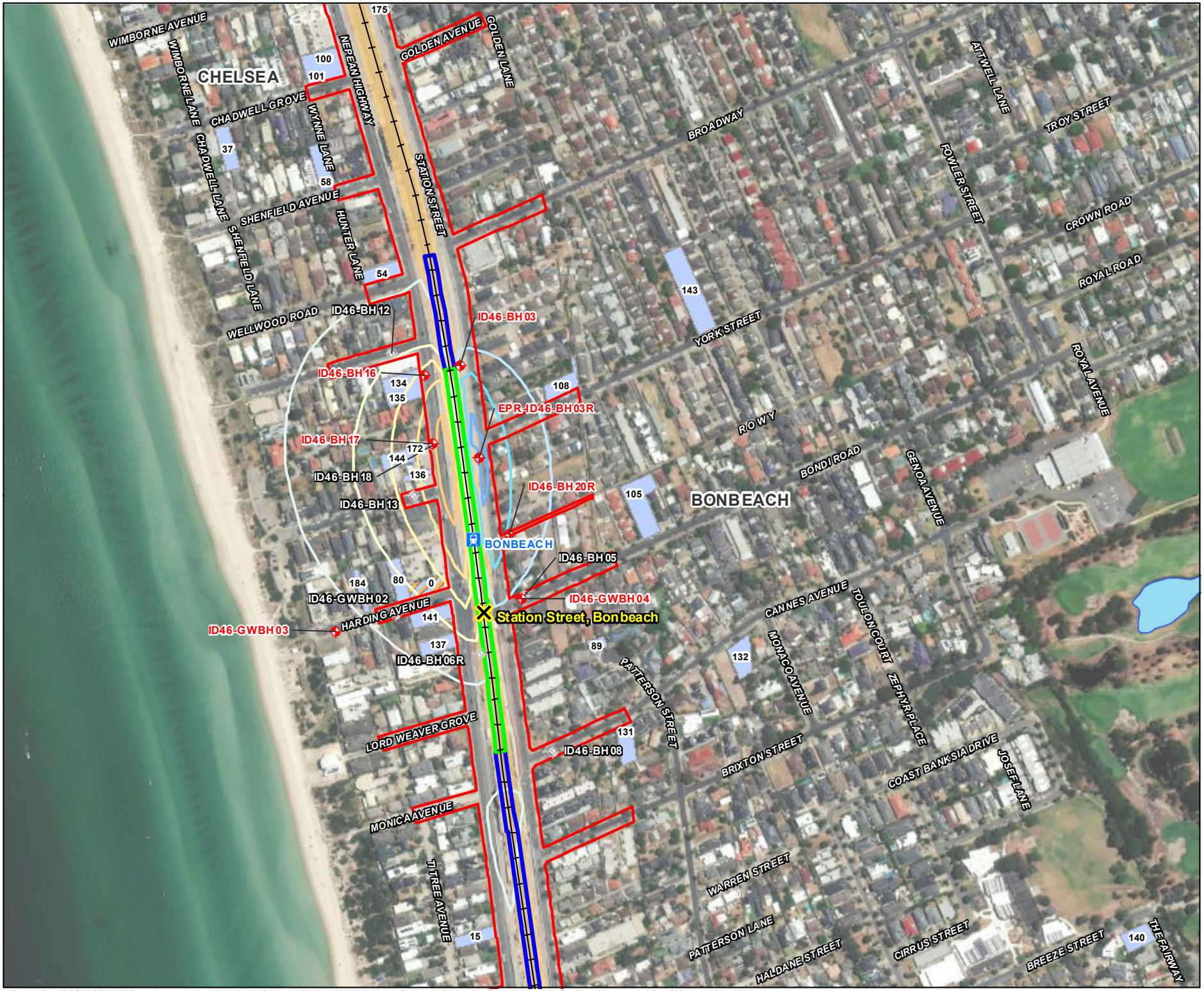
Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								Monitoring and Mitigation Plan (EPR_FF7)	
ID18-GWBH05	Not monitored	334373.48	5788332.30	UTAF	14.0	11.0	14.0	Monitoring for groundwater change between trench and Edithvale Wetland, as per section 5.1.1 of the Edithvale Monitoring and Mitigation Plan (EPR_FF7)	N/A
EPR-ID18-BH05	Actively monitored	333966.88	5788258.43	QA	7.0	3.5	6.5	Targeting multiple sites including: • Former Laundry at 251 Nepean Highway, Edithvale (Figure 8, site 24) • Former Motor Cycle Dealers &/or Repairers at 253 Nepean Highway, Edithvale (Figure 8, site 4) • Former Boat Hire at 2 Sinclair Avenue, Edithvale (Figure 8, site 194) • Former Clothing Manufacturers at 254 Nepean Highway, Edithvale (Figure 8, site 19)	Bore EPR-ID18-BH05 is screened across the water table targeting the top of the Quaternary Aquifer Bore EPR-ID18-BH05 is located: • approximately 50 m south and inferred cross hydraulic gradient from closest boundary of the Former Laundry • approximately 50 m south east and inferred cross hydraulic gradient from closest boundary of the Former Motor Cycle Dealers &/or Repairers • approximately 70 m south east and inferred cross hydraulic gradient from closest boundary of the Former Boat Hire • approximately 30 m south and inferred cross hydraulic

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								• Former Dry Cleaners, Dyers & Pressers at 259 Nepean Highway, Edithvale (Figure 8, site 21) EPR-ID18-BH05 is located between the sub-surface project infrastructure and the sites listed above.	gradient from closest boundary of the Former Clothing Manufacturers • approximately 5 m east and inferred up hydraulic gradient from closest boundary of the Former Dry Cleaners, Dyers & Pressers
EPR-ID18-BH06	Actively monitored	334019.27	5788283.93	QA	7.0	3.5	6.5	Trigger level monitoring location to provide groundwater level and quality information outside the area of predicted groundwater impact	Bore EPR-ID18-BH06 is screened across the water table targeting the top of the Quaternary Aquifer
EPR-ID18-BH07	Actively monitored	334044.39	5788141.81	QA	7.0	3.5	6.5	Targeting multiple sites including: • Former Caravan &/or Trailer Builders at 277 Nepean Highway, Edithvale (Figure 8, site 167) • Former Dry cleaners and Former Boat Sales &/or service at 280 Nepean Highway, Edithvale (Figure 8, site 193)	Bore EPR-ID18-BH07 is screened across the water table targeting the top of the Quaternary Aquifer Bore EPR-ID18-BH07 is located: • approximately 10 m south and inferred down hydraulic gradient from closest boundary of the Former Caravan &/or Trailer Builders • approximately 10 m north and inferred up hydraulic gradient from closest boundary of the Former Dry

