Shotover WWTP

Surface Water and Groundwater Assessment

Queenstown Lakes District Council

28 May 2026

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Executive summary

Queenstown Lakes District Council (QLDC) are applying for resource consents for construction and operation of a wastewater discharge structure on the Shotover Delta and the discharge of treated wastewater to the Kawarau River. The discharge structure is proposed to comprise a rock outfall structure, which delivers treated wastewater into the Kawarau River, at a location immediately upstream of the confluence of the Kawarau and Kimiākau/Shotover Rivers.

This report documents the existing environment, including the effects of the current and former wastewater discharge on the environment, and the effects of the proposed discharge into the Kawarau River. The assessment utilises qualitative and quantitative methods as well as modelling of mixing and dispersion within the river environment, to provide water quality predictions incorporating increases in wastewater flows driven by population increases. This report also includes a public health risk assessment to assess the risk to public health, through recreational activities (bathing).

The assessment is informed by extensive site investigations and water quality monitoring. The design of the proposed outfall, with a discharge point approximately 10 m from the river edge, considers the river dynamics and will result improved mixing and dispersion of the highly treated wastewater with the river.

A summary of the assessment findings and potential effects assessed, associated with the proposed discharge, is provided in the table below.

Table 1.1 Summary of effects

Category	Description
Effects to groundwater	– Ceasing use of the dose and drain field (DaD) is resulting in progressive improvements in groundwater quality, and improvements in surface water quality where impacted groundwater discharge to the riverbanks of the Shotover and Kawarau Rivers. Effects of the proposed discharge to the Kawarau River on groundwater quality are predicted to be negligible. – Seepage rates and contaminant discharge from the treated wastewater calamity pond are expected to be limited, particularly in the context of the historical oxidation pond conditions. The potential effects of this pond discharge are expected to be negligible.
Effects to hydrology	– Construction of the discharge structure in the bed and on the bank of the Kawarau River is expected to result in a small reduction in channel cross-sectional area at the proposed location. However, given the much larger variability of channel area over time, the current relatively large area of the channel and reduced potential for sediment aggregation in the lee of the training line, the structure is not expected to result in damming effects or changes in return flow beyond those that have existed in the past. The effects on river hydrology are considered to be less than minor. It is considered that the requirements of the WCO are met in this regard. – The diversion of river water around the discharge structure is considered to have limited influence on river hydrology, with shallow water flow continuing downstream of the structure. The effects to flow paths are therefore considered to be less than minor.
Effects to water quality	– Effects to water quality after reasonable mixing are assessed as being predominantly less than minor. With ecotoxicity effects considered to be less than minor, and negligible change in temperature, pH and DO are expected. Water quality is predicted to remain consistent with a high quality of water, as indicated by NPSFM and ANZG criteria, with the exception of phosphorus. – Potential periodic increases in phosphorus concentrations under low flow conditions are expected to be limited in duration and unlikely to result in more than minor effect on water quality or an increase in primary production at such times (refer Boffa Miskell (2026)). With further mixing downstream of the reasonable mixing zone (complete mixing), phosphorus concentrations are predicted to meet NPSFM attribute band A

Category	Description
	– Cumulative effects on water quality, and downstream effects of the discharge on water resources, such as Lake Dunstan, are considered to be no more than minor, with water remaining consistent with NPSFM attribute band A, and meeting the Schedule 15 Water Group two criteria after complete mixing.
Effects to public health	– A high level of treatment wastewater currently receives, proposed improvements in filtration, and enhanced UV treatment, are predicted to limit the potential risk of wastewater derived pathogens to public health downstream of the discharge structure. Water quality is considered to remain suitable for bathing downstream of the discharge structure and at the primary contact site identified. – The requirements of the WCO in regard to water quality suitable for contact recreation are assessed as being met, with water quality predicted to be consistent with Attribute Band A (Blue) after reasonable mixing. – Effects to public health from recreational water use are considered to be less than minor, with improved treatment expected to result in water quality with very low levels of additional risk of infection. – Effects to downstream users of water for potable supply are considered to be less than minor, in the context of the existing catchment impacts on Kawarau River water quality and the need for disinfection to provide a water supply consistent with the DWSNZ microbiological MAVs.

A number of specific refinement activities are proposed during detailed design, to provide further confirmation of assessment and to support detailed design decisions relating to the discharge structure design and the level of enhanced UV treatment achieved.

1. Analysis of the discharge structure influence on upstream water levels under specific flood conditions, to confirm the limited impact of the structure on flood events and return flow.
2. Extended microbiological monitoring of wastewater and river water, and refinement of the public health risk assessment via location specific QMRA.

The findings of these refined assessments will be used to direct detailed design decisions, providing a high degree of confidence that the designs will achieve the required outcomes. This will include potential changes to the discharge structure, such as elevations, and inclusion of additional UV treatment, to further improve management of public health risks in the sensitive Kawarau River environment.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

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List of Acronyms

Acronym or Definition	Full Term
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Quality (2018)
$cBOD_5$	Carbonaceous 5-day Biochemical Oxygen Demand
CFD	Computational Fluid Dynamics
DaD	Dose and drain structure
LoD	Limit of detection
DGVs	Default guideline values
DRP	Dissolved reactive phosphorus
DWSNZ	Water Services (Drinking Water Standards of New Zealand) Act 2022
E. coli	*Escherichia coli*
FRE(x) (e.g. FRE3)	Average number of flow events per year that exceed (X)times median flow
MALF	Mean Annual Low Flow
MAV	Maximum allowable value
MLE	Modified Ludzack–Ettinger
NEMP 3.0	PFAS National Environmental Management Plan (NEMP) Version 3.0 (HEPA, 2025)
NPS FM	National policy statement for Freshwater Management 2020 – Amended 2025
PDWF	Peak Dry Weather Flow
REMP	Receiving Environment Monitoring Plan
RPW	ORC Regional Plan: Water
QMRA	Quantitative microbial risk assessment
TAN	Total ammoniacal nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total suspended solids/sediment
UV	Ultraviolet
WCO	Water Conservation (Kawarau) Order 1997
WW	Wastewater
WWTP	Wastewater Treatment Plant

1. Introduction

Queenstown Lakes District Council (QLDC) are applying for resource consents for construction and operation of a wastewater discharge structure on the Shotover delta and the discharge of treated wastewater to the Kawarau River. The discharge structure is proposed to comprise a rock outfall structure, which delivers treated wastewater into the Kawarau River, at a location immediately upstream of the confluence of the Kawarau and Kimiākau/Shotover Rivers. To support identification of wastewater treatment requirements, design of the discharge structure and to provide technical analysis to inform the assessment of environmental effects for the consent application, GHD Limited (GHD) were engaged to undertake an assessment of effects to groundwater, surface water, water quality and public health.

Site investigations to inform these assessments have been carried out by GHD over the period March 2025 to April 2026, with monitoring of wastewater, groundwater and surface water ongoing to further support specification of treatment and discharge detailed design.

This report documents the existing environment, including the effects of the current and former wastewater discharge on the environment, and the effects of the proposed discharge into the Kawarau River. The assessment utilises qualitative and quantitative methods as well as modelling of mixing and dispersion within the river environment, to provide water quality predictions, incorporating increases in discharge rates driven by population increases. This report also includes a public health risk assessment to assess the risk to public health, through recreational activities (bathing).

1.1 Purpose of this report

The purpose of this report is to provide an assessment of effects to groundwater, surface water, water quality and public health in relation to the consent applications for the proposed long-term (35 years) discharge of treated wastewater to the Kawarau River via a rock outfall structure.

1.2 Scope and limitations

This report: has been prepared by GHD for Queenstown Lakes District Council and may only be used and relied on by Queenstown Lakes District Council for the purpose agreed between GHD and Queenstown Lakes District Council as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Queenstown Lakes District Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

GHD has prepared the dispersion model ("Model") for, and for the benefit and sole use of, Queenstown Lakes District Council to support the assessment of effects to surface water from the proposed discharge and must not be used for any other purpose or by any other person.

The Model is a representation only and does not reflect reality in every aspect. The Model contains simplified assumptions to derive a modelled outcome. The actual variables will inevitably be different to those used to prepare the Model. Accordingly, the outputs of the Model cannot be relied upon to represent actual conditions without due consideration of the inherent and expected inaccuracies. Such considerations are beyond GHD's scope.

The information, data and assumptions ("Inputs") used as inputs into the Model are from publicly available sources or provided by or on behalf of the Queenstown Lakes District Council, (including possibly through stakeholder engagements). GHD has not independently verified or checked Inputs beyond its agreed scope of work. GHD's scope of work does not include review or update of the Model as further Inputs becomes available.

The Model is limited by the mathematical rules and assumptions that are set out in the Report or included in the Model and by the software environment in which the Model is developed.

The Model is a customised model and not intended to be amended in any form or extracted to other software for amending. Any change made to the Model, other than by GHD, is undertaken on the express understanding that GHD is not responsible, and has no liability, for the changed Model including any outputs.

GHD has prepared this report on the basis of information provided by Queenstown Lakes District Council and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

GHD has relied on information from a number of other reports (referenced throughout this report) and various public data sources, including but not limited to:

- ORC records on groundwater and surface water.
- River flow records supplied by Earth Sciences New Zealand (ESNZ)
- Climate information from StatsNZ

We have assumed that information is correct and have not independently validated the information. Assumptions relating to assessment inputs are documented in the relevant sections of this report.

2. Proposed activity

2.1 Background

The Shotover Wastewater Treatment Plant (Shotover WWTP) was originally constructed in 1974, to treat wastewater for the wider Queenstown area with a basic inlet works channel and three oxidation ponds. The plant has evolved significantly over time to both improve plant infrastructure, treatment and allow for the plant to cater for population growth in the Wakatipu Basin. Previous upgrades include:

- In 1987, an aeration septage lagoon and new inlet works were built.
- New inlet works were built in 2014 to replace the previous inlet works.
- Stage 1 upgrades were commissioned in 2017, including a grit removal system, a septage receiving facility, a MLE reactor with secondary clarifier, and UV disinfection. The oxidation ponds were retained to treat a portion of the incoming wastewater, and the effluent streams are combined upstream of the UV for disinfection.
- Stage 2 upgrades were undertaken in 2019, which involved the implementation of a “disposal to land” scheme via rapid infiltration into the Shotover Delta gravels. This was known as the Dose and Drain (DaD).
- Stage 3 upgrades were completed in late 2025 to accommodate growth in the Queenstown area. The upgrades added the second MLE reactor and another clarifier to increase the treatment capacity to a 2048 population forecast. The oxidation ponds have been decommissioned.

2.1.1 History of discharge to the Kimiākau/Shotover River

Prior to 2019, treated wastewater was discharged directly to the Kimiākau/Shotover River via open channels. Discharge was originally via an open channel diagonal to the main river flow direction (shown as first drain on Figure 2.1) however due to changes in the braided river form (location of flowing braids and gravel banks) discharge via this first drain was discontinued. A second drain, oriented perpendicular to the river flow, became the preferred discharge outfall. This second drain was utilised until 2019.

Figure 2.1 ***Approximate location of first drain (orange) and second drain (blue) where treated wastewater was discharge to the Kimiākau/Shotover River. Approximate location of the DaD field is shown by dashed red line.***

2.1.2 DaD discharge to Shotover Delta

The DaD was commissioned in early 2019 as part of the Stage 2 upgrades. The DaD received treated wastewater from both the MLE/Clarifier process train (~80%) and oxidation ponds process (~20%) following UV treatment. The original design comprised a series of buried, linear basket structures within a gravel bed into which the treated wastewater was discharged. It is understood that underlying river delta gravels were excavated to a depth of 1-1.5 m below ground level to construct the disposal field. Operation of the DaD constituted flooding (dosing) of the gravels and allowing the treated wastewater to soak (drain) into the underlying gravels and into the shallow groundwater system.

The DaD field experienced numerous issues after commissioning, with overflows and large areas of ponding. Due to the ongoing disposal issues, the DaD was modified to a series of open infiltration ponds (approximately 2.5 m depth). Further modifications were undertaken in 2024, with a perimeter bund constructed to increase wastewater level, storage capacity, increase the hydraulic gradient for discharge to ground and prevent seepage through the perimeter (May 2024). An overflow pipe was also installed in the perimeter bund in the final downgradient DaD cell in order to reduce the risk of perimeter bund scouring and failure. The overflow pipe directed excess treated wastewater to an adjacent pit which subsequently overflowed to delta immediately southeast of the DaD. These modifications improved discharge rates, however there remained large areas of ponded wastewater, both within the DaD footprint and between the DaD and Kawarau River.

The occurrence of spring discharges (of treated wastewater) immediately downgradient of the DaD (Figure 2.2), noted during site visits undertaken by GHD, indicate that the aquifer permeability was not sufficient to allow complete sub-surface flow of wastewater at the rates applied. The high wastewater level (elevation) within the DaD created steep hydraulic gradients, with the piezometric surface being greater than ground level. This was particularly evident during periods of high river and groundwater levels (spring and early summer). During low flow (river) conditions in March 2025, ponding was limited to the area immediately downgradient of DaD.

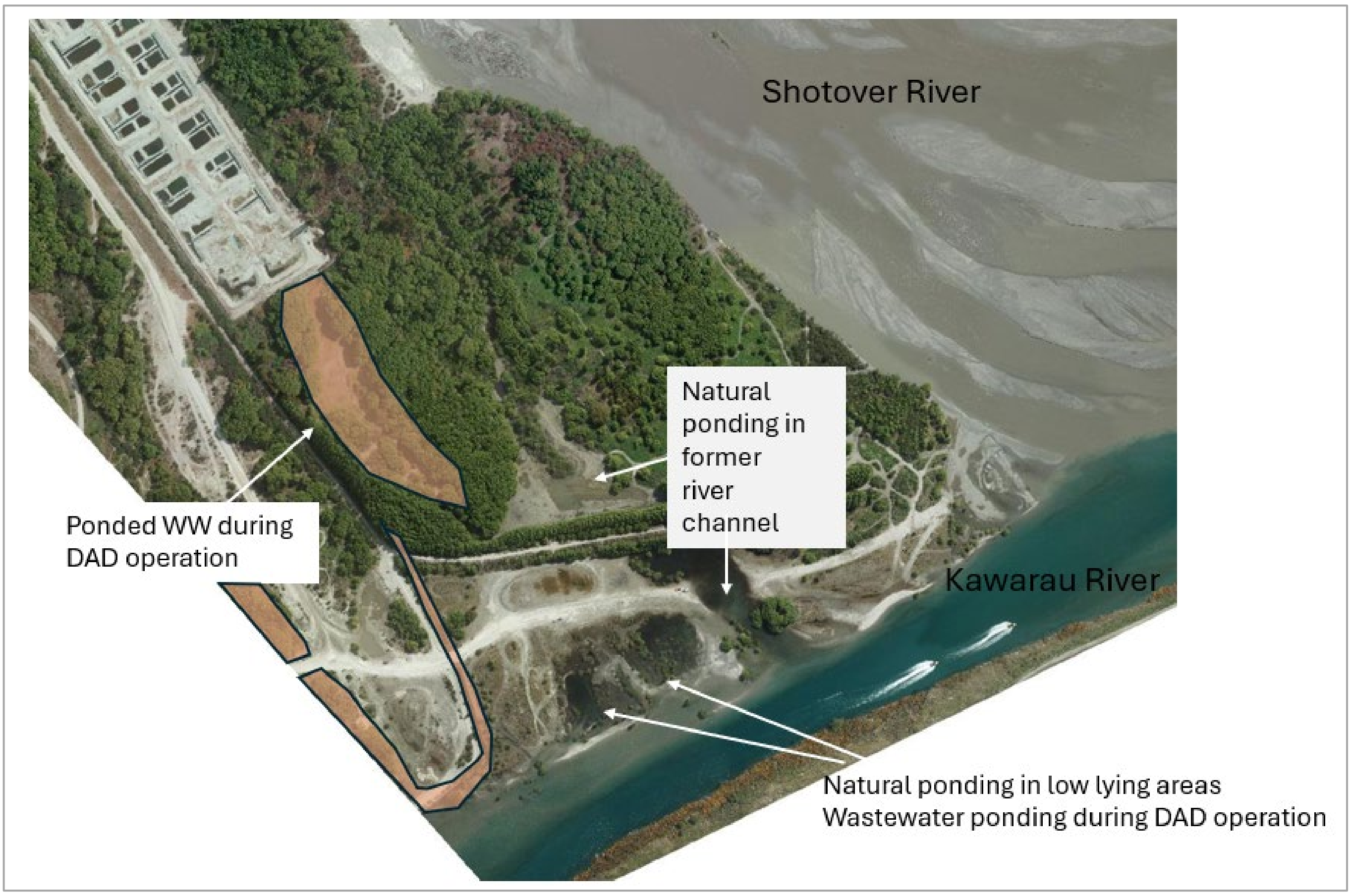


Figure 2.2 Aerial photograph of lower delta during high flow conditions (November 2025)

2.1.3 Emergency discharge to Kimiākau/Shotover River

The presence of ponded water presented an unacceptable bird strike risk to aircraft due to the increasing numbers of waterfowl directly below the flight path for landing at Queenstown airport. Due to this increasing risk, QLDC decided to redirect the treated wastewater down an existing open discharge channel (second drain as shown in Figure 2.1, last used in 2019) to the Kimiākau/Shotover River under emergency works provisions. A summary of the activities associated with the emergency works is provided below:

- As the discharge channel had not been used for a number of years, the channel was overgrown with vegetation. Clearance of vegetation was undertaken using two excavators on 27-28 March 2025. These works were confined to the land parcels owned by QLDC and did not include the final 100 m of the channel on the land parcel owned by the Department of Conservation (DoC).
- Discharge down the channel commenced at approximately 7:45 am on the 31 March 2025.
- Approximately two days of dual discharge to the disposal field and discharge channel occurred. The discharge to the disposal field ceased at approximately 5:30 pm, 1 April 2025.
- There was a noticeable colour change in the treated wastewater within the discharge channel once wastewater from the oxidation ponds was directed to the channel.
- Wastewater quality and appearance have improved following the completion of the Stage 3 upgrades and the cessation of use of the oxidation ponds for wastewater treatment.

The discharge channel directs treated wastewater to a river braid adjacent to the true right bank of the Kimiākau/Shotover River. Pooling of treated wastewater occurs at the immediate discharge before mixing with water from the braid. Mixed water flows downstream adjacent to the riverbank, before mixing with a second river braid approximately 190 m downstream of the discharge point. Water quality immediately downstream of this mixing point is considered to represent water quality after reasonable mixing, with a monitoring location (RS06B) in this location considered representative of these conditions.

Due to the variable nature of the braided river form, the proportion of flow available for mixing changes with river dynamics. This is discussed further in the application for resource consents to authorise the ongoing adverse effects of the emergency discharge (the short-term consents to 31 December 2030).

2.2 Shotover WWTP operations

2.2.1 Current treatment plant

The QLDC Shotover WWTP treats wastewater from the wider Queenstown urban area. The existing treatment process has recently undergone the Stage 3 upgrade, completed in late 2025, and currently comprises the following stages:

- Preliminary treatment – three inlet screens and grit removal
- Secondary treatment – via two bioreactor tanks of Modified Ludzack-Ettinger (MLE) arrangement to achieve biological nutrient removal. The microbes (Mixed liquor) are separated by two secondary clarifiers and returned back to the bioreactor tanks.
- UV disinfection – The existing UV system was installed since Stage 1, where it was originally designed for a blend of highly treated secondary clarifier effluent and pond effluent.
- Two calamity ponds stored onsite:
  - Raw wastewater calamity pond (RWCP) – this was constructed as part of the Stage 3 upgrade
  - Treated wastewater calamity pond (TWCP) - this is being designed at present, for construction and operational by December 2027 to comply the Enforcement Order timeframe. QLDC is undertaking this as a separate project.
- Sludge management – two centrifuges for mechanical dewatering of biosolids generated from the secondary treatment process and filtered solids from tertiary filters (proposed upgrade)

The recent Stage 3 MLE and clarifier expansion was designed to accommodate the catchment growth up to 2048 (based on previous population forecast), or an average flow of 19,100 m^3/day. A further capacity upgrade will be required within the consent duration when the capacity is reached. This could be in the form of additional trains (e.g. MLE3) or process intensification, and the exact upgrade requirements and design will be developed in future.

Items in Blue are existing infrastructure.
Items in Green relate to the Short-Term discharge.