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rationale	Limitations
								EPR-ID18-BH07 is located between the sub-surface project infrastructure and the sites listed above.	cleaners and Former Boat Sales &/or service
EPR-ID18-BH08	Actively monitored	334077.44	5788155.80	QA	7.0	3.5	6.5	Trigger level monitoring location to provide groundwater level and quality information outside the area of predicted groundwater impact	Bore EPR-ID18-BH08 is screened across the water table targeting the top of the Quaternary Aquifer

Appendix E: Bore locations: Bonbeach

Figure 6 Bonbeach Project Area Borehole Locations



LEGEND

- Project Area
- Level Crossing Site
- Active bores
- Inactive bores
- Rail Station
- Railway

Trench extents (March 2021)

Flag

- Extent of trench (tanked)
- Extent of intermediate piles

Potential sites of concern

- Audit site
- Rail Corridor
- Matched addresses identified from review of Lotsearch reports LS006551_EP, LS008943_EP and LS008948_EP

Model Year 5 (November 2019 model update)

Mounding (m -ve)

- -0.1
- -0.2
- -0.3

Drawdown (m +ve)

- 0.1
- 0.2
- 0.3
- 0.4
- 0.5

Bonbeach Project Area
Borehole Locations

Figure 6 Page 1 of 2

LEVEL CROSSING REMOVAL AUTHORITY

AECOM GHD JOINT VENTURE

0 25 50 100
Metres

Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

LEGEND

- Project Area
- Active bores
- Inactive bores
- Railway
- Watercourse

Trench extents (March 2021)

Flag

- Extent of trench (tanked)
- Extent of intermediate piles

Potential sites of concern

- Rail Corridor
- Matched addresses identified from review of Lotsearch reports LS006551_EP, LS008943_EP and LS008948_EP

Drawdown (m +ve)

- 0.1

Bonbeach Project Area
Borehole Locations

Figure 6 Page 2 of 2

LEVEL CROSSING REMOVAL AUTHORITY

AECOM GHD JOINT VENTURE

0 25 50 100
Metres

Paper Size A4
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Data source: VicMap data, 2020, Created by: sacevedo.

X:\Project Data\PRGM\GIS\MXD\Bore_decommissioned\20230503_Edithvale_Bonbeach\20230508_06_Bonbeach_ProjectAreaBoreholeLoc_A4L_RevD.mxd | sacevedo | Rev D| Date: 09 May 2023

Table 21 Monitoring bores - Bonbeach

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
EPR-ID46-BH03R	Actively monitored	335057.54	5785617.77	QA	7.0	4.0	7.0	Trigger monitoring bore to provide groundwater level and quality information within the area of predicted groundwater impact Bore EPR-ID46-BH03R replaces bore EPR-ID46-BH03 which was decommissioned due to project design changes resulting in the original bore location (EPR-ID46-BH03) being located within excavation zone of the project. EPR-ID46-BH03R is located approximately 20 m north of the original bore EPR-ID46-BH03	Bore EPR-ID46-BH03R is screened across the water table targeting the top of the Quaternary Aquifer
EPR-ID46-BH03	Decommissioned 2021	335059.831	5785598.361	QA	7.0	4.0	7.0		
ID46-BH03R	Actively monitored	335039.253	5785713.180	UTAF	16.1	13.1	16.1	Trigger monitoring bore to provide groundwater level and quality information within the area of predicted groundwater impact ID46-BH03 was located within the piling area, had to be redrilled in 2020 due to damage during construction. It was redrilled at the same location, keeping the same name for practical purposes	Bore ID46-BH03 is screened below the water table within the Upper Tertiary Aquifer
ID46-BH03	Decommissioned 2020	335037.77	5785712.89	UTAF	16.2	13.2	16.2		
ID46-BH05	Not monitored	335104.90	5785474.70	UTAF	14.7	11.7	14.7	Background bore to provide groundwater quality information	Bore ID46-BH05 is screened below the water

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
								within the area of predicted groundwater impact	table within the Upper Tertiary Aquifer
ID46-BH06R*	Not monitored	335058.819	57855415.84	UTAF	17.20	14.0	17.0	Trigger monitoring bore to provide groundwater quality information within the area of predicted groundwater impact	Bore ID46-BH06R is screened below the water table within the Upper Tertiary Aquifer
ID46-BH06	Decommissioned 2022	335059.37	5785415.79	UTAF	17.5	14.52	17.52		
ID46-BH08	Not monitored	335134.26	5785315.19	QA	14.0	11.0	14.0	Background bore to provide groundwater quality information outside the area of predicted groundwater impact	Bore ID46-BH08 is screened below the water table at the base of the Quaternary Aquifer
ID46-BH10	Not monitored	335048.22	5785051.19	QA	9.7	6.7	9.7	Trigger monitoring bore to provide groundwater level and quality information outside the area of predicted groundwater impact	Bore ID46-BH10 is screened below the water table at the base of the Quaternary Aquifer
ID46-BH12	Not monitored	334967.97	5785725.18	QA	11.5	8.5	11.5	Targeting multiple sites including: • The furniture and boat manufacturer at 517 Nepean Highway, Bonbeach (Figure 9, site 135) • The mower sales/service centre at 523 Nepean Highway,	Bore ID46-BH12 is below the water table targeting the base of the Quaternary Aquifer Bore ID46-BH12 is located: • approximately 10 m north and inferred cross hydraulic

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
								Bonbeach (Figure 9, site 144)	gradient from the closest boundary of the furniture and boat manufacturer. • approximately 60 m north and inferred cross hydraulic gradient from the closest boundary of the mower sales/service station
ID46-BH13	Not monitored	334990.06	5785578.18	QA	7.0	4.0	7.0	Targeting multiple sites including: • The mower sales/service centre at 523 Nepean Highway, Bonbeach (Figure 9, site 144) • The Laundromat at 525C Nepean Highway, Bonbeach (Figure 9, site 136)	Bore ID46-BH13 is screened across the water table targeting the top of the Quaternary Aquifer Bore ID46-BH13 is located: • approximately 47 m south and inferred down hydraulic gradient from closest boundary of the mower sales/service centre

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
									approximately 17 m south and inferred down hydraulic gradient from closest boundary of the laundromat
ID46-BH16	Actively monitored	335000.67	5785702.38	QA	11.4	8.4	11.4	Targeting multiple sites including: • Former Boot & Shoe Manufacturers/Repairers at 516 Nepean Highway, Bonbeach (Figure 9, site 134) • Furniture manufacturer and former boat manufacturer at 517 Nepean Highway, Bonbeach (Figure 9, site 135) Bore ID46-BH16 is located between the sub-surface project infrastructure and sites listed above.	Bore ID46-BH16 is screened below the water table targeting the base of the Quaternary Aquifer Bore ID46-BH16 is located: • approximately 10 m east and inferred up hydraulic gradient from closest boundary of the Former Boot & Shoe Manufacturers/ Repairers approximately 10 m east and inferred up hydraulic gradient from closest boundary of the Furniture manufacturer
ID46-BH17	Actively monitored	335009.79	5785631.61	QA	6.6	3.5	6.5	Targeting multiple sites including: • Former Printers at 522 Nepean Highway,	Bore ID46-BH17 is screened across the water table targeting the top of the Quaternary Aquifer

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
								Bonbeach (Figure 9, site 172) • Mower sales/service centre at 523 Nepean Highway, Bonbeach (Figure 9, site 144) Laundromat at 525C Nepean Highway, Bonbeach (Figure 9, site 136) Bore ID46-BH17 is located between the sub-surface project infrastructure and the sites listed above.	Bore ID46-BH17 is located: • approximately 10 m east and inferred up hydraulic gradient from closest boundary of the Former Printers • approximately 30 m east and inferred up hydraulic gradient from closest boundary of the Mower sales/service centre • approximately 30 m north and inferred cross hydraulic gradient from closest boundary of the Laundromat
ID46-BH18	Not monitored	335010.17	5785629.57	QA	10.7	8.0	11.0	Targeting multiple sites including: • Former Printers at 522 Nepean Highway, Bonbeach (Figure 9, site 172)	Bore ID46-BH18 is screened below the water table targeting the base of the Quaternary Aquifer

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
								• Mower sales/service centre at 523 Nepean Highway, Bonbeach (Figure 9, site 144) • Laundromat at 525C Nepean Highway, Bonbeach (Figure 9, site 136) Bore ID46-BH18 is located between the sub-surface project infrastructure and the sites listed above.	Bore ID46-BH18 is located: • approximately 10 m east and inferred up hydraulic gradient from the closest boundary of the Former Printers • approximately 30 m east and inferred up hydraulic gradient from closest boundary of the Mower sales/service centre • approximately 30 m north and inferred cross hydraulic gradient from closest boundary of the Laundromat
ID46-BH20R	Actively monitored	335089.38	5785538.97	QA	7.0	4.0	7.0	Targeting the Former Paint and Decorator and Plumbers at 13	Bore ID46-BH20R is screened across the water

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
ID46-BH20	Decommissioned 2022	335069.830	5785526.680	QA	7.0	4.0	7.0	Bondi Road, Bonbeach (Figure 9, site 105) Bore ID46-BH20R is located between the sub-surface project infrastructure and the site listed above Bore ID46-BH20R replaces bore ID46-BH20 which was decommissioned due to project design changes resulting in the original bore location (ID46-BH20) being located within excavation zone of the project. ID46-BH20R is located approximately 15 m east of the original bore ID46-BH20	table targeting to top of the Quaternary Aquifer Bore ID46-BH20R is located approximately 135m west and inferred cross hydraulic gradient from the closest boundary of the Former Paint and Decorator and Plumbers.
ID46-GWBH02	Not monitored	334971.77	5785456.13	QA	8.0	5.0	8.0	Trigger monitoring bore to provide groundwater level and quality information within the area of predicted groundwater impact	Bore ID46-GWBH02 is screened below the water table within the Quaternary Aquifer
ID46-GWBH03	Actively monitored	334909.60	5785438.01	UTAF	15.9	12.5	15.5	Trigger monitoring bore to provide groundwater level and quality information within the area of predicted groundwater impact	Bore ID46-GWBH03 is screened below the water table within the Upper Tertiary Aquifer
ID46-GWBH04	Actively monitored	335101.86	5785473.27	QA	9.0	6.0	9.0	Trigger monitoring bore to provide groundwater quality	Bore ID46-GWBH04 is screened below the

Bore ID	Status	Easting	Northing	Monitored Aquifer	Bore Depth (m)	Top of Screen (mbgl)	Bottom of Screen (mbgl)	Bore Location Rational	Limitations
								information within the area of predicted groundwater impact	water table within the Quaternary Aquifer
ID46-CASS23	Actively monitored	335137.37	5784847.96	QA	5.7	2.7	5.7	Control monitoring bore that also targets the presence of PASS to the west of the rail alignment at the western end of Breeze Street, Bonbeach	Bore ID46-CASS23 is screened across the water table targeting the top of the Quaternary Aquifer

Appendix F: Quality assurance and quality control

Established quality assurance/quality control (QA/QC) procedures to assess data quality must be employed during implementation of this Plan. This section outlines the QA/QC requirements as they relate to field investigations, laboratory analysis and data management.