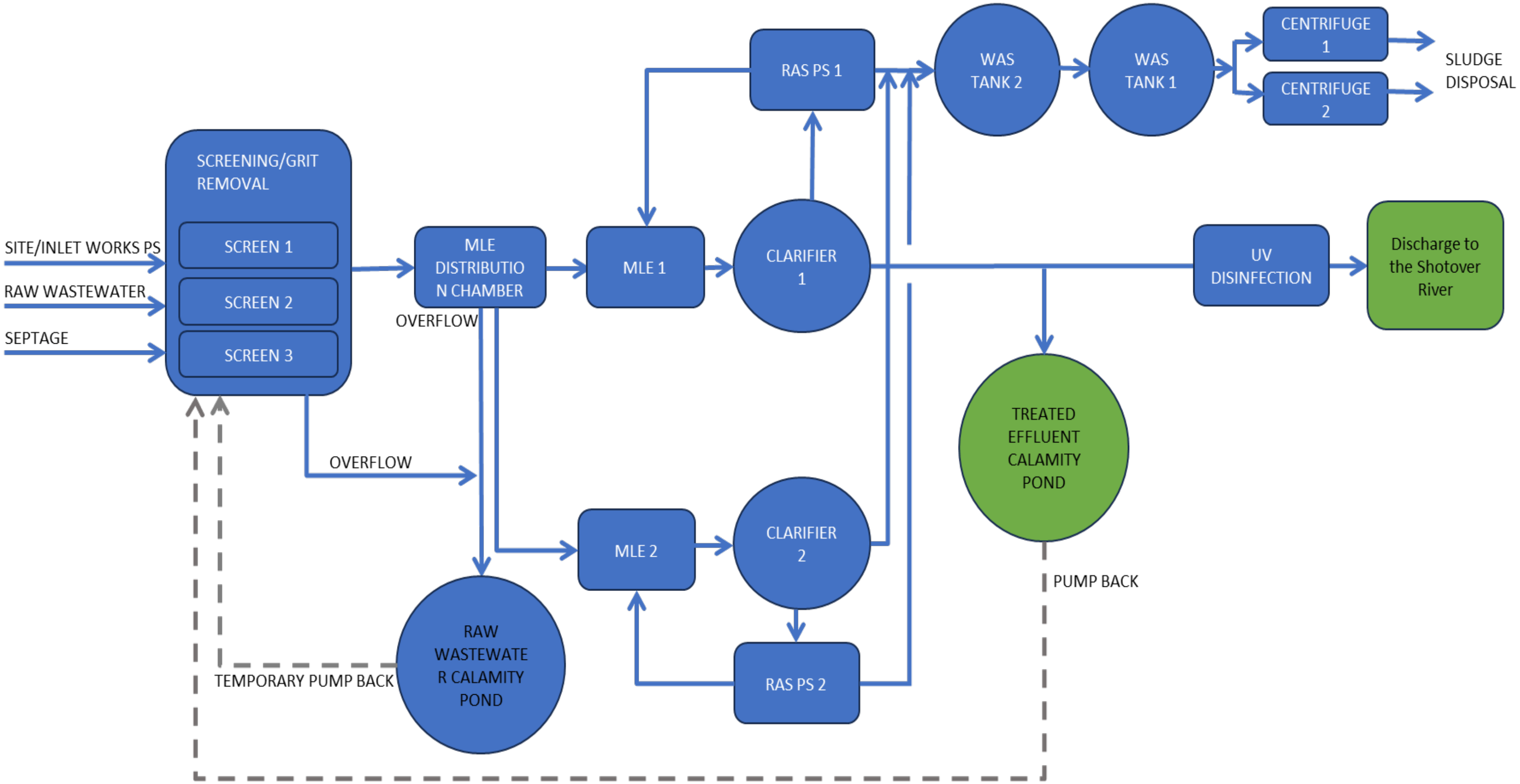


Figure 2.3 Shotover WWTP process block diagram - current

2.2.2 Planned upgrade

In reliance on the long-term operation of the Shotover WWTP discharges, additional upgrades are proposed for the Shotover WWTP to improve the treated effluent quality and reduce potential effects associated with discharge of treated wastewater via a rock outfall to the Kawarau River. The proposed upgrades comprise the following plant improvements / modifications:

- Supplementary chemical dosing for phosphorus removal, by December 2027.
- Tertiary filtration which removes fine solids and solids-bound contaminants in the secondary clarifier effluent. The tertiary filters will be situated in an engineered fill within Pond 3, which is to be re-purposed as the TWCP.
- Enhanced UV disinfection which is designed for higher capacity (future-proof) and higher treatment capacity for virus removal by December 2028 (subject to QMRA assessment).

The new infrastructure of tertiary filters and enhanced UV is located within the existing Shotover WWTP site boundary, primarily on the engineered fill platform within the decommissioned oxidation pond (Pond 3). Pond 3 is converted into the TWCP, operational by December 2027 as per Enforcement Order timeframe.

The upgraded discharge also includes new effluent conveyance and rock outfall. The conveyance system transfers treated effluent from the Shotover WWTP to the Kawarau River.

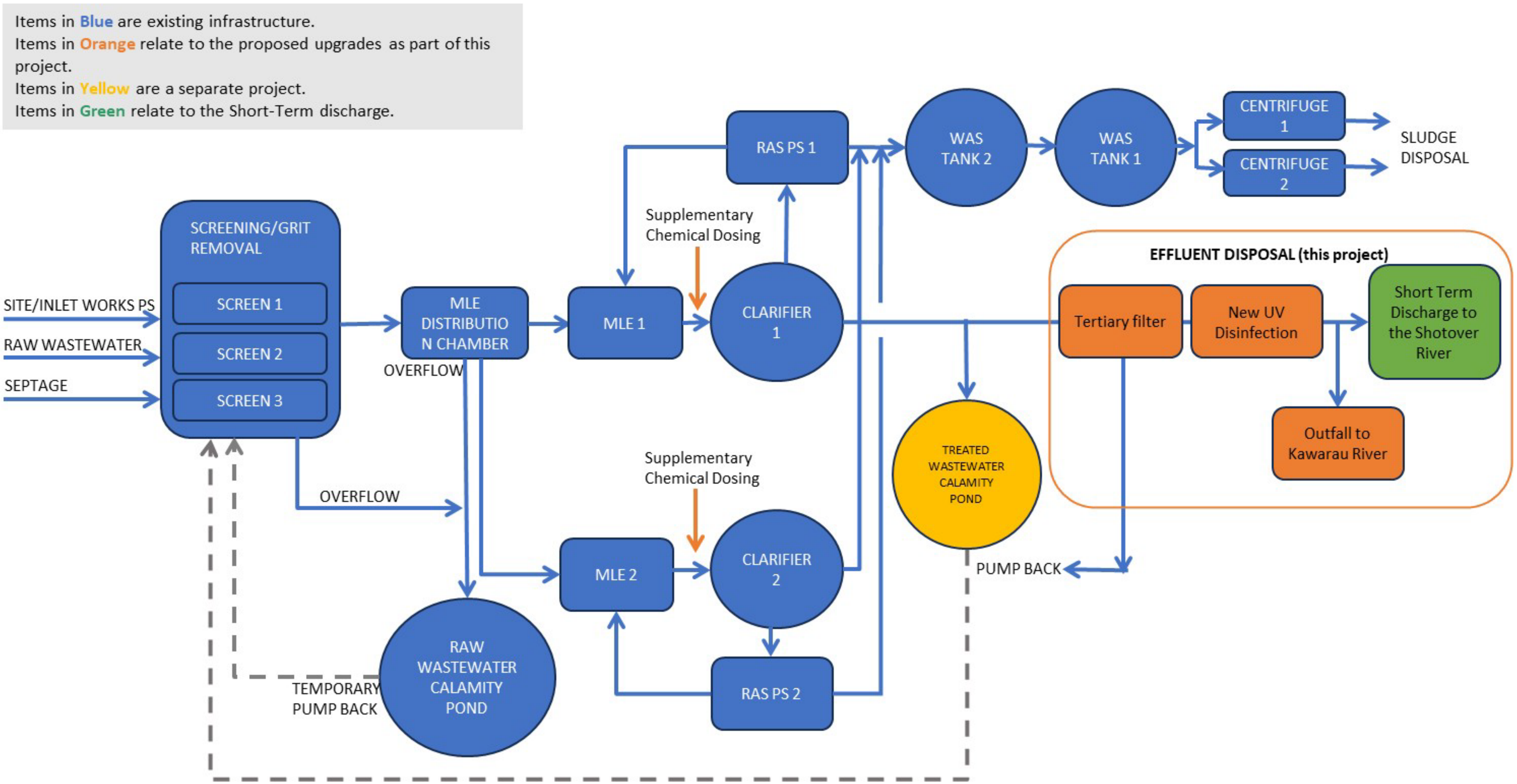


Figure 2.4   ***Shotover WWTP process block diagram – including planned upgrades***

Tertiary Filtration

The new filtration system will include a tertiary filter pump station and tertiary filters.

Tertiary filtration plays a significant role in reducing fine suspended solids prior to UV disinfection. Pile cloth media disc filters have been selected as the preferred for its robustness (e.g. outside in flow pattern) and longevity. It is widely used in the UK, USA and Europe for similar tertiary filtration applications.

The tertiary filters will be sized to achieve median and 95%ile total suspended solids (TSS) limits of 5 and 10 mg/L respectively. The filter media nominal pore size is 10 µm, however the pile cloth on the media surface traps more fine solids for depth filtration and further enhances the filtration efficiency and suspended solids removal.

A new pump station will be installed to continuously transfer secondary clarifier effluent into the tertiary filters. There is also provision for controlled diversion of flows into the treated effluent calamity pond under abnormal or fault conditions.

Three tertiary filters are proposed to handle the maximum discharge volume of 60,000 m^3/day as sought in this application. A space provision has been made for a fourth tertiary filter, for future expansion or additional process redundancy. The filtered effluent will be directed to the downstream UV system for disinfection.

Solids captured by the filters as filter backwash/sludge stream will be returned to the Shotover WWTP for treatment.

The tertiary filters are proposed to be operational by December 2028, and this is to be confirmed as part of the short-term consent condition finalisation.

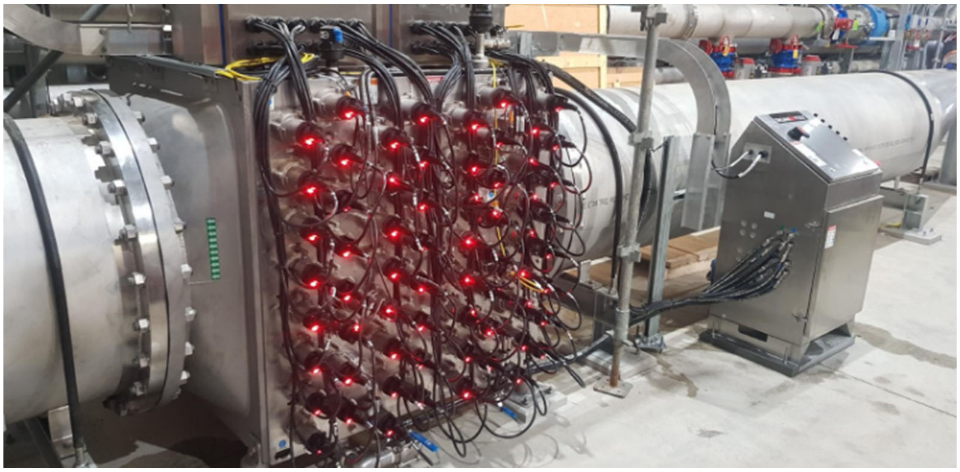
Enhanced UV treatment

Filtered effluent will pass through the new enhanced UV system for disinfection, particularly for virus removal. The existing UV system which was sized for a smaller capacity and for *E. coli* disinfection will be decommissioned. For the purpose of preliminary design, it has been assumed that the UV reactors will be sized for up to 2 log virus removal, which will be subjected to QMRA findings which commences after the lodgement of the consent application.

The UV reactors will be installed in a building, with a much higher dose rate achieving high virus removal rates. These types of UV reactors are used in drinking water (for taste and odour treatment) and recycled water. A high-quality feed water (i.e. low in TSS) is necessary for the UV reactors to operate effectively. Online water quality analysers will be installed to monitor the filtered effluent quality in real-time.

Two reactor units are expected to be required for meeting the peak discharge volume of 60,000 m^3/day in 2060. A space provision in the new building is made for the third UV reactor for additional process redundancy and future expansion.

Virus removal certification will be supplied by the manufacturer, and these certifications are based on meeting the target dose specified in USEPA or other guidelines.



Chemical dosing for phosphorus removal

The existing Modified Ludzack Ettinger (MLE) bioreactor configuration is a well-established secondary treatment process, for excellent removals of total nitrogen and ammoniacal nitrogen with moderate phosphorus removal. To comply with the dissolved reactive phosphorus limit in the short-term consent (expires in December 2030) and this long-term consent application, supplementary chemicals such as aluminium sulfate solution (alum) or poly aluminium chlorine (PACL) will be dosed in the secondary clarifier inlet to remove phosphorus as precipitates. This is commonly practised to achieve similar phosphorus limits for treatment plants based in New Zealand and others overseas.

Due to the chemical quantity used, chemical solutions will be delivered in bulk, and stored in a purpose-built chemical storage facility, comprising of self-bunded tank(s) and chemical dosing station(s). The chemical facility will have an unloading bund.

Treated Wastewater Calamity Pond (TWCP)

The Enforcement Order requires the upgrade of a treated wastewater calamity pond (TWCP) be completed by December 2027. The calamity pond will require decommissioning of the existing oxidation pond 3, including sludge removal, reshaping of the pond base, topsoil spreading with grass seeds.

This calamity pond (TWCP) will be kept dry most of the time, and any stored treated effluent will be returned back to the Shotover WWTP inlet works, or for discharge to the downstream UV.

QLDC is undertaking the design and construction of TWCP as a separate project to this long-term effluent disposal project.

2.3 Discharge activity to Kawarau River

2.3.1.1 Discharge location

The highly treated effluent from the Shotover WWTP is to be discharged to the Kawarau River via a rock outfall structure. A conceptual design of the outfall structure has been developed to meet the following objectives:

- Dispersion of treated effluent into the Kawarau River
- A passive structure that blends in with the surrounding environment
- Limit exposure of public members with the treated effluent before mixing with river

The recent river bathymetry survey at a low-flow condition (ESNZ, 2026) has indicated that better dispersion into the river is achieved with discharge approximately 10 metres away from the shoreline. Below is an indicative general arrangement of the outfall structure, which aims to blend with the surroundings, with shrubs and trees for visual screening and keeping the public away from entering the outfall structure and extending 10 m into the river at low flow conditions for better dispersion.

Figure 2.5 Rock outfall general arrangement drawing (indicative)

2.3.2 Discharge rates

The wastewater flow basis has been adopted from the Short List Option Report (GHD Ltd, 2025b), where GHD assessed the recent QLDC flow data and the latest population forecast estimate from April 2025. The following Table 2.1 summarises these flow estimates for the 2060 design horizon.

Table 2.1 Flow estimates (GHD Ltd, 2025b)

	Recent WW Flows (Discharge Flow)		Wastewater Flow Estimations			
Year	**2023**	**2024**	**2030**	**2040**	**2048**	**2060**
Average Population	46,002	49,359	57,265	69,892	82,325	94,887
Peak Day Population	65,685	72,565	84,830	103,759	122,399	141,233
Average Daily Flow (m^3/d)	9,995	12,060	15,061	19,080	22,475	25,904
Peak dry weather flow (m^3/d)	13,388	15,934	18,675	22,897	26,970	31,085
Peak wet weather flow (m^3/d)	18,861	32,724	34,640	43,885	51,692	59,579

A maximum discharge rate of 694 L/s and a maximum daily discharge volume of 60,000 m^3/day are sought for a term of 35 years.

Several additional assumptions have been included:

- The short-term consent (a December 2030 expiry date is sought) has a maximum discharge rate of 400 L/s, and a maximum daily discharge volume of 29,100 m^3/day.
- The current minimum flow, assuming the plant is in normal operation is 144 L/s or 12,500 m^3/d.
- The 2030 minimum flow, assuming the plant is in normal operation is 174 L/s or 15,061 m^3/d.
- Monitoring of wastewater network inflow and infiltration will be necessary to control the peaking factor of the wastewater flows during significant wet weather events. This is assumed to be undertaken as part of the ongoing overall wastewater management practice by QLDC

2.3.3 Treated wastewater quality and contaminants

Treated wastewater is monitored for primary wastewater contaminants (nutrients and particulate material) on a weekly basis. The implementation of the Stage 3 upgrades and removal of the oxidation pond process in September 2025 has resulted in improved treated water quality, with lower concentrations of key wastewater contaminants such as Total Ammoniacal-N (TAN).

Table 2.2 presents a summary of treated wastewater sampling data collected prior to implementation of the Stage 3 upgrades, while Table 2.3 summarises treated wastewater quality following commissioning of the upgrades.

Comparison of the two datasets indicates a substantial improvement in effluent quality post-Stage 3 for Total Suspended Solids (TSS), TAN, Total Nitrogen (TN), and Biochemical Oxygen Demand (BOD_5), as shown in the Figure 2.6 to Figure 2.12 below.

The treated wastewater concentrations are consistently with the proposed short-term consent limits (currently under processing by ORC) except for total phosphorus and dissolved reactive phosphorus. Supplementary chemical dosing will be needed to reduce the phosphorus levels in the treated effluent.

2.3.3.1 Commonly monitored wastewater contaminants and properties

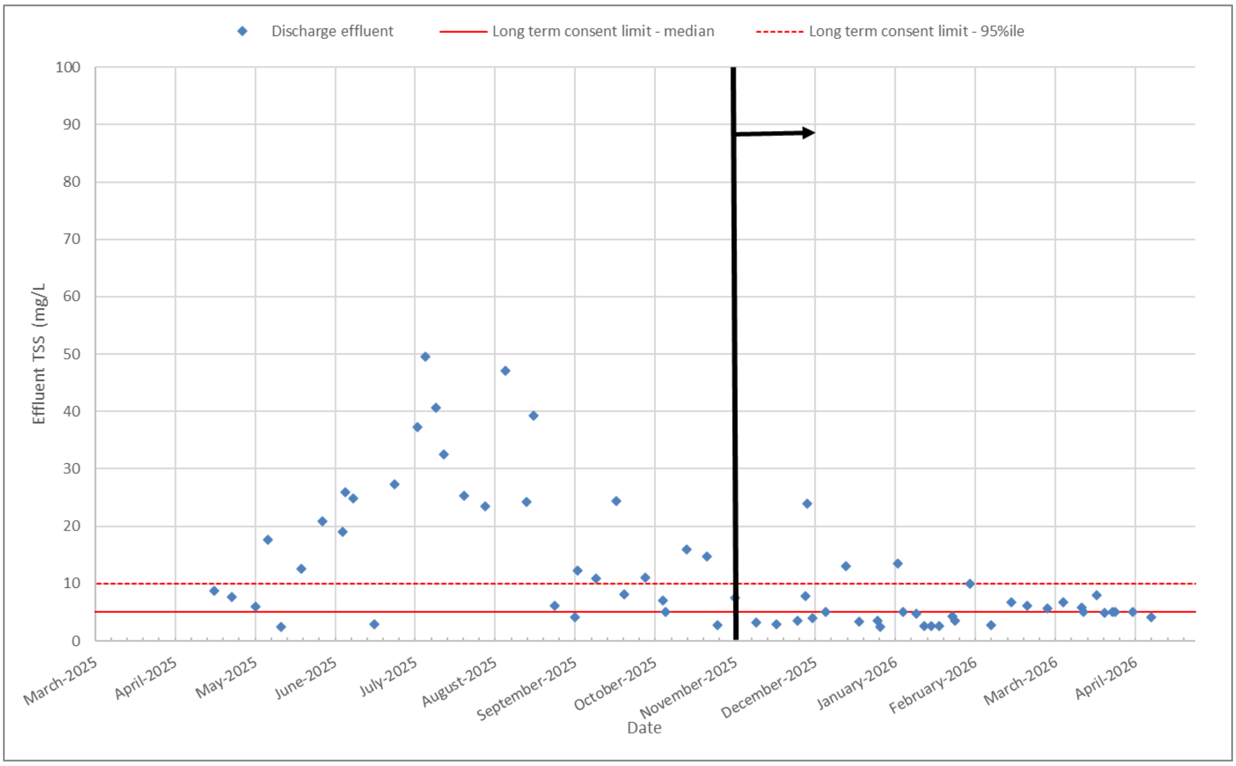


Figure 2.6 Discharge Effluent TSS (mg/L) Results – compared with long term consent

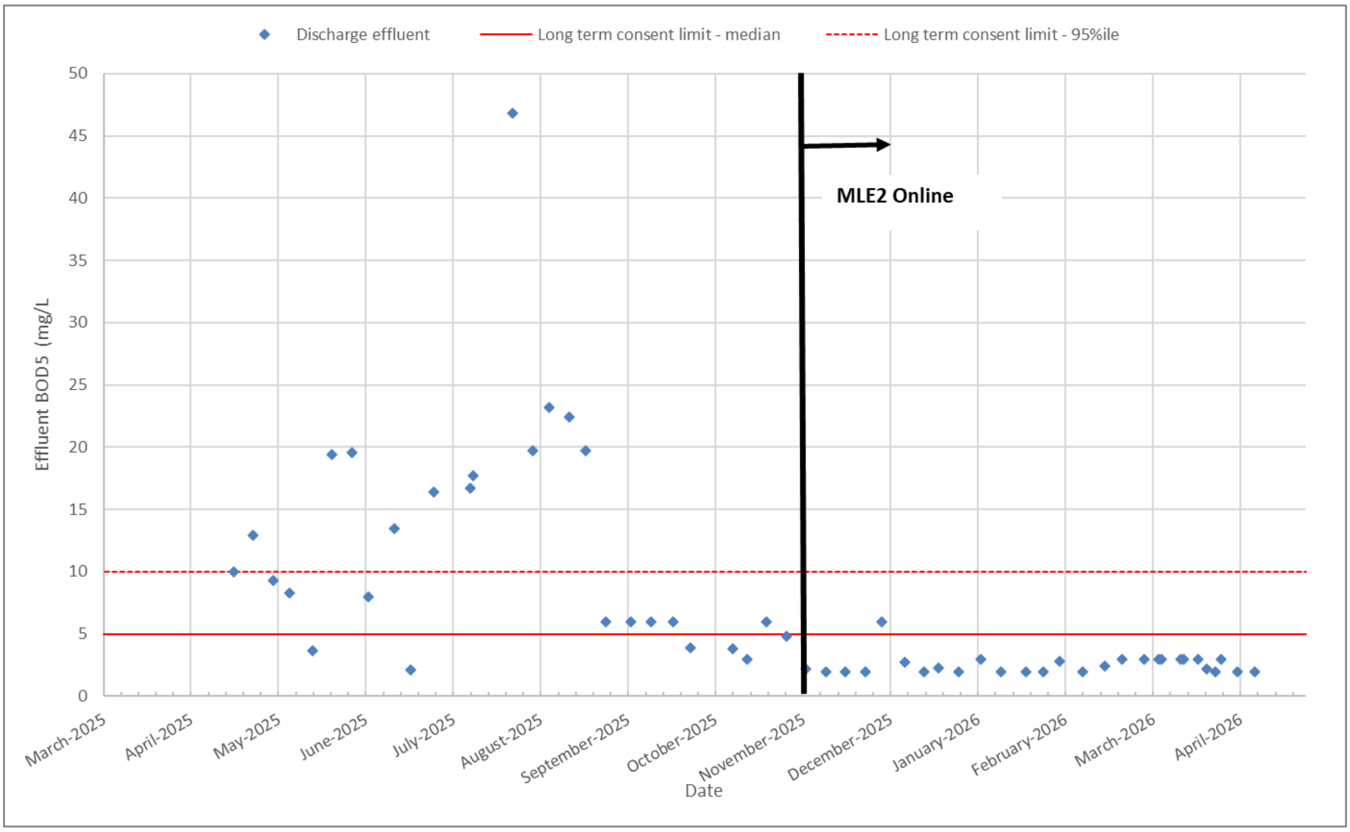


Figure 2.7 **Discharge Effluent BOD$_5$ (mg/L) – compared with long term consent**