The QA/QC program must be undertaken in accordance with the general requirements set out in:

- Australian Standard (AS) 4482 – 2005: Guide to the investigation and sampling of sites with potentially contaminated soil
- Australian / New Zealand Standard (AS/NZS) 5667.1.1: Guidance on the design of sampling program techniques and the preservation and handling of samples
- AS/NZS 5667.11: 1998 Water quality—Sampling – Guidance on sampling of groundwaters

Field Quality Assurance and Quality Control

QC samples collected in the field provide information that discounts or potentially identifies errors due to possible sources of cross contamination, inconsistencies in measurement, sampling and analytical techniques used. The QC program must include the collection and analysis of the following QC samples:

- Blind duplicate samples: These are coded duplicate samples submitted to the primary laboratory for analysis as individual samples without any indication to the laboratory that they have been duplicated
- Split duplicate samples: These are duplicate samples split in the field, with one sample being sent to a secondary laboratory for check analysis. The same parameters are analysed utilising similar analytical techniques
- Trip Blank: A blank sample placed into an ice chest to indicate whether cross contamination has occurred during transport
- Rinsate blank: A sample of deionised water collected from equipment used during sampling to indicate whether cross contamination occurred from equipment

A quantitative measure of the accuracy of the check analyses results obtained must be made using calculated relative percentage difference (RPD) values. The RPD values are to be calculated using the following equation.

$$\text{RPD (\%)} = \frac{\langle Co - Cs \rangle}{\left\langle \frac{Co + Cs}{2} \right\rangle} \times 100$$

Where Co = concentration obtained from the original sample

Cs = concentration obtained from the duplicate sample

The QA/QC program must include the following:

- Use of appropriately qualified and trained staff
- Calibration of all field equipment used
- The use of dedicated equipment where possible
- Preservation of samples at or below 4°C during transport from the field to the laboratory
- Transportation of samples with accompanying chain-of-custody documentation
- Compliance with sample holding times
- Review of results of blind duplicate and split duplicate samples
- Review of internal analysis of laboratory duplicates, spikes and blanks
- Comparison of field and analytical data

Laboratory Quality Assurance and Quality Control

NATA accredited laboratories are required to conduct internal QA/QC procedures, which in implementing this Plan, must include the following:

- Method Blank: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. Used for monitoring contamination introduced in the laboratory.
- Instrument Blank: An analyte-free reagent grade water or solvent. Used to monitor sample carry over and instrument (zero) drift
- Laboratory Control Sample (LCS): A known; interference-free matrix spiked with target analytes. Prepared independently from a standard source and used in monitoring laboratory preparation technique and accuracy
- Laboratory Duplicate: An intra-laboratory split sample. Used in monitoring method precision in a given sample matrix
- Matrix Spike (MS): An intra-laboratory split sample spiked with the target analytes prior to sample preparation and analysis. Used in monitoring method bias in a given sample matrix (matrix interference).
- Surrogate Spike: Compounds similar in composition and behaviour to the target analytes but not commonly found in the environment. Monitoring matrix interference on a per sample basis.

Data quality indicators

Compliance with the field QA/QC program must be measured and reported against the data quality indicators outlined in Table 22.

Table 22 Data quality indicators

Responsible entity	Item	Objective
Entity undertaking field investigation programs	Comparison of field and analytical data	Agreement between visual and olfactory evidence with laboratory results
	Calibration of field instruments	Meet calibration specifications
	Chain of Custody documentation	Supply chain of custody documentation with all samples
	Sample analysis and extraction holding times	Comply with holding times
	Analysis of inter and intra-laboratory duplicate samples	Analysis of duplicate samples in 5% of primary samples
	Analysis of rinsate and trip blank samples	Analysis of one (1) trip blank and one (1) rinsate blank sample per day. Reported concentrations to be below the laboratory limit of reporting (LOR)
	Temperature that samples are received	Recommended to be less than or equal to 4° Celsius for chemical analysis
Laboratory undertaking sample analysis	Analysis of laboratory method blanks	No contamination of blanks
	Analysis of laboratory spike recoveries	Recoveries within the laboratory specified recovery limit
	Analysis of laboratory internal duplicates	Frequencies and RPDs within guideline and internal laboratory limits (RPD of 0-30%)

Responsible entity	Item	Objective
	Analysis of laboratory control outliers	Recoveries within the laboratory specified recovery limit
	Analysis of surrogate recovery for all regular sample matrices	Recoveries within the laboratory specified recovery limit
	Frequency of quality control samples	Frequency of analysis within specified limit

Data management protocols

This section provides a broad overview of data management protocols to be adhered to during implementation of the Plan. Many QA aspects, from collection of data to input into a software platform, will vary depending on whether paper forms or a digital solution is being utilised.

If paper forms are being utilised a set of standard templates will be set up and used in implementing the Plan. Each collection template will appropriately record time, date, location, field staff and collection details. Completed templates will be digitally scanned and saved within a project server repository as a backup measure. If a digital solution is being utilised in the field to capture data, standard templates will be set up, training completed, and testing undertaken to ensure synchronisation with the environmental system that the data will integrate to.

When inputting data into a database, a user will have familiarity with the software and data they are inputting. A user will look for inconsistencies within the data and understand any relevant datum / measuring point elevation, chemical codes or environmental standards that need to be verified for the project. A spreadsheet can be set up within the project folder to validate site sampling dates, dates input into the database and when the data was validated by a secondary user.

Backing up of data is accomplished through server architecture, depending on the solution, this would either be through cloud-hosted solutions or through daily backups over local data stores. Transferring of data from the repository to another entity can be achieved through multiple platforms, and the output would be highly dependable on what the specific entity (e.g. regulatory authority) would like to view, and how much manipulation / interrogation control they require from the data.

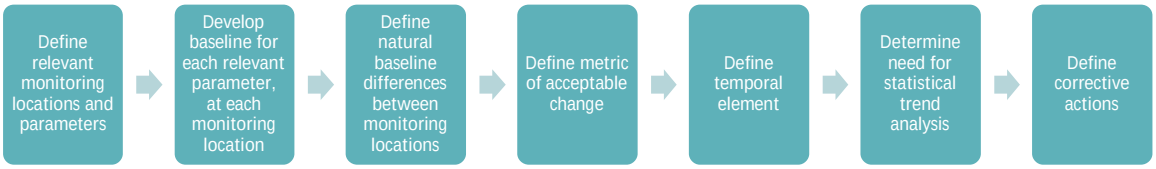
If the receiving entity has the same software that is being used to analyse the data, the data collection entity may be able to provide a complete export of the data to the receiving entity. If not, the data collection entity must still provide a full set of data collected, laboratory results, field records, and export tables and graphs or what may be requested by the receiving entity.

Appendix G: Trigger rationale

Background to trigger levels

To develop a trigger level, an understanding of baseline groundwater conditions is required. That is, the natural background differences in groundwater levels and/or quality between monitoring points need to be considered in evaluating whether a trigger has been met. Baseline conditions were determined through monitoring undertaken during the pre-construction phase, measuring groundwater levels and/or quality at the key groundwater monitoring bores located within or near to the predicted areas of groundwater impact, along with control areas located beyond the predicted areas of groundwater impact or other project influences.