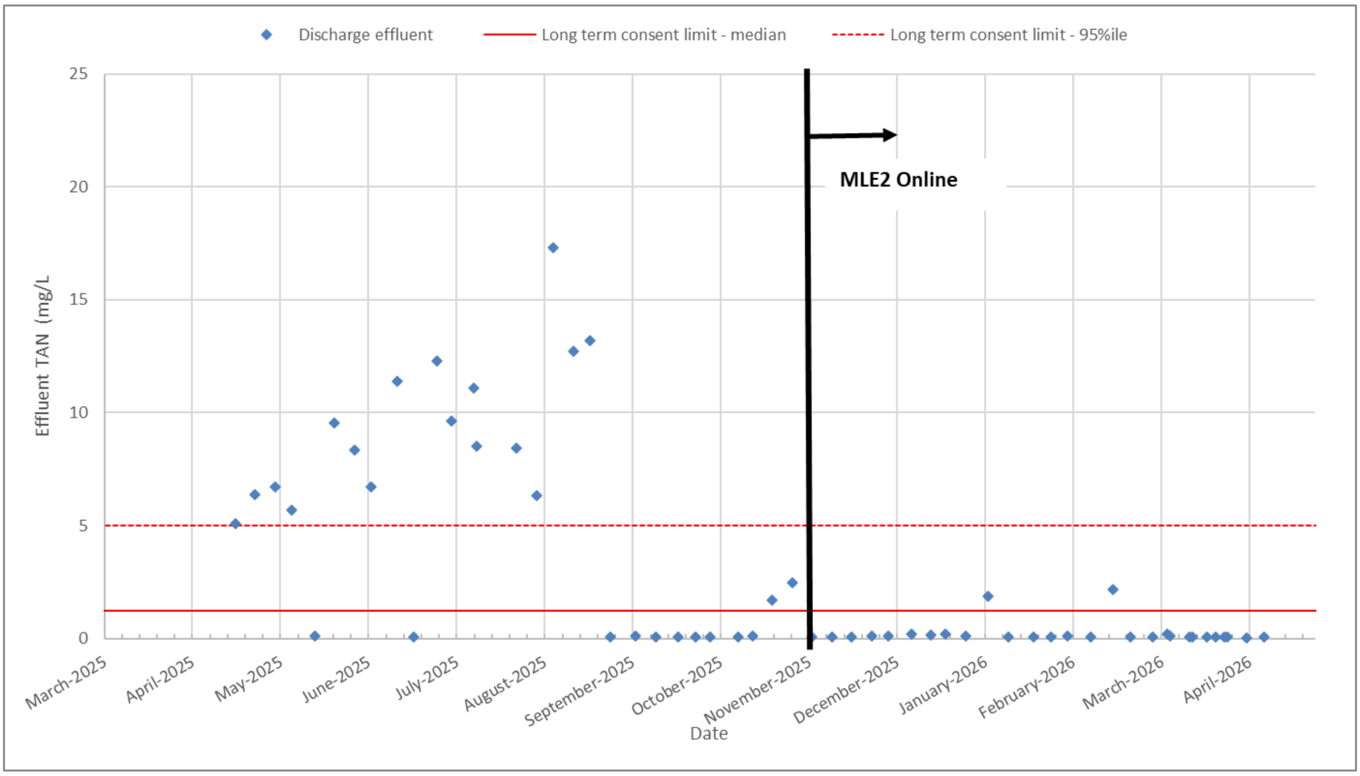


Figure 2.8 **Discharge Effluent TAN (mg/L) – compared with long term consent**

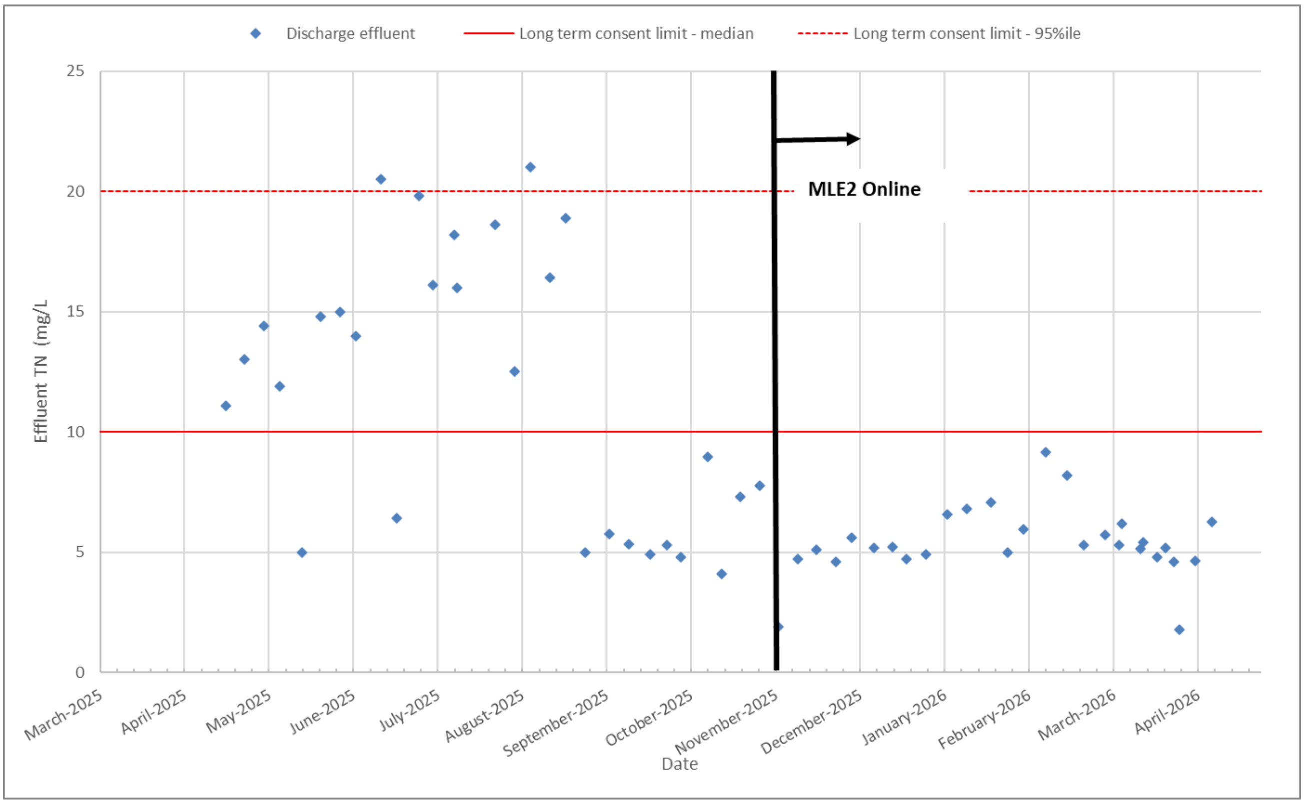


Figure 2.9 ***Discharge Effluent TN (mg/L) – compared with long term consent***

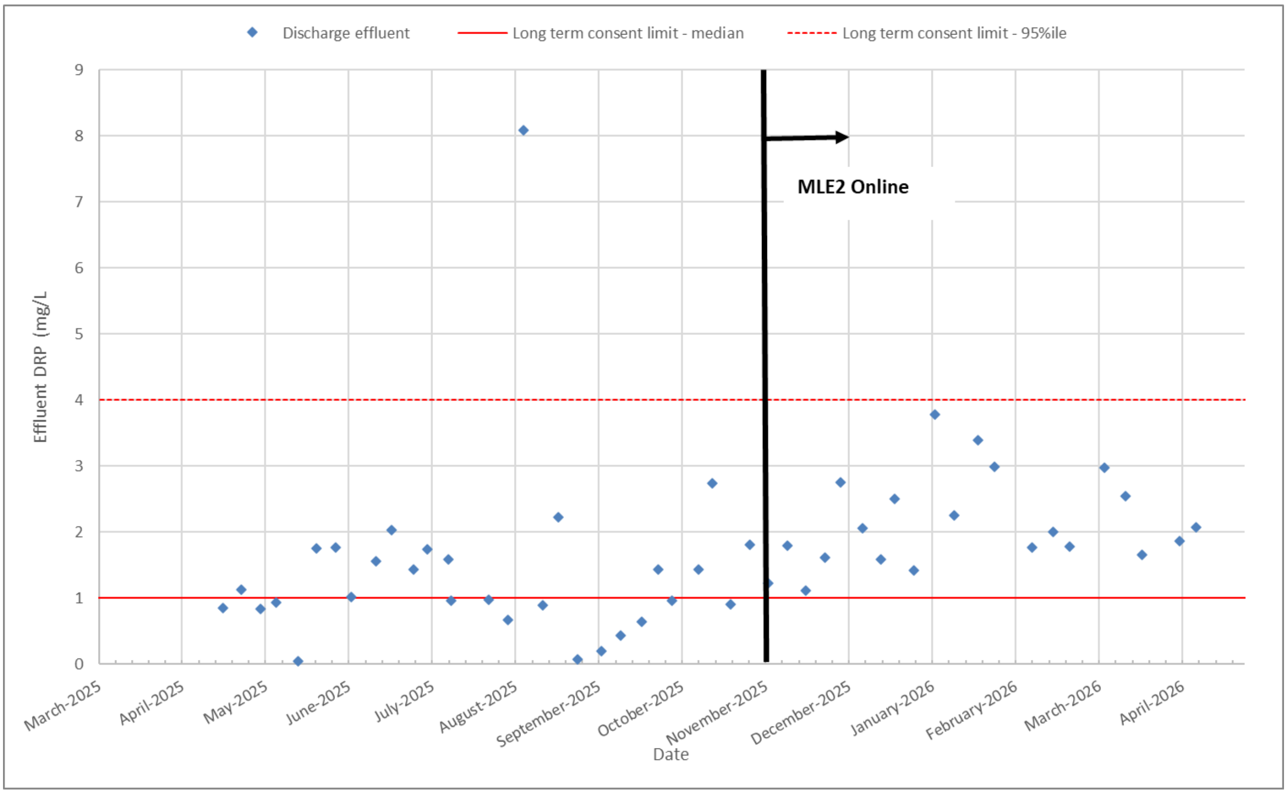


Figure 2.10 ***Discharge Effluent DRP (mg/L) – compared with long term consent***

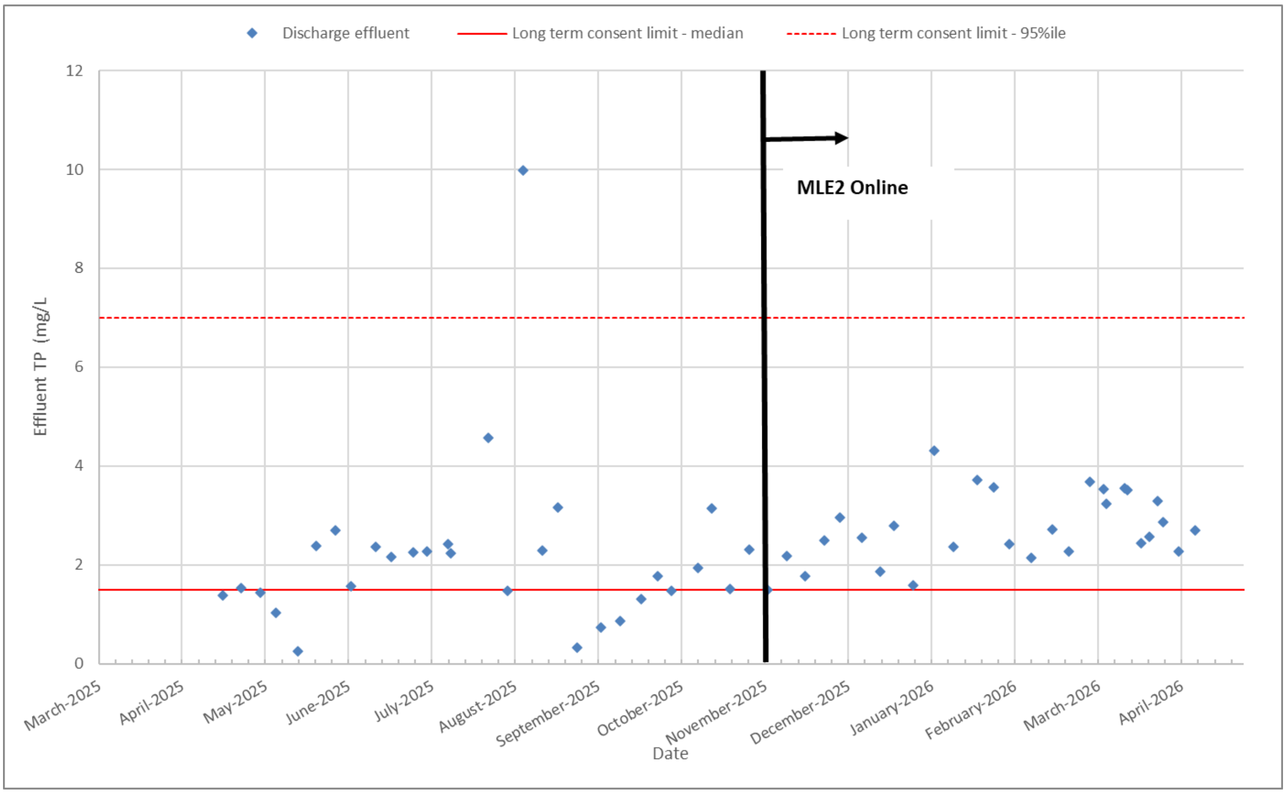


Figure 2.11 *Discharge Effluent TP (mg/L) – compared with long term consent*

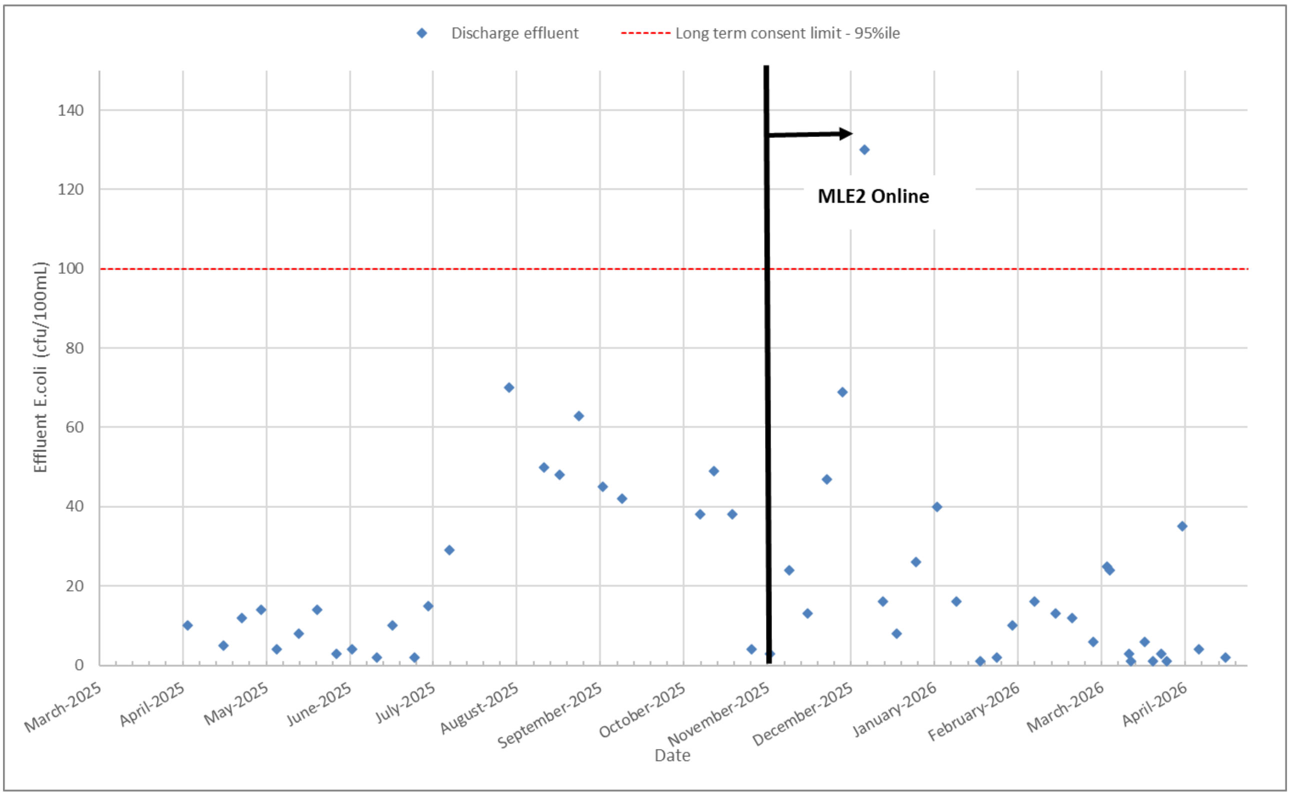


Figure 2.12 *Discharge Effluent E. coli (cfu/100mL) – compared with long term consent*

QLDC and the plant operators (Veolia) have made additional adjustments to the UV operation in November 2025, which encompassed linking the UV disinfection dose to both secondary clarifier outlet flowmeters, increase UV dose target for better *E. coli* results and increased frequency of inspection and cleaning of UV intensity meter which could impact the efficacy of the UV system. In addition, the UV dose target has formed part of the short-term consent conditions (currently in discussion with ORC) as an indicator of UV disinfection performance.

Table 2.2 *Plant discharge sampling data (Eurofins sampling only) prior to stage 3 upgrades (Nov 2023 – October 2025)*

	TSS	cBOD5	Total Ammoniacal Nitrogen	TN	TP	*E. coli*	Nitrate (as N)
Average	14.3	13.6	8.9	16.2	2.7	548	8.2
Median	12	13.2	9.6	16.8	2.4	10	1.6
90%ile	27.5	22.2	13.2	23.8	4.5	130	21.4
95%ile	38.9	23.3	17.6	27.5	4.9	1098	28
Count	63	67	73	70	60	31	5

Table 2.3 *Plant discharge sampling data (Eurofins sampling only) following stage 3 upgrades (Nov 2025 – April 2026)*

	TSS	cBOD5	Total Ammoniacal Nitrogen	TN	DRP	TP	*E. coli*	Nitrate (as N)
Average	5.9	2.6	0.2	5.4	2.2	2.8	19	3.6
Median	5	2.3	0.1	5.2	2	2.6	12	3.4
90%ile	11.5	3	0.4	7.2	3.3	3.7	47	4.7
95%ile	16.2	4.6	2	8.7	3.7	4	100	4.9
Count	34	28	28	28	21	28	29	26

Historical treated effluent monitoring data for DO, temperature and pH are summarised in Table 2.4. The dataset includes periods when Pond 3A was still discharging (ceased October 2025) and covers April 2025 to April 2026, providing an indication of seasonal and annual conditions. It is noted that the minimum pH reading of 6.4, coincided a period where a high dose of aluminium sulphate was applied to assist the treatment process in late 2025. This was later changed to poly aluminium chloride (PACL) which consumes less alkalinity. Generally peaking the pH and DO in the plant discharge is considered to be similar to most well-operating treatment plant discharges.

Table 2.4 *Historical treated effluent sampling data for pH, DO and temperature (including periods where the pond 3a was still discharging)*

Parameter	Period	Statistics		
		Min	Median	Max
DO (mg/L)	Summer (1/12/2025 - 28/02/2026)	6	7	7
	Winter (1/06/2025 - 31/08/2025)	4	8	10
	Annual (April 2025 - April 2026)	4	7	10
Temperature (℃)	Summer (1/12/2025 - 28/02/2026)	19	21	24
	Winter (1/06/2025 - 31/08/2025)	10	12	15
	Annual (April 2025 - April 2026)	10	18	24
pH	Summer (1/12/2025 - 28/02/2026)	6.7	6.9	7.1
	Winter (1/06/2025 - 31/08/2025)	7.0	7.2	7.6
	Annual (April 2025 - April 2026)	6.4	6.9	7.6

2.3.3.2 Metal contaminants

Trace metals are present in treated wastewater at low concentrations, arising from both domestic sources (e.g. plumbing materials and household products) and minor industrial inputs within the catchment.

Sampling of metals in the treated effluent since October 2025 to April 2026 (approximately 13 samples) indicates that other metals are present at low concentrations. The maximum recorded total concentrations during this period were:

- Copper of 0.008 mg/L
- Zinc of 0.121 mg/L.
- Nickel of 0.005 mg/L
- Aluminium of 0.183 mg/L

Concentrations of arsenic, lead, mercury, chromium, cadmium were reported at or below detection limits.

These values are consistent with typical wastewater characteristics and indicate that metals are present at trace levels[1].

A round of aluminium testing was conducted in April 2026 to characterise the background of total and dissolved aluminium concentrations in the treated wastewater and the sample locations. This particular treated wastewater sample showed total and dissolved aluminium level of 0.183 and <0.030 mg/L (below detection limit) respectively. The total aluminium level is similar to the reported typical range for municipal wastewater[1].

Where available, dissolved metal concentrations are considered the most relevant indicator of potential biological effects, as they represent the bioavailable fraction. These concentrations have been used in the downstream water quality assessment (refer Section 6), with comparison to ANZG (2018) Default Guideline Values to assess potential changes in aquatic ecosystem protection levels.