Triggers for groundwater levels in this Plan have been developed on the basis of potential project induced groundwater mounding and drawdown, which are defined as raising or lowering of the water table from a baseline groundwater level, respectively. The rationale to trigger development involved the following key steps:



The effect of natural and seasonal groundwater level variations and short-term climatic events (not related to the project) that may result in significant episodic groundwater recharge, are considered in the developed rationale.

Natural hydraulic head differences

Based on pre-construction phase data, it was identified that in the order of 0.3 metres of natural hydraulic head difference occurred across the rail line on average, at the pre-construction phase, owing to variations in topography and the natural hydraulic gradient of groundwater in the water table aquifer.

Figure 7 provides a schematic representation of inferred project area hydraulic head differences. Each bore pair showed different natural hydraulic head differences; therefore an understanding of existing baseline conditions was required to refine the adopted trigger level. This required the establishment of background (control) bores located at distance from predicted or potential areas of groundwater level impacts. The groundwater level triggers for each project are based on changes in groundwater level at specific monitoring locations, over a defined period.

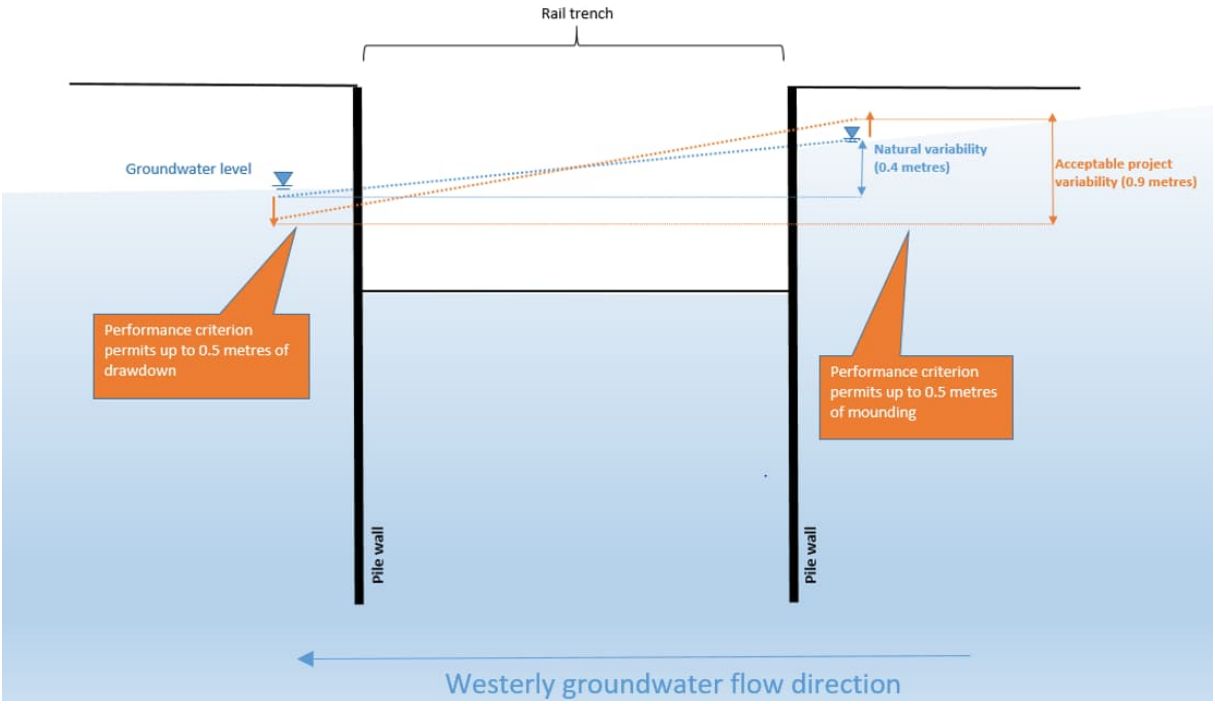


Figure 7 Acceptable change in hydraulic head difference

Correcting for baseline differences

With respect to the 'correction for baseline differences', the rationale required:

1. Measurement of groundwater level data at several specific locations along and across the rail trench, including the collection of data from representative groundwater monitoring bores located across the rail trench and, development of baseline data during the pre-construction period
2. Establishing through data analysis (during the pre-construction period), the average natural hydraulic head differences between control bore sites and each key monitoring location, ideally based on at least 12 months of continuous monitoring data, but acknowledging that a long data record was not available for all monitoring locations
3. Deducting the average natural hydraulic head differences between relevant monitoring locations (i.e. zero the data)
4. Assessing the groundwater levels against the adopted triggers (acceptable project induced changes)

To date, monitoring program implementation has identified the need to replace Plan bores occasionally due to bore integrity issues, damage or interaction with project construction activities. These issues present challenges in the ability to correct for baseline differences, as baseline values (for either groundwater levels or specific groundwater quality parameters) cannot be calculated for replacement groundwater monitoring bores. This is because there is no pre-construction data available for these replacement bores, as project construction (i.e. the approved action to which this Plan relates) is now completed and natural hydraulic head differences (discussed previously) can no longer be determined.

It is suggested that where Plan bores need to be replaced, trigger analysis is undertaken by way of adopting the initial difference in groundwater levels between the replacement bore and other trigger bores, as the adopted baseline difference. While this approach may not be representative of longer-term groundwater level differences, it presents a starting point by which the trigger can be assessed. The limitations in not having baseline values for replacement bores should be considered if a trigger is met/exceeded.

Trigger to measure operational performance of project infrastructure

The triggers described herein are the most sensitive triggers that could be met; the intention being that if met, they would instigate monitoring of project infrastructure to resolve potential project induced changes to groundwater.

Edithvale Project

This discussion is provided for context to support the trigger level specified within the 'Operational Maintenance' EPR (EPR_GW4), which requires maintenance of the Edithvale groundwater management system to ensure it continues to operate as intended. As outlined throughout this document, EPR_GW4 specifically considers the effective performance of a groundwater management system at the Edithvale Project, which, due to subsequent updates to the project designs, was no longer required and therefore, not installed.

The groundwater level trigger at the Edithvale project is defined as a measured increase in natural hydraulic head differences or a change in natural groundwater levels, that would indicate that project infrastructure at the Edithvale Project is not performing as intended. The intent of EPR_GW4 is however, still considered by way of the Table 4 Trigger level, within this document. The monitoring and assessment triggers stipulated in Table 4 of this Plan effectively confirm that the Operational Maintenance (EPR_GW4) requirements are being met.

The metrics adopted to represent triggers for further action are project specific and those adopted for the Edithvale Project are outlined below.

The monitoring locations included in this trigger have been reduced in this Version 5 of the RAMP, following a review undertaken in accordance with Section 8.2 of Version 4 of the RAMP, which resulted in a rationalisation of the monitoring program through review and analysis undertaken on groundwater conditions at the Projects during construction and operation phases between September 2020 and January 2023.

Natural hydraulic head differences
This aspect represents a criterion based on differences in groundwater level across the rail trench. The measurement of paired monitoring locations is necessary as the key indicator that the project infrastructure is performing as expected and that potential impacts (if identified) are due to the project or other factors.

If the difference in groundwater levels across the rail line increases by 0.5 m (for a sustained period of 3 months), this represents a line of evidence that groundwater levels have been affected by the project. This trigger component relating to measurement of natural hydraulic head difference across the trench is considered the most relevant

aspect of the trigger, as it indicates potential project induced change to groundwater conditions. If this trigger is met, the process therefore instigates further assessment / action, irrespective of whether the other component of the trigger (a change in natural groundwater levels) is measured.

Change in natural groundwater levels
This aspect represents a criterion based on the differences in groundwater levels to the east (up hydraulic gradient) of the pile walls, between the project area and a control site that is distant but comparable to, the project area. This is to take into account natural climatic variations in groundwater levels that may occur over time.

If the difference in groundwater levels on the up-gradient side of the rail line are greater than a control bore site after correcting for baseline differences, by more than 0.5 m for a sustained period of 3 months, then there is potential that groundwater levels have been affected by the project.

The value of 0.5 metres of additional difference in average groundwater levels across the rail line was adopted as an indicator of potential operational issue with project infrastructure. The value of the 0.5 metres trigger still represents an acceptable change in hydraulic head, as it would not result in impacts to Edithvale Wetland. The model predictions obtained through the 'initial assessment' showed that groundwater mounding of 1.5 metres would be required to potentially impact Edithvale Wetland.

The value of 0.5 metres of acceptable groundwater mounding is a conservative trigger, on the basis that it represents approximately 30% of the groundwater mounding predicted to occur with no resulting impact to Edithvale Wetland. This conservatism provides sufficient early warning time to implement monitoring and maintenance on project infrastructure that would aim to reduce groundwater mounding to maintain operational performance and avoid the implementation of the *Edithvale Wetlands Monitoring and Mitigation Plan (EPR_FF7)*.

Monitoring of natural conditions through a control site
Bore ID18-BH01 represents a suitable control site as it is located more than 250 metres north of the predicted area of groundwater impact at Edithvale and well beyond the extent of piling. Additionally, bore ID18-BH01 is located along the coastal sand dune, in a similar geomorphic setting to the project area trigger bores. Bore ID18-BH01 is inferred to be subject to similar groundwater recharge, discharge and flow characteristics to the Edithvale project area, and is therefore considered suitable to use as a comparison/control site.

Regression analyses have confirmed that Edithvale bore ID18-BH01 is suitable for use as a control location that is representative of groundwater level conditions across the Edithvale Project. In October 2022, LXRP announced the future removal of level crossings at Station Street and Groves Street, Aspendale. The suitability of the Edithvale control bore ID18-BH01 should be reviewed in the context of these projects, once designs are underway.

Bonbeach Project

The rationale adopted to develop groundwater level triggers at the Bonbeach project is the same as that described previously for the Edithvale Project. The metrics adopted to represent triggers for further action however, are project specific. The Bonbeach Project trigger metrics adopted are outlined below.

As with the Edithvale project, the monitoring locations included in this trigger have been reduced in this Version 5 of the RAMP, following a review undertaken in accordance with Section 8.2 of Version 4 of the RAMP.

Natural hydraulic head differences
This component of the trigger adopts a value of an additional 2.1 metres of groundwater level difference (above the baseline) across the rail trench, on the basis of previous modelling, which indicated that 2.1 m of groundwater level difference at Bonbeach was unlikely to result in unacceptable impacts.

Change in natural groundwater levels
This aspect represents a criterion based on the differences in groundwater levels to the east (up hydraulic gradient) of the pile walls, between the project area and a control site that is distant but comparable to, the project area.

This component of the trigger adopts a value of 1.3 metres as an acceptable difference in groundwater levels to the east (up hydraulic gradient) of the pile walls, between the project area and a control site that is distant but comparable to, the project area. The value of 1.3 m was adopted on the basis of previous modelling, which indicated that 1.3 m of predicted mounding was unlikely to result in unacceptable impacts.

Monitoring of natural conditions through a control site

Bore ID46-CASS23 represents a suitable control site as it is located more than 500 metres south of the predicted area of groundwater impact at Bonbeach and over 100 m beyond the extent of piling. Additionally, bore ID46-CASS23 is

located along the coastal sand dune, in a similar geomorphic setting to the project area trigger bores. Bore ID46-CASS23 is inferred to be subject to similar groundwater recharge, discharge and flow characteristics to the Bonbeach project area, and is therefore considered suitable to use as a comparison/control site.

The suitability of the nominated control bore (ID46-CASS23) was appraised during previous Plan reviews and remains suitable as a control bore.

Trigger to implement the *Edithvale Wetlands Monitoring and Mitigation Plan*

The triggers described herein are less sensitive compared with those for Operational Performance Monitoring, as they are intended to be instigated only if Table 4 triggers are met.

The monitoring locations included in this trigger have been reduced in this Version 5 of the RAMP, following a review undertaken in accordance with Section 8.2 of Version 4 of the RAMP.

Edithvale Project

Natural hydraulic head differences
This aspect represents a criterion based on differences in groundwater level across the rail trench. The measurement of paired monitoring locations is necessary as the key indicator that project infrastructure is performing as expected and that potential impacts (if identified) are due to the project or other factors.