2.3.3.3 Per- and polyfluoroalkyl substances

Per- and polyfluoroalkyl substances (PFAS) are highly persistent and mobile chemical compounds that can be transported within freshwater systems and accumulate in aquatic biota. The man-made substances have been used for decades in a very broad range of products, and trace concentrations of the compounds are ubiquitous in the environment. PFAS are consistently identified in wastewater and landfill leachate, being associated with building and home products, clothing and commercial/industrial processes. Testing of Shotover WWTP treated wastewater has identified low concentrations of PFAS, with results provided in Appendix B.

2.3.3.4 Emerging contaminants

The wastewater can contain other trace contaminants such as microplastics from washing of clothing and other sources. Concentrations of these contaminants are typically very low, and they are not the driver for risk to human health or the environment.

For emerging contaminants, where the understanding of the potential toxicity of these contaminants is developing, there are typically no regulations or accepted receiving environment criteria from which to undertake risk assessment. While no risk assessment is provided for microplastics, a treated wastewater sample was analysed for microplastics, with the aim of providing a benchmark of the current discharges for potential future reference. The results of testing are provided in Appendix B. Assessment did include consideration of how the microplastics content of treated wastewater may change in the future, with the proposed wastewater treatment.

2.3.4 Proposed consent limits

This section describes the proposed discharge limits and how additional polishing treatment will be applied to assist the Shotover WWTP to meet these limits.Table 2.5 below provides a summary of the Shotover WWTP

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[1] Comparison with Table 1.9 of Wastewater Treatment – Biological and Chemical Processes (3rd Edition, 2002), derived from Mogens Henze in 1982..

proposed consent limits and recent effluent quality, with the figures in red fill showing possible exceedance against the proposed limits and the cells in orange fill showing recent performance is at the proposed limits.

Table 2.5 Shotover WWTP Proposed Term Consent Limits and Recent Shotover WWTP Effluent Quality

Parameters	Units	Proposed Consent Limits		Nov 25 to April 26 Final Effluent Results	
		12 months Rolling Median	95%ile	Median Values	95%ile
BOD_5	g/m^3	5	10	2.3	4.6
TSS	g/m^3	5	10	5.0	16.2
TAN	g/m^3	1.25	5	0.1	2.0
TN	g/m^3	10	20	5.2	8.7
Nitrate-N	g/m^3	7	10	3.4	4.9
TP	g/m^3	1.5	7	2.6	4.0
DRP	g/m^3	1	4	2.0	3.7
E. coli	cfu/100mL	--	100	19 (geomean)	100
Note: Cells shaded red indicating possible exceedance against proposed limits Cells shaded orange showing recent performance is at the proposed limits 1 g/m^3 = 1 mg/L in water					

From the comparison of the recent treated effluent results against the proposed discharge limits, several improvements have been identified:

Reduction of suspended solids in the discharge effluent, which also improves the visual clarity of the discharge when it enters the receiving water. A relatively stringent TSS limit will lead to more consistent disinfection performance for complying with the *E. coli* limits.

– Reduction of dissolved reactive phosphorus and total phosphorus in the discharge effluent, this reduces the impact of nutrients in the receiving water.

2.4 Treated wastewater calamity pond discharges

The treated wastewater calamity pond is proposed to be used for temporary storage of treated wastewater at times when discharge is to be reduced or ceased for a short period. This is expected to be used in event of issues with the treatment (i.e. UV or filter shut down) and/or if there is maintenance required along the pipeline or outfall structure is needed. Treated wastewater would then be recycled back through the treatment plant for discharge to the Kawarau River.

During periods when the pond is used, a small amount of seepage to ground and to underlying groundwater is likely to occur. While the pond base is expected to provide a low permeability barrier for significant soakage to ground, and the volume of water discharging is expected to be less than that occurring when oxidation ponds were in use, some very small discharge may occur.

2.5 Relevant regulatory requirements

2.5.1 National Policy Statement for Freshwater Management (NPS FM)

The NPS FM (MfE, 2020 amended December 2025) provides national freshwater quality limits and objectives that give effect to Te Mana o te Wai and set minimum expectations for river health in New Zealand.

Under the NPS FM, attribute states describe the condition of freshwater by assigning measured values (such as nutrients, clarity, or *E. coli*) to nationally defined bands or states. These states provide a consistent way to assess current water quality, track change over time, and determine whether objectives and bottom lines are being met. For example, an Attribute Band A generally indicates very good water quality, supporting swimming and contact recreation, with minimal effects on aquatic ecosystems, whereas Band D reflects poor water quality, where ecological and human health values are significantly compromised and improvement is required (unless considered to be naturally occurring, i.e. clarity in high sediment rivers).

In this assessment, NPS FM attribute limits are used as guidelines, alongside ORC regional plan objectives and limits, to contextualise surface water quality in the Shotover and Kawarau Rivers.

2.5.2 Otago Regional Council: Regional Plan

Schedule 15 of the ORC Regional Plan: Water for Otago (Otago Regional Council (ORC), 2025), sets out the characteristics, numerical limits, and target values that define good quality water for rivers and lakes across the region. It provides both qualitative descriptors and quantitative thresholds for key water quality parameters to protect ecological, recreational, and human health values. Table 15.2.2 within Schedule 15 of the Regional Plan specifies the numerical water quality limits and target dates for Receiving Water Group 2 catchments, including rivers such as the Shotover and Kawarau. These limits cover nitrate-nitrite nitrogen, DRP, ammoniacal-N, *E. coli* and turbidity.

2.5.3 Water Conservation (Kawarau) Order 1997

The Water Conservation (Kawarau) Order 1997 (WCO) (New Zealand Government, 1997) is a national instrument that regional plans and resource consenting in the Kawarau River system, including the Shotover River, must be consistent with. It requires regional councils to manage activities such as water takes, discharges, and river works in a way that preserves specified outstanding values, and it sets mandatory water quality management standards that must be reflected in regional plan provisions and considered when interpreting water quality monitoring results and consent effects.

The Water Conservation Order provides the highest level of protection for the Kawarau River system by requiring outstanding natural and recreational values to be preserved through restrictions on activities and water quality management classes.

Schedule 2 of the WCO references the outstanding characteristics of the Kawarau River including:

- Wild and scenic characteristics.
- Natural characteristics, in particular the return flow in the upper section when the Shotover River is in high flood;
- Recreational purposes, in particular rafting, jetboating, and kayaking.

The restrictions and prohibitions to reflect this include the following requirements:

1) No damming of the Kawarau River.
2) Water quality to be managed to Class Contact Recreation (CR) standard.

Schedule 3 of the Resource Management Act provides the water quality class descriptions, including the class CR referenced within the WCO. These standards apply after reasonable mixing with the receiving water and disregard the effect of any natural perturbations that may affect the water body. In the context of the Kawarau River, such perturbations include characteristics during high flow events, when water clarity is low and catchment influences such as elevated *E. coli*, can be high. Additionally, the influence of local geology on trace element concentrations in the water.

The CR water is defined as being managed for contact recreation purposes:

1) The visual clarity of the water shall not be so low as to be unsuitable for bathing.
2) The water shall not be rendered unsuitable for bathing by the presence of contaminants.
3) There shall be no undesirable biological growths as a result of any discharge of a contaminant into the water.

Point 1 of the CR water class provides for reasonable visibility of the river when entering and within the water to avoid potential hazards.

Point 2 of the CR water class provides for limits of water quality such that contact with and ingestion of water during the recreation activity does not result in unacceptable risk of adverse health effect. This is predominantly related to the presence of pathogens within water that may result in illness.

In considering the interpretation of bathing, it has been assumed that this includes all recreation that involve entering and immersion in water. Of the range of recreational activities possible, swimming, is considered to represent the risk limiting scenario when swimming in rivers. This due to:

– Swimming being undertaken by a broad age range, including young children.

– Prolonged periods of immersion resulting in high probability of ingesting water.

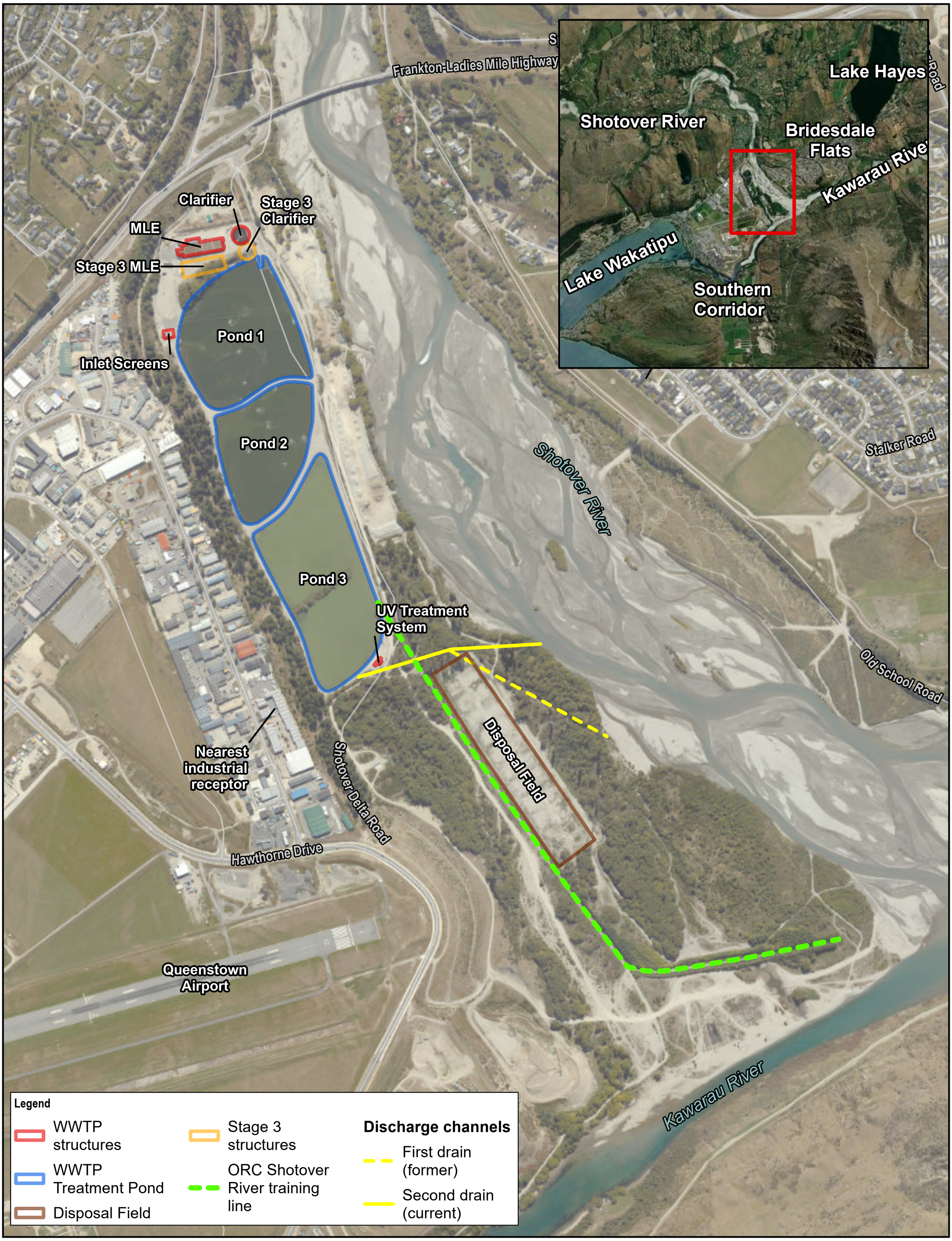
– Potential for accidents where water clarity is poor.

3. Description of the environment

3.1 Site setting

The Shotover WWTP is located on the Shotover Delta, on the true right bank of the Kimiākau/Shotover River, near the State Highway 6 bridge. The river delta sits approximately 40 m below the Frankton terrace (also known as Frankton Flats), and fans from an upper, narrow section of approximately 300 m width, where the Shotover WWTP and the now decommissioned oxidation ponds are located, to a broad exposed gravel bed of approximately 700 m width where it terminates at the Kawarau River. The site layout is shown in Figure 3.1 with key features including:

- MLE and Clarifier
- Inlet screens
- UV treatment system
- Treatment Ponds
- Discharge channels to Kimiākau/Shotover River
- Disposal field
- River Training Line



Paper Size ISO A4
Scale: 1:10,000

0 0.1 0.2 0.3 0.4

Kilometers
Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

Queenstown Lakes District Council

Long Term Discharge Assessment

Site Layout

Project No.	**12645246**
Revision No.	**0**
Date	**29/04/2025**

FIGURE 3.1

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Data source: NZ - Imagery: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors
World Imagery: Environment Southland, Earthstar Geographics. Created by: nrama

3.2 Climate

The average annual rainfall from 1990 – 2020 is shown below in Figure 3.2.

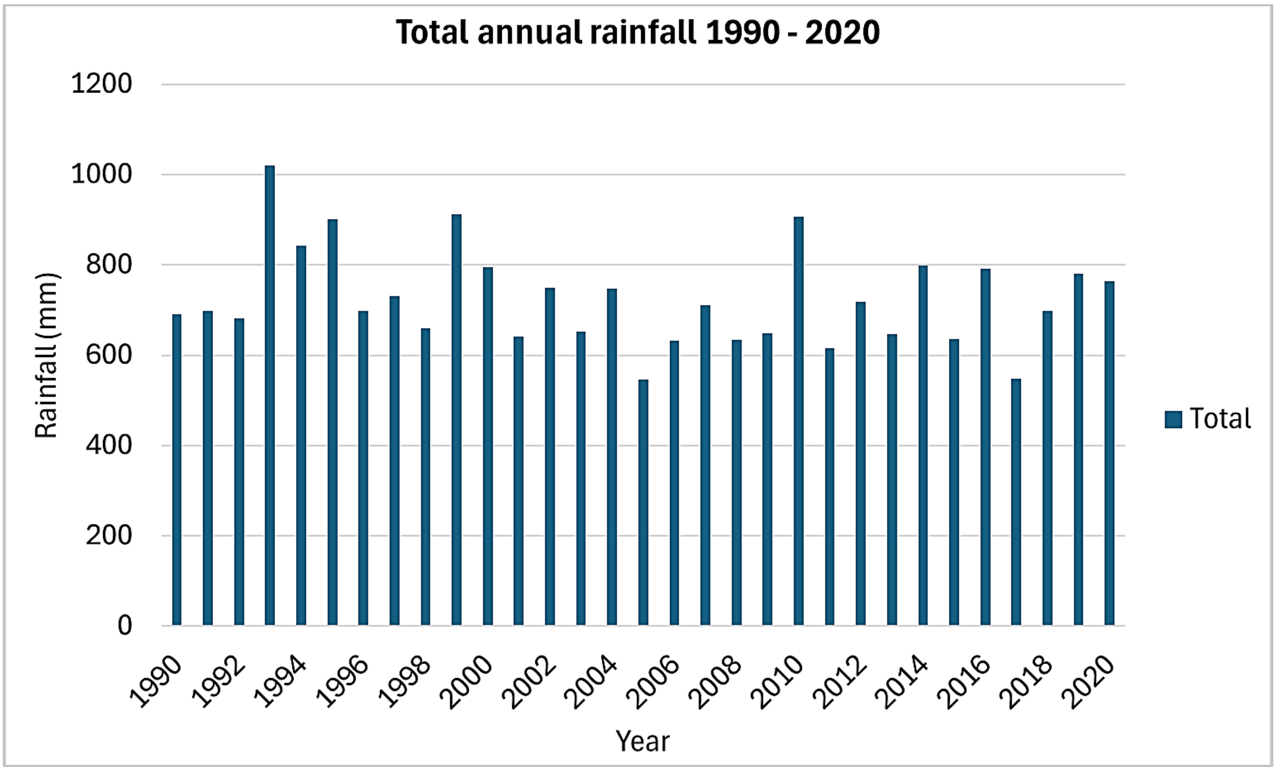


Figure 3.2 ***Annual rainfall in Queenstown from 1990 – 2020. Data source: NIWA climate database (StatsNZ 2023).***

From 2020 – 2024 the average annual sunshine hours were 2,338 and the mean temperature was 10.5°C (NIWA 2025). The overall climate in Queenstown consists of warm summers, typically 20 – 30°C during the day, and cold winters with occasional low elevation snowfall. Table 3.1 provides a summary of seasonal rainfall from 1990 to 2020, sourced from NIWA's climate database (link to data from StatsNZ, 2023).

Queenstown is situated on the eastern side of the Southern Alps. The prevailing westerly winds bring moist air from the Tasman Sea, which rises over the mountains, cools, and condenses, leading to precipitation (NIWA 2015). Greater variability in rainfall occurs in spring and summer, where prolonged dry periods or high intensity rain events result from the influence of these westerly winds and annually variable occurrence of frontal systems.

Table 3.1 ***Seasonal rainfall summary from 1990 – 2020. Data sourced from NIWA Climate Database (StatsNZ 2023)***

Season	Min (mm)	Max (mm)	Average (mm)
Autumn	103.4	271.6	179.3
Spring	70.3	333.2	181.0
Summer	83.6	454.8	190.5
Winter	100.4	273.1	175.0

3.3 Hydrology

3.3.1 Setting

The area of proposed treated wastewater discharge to the Kawarau River is from the Shotover Delta, on the true left riverbank of the Kawarau, immediately upstream of the current day confluence of the Shotover and Kawarau Rivers. The two rivers have very different characteristics. The Kawarau River is fed from Lake Wakatipu and flows east as a large high energy river that is generally constrained to a single channel and is typically clear and gravel-bed dominated. The Kimiākau/Shotover River is a steep, braided alpine river draining an erodible schist catchment.

At the confluence, the Shotover forms a gravel delta that extends into the Kawarau channel. The Kimiākau/Shotover Delta has currently active flows and channels on its true left bank which is approximately 650 m in width. A further 700 m (width) of the delta on the true right bank is covered with established vegetation and flow in this area is constrained by flood infrastructure. Ongoing movement of the Kimiākau/Shotover River channels occurs, particularly with flood events, as large volumes to coarse sediment and fine suspended material are delivered in the lower delta. These inputs also locally alter channel form, flow patterns, and water clarity in the Kawarau at and downstream of the confluence.

Downstream of the confluence with the Kimiākau/Shotover River, the Kawarau River receives flow from the Arrow River, before flowing through the Kawarau Gorge, and ultimately joining with Lake Dunstan upstream of Cromwell.

3.3.2 Kawarau River morphology

3.3.2.1 Training line background

The Kimiākau/Shotover River catchment produces high flows, which typically peak before the outflow from the lake. Under some conditions, the Shotover flood can produce a return flow up the Kawarau River to Lake Wakatipu. This has occurred 26 times between August 1970 and December 2004 (MacMurray, 2010). In November 1999, a large flood event highlighted this, with the Shotover at its peak flowing back up the Kawarau River and into Lake Wakatipu with extensive flooding in Queenstown. These large inflows to the Kawarau from the Kimiākau/Shotover River cause a negative difference in lake level in Lake Wakatipu between Frankton and Queenstown, resulting in a flood risk to Queenstown. For this reason, the ORC constructed a river training line (completed in 2011) on the Shotover delta to direct floodwaters more predictably from the Kimiākau/Shotover River to the Kawarau at the more favourable (eastern) side of the delta (Figure 3.3).

Construction of the flood training wall on the true right of the river delta has permanently altered the hydrology of the river during flood conditions. Where historically Kimiākau/Shotover River waters entered the Kawarau River across the full extent of the confluence (approximately 1300 m width), flow is now constrained to approximately half of the delta.

Figure 3.3 *Overview of training line and river confluence location (Google Earth)*

3.3.2.2 Morphology

Aerial imagery of the Shotover Delta and Kawarau River illustrate the significant change in the Shotover Delta following construction of the flood training wall in 2011 (Figure 3.4 to Figure 3.6). In 2010, the river formed a wide, active braided delta with multiple channels spreading sediment laterally before entering the Kawarau River. By 2013, flows were more constrained and focused toward a single outlet, reducing braiding near the confluence. By 2024, the main channel appears more stable and entrenched, with reduced delta extent and increased vegetation on former gravel bars, indicating long-term stabilisation and reduced channel mobility caused by the training wall.

Figure 3.4 Aerial image taken 05 February 2010, prior to flood training wall construction

Figure 3.5 Aerial image taken 21 January 2013, shortly after flood training wall construction

Figure 3.6 ***Aerial image taken 11 May 2024, post flood training wall construction***

Cross section surveys performed on the Kawarau indicate that its depth varies given the season and location (Figure 3.7 to Figure 3.10), from (Haskoning, 2025)). At the location of the proposed outfall, the depth of the river during low flow conditions in March 2026 was approximately 2 m ((ESNZ, 2026), included in Appendix C)

Figure 3.7 ***Kawarau River cross-section survey locations (Haskoning, 2025)***

Cross-section 24 (Figure 3.8) is sheltered by vegetation and the training line and thus is less disrupted by the active channel position of the Kimiākau/Shotover River. The 2001 survey appears to capture the peak of the impacts associated with the November 1999 flood event. The bed level has lowered by over 2 m since the 2001 survey; the 2024 survey suggests that the channel has largely regained the cross-sectional area it had in 1996 and although slightly shallower than the earliest surveyed profile (1989) it also has appreciably more cross-section area (Haskoning, 2025)

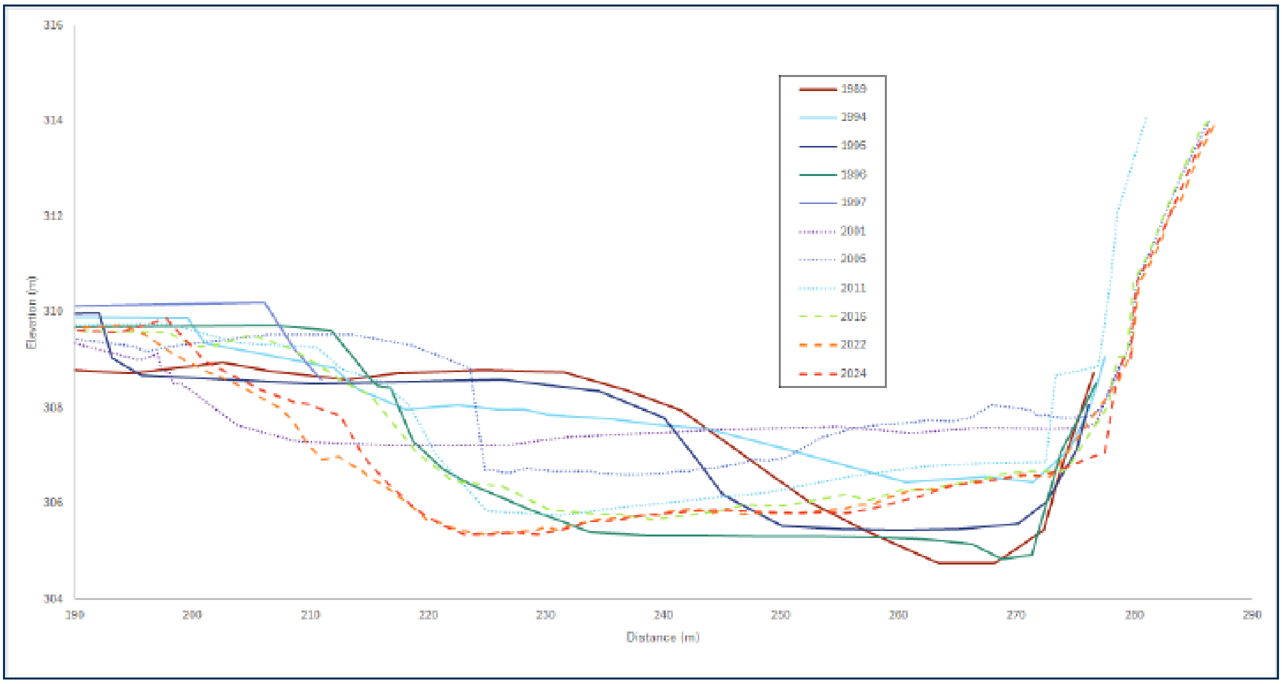


Figure 3.8 ***Kawarau River cross-section 24. Dotted line type denotes surveys post November 1999 and dashed line type post training line construction (2011). (Haskoning, 2025)***

Cross-section 25 (Figure 3.9) illustrates the effects of the training line through increasing uniformity. The surveys since 2001 show a clear deepening trend. It is also deeper and wider than the earliest surveyed profile (1987).

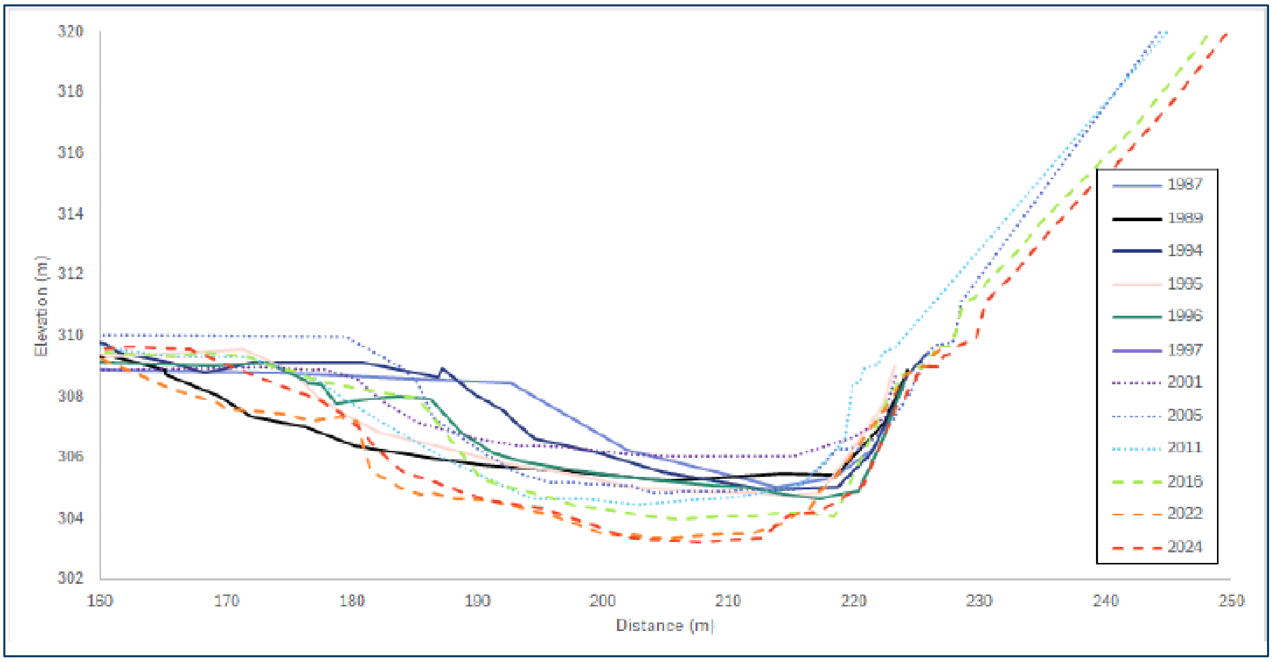


Figure 3.9 ***Kawarau River cross-section 25. Dotted line type denotes surveys post November 1999 and dashed line type post training line construction (2011). (Haskoning, 2025)***

Cross section 26 (Figure 3.10) is at the western edge of the delta and also in the lee of the training line. River depth rose between the 2001 and 2005 surveys, possibly due to the lobe of material apparent in cross-section 25 (Figure 3.9) redistributing in the Kawarau River channel, as stated in the Haskoning report (Haskoning, 2025) Channel widths between the 2005 and 2024 surveys are similar but the 2024 bed level is around 2 m lower.

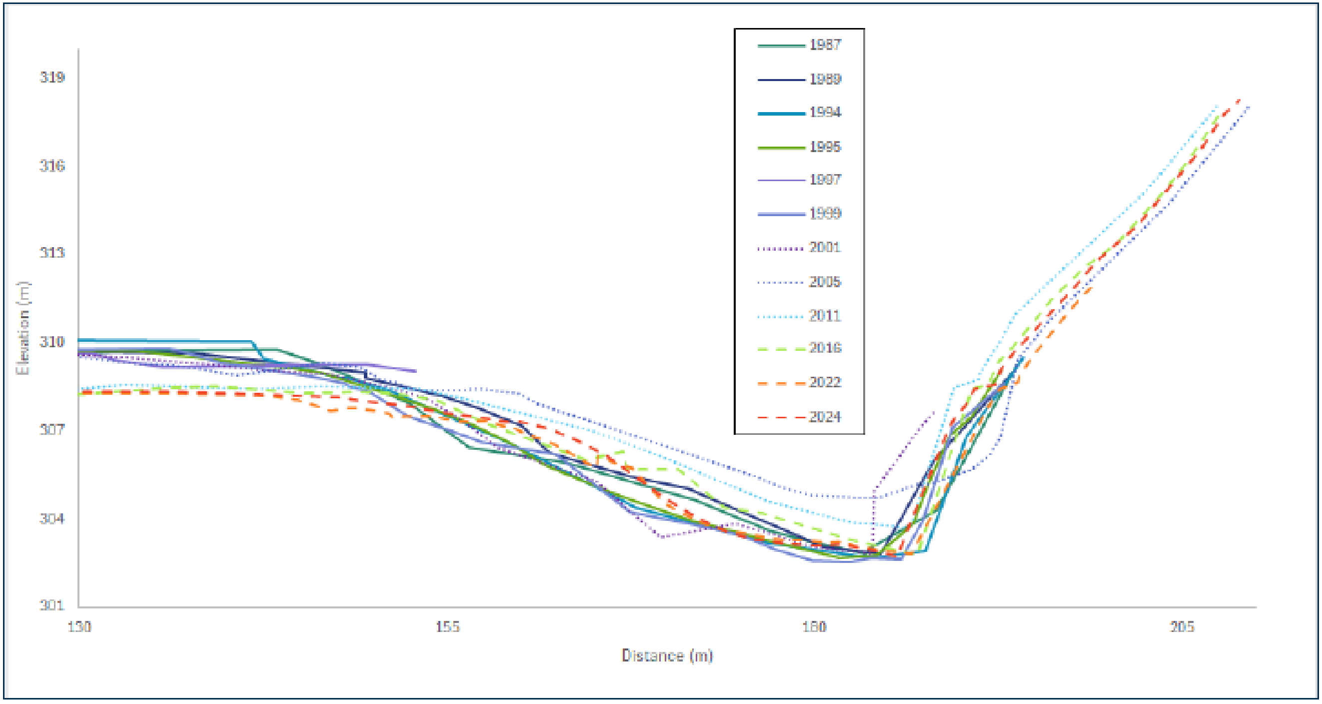


Figure 3.10 ***Kawarau River cross-section 26. Dotted line type denotes surveys post November 1999 and dashed line type post training line construction (2011). (Haskoning, 2025)***

3.3.3 River flows

High flows in both the Kawarau and Kimiākau/Shotover Rivers typically occur in spring, due to a combination of snow melt and westerly weather patterns resulting in heavy rainfall in the upper catchment (GHD Ltd, 2025a). However, river flows in the Kawarau River are disturbed by floods to a lesser extent than the Kimiākau/Shotover River with Lake Wakatipu providing a buffering effect. This seasonal storage and release of catchment waters results in generally predictable and relatively stable seasonal flow behaviour. The Kimiākau/Shotover River responds rapidly to rainfall, with flood flows characterised by high sediment load and turbid waters due to the geology and topography of the headwaters. Flow monitoring locations are shown inFigure 3.11. A 10-year flow record and a 1-year flow record are provided as Figure 3.12 and Figure 3.13 respectively.

Flow statistics for the ESNZ monitoring sites (Kawarau @ Chard Rd and Shotover @ Bowens Peak) are provided in Table 3.2, showing that the highest average and median flows in both the Kawarau and Kimiākau/Shotover Rivers occur over spring and summer. The mean annual low flow (MALF) for the Kawarau at Chard Rd is in the order of 88.6 m^3/s (Table 3.3). For both rivers, the mean flow exceeds the median flow indicating a right-skewed flow regime (i.e., occasional high-flow events lift the mean above the "typical" median), for the Shotover River in particular, a flashier braided-river character.

The relatively stable flow of the Kawarau River is reflected in a low FRE3 (average number of flow events per year that exceed three times median flow) calculated from the flow record of approximately 0.5 (events/year), whereas the more responsive Kimiākau/Shotover River, FRE3 is approximately 8.5 (events/year). The average event duration also differed with the Kawarau River having a median event duration of 3 days compared to the Shotover River median event duration of 1 day. This data is presented in Table 3.4 below.

Figure 3.11 ESNZ monitoring locations in the Shotover and Kawarau Rivers

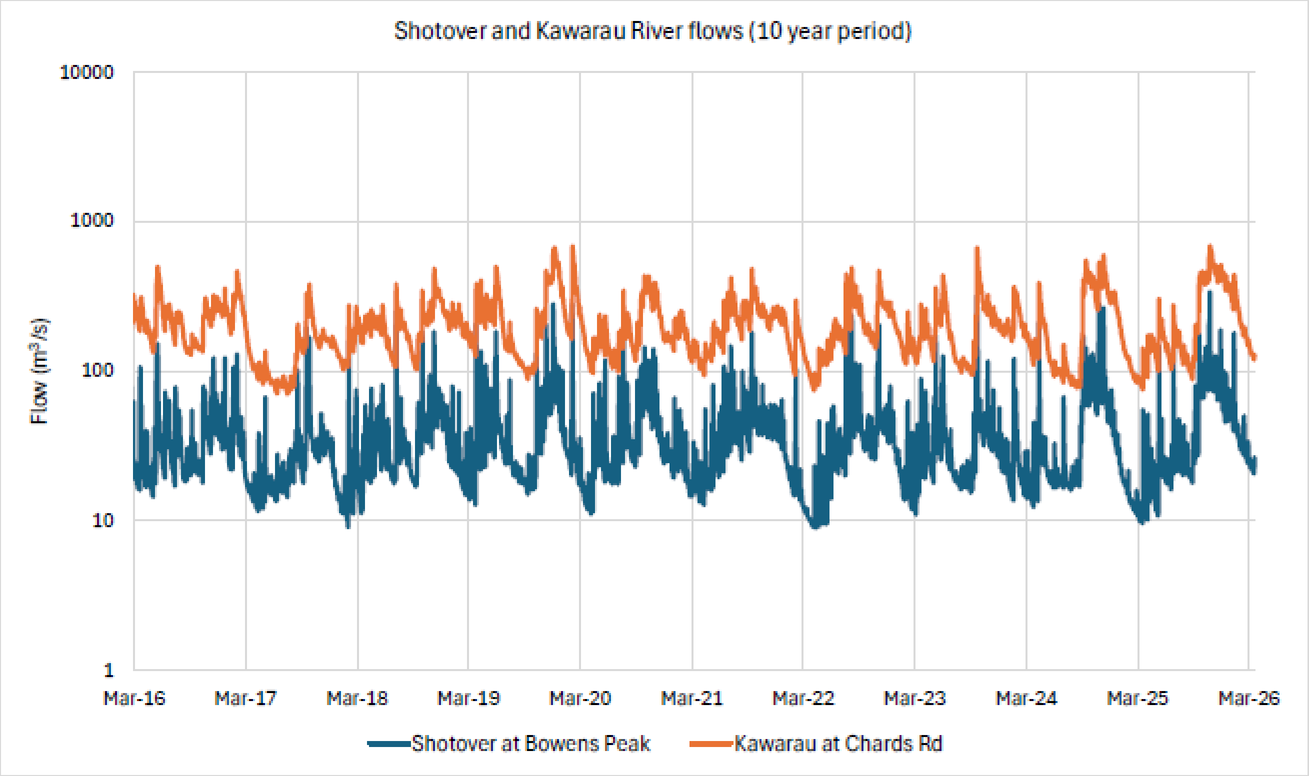


Figure 3.12 Flow at Shotover and Kawarau River monitoring sites over a ten year period

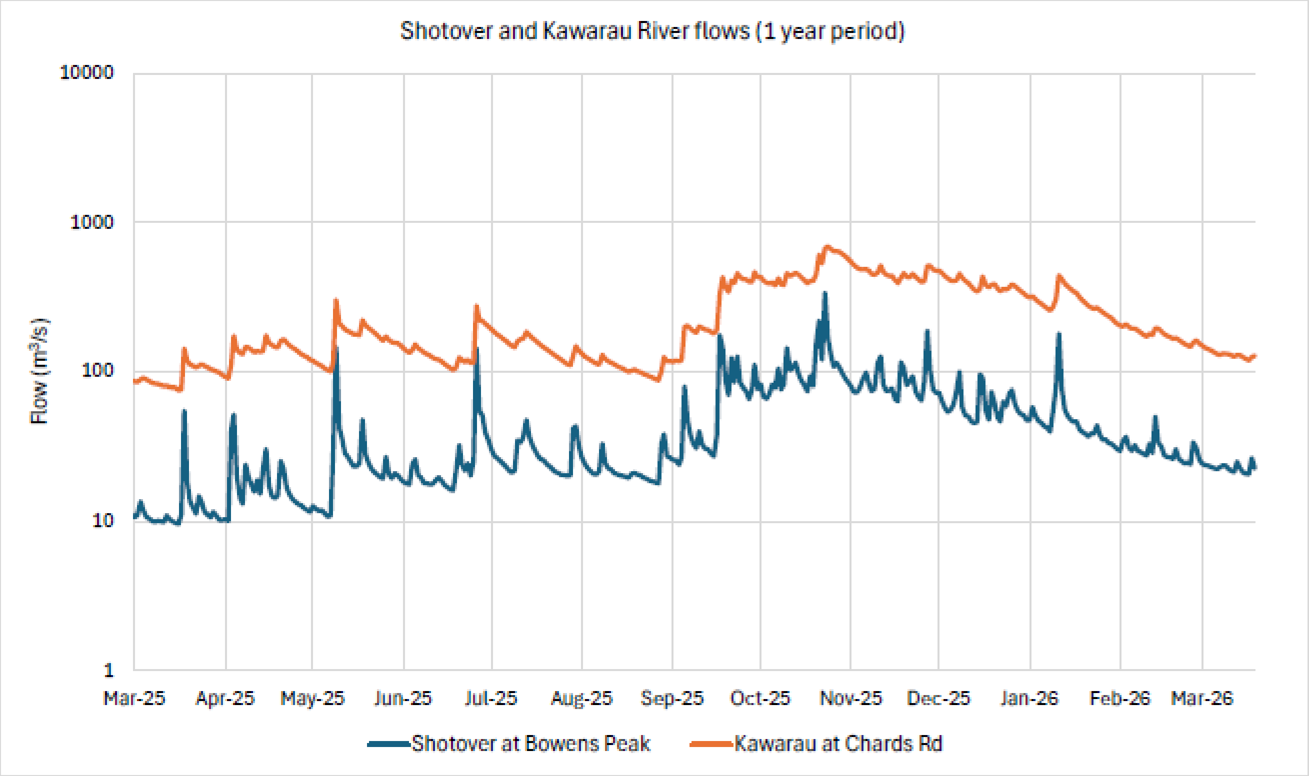


Figure 3.13 *Flow at Shotover and Kawarau River monitoring sites over a one year period*

Table 3.2 *Flow statistics from ESNZ monitoring site data. All flows in m³/s*

10-yr and 1-yr flow statistics					
Location		10 yr mean	10 yr median	10 yr min	10 yr max
Kawarau at Chards Rd		207.2	184	71.2	692.6
Shotover at Bowens Peak		36.2	27.6	9	338.2
		1 yr mean	**1 yr median**	**1 yr min**	**1 yr max**
Kawarau at Chards Rd		242.4	177.8	76.2	692.6
Shotover at Bowens Peak		45.2	30.5	9.6	338.2
Seasonal flow statistics					
		Spring	**Summer**	**Autumn**	**Winter**
Kawarau at Chards Rd	10 yr seasonal average	275.1	225.5	168.8	167.2
	10 yr seasonal median	252.6	202.4	154.2	148.0
Shotover at Bowens Peak	10 yr seasonal average	56.1	32.8	26	31.7
	10 yr seasonal median	44.9	26.7	19.8	24.7

Notes:
10-year statistics calculated from 01 March 2016 to 01 March 2026
1-year statistics calculated from 01 March 2025 to 01 March 2026

Table 3.3 Summary MALF statistic

Parameter	Kawarau River	Shotover River
Time period	22/11/62 – 19/03/26	10/06/1967 – 19/03/2026
MALF (7 day) (m^3/s)	88.6	13.7

Table 3.4 River flood statistics

Parameter	Kawarau River	Shotover River
FRE3 (events/year)	0.55	8.50
FRE2 (events/year)	3.24	13.66
FRE1.5 (events/year)	5.65	16.28
FRE3 median event duration (days)	3	1

3.3.4 Hydrodynamics

Earth Sciences New Zealand (ESNZ) undertook a bathymetry survey of the Kawarau River in March 2026, along transect locations shown in Figure 3.14 (ESNZ, 2026). Summarised details are provided in Figure 3.15, showing that the maximum channel depth ranged from 1.83 m (CX5) to 5.25 m (CX1). Mean channel velocity was highest at transect CX5 (1.120 m/s), and the lowest at CX2 (0.581 m/s).