If the difference in groundwater levels across the rail line increases by 3.0 m (above the baseline differences) for a sustained period of three months, this represents a line of evidence that groundwater levels have been affected by the project. This trigger component relating to measurement of natural hydraulic head difference across the trench is considered the most relevant aspect of the trigger, as it indicates potential project induced change to groundwater conditions. If this trigger is met, the process therefore instigates further assessment / action, irrespective of whether the other component of the trigger (a change in natural groundwater levels) is measured.

Change in natural groundwater levels
This aspect represents a criterion based on the differences in groundwater levels to the east (up hydraulic gradient) of the pile walls, between the project area and a control site that is distant but comparable to, the project area.

If the difference in groundwater levels on the up-gradient side of the rail line are greater than a control bore site by more than 1.5 m (after correcting for baseline differences) and for a sustained period of 3 months, then there is potential that groundwater levels have been affected by the project.

The value of the 1.5 metres trigger still represents an acceptable change in hydraulic head, as it would not result in impacts to Edithvale Wetland, but would instigate further assessment and if required, the *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7) could subsequently be initiated.

Bonbeach Project

The Bonbeach Project triggers to implement the *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7) adopt the same rationale and metrics as per the Edithvale Project. The monitoring locations are specific to the Bonbeach Project area and Bonbeach control site.

The adopted triggers at Bonbeach still represent acceptable changes to groundwater conditions that would not result in impacts to Edithvale Wetland, but would instigate further assessment and if required, the *Edithvale Wetlands Monitoring and Mitigation Plan* (EPR_FF7) could subsequently be initiated.

Groundwater quality

Groundwater salinity

The groundwater salinity triggers for both the Edithvale and Bonbeach projects aim to assess the potential for adverse effects on groundwater quality and environmental values resulting from potential saltwater intrusion.

The trigger comprises criteria based on temporal change (increase) in groundwater salinity measured against ambient groundwater salinity at specific groundwater monitoring bores, including:

- A criterion measured periodically to assess for a continually increasing trend using the Mann-Kendall trend analysis, relative to groundwater salinity at a control bore site.
- A second criterion that considers the situation where large changes in salinity occur from one event to another, which may not be identified as a trend using the Mann-Kendall trend analysis.

The monitoring locations included in this trigger have been modified in this Version 5 of the RAMP, following a review undertaken in accordance with Section 8.2 of Version 4 of the RAMP, which resulted in a rationalisation of the monitoring program. The salinity trigger includes monitoring of groundwater salinity in the Quaternary Aquifer (through trigger EPR-ID18-BH05 and control bore ID18-BH01) and the deeper Upper Tertiary Aquifer (through trigger bore ID18-GWBH02 and control bore ID18-BH01A). The rationale being that potential changes to salinity through landward migration or up-coning of the saltwater wedge would be measured in the deeper aquifer first, which has fewer protected environmental values owing to its saline water quality. This approach would provide early warning and time for further assessment to be undertaken or mitigation measures to be established.

Contamination migration

Groundwater quality data

Groundwater quality for any plume at a given bore will vary over time, even in the situation where the concentration and extent of the plume are stable. Plume stability is generally assessed by evaluating time series data. The trigger levels have been set at a level to distinguish between normal variations that will depend on aspects such as natural water level variations and changes in plume concentrations and extent. If these triggers are met, the assessment will consider this information when the significance of the results is analysed.

Natural hydraulic head differences

This aspect represents a criterion based on differences in groundwater level across the rail trench.

Through a review undertaken in accordance with Section 8.2 of Version 4 of the RAMP, additional statistical analysis has been undertaken to provide a technical review of groundwater level trends at Edithvale and Bonbeach, and inform revision of the trigger approach and/or trigger metrics.

Water level changes were evaluated and compared to each project's control bore, using two different methodologies:

- Three different methods were applied to assess groundwater level changes, including:
  1. Hydrographs vs Rainfall
  2. Groundwater level difference from initial water level (DFWL)
  3. Groundwater level difference from baseline levels (DFB)
- Cumulative deviations from DFWL and DFB were also calculated in this process.

The review defined three different impact categories to group bores according to their water level trends compared to the relevant control bore:

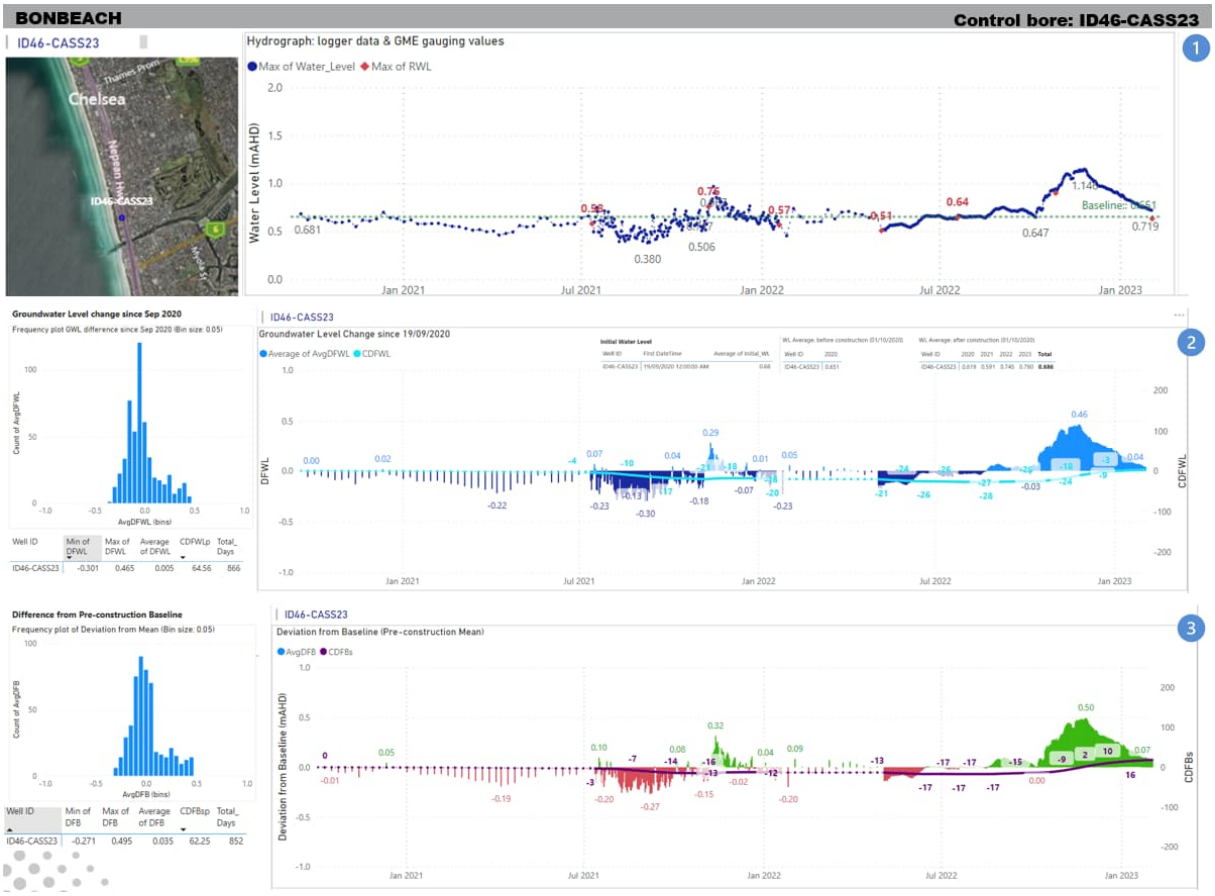
1. Highly affected: representing bores with 100% deviation from the relevant control bore
2. Moderately affected: representing bores with deviations 25% above the relevant control bore
3. Minimally affected: representing bores with deviations less than 25% from the relevant control bore