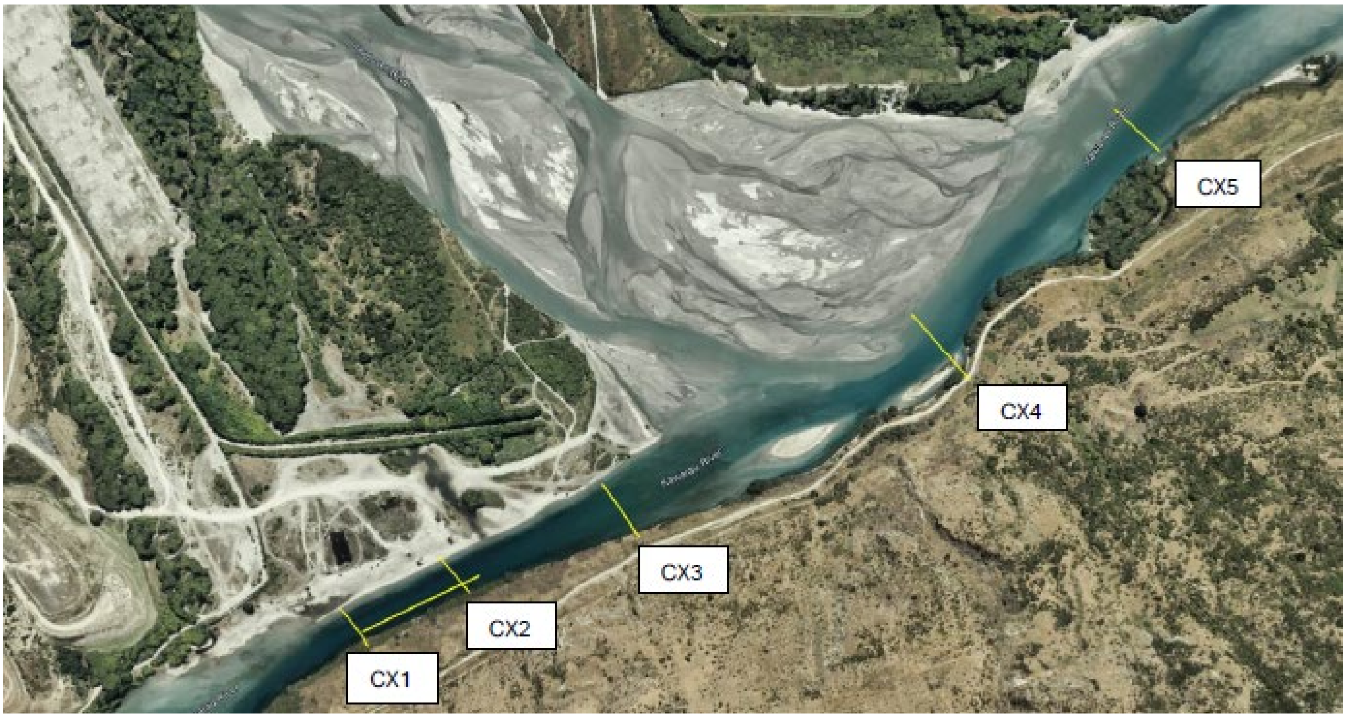
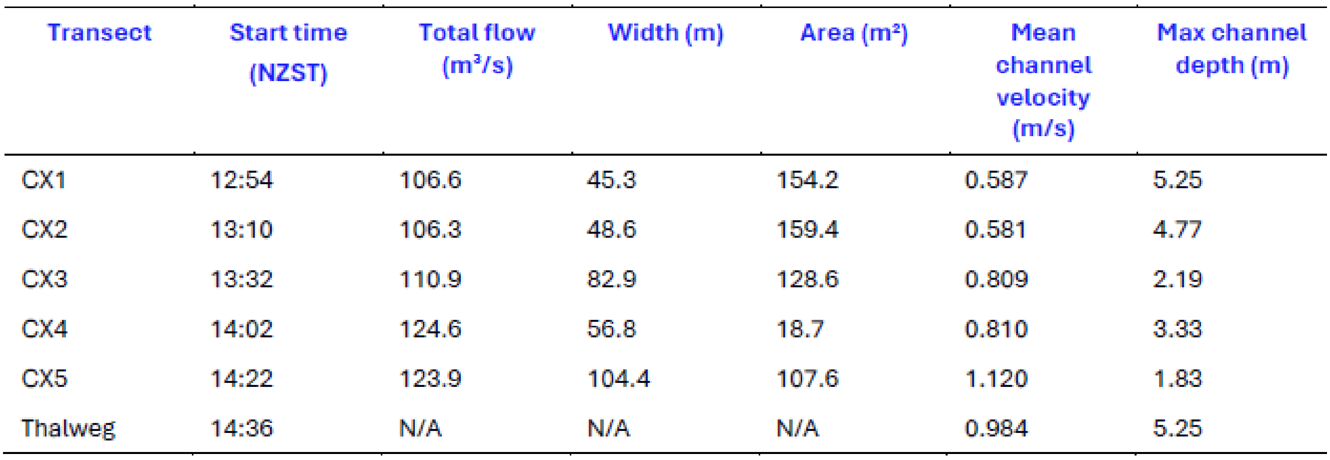


Figure 3.14 Kawarau River surveyed transect locations, as indicated by yellow lines with cross-sections numbered. Longitudinal profile indicated between cross-sections CX1 and CX2 (ESNZ, 2026)



Transcect	Start time (NZST)	Total flow (m³/s)	Width (m)	Area (m²)	Mean channel velocity (m/s)	Max channel depth (m)
CX1	12:54	106.6	45.3	154.2	0.587	5.25
CX2	13:10	106.3	48.6	159.4	0.581	4.77
CX3	13:32	110.9	82.9	128.6	0.809	2.19
CX4	14:02	124.6	56.8	18.7	0.810	3.33
CX5	14:22	123.9	104.4	107.6	1.120	1.83
Thalweg	14:36	N/A	N/A	N/A	0.984	5.25

Figure 3.15 Acoustic Doppler current profiler (ADCP) summary statistics in the Kawarau River (ESNZ, 2026)

Visual profiles of water velocity for each transect indicates that water flows slower along both riverbanks and at higher velocities through the middle of the channel (see Figure 3.17 to Figure 3.20). Near the margins, velocities are lower due to shallow depths and interactions with bed and bank roughness, providing increased friction. In contrast, the central portion of the channel shows higher velocities, reflecting greater flow depth and reduced boundary resistance.

The visual profile of the CX5 transect, when compared to that of CX1, illustrates the change in river morphology that occurs as a result of the Shotover Delta and confluence with the Kimiākau/Shotover River (see Figure 3.17 to Figure 3.20). The CX5 (located downstream of the Shotover confluence) transect is across a shallower and more hydraulically uniform channel, with consistently higher velocities across a larger proportion of the cross-section. In contrast to CX1 for example, CX5 section exhibits elevated velocities extending across most of the width. The bed is flatter and less deeply incised, suggesting a run or riffle-like morphology rather than a pool-dominated section. As a result, flow is more evenly distributed laterally, with less pronounced velocity contrast between the banks and the channel centre. The river characteristics at the location of the proposed outfall structure is represented by CX3.

The relatively straight channel flow of the Kawarau River limits the degree of mixing that occurs with the Kimiākau/Shotover River, with aerial imagery during high flow events demonstrating that suspended sediment from the Kimiākau/Shotover River remains on the true left side of the Kawarau Rivier until after the two right-angle river bends at Gurnell/Robertson Beach (approximately 3 km downstream of the river confluence and 4 km downstream of the discharge point). The Figure 3.16 provides an aerial image showing this occurrence under high flow conditions.

Figure 3.16 Kimiākau/Shotover River Mixing with the Kawarau River

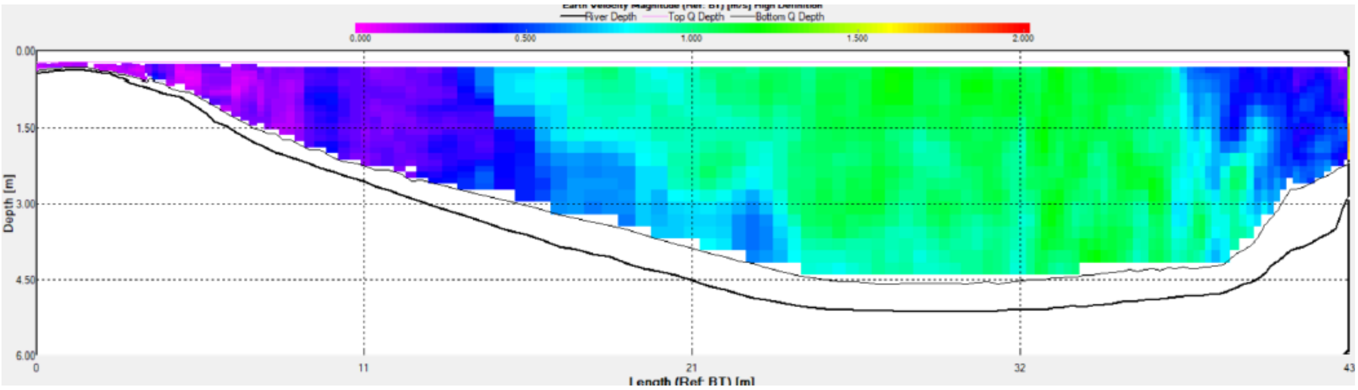


Figure 3.17 CX1 profile (ESNZ, 2026)

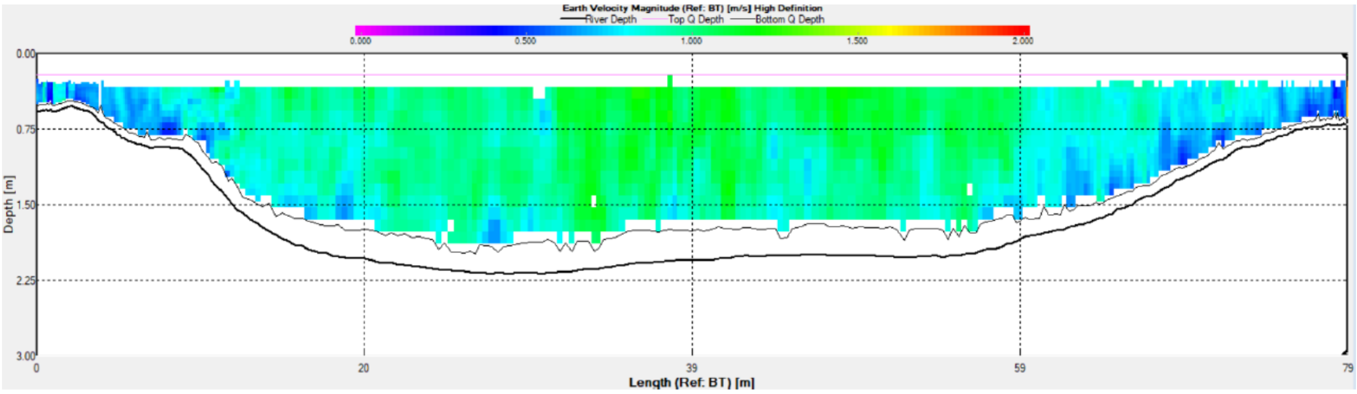


Figure 3.18 CX3 profile (ESNZ, 2026)

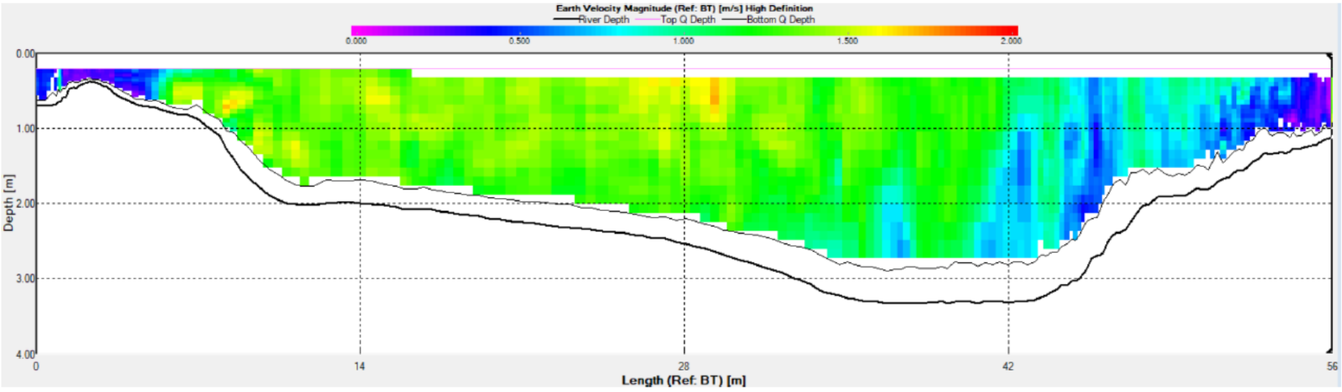


Figure 3.19 CX4 profile (ESNZ, 2026)

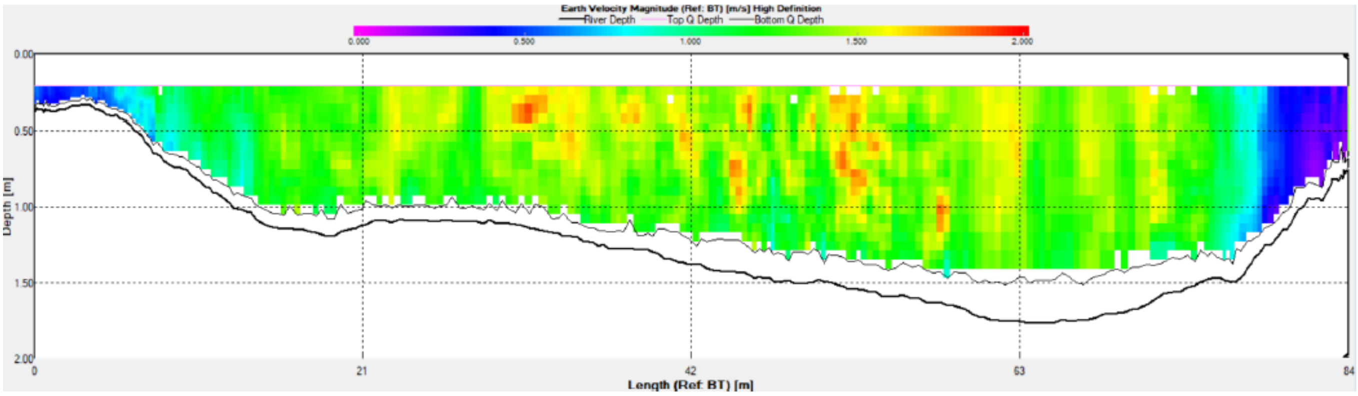


Figure 3.20 CX5 profile (ESNZ, 2026)

3.4 Geology

The Queenstown area is underlain by schist and semi-schist of the Torlesse and Caples supergroup. The schist forms the mountain ranges and high points (e.g. Morven Hill) in and around the Wakatipu Basin. The basin geology is influenced by multiple glacial advances, carving out the basin and leaving behind glacial sediments (till and outwash gravels) as the glaciers retreated.

Frankton flats and the Shotover Delta are underlain by recent (Holocene) alluvial and fan deposits, comprising unconsolidated gravel, sand and silt. The depth of the alluvium is unknown, with a 90 m deep bore hole drilled on the terrace (near 5 Mile development) not encountering basement schist (Otago Regional Council (ORC), 2014).

Several investigations have been undertaken to understand the geology of the Shotover Delta (GHD Ltd, 2026a). The geology underlying the delta is predominantly a gravelly fine to coarse sand or sandy gravel with some cobbles. The gravel is made up of subrounded to subangular schist fragments. However, there are lenses or layers with fine sand and silt. A geological cross section was created from borehole data extending from the top end (northwest) of the DaD to the Kawarau River (Figure 3.21). This section shows the following geological profile:

- Gravelly fine to coarse sand at surface extending for 1-2 m.
- A layer of sandy gravel, ~1 to 2.5 m thick.
- Gravelly fine to coarse sand extending to at least 20 m depth below ground level (based on the logs of IH2 and IH3).
- A fine silty sand is present near the Kawarau River (BH17 and BH18) extending to at least 9 m depth. It is not known whether this sand continues deeper or is underlain by more permeable coarse sand or gravel.

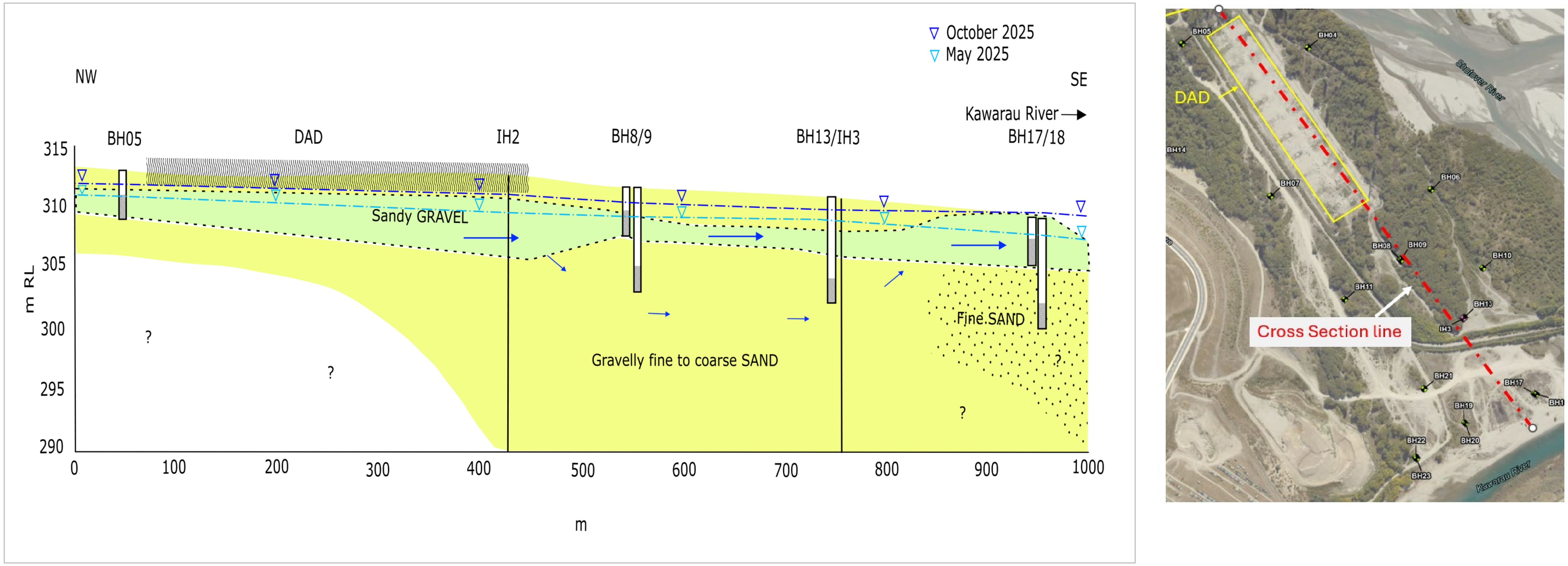


Figure 3.21 *Conceptual cross section*

3.5 Hydrogeology

3.5.1 Setting

The glacial geology within the Wakatipu basin has resulted in a series of small, disconnected aquifer zones. These aquifers comprise glacial outwash gravels, lake fans and alluvium containing sand, silt and gravel. The presence of bedrock and/or low permeability lake silt or glacial till separates the permeable aquifer zones from other areas. These aquifer zones have been collectively mapped as the Wakatipu Basin aquifer by ORC[2].

The Wakatipu Basin Aquifer encompasses the Kimiākau/Shotover Riverbed from approximately 2 km downstream of Arthurs Point to Shotover Downs, approximately 1 km upstream of the SH6 Bridge. From Shotover Downs, the Wakatipu Basin Aquifer is mapped only to cover a portion of the riverbed on the true left bank of the Kimiākau/Shotover River. The Shotover WWTP site and location of the discharge structure are outside of the mapped aquifer zone.

QLDC abstract groundwater from a series of groundwater bores on the true left bank of the Kimiākau/Shotover River (opposite riverbank to the Shotover WWTP), approximately 1.5 km upstream of the confluence with the Kawarau River. The bores are screened at approximately 30 - 45 m depth. Bore logs for the production bores show a thick sequence of sandy gravels from near surface to the base of the bores.

3.5.2 Shotover Delta

Extensive investigations were undertaken in and around the Shotover Delta to characterise the groundwater environment and the effects of the DaD discharge on groundwater in accordance with the REMP (GHD Ltd, 2025b). These investigations comprised drilling of boreholes and installation of groundwater monitoring wells, hydraulic testing of aquifer properties, test pitting, monitoring for groundwater levels and groundwater quality. Investigation data, bore logs and monitoring data are included in Appendix A. The results of these investigations are discussed in the following sections.

A brief overview of the Shotover Delta shallow aquifer is provided below:

- The shallow aquifer comprises alluvial gravels, with variable proportions of silt and sand.
- Groundwater levels are shallow, with a strong hydraulic connection to surface water (particularly Kimiākau/Shotover River)
- The groundwater flow direction is generally towards the south (approximately parallel to the direction of Kimiākau/Shotover River flow). Therefore, groundwater within the delta will generally flow towards the Kawarau River, discharging from the gravel alluvium as seeps into the River.
- Due to the depositional setting (braided river) it is expected that preferential groundwater flow paths exist with lenses and/or channels of higher permeability gravels and sands and lower permeability sands and silts, controlling local flow and hydraulic connectivity.
- Monitoring shows distinct seasonality in groundwater levels, with elevated groundwater and river levels during spring due to a combination of seasonal weather patterns and snow melt.
- Groundwater quality reflects upstream (Kimiākau/Shotover River) inputs and activities on the delta, such as discharge from the DaD.

3.5.2.1 Groundwater in the WWTP area

Prior to the Stage 3 upgrades, wastewater treatment via the oxidation ponds was an important part of the treatment process. While the ponds are likely to have been lined with a low permeability liner, some degree of seepage to ground is expected to have occurred. While seepage rates have not been quantified, it is expected that the seepage may have resulted is locally elevated groundwater levels beneath the oxidation ponds.

Decommissioning of the ponds is expected to result in lower groundwater levels in the vicinity of the ponds.

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[2] ORC Aquifer Map C4, **c-map-series-c4.pdf**

3.5.2.2 Groundwater flow direction

Wastewater discharged through the DaD is expected to flow generally towards the south to east, away from the DaD, discharging to the Kawarau and Kimiākau/Shotover Rivers. Groundwater contours based on April 2025 water levels are shown in Figure 3.22. Seasonal variation in groundwater and river levels may locally influence groundwater flow direction, however the general flow direction is expected to be as shown in Figure 3.22.

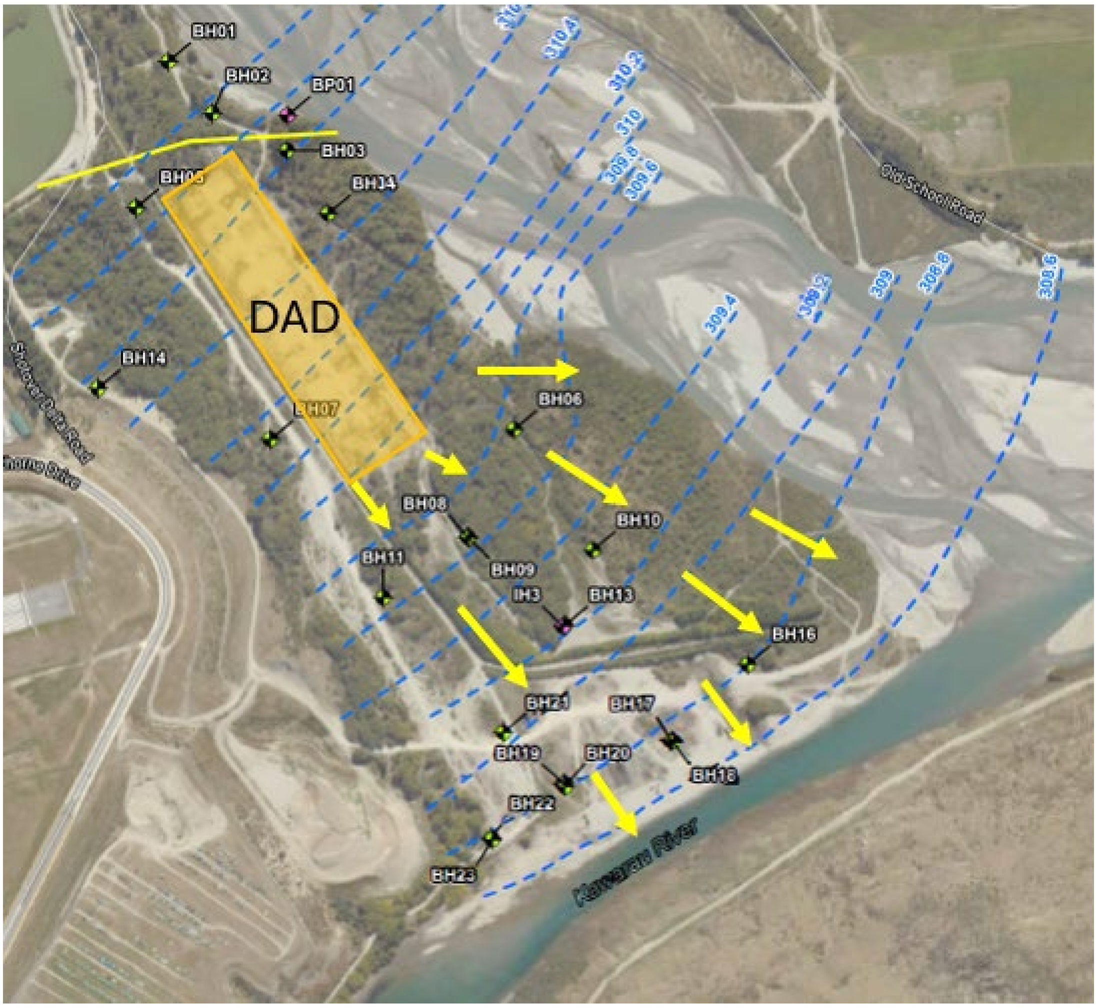

Figure 3.22 *April 2025 groundwater contours, general groundwater flow direction downgradient of the DaD is shown by yellow arrows*

3.5.2.3 Groundwater levels

Groundwater levels have been measured since April 2025. Pressure transducers with data loggers were installed in 15 wells and recorded water levels at 15-minute intervals. Groundwater levels are measured periodically using manual dip approach, in the remaining 7 wells.

Groundwater levels for shallow wells down gradient of the DaD are shown in Figure 3.23. Due to a blockage in the casing of well IH3, the deep well (BH13) record is shown instead. The groundwater level data shows a strong correlation to Kimiākau/Shotover River flow, with higher groundwater during high flow periods from mid-September 2025 onwards. The highest mean daily flow of the monitoring period, 338 m^3/s, was recorded on 23 October 2025, with this flood event resulting in peak flows up to approximately 580 m^3/s (source ORC[3]).

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[3] **Data - ORC Environmental Data Portal**

Table 3.5 Summary flow statistics Kimiākau/Shotover River @ Bowens peak – 1 January to 12 December 2025 (source NIWA)

	Value (m^3/s)	Date
Maximum daily mean flow	338.19	23 October 2025
Minimum daily mean flow	9.65	16 March 2025
Median daily mean flow	22.30	-

Groundwater levels for May and October 2025 are shown on the cross section (Figure 3.21), with May representing average flow conditions and October representing high flow conditions. It is likely that the lower groundwater levels occurred in March 2025 (when Kimiākau/Shotover River flow averaged <20 m^3/s), prior to well installation in April 2025. The groundwater level data indicates the following:

- Groundwater levels between the DaD and Kawarau River are within 0.5 m or above ground surface for extended periods during spring. In addition, the groundwater level in BH17 was close to ground surface during relatively small flood events in May and June 2025.
- The water table generally sits within the shallow sand layer, meaning that the (highly permeable) sandy gravel layer is fully saturated, except during very low groundwater level periods.
- During periods of high groundwater levels groundwater daylights at surface in channels or depressions for extended periods.

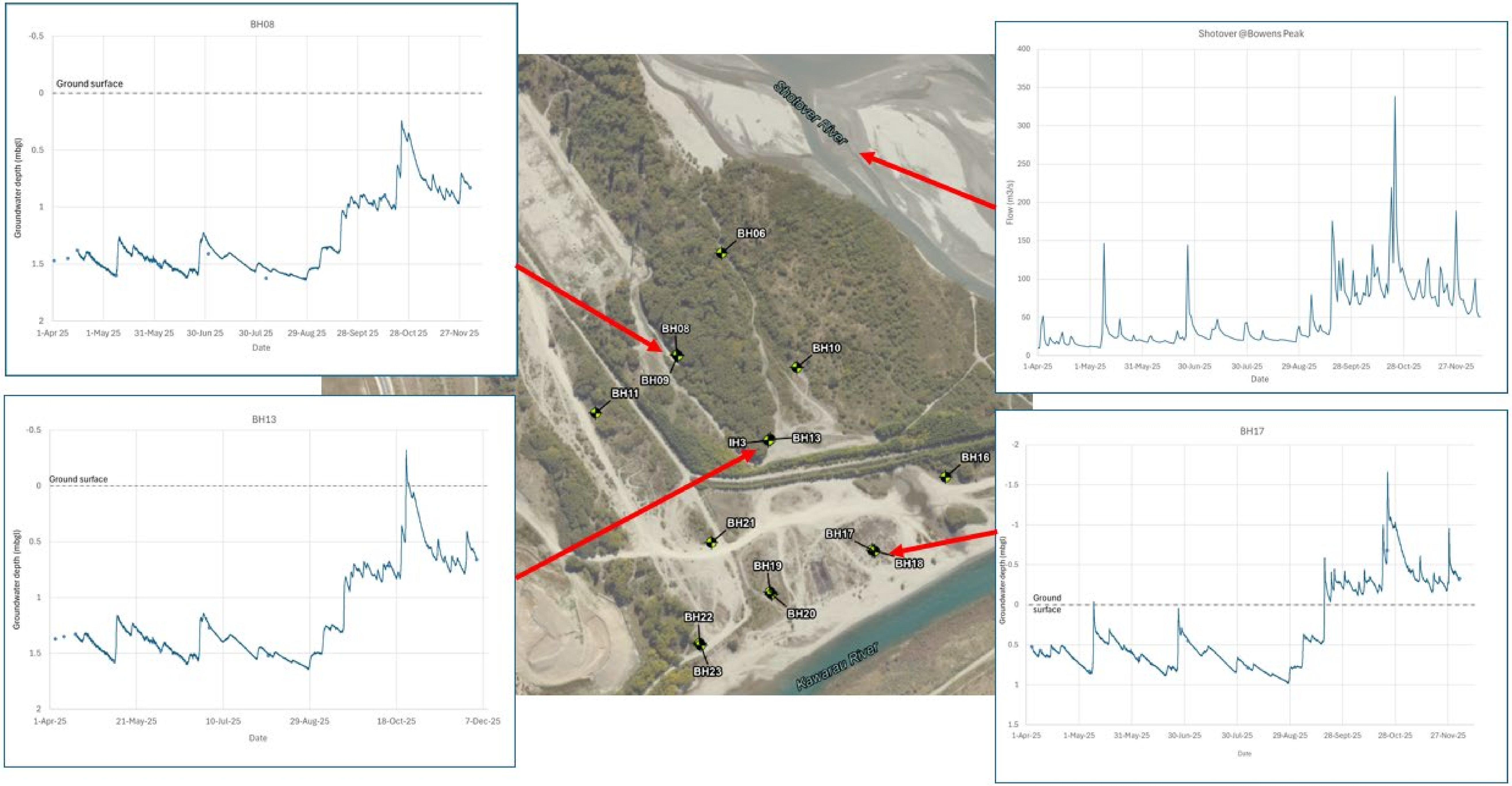

Figure 3.23 Groundwater levels and river flow April to December 2025

3.6 Water quality

3.6.1 Groundwater quality

3.6.1.1 Introduction

Groundwater quality monitoring was historically carried out during the period of DaD operation. The wells were located around the perimeter of the DaD field and did not provide an indication of groundwater quality across the wider Shotover Delta shallow aquifer or quality of groundwater discharging to the Shotover and Kawarau River.

Installation of additional monitoring wells and groundwater quality monitoring across the Shotover Delta commenced in April 2025, approximately 1-2 weeks after cessation of discharge to the DaD. Water levels within the DaD (treated wastewater) remained elevated for several weeks after discharge ceased as the water slowly drained to ground. Therefore, it is considered that groundwater samples collected in April 2025 and likely May and June 2025 are representative of the effects of the DaD discharge during operation.

3.6.1.2 DaD compliance monitoring

The DaD discharge consent required water level and water quality monitoring of monitoring wells. The wells were installed around the perimeter of the disposal field, with two wells (ORC3 and ORC6) located in the middle of the DAD field. Water levels were monitored via telemetry every 30 mins, with regular water quality sampling undertaken. The location of the wells used during operation of the DaD are shown on Figure 3.24.

Figure 3.24 shows the ammoniacal-N concentration in groundwater sampled from the upgradient (ORC1), downgradient (ORC 8) and mid field (ORC3) monitoring wells. Ammoniacal-N is generally lowest in the upgradient well (ORC1), with very high concentrations, up to 156 g/m^3, recorded in downgradient well ORC8 in 2024. During this period the ammoniacal-N concentration in the effluent averaged 19.8 g/m^3, which was approximately double the long-term average (2018-2024) of ~7.5 g/m^3.

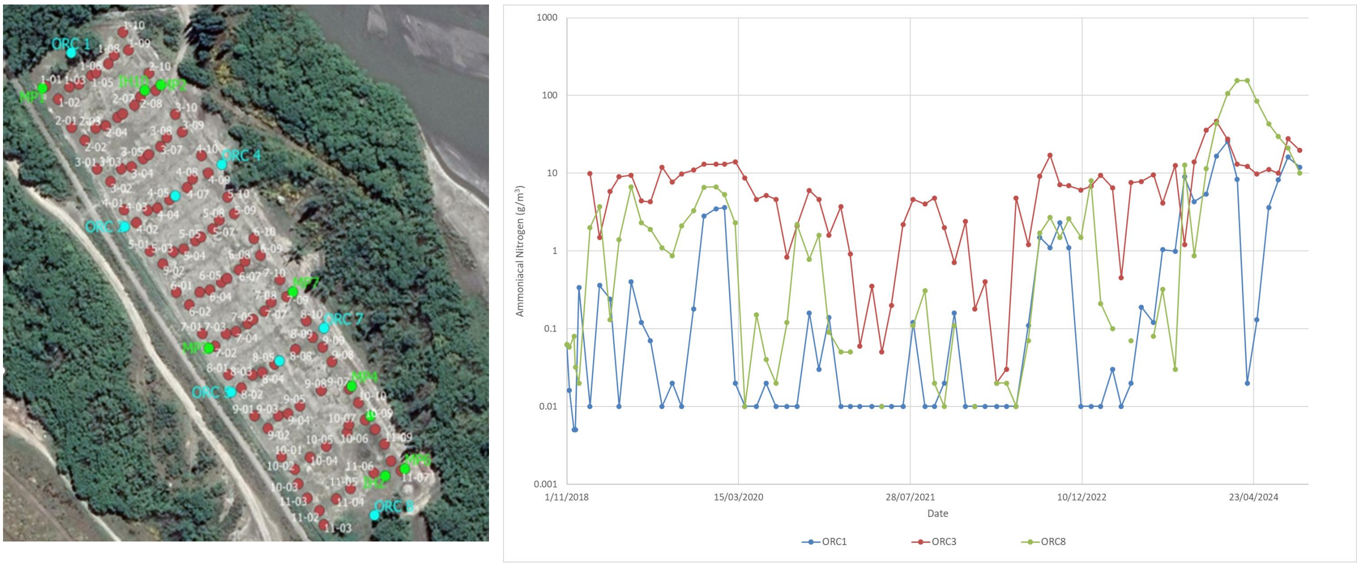

Figure 3.24 DaD compliance monitoring – layout of piezometers and ammoniacal nitrogen concentrations.

3.6.1.3 Shotover Delta groundwater monitoring

Groundwater monitoring has focussed on key wastewater indicators, including nitrogen and phosphorus. Monitoring wells were sampled by low-flow methodology, with samples collected after stabilisation of field parameters (pH, temperature, DO and electrical conductivity). Testing of groundwater samples for additional parameters, such as major ions and metals has also been undertaken in March 2025 and April 2026 (metals only). These results are tabulated in Appendix B.

As noted in Section 3.6.1.2 the long-term average for ammoniacal-N concentration in effluent was approximately 7.5 g/m^3. Figure 3.25 which illustrates the treated wastewater ammoniacal-N concentration over the period of groundwater monitoring, is provided for context. The sharp reduction in ammoniacal-N that occurred September 2025 was as result of the Stage 3 upgrades coming online and removal of the oxidation ponds from the treatment system.

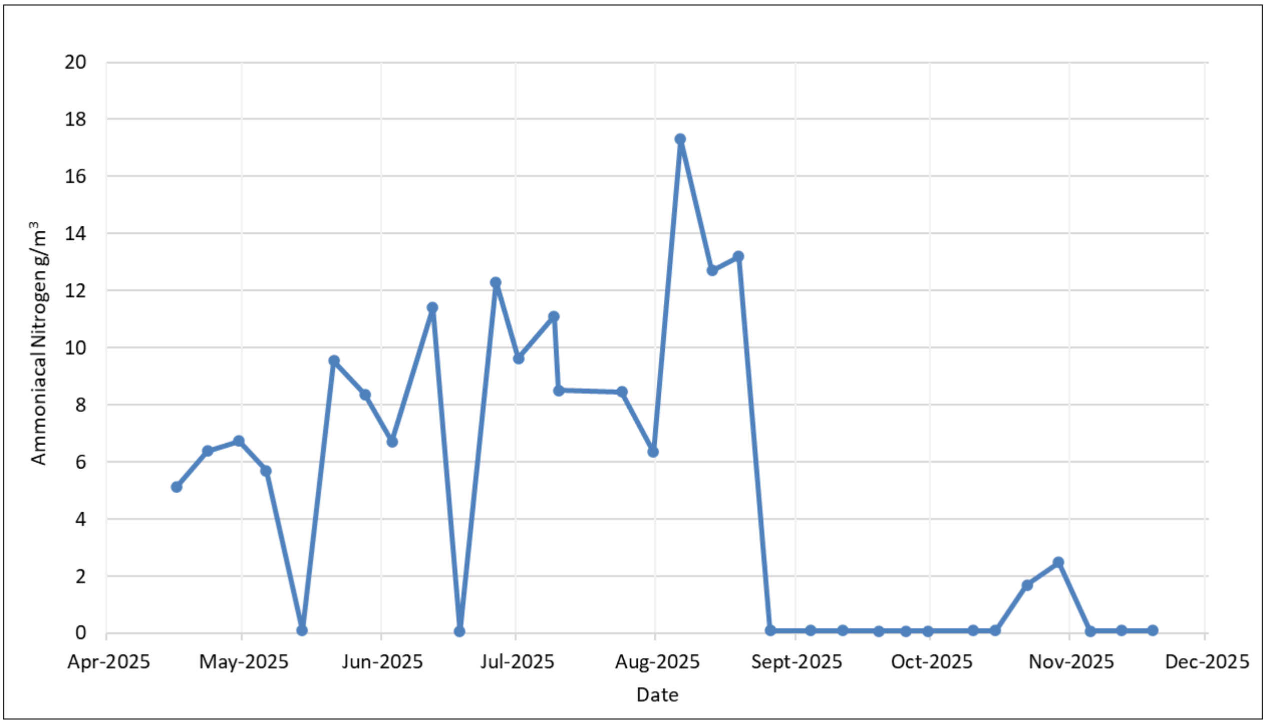

Figure 3.25 *Ammoniacal-N in effluent prior to entering discharge channel*

Wastewater has the potential to effect groundwater quality through the following seepage paths:

– Infiltration through the base of the DaD (primary influence on groundwater).

– Seepage through the base and sides of discharge channel used for the short-term discharge to the Kimiākau/Shotover River.

– Seepage through the base of the oxidation ponds (when pond were used as part of treatment process)

Table 3.6 summarises nutrient water quality trends and distribution in groundwater. Figure 3.26 demonstrates the general monitoring trend, with improving water quality in most wells over the past year. Full results and graphs are presented in Appendix B.

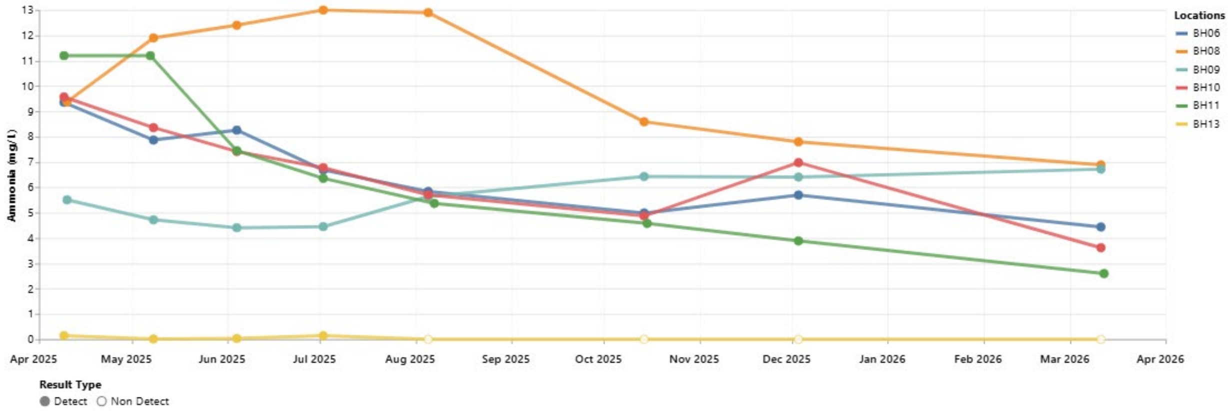

Figure 3.26 *Ammoniacal-N concentration in groundwater downgradient of the DaD*

Table 3.6 Groundwater quality trends and distribution

Location	Wells	Water quality
Upgradient	BH01	Nutrient concentrations in BH01 are very low with most parameters (including Ammoniacal-N) below laboratory detection limits. Nitrate-N concentration varies, but typically less than 0.4 g/m^3.
Around discharge channel	BH02 BH03 BH04	Nutrient concentrations are higher on the downgradient side of the channel, with BH03 recording elevated Ammoniacal-N compared to BH02 (below laboratory detection limit). Ammoniacal-N in BH03 shows a decreasing trend, with low concentrations recorded in December 2025 and March 2026. This decreasing trend occurred before the improvement in effluent quality in September 2025 (stage 3 upgrades) indicating that the wastewater influence is likely related to effects of the DaD discharge, however the improved effluent quality may also be influencing the low concentrations recorded in December 2025 and March 2026 BH04 shows similar water quality trends to BH03, although at slightly higher concentrations. The location of BH4 is slightly more downgradient of the DaD relative to BH3, there is likely to receive a higher proportion of wastewater from the DaD. Nitrate-N is low in all wells in a similar range to BH01. DRP is elevated in BH03 and BH04 compared to the upgradient wells. BH04 recorded high concentrations in April and May 2025, however all results from June 2025 have been <0.1 g/m^3. DRP concentrations in BH03 have fluctuated between 0.65 and 0.03 g/m^3.
Downgradient from DaD	BH08 (shallow) BH09 (deep)	Paired piezometers BH08 (screened 1-3 mbgl) and BH09 (screened 6-8 mbgl) are located directly downgradient of the DaD and adjacent to an area of ponded wastewater during DaD operation (spring discharge from the DaD) Ammoniacal-N concentrations in BH08 are similar to the effluent quality. The high concentrations indicate that groundwater in this location is effectively wastewater with negligible in ground attenuation. Ammoniacal-N concentration peaked in July 2025 at 13.0 g/m^{3,} reducing to 6.9 g/m^3 by March 2026. BH09 also shows elevated ammoniacal-N, but in contrast to most other wells shows a slight increasing trend, with the ammoniacal-N in March 2026 (6.7 g/m^3) almost equalling BH08 concentration. This suggests mixing within the aquifer with downward movement of wastewater contaminants. DRP is elevated in BH08 compared to the deeper BH09. DRP peaked in BH08 at 1.4 g/m^3 in May 2025, decreasing to <0.1 g/m^3 since October 2025. In contrast to the ammoniacal-N trend, DRP concentration in BH09 is consistently very low or below laboratory detection limit. Nitrate-N concentrations in both wells are low, with most results <0.02 g/m^3
	BH06 BH10 BH11	The monitoring wells in this grouping are not situated directly downgradient of the DaD but nonetheless show evidence of influence from DaD discharges. All three monitoring wells show decreasing ammoniacal-N concentrations from the peak values recorded in April 2025, with a general range of 9-11 g/m^3 reducing to 3-5 g/m^3 in March 2026. BH06 and BH10 both recorded a small increase in ammoniacal-N in December 2025, this increase may be related to the flushing/remobilisation of the DaD discharge plume during high river flows. In contrast, BH11 located further from the river, continued to show a consistent decreasing trend. DRP concentrations in BH06 and BH10 has decreased slightly from the April 2025 peak but have remained elevated at around 0.3 g/m^3 with no clear reducing trend. DRP in BH06 and BH10 is higher than BH08 (directly downgradient of the DaD). DRP concentration in BH11 has decreased to low concentrations from the initial April 2025 measurement. All wells in this group have low concentrations of nitrate-N with no trends evident, the highest concentration was recorded in BH10 at 0.1 g/m^3
	BH13 (deep)	BH13 is located directly downgradient of the DaD and is screened from 4.5-6.5 m bgl. A shallow piezometer (IH3) at this location cannot not be sampled due to a blockage. Ammoniacal-N concentrations are significantly lower than BH09, from 0.15 g/m^3 in April reducing to below laboratory detection limits from August 2025. Likewise, DRP concentration is low mostly <0.01 g/m^3. Nitrate-N concentration is higher than monitoring wells influenced by wastewater and is comparable concentrations in the upgradient well BH01.
	BH21	BH21 is an outlier with regards to groundwater quality on the Shotover Delta. This well has recorded high Nitrate-N concentrations with a maximum value of 4.5 g/m^3 in July 2025. Recent Nitrate-N results (December 2025 and March 2026) are similar to other nearby wells. Ammoniacal-N concentration shows similar decreasing trends as other wells, decreasing from a peak of 6.4 g/m^3 to <1 g/m^3. The monitoring shows low DRP concentrations in BH21 with all results <0.1 g/m$^{3.}$
Kawarau River frontage	BH22 (shallow) BH23 (deep) BH19 (shallow) BH20 (deep) BH17 (shallow) BH18 (deep) BH16 (shallow)	Monitoring wells were installed parallel to the Kawarau River to characterise the groundwater seepage to the river. Three sets of paired shallow and deep monitoring wells were installed, with BH16 being a standalone shallow well. However, while deeper, BH23 and BH20 also intercept the same sandy gravel aquifer of the paired shallow well. This allows for characterisation of the vertical variation in groundwater contaminant concentration in the shallow aquifer discharging to the river. BH18 is the exception, this well is screened from 6-8 mbgl in a fine sand unit which underlies the gravel near the Kawarau River frontage (also encountered during drilling of BH23 and BH20). The low permeability of the sand is likely to restrict groundwater flow and concentrate groundwater flow through the overlying gravel as shown in Figure 3.21. The monitoring data shows a general difference between the shallow and deep wells, with elevated ammoniacal- N in the shallow aquifer. Ammoniacal-N concentration in the shallow wells shows a decreasing trend from July 2025 onwards, with concentrations in BH16 and BH19 less than half the initial concentrations. BH17, located directly downgradient of the DaD records the highest ammoniacal-N concentrations. Of the shallow wells, BH22 records the lower ammoniacal -N concentration, its location, to the side of the primary groundwater flow direction (Figure 3.22) likely results in a smaller proportion of wastewater influence. BH23 shows similar ammoniacal-N trends but with slightly lower concentrations compared to BH22. Despite being a classed a deep well, BH20 shows similar Ammoniacal-N concentrations and trends to BH19. In contrast BH18 screened in the underlying fine sand has very low ammoniacal-N concentrations compared to other nearby wells. This suggests that the upper sandy gravel layer is well mixed and likely indicative of the discharges to the Kawarau River. The low permeability of the deeper fine sand limits the movement of wastewater contaminants. DRP concentrations are generally low in most wells, the exception is BH17 with a stable DRP concentration of approximately 0.3 g/m^3. Nitrate-N concentrations are generally low in all wells <0.5 g/m^3. There is no obvious trend in Nitrate-N concentrations, however all wells in this grouping recorded low Nitrate-N in December 2025. This may reflect flushing and/or dilution during high flow conditions.