Almost 56% of Bonbeach monitored bores were considered highly to moderately affected by the project construction, compared to 24% at Edithvale.

Based on this review, changes to the RAMP groundwater monitoring program were implemented, through the updated understanding of the influence of natural and project induced impacts at each monitoring location, including the cumulative effect of consecutive wet periods.

Specifically relating to the trigger metrics for contamination migration, the maximum DFB values calculated at the two project control bores were used to inform the RAMP trigger metrics, particularly in defining the acceptable difference in groundwater levels between any of the bore pairs in the project area. Figure 8 and Figure 9 present this data and statistical analysis for Bonbeach and Edithvale, respectively. These figures show that the maximum DFB at the projects were calculated to be 0.5 m for Bonbeach and 0.4 m Edithvale and it is these metrics that have been used to inform the Table 8 trigger.

Figure 8 Hydrograph showing DFWL distribution for Bonbeach project bores



Notes:
a. Hydrograph for Bonbeach control bore ID46-CASS23
b. Histogram showing DFWL distribution for ID46-CASS23 (Min: -0.3, Max: 0.46, Average: 0.005)
c. Deviation from Initial Water Level (Sep 2020) for ID46-CASS23 over time showing the DFWL maximum of 0.46 m in November 2022
d. Histogram showing DFB distribution for ID46-CASS23 (Min: -0.271, Max: 0.495, Average: 0.035),
e. Deviation from Baseline (Oct 2020) for ID46-CASS23 over time showing the DFB maximum of 0.495 m in November 2022

Figure 9 Hydrograph showing DFWL distribution for Edithvale project bores

Notes:

a. Hydrograph for Edithvale control bore ID18-BH01
b. Histogram showing DFWL distribution for ID18-BH01 (Min: -0.33, Max: 0.29, Average: -0.03)
c. Deviation from Initial Water Level (Sep 2020) for ID18-BH01 over time showing the DFWL maximum of 0.29 m in November 2022, correlating with water level peak
d. Histogram showing DFB distribution for ID18-BH01(Min: -0.260, Max: 0.358, Average: 0.042)
e. Deviation from Baseline (Oct 2020) for ID18-BH01 over time showing the DFB maximum of 0.358 m in November 2022

Change in natural groundwater levels

This aspect represents a criterion based on the differences in groundwater levels to the east (up hydraulic gradient) of the pile walls, between the project area and a control site that is distant but comparable to, the project area. This is to take into account natural climatic variations in groundwater levels that may occur over time.

If the difference in groundwater levels on the up-gradient side of the rail line are greater than a control bore site by more than 0.5 m for Bonbeach and 0.4 m Edithvale (after correcting for baseline differences, where baseline data is available) for a sustained period of 3 months, then there is potential that groundwater levels have been affected by the project.

Groundwater acidity

The groundwater acidity triggers for both the Edithvale and Bonbeach projects aim to assess the potential for project-induced activation of CASS and/or mobilisation of any existing acidity, such that groundwater acidification affects environmental values of land and groundwater.

The trigger comprises the following criteria:

- An initial criterion based on the measurement of groundwater levels and identification of project induced groundwater drawdown. This trigger is based on the differences in groundwater levels to the west (down hydraulic gradient) of the pile walls, between the project area and a control site that is distant but comparable to, the project area.
- Secondary criteria based on temporal change in groundwater quality (primarily pH as an indicator parameter, which can be measured through automatic downhole techniques) from a predetermined baseline of ambient levels. This trigger is reliant on developed groundwater pH data from specific groundwater monitoring bores, which are measured periodically to assess for either a decrease in pH by more than one pH unit, or, a reduction in groundwater pH condition over three months, measured either by:
    - A statistically significant decreasing trend (i.e. CF > 90% using Mann-Kendall trend test) that has resulted in, or is likely to result in, an exceedance of relevant environmental value criteria below the ambient pH range; or
    - A decrease in pH by more than one pH unit over three months compared to ambient levels calculated during baseline monitoring using the 20th percentile of concentration values
- A tertiary criterion requiring physical laboratory testing, undertaken if the preceding criteria are met (i.e. if a reduction in pH condition is identified). This criterion requires collection of samples for laboratory testing for a suite of parameters including dissolved metals, alkalinity, acidity, cations and anions.

The rationale with this approach is that groundwater level drawdown must be evident (at specific locations) for a project-induced acidity risk to be present, and groundwater pH (and other indicatory analytes) must indicate a trend towards acidification for the risk to be realised.

Appendix H: Key personnel contact details

- *LXRP Environment Manager*
- *Southern Program Alliance Environment Manager*
- *Department of Transport and Planning*
- *Vic Track Environment Manager*
- *EPA Victoria*
- *Melbourne Water*
- *Kingston City Council*
- *Southern Rural Water*
- *Commonwealth Department of Climate Change, Energy, the Environment and Water*
- *Victorian Department of Energy, Environment and Climate Action*

Note: This appendix may be updated as required without approval from the Commonwealth Minister for the Environment or delegate.