3.6.1.4 Groundwater quality summary

The groundwater quality data shows the following general patterns (Table 3.7).

Table 3.7 Groundwater summary

Parameter	Comment
Spatial distribution	The influence of wastewater discharges on groundwater quality is widespread across the Shotover Delta with highest contaminant concentrations directly down gradient of the DaD. Wells that are located oblique to the main groundwater flow path (e.g. BH03, BH22 and BH23) show a smaller proportion of wastewater influence. Only the upgradient wells BH01 and BH02 show no influence of wastewater impact.
Depth	Wastewater contaminants are generally higher in shallow wells compared to deep wells. The exception to this is monitoring well pair BH19 and BH20, which are both screened in gravel over a low permeability sand layer. The low contaminant concentrations in BH18 indicates that most of the flow is through the overlying sandy gravel.
Trends	Most wells show a reduction in the main wastewater contaminant, ammoniacal-N, with concentrations decreasing by half or more in many wells over the past year. BH09 is an exception, with a small increase in concentration to a similar level to match BH08 (paired shallow well). DRP concentrations are generally low, however there is some variability over time and spatial distribution. Unlikely mobile nitrogen species, phosphorus mobility is influenced by adsorption to fine sediments, which varies both spatially and over time with variable groundwater levels.

3.6.2 Surface water quality

3.6.2.1 Setting

Lake Wakatipu is currently classified as being in an oligotrophic state. The major inputs into Lake Wakatipu are the Dart and Rees Rivers, both of which have glacial origins and high water quality. The immediate catchment is likely to contribute some nutrient input into the lake, including Horne Creek from its agricultural, urban and industrial catchment. ORC monitors water quality in Lake Wakatipu; LAWA reports the lake as having a “very good” Trophic Level Index score of 1.3 (calculated from chlorophyll *a*, total nitrogen, total phosphorus and water clarity)[4].

Water quality in the Kimiākau/Shotover River is monitored in accordance with QLDC’s REMP, with results from March 2025 onwards (GHD Ltd, 2025b). Locations are shown in Figure 3.27 below. Water quality upstream of the Shotover WWTP (RS01 and RS04B) is generally good, with ammoniacal-N is nearly always below lab detection (Attribute Band A in NPS FM), nitrate-N is consistent with Attribute Band A and DRP is consistent with Attribute Band A criteria the majority of the time.

The Shotover WWTP discharges treated wastewater into a channel that then directs the flow to a river braid adjacent to the true right bank of the Kimiākau/Shotover River. Monitoring locations RS06B and RS09 are downstream of the discharge in the Kimiākau/Shotover River. Water quality at these sites has significantly improved since plant upgrades were completed in late 2025. Since November 2025, ammoniacal-N and nitrate-N concentrations at RS06B have been consistently within NPS FM Attribute Band B, with no visible change in river clarity or colour of river water evident after reasonable mixing. DRP results at RS06B and RS09 are consistent with Attribute Band D criteria, however, water quality increases at RS10, further downstream and immediately after the confluence with the Kawarau River, changing the DRP Attribute Band from D to B (NPS FM).

The Kawarau River water quality is monitored by ESNZ at the Chard Rd monitoring station (as shown in Figure 3.11), downstream of the confluence with the Kimiākau/Shotover River[5], reflects the inputs of Lake Wakatipu and the Kimiākau/Shotover River. The Kawarau River at Chard Road has high water quality, with LAWA reporting ammoniacal nitrogen, nitrate nitrogen and dissolved reactive phosphorus (DRP) as being consistent with

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[4] **https://www.lawa.org.nz/explore-data/otago-region/lakes/lake-whakatipu**

[5] **https://www.lawa.org.nz/explore-data/otago-region/river-quality/dunstan-rohe/kawarau-at-chard-road**

Attribute Band A of the NPS FM (MfE, 2020 amended December 2025). Water clarity is consistent with Attribute Band C, reflecting the influence of the Kimiākau/Shotover River, which provides a naturally high sediment load.

Further downstream, the Kawarau River flows into Lake Dunstan near Bannockburn. Monitoring of Lake Dunstan at Dead Mans Point near Cromwell, indicates that the lake has an attribute status of Band A[6] with regards to total phosphorus, total nitrogen and ammoniacal-nitrogen.

3.6.2.2 Water quality criteria

National Policy Statement for Freshwater Management (NPS FM)

The NPS FM (MfE, 2020 amended December 2025) provides national freshwater quality limits and objectives that give effect to Te Mana o te Wai and set minimum expectations for river health in New Zealand.

Under the NPS FM, attribute states describe the condition of freshwater by assigning measured values (such as nutrients, clarity, or *E. coli*) to nationally defined bands or states. These states provide a consistent way to assess current water quality, track change over time, and determine whether objectives and bottom lines are being met. For example, an Attribute Band A generally indicates very good water quality, supporting swimming and contact recreation, with minimal effects on aquatic ecosystems, whereas Band D reflects poor water quality, where ecological and human health values are significantly compromised and improvement is required (unless considered to be naturally occurring, i.e. clarity in high sediment rivers).

In this assessment, NPS FM attribute limits are used as guidelines, alongside ORC regional plan objectives and limits, to contextualise surface water quality in the Shotover and Kawarau Rivers.

Otago Regional Council: Regional Plan

Schedule 15 of the ORC Regional Plan: Water for Otago (Otago Regional Council (ORC), 2025), sets out the characteristics, numerical limits, and target values that define good quality water for rivers and lakes across the region. It provides both qualitative descriptors and quantitative thresholds for key water quality parameters to protect ecological, recreational, and human health values. Table 15.2.2 within Schedule 15 of the Regional Plan specifies the numerical water quality limits and target dates for Receiving Water Group 2 catchments, including rivers such as the Shotover and Kawarau. These limits cover nitrate-nitrite nitrogen, DRP, ammoniacal-N, *E. coli* and turbidity.

Water Conservation (Kawarau) Order 1997

The Water Conservation (Kawarau) Order 1997 (New Zealand Government, 1997) is a national instrument that regional plans and resource consenting in the Kawarau River system, including the Kimiākau/Shotover River, must be consistent with. It requires regional councils to manage activities such as water takes, discharges, and river works in a way that preserves specified outstanding values, and it sets mandatory water quality management standards that must be reflected in regional plan provisions and considered when interpreting water quality monitoring results and consent effects.

The Water Conservation Order provides the highest level of protection for the Kawarau River system by requiring outstanding natural and recreational values to be preserved through restrictions on activities and water quality management classes. Similarly, the NPS FM sets the national framework for freshwater management, but it does not override the protections of the Water Conservation Order. Within this context, Schedule 15 of the Otago Regional Plan translates requirements of both the NPS FM and the Water Conservation Order into region specific numerical limits, which are commonly used as practical benchmarks for consent assessment and water quality monitoring where they are consistent with, and do not undermine, the Water Conservation Order.

3.6.2.3 Surface water monitoring

QLDC undertakes surface water monitoring of the Shotover and Kawarau Rivers at various sites on a weekly and monthly basis in accordance with the REMP (GHD Ltd, 2025b). Figure 3.27 shows the locations of the monitoring sites.

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[6] **Land, Air, Water Aotearoa (LAWA) - Lake Dunstan at Dead Mans Point**

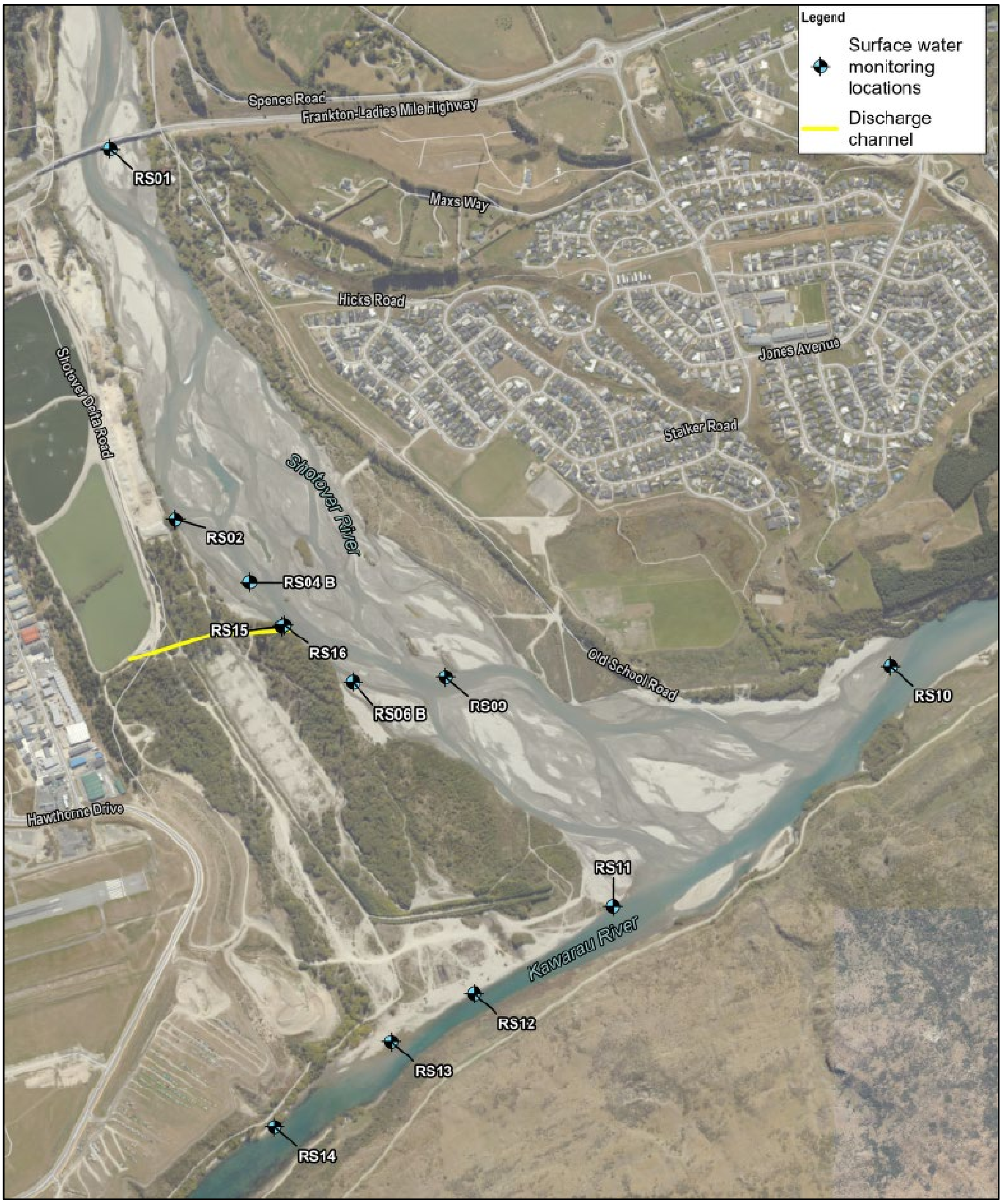

Figure 3.27 Surface water monitoring locations (REMP)

3.6.2.4 Temperature, dissolved oxygen and pH

Baseline physiochemical conditions in the receiving Kawarau River can be characterised using measurements of temperature, dissolved oxygen (DO), and pH, given their role as key physiochemical parameters used to characterise and assess water quality and aquatic ecosystem conditions (Larance, 2025) (ANZG, 2018).

Monitoring at the Kawarau location RS10 (post-confluence) indicates clear seasonal variability, with winter (Jun - Aug 2025) conditions characterised by a median pH of 8.00 and a low median temperature of 5.7 °C, and summer (Dec 2025 - Feb 2026) conditions showing a more neutral median pH of 7.85 and elevated median temperatures of 15.8 °C. These seasonal shifts are consistent with expected climatic and hydrological influences on river systems and have important implications for chemical behaviour.

DO median concentration measured at RS10 Kawarau (Mar 2025 – May 2026) is 11.2 mg/L, which is indicative of a well oxygenated river conditions (USEPA, 2026). The low organic carbon content of the water, relatively shallow water and turbulence in the rivers is considered to limit the potential for low microbial processes to reduce DO to any meaningful extent, even during nighttime periods when temporal reduction in DO can occur in rivers with elevated organic carbon concentrations.

3.6.2.5 NPS FM parameters

The annual median and 95th percentile (95%ile) values of the upstream (RS14) and downstream (RS10) monitoring locations in the Kawarau River are provided in Table 3.8. Ammoniacal-N and Nitrate-N 95%ile concentrations are consistent with Attribute Band A criteria of the NPS FM both upstream and downstream. The DRP 95%ile for RS14 is consistent with Attribute Band A criteria, while RS10 falls into Attribute Band B criteria.

Table 3.8 Annual median and 95th percentile values for Kawarau River monitoring locations

Parameter	Ammoniacal-N (adjusted for pH 8 at 20°C) (mg/L)		Nitrate-N (mg/L)		Dissolved Reactive Phosphorus (mg/L)	
Location	**Median**	**95%ile**	**Median**	**95%ile**	**Median**	**95%ile**
RS10 (downstream)	0.0022	0.015	0.036	0.07	0.005	0.024
RS14 (upstream)	0.0009	0.0021	0.031	0.083	0.001	0.003
NPS FM National Bottom Line	0.24	0.4	2.4	3.5	0.018*	0.054*
Notes: *NPS FM Attribute Band D value (as no National Bottom Line) - Noting that NPS FM DRP criteria is based on monthly monitoring over 5 years - Data from 11 March 2025 to 18 March 2026						

A Wilcoxon signed-rank test was undertaken to compare RS10 and RS14. Results found that downstream at monitoring location RS10, downgradient of the confluence with the Kimiākau/Shotover River, ammoniacal-N, nitrate-N and DRP concentrations are not statistically different from upstream water quality at RS14. However, the statistical test is impacted by the small dataset available and occurrence of concentrations often below detection level.

Water quality within the Kawarau River downstream (RS10) of the confluence has also remained within the Regional Plan Schedule 15 criteria as outlined in Table 3.9 below. Overall, the influence of surface water and groundwater discharges from the Shotover WWTP and DaD disposal field do not appear to have a more than minor cumulative effect on water quality immediately downstream of the confluence.

Table 3.9 80th percentile concentrations at or below median flow (179.1 m^3/s) in Kawarau River

Location	Parameter	Nitrate-nitrite nitrogen	DRP	Ammoniacal-N	Ammoniacal-N (adjusted for pH 8 at 20°C)	*E. coli*	Turbidity
	Unit	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**cfu/100mL**	**NTU**
	Date range	**80%ile**	**80%ile**	**80%ile**	**80%ile**	**80%ile**	**80%ile**
RS10 - Kawarau River downstream of Shotover Delta	11/03/2025 - 18/03/2026	0.041	0.007	0.03	0.012	26	57*
RS14 - Kawarau River upstream of Shotover Delta	11/03/2025 - 10/03/2026	0.05	<0.002	0.01	0.001	70	1.4
ORC Regional Plan - Schedule 15, Water Group 2, water quality criteria		0.075	0.01	0.1	0.1	260	5
Notes: *Natural sediment induced turbidity							

3.6.2.6 Metals

Select water quality samples were tested for the metals aluminium, copper and zinc, which have the potential to be elevated in wastewater.

In the absence of upstream monitoring data for aluminium and copper prior to the confluence with the Shotover (RS14, RS13, and RS12), locations RS11 and RS10 were considered as indicators of these metal concentrations in the Kawarau River.

For copper, the low concentrations measured at RS10, following the confluence with the Kimiākau/Shotover River, are generally consistent with those of the upstream Shotover conditions (RS04B). This indicates that copper concentrations measured at RS10 are primarily reflective of Kimiākau/Shotover River water quality, and therefore concentrations in the Kawarau River upstream of the confluence are likely to be lower than those measured at RS10.

Aluminium is elevated in the Kimiākau/Shotover River, both upstream and downstream of the current wastewater discharge location (Table 3.10). Aluminium is a commonly present element in clay minerals and a range of silicates. The geology of the Shotover River catchment is dominated by schist. Mica, an aluminosilicate mineral, is a major mineral component of schist, this in combination with the steep topography and high rainfall in the upper catchment resulting in high sediment load in the River and is considered to be the most likely source of this high background aluminium concentration. RS10, below the confluence, is influenced by the Shotover River waters and as a result is also considered to have naturally elevated aluminium.

Dissolved aluminium concentrations were notably lower than the total concentrations, reflecting the high proportion of aluminium as sediment and the reduced solubility aluminium species have at the pH of the river waters.

Measured dissolved aluminium, copper and zinc concentrations for the samples collected in the 22 April 2026 GME are presented in Table 3.10 below, against ANZG (2018) Default Guideline Values (DGVs). At RS10, the background concentration of zinc is already greater than the 99% species protection DGV. This indicates that in some instances a background presence of these contaminants may influence the that predicted water quality values causing exceed criteria independently of the proposed discharge.

Water quality monitoring carried out in April 2026 identified relatively high total aluminium concentrations in the Kimiākau/Shotover River upgradient of the current discharge location (location RS04B had a total aluminium concentration of 0.56 mg/L), while the treated wastewater quality prior to entering the discharge and prior to discharge to the river (RS15) had relatively low concentration (<0.2 mg/l). Water quality in downstream Kimiākau/Shotover River samples (RS06B and RS09) and in the Kawarau River, at location RS10, had aluminium concentrations equivalent or greater than the upstream RS04B location. As noted above, elevated concentrations of aluminium observed in the Kimiākau/Shotover River relative to the Kawarau River are interpreted to reflect natural background conditions associated with catchment geology and mineralogy, rather than related to effects from current wastewater discharge.

Table 3.10 Dissolved metals concentrations for Kawarau & Kimiākau/Shotover river monitoring locations (April 2026 sampling)

Location	Dissolved Aluminium (mg/L)	Dissolved Copper (mg/L)	Dissolved Zinc (mg/L)
RS04B (Shotover upstream)	0.025	0.0006	<0.0005*
RS14 (Kawarau upstream)	-	-	0.002
RS11 (Just above confluence)	0.007	0.0007	<0.0005*
RS10 (Kawarau downstream)	0.023	0.0005	0.0061
ANZG 2018 DGV (g/m^3) **99% Protection of species**	0.027**	0.001	0.0024
ANZG 2018 DGV (g/m^3) **95% Protection of species**	0.055**	0.0014	0.008

Notes:
*Concentration at or below Limit of Reporting (LOR)
**DGV for aluminium for pH >6.5 (ANZG, 2018)

3.6.2.7 Effect of groundwater discharges on surface water quality

Surface water sample results show elevated nutrient concentrations in surface water at RS11, RS12 and RS13 along the Kawarau River beach frontage relative to the upstream sample location RS14. The increase in nutrient concentrations in surface water at these locations, in addition to relatively elevated concentrations of other parameters such as manganese, is considered to be due to groundwater seepage from the Shotover Delta gravels into the river. The locations with highest nutrient concentrations are directly downgradient (i.e. main groundwater flow direction) of the DaD.

Figure 3.28, Figure 3.29 and Figure 3.30 provide the timeseries for the ammoniacal-N, nitrate-N and DRP concentrations measured in the Kawarau River water samples along the Shotover Delta river frontage.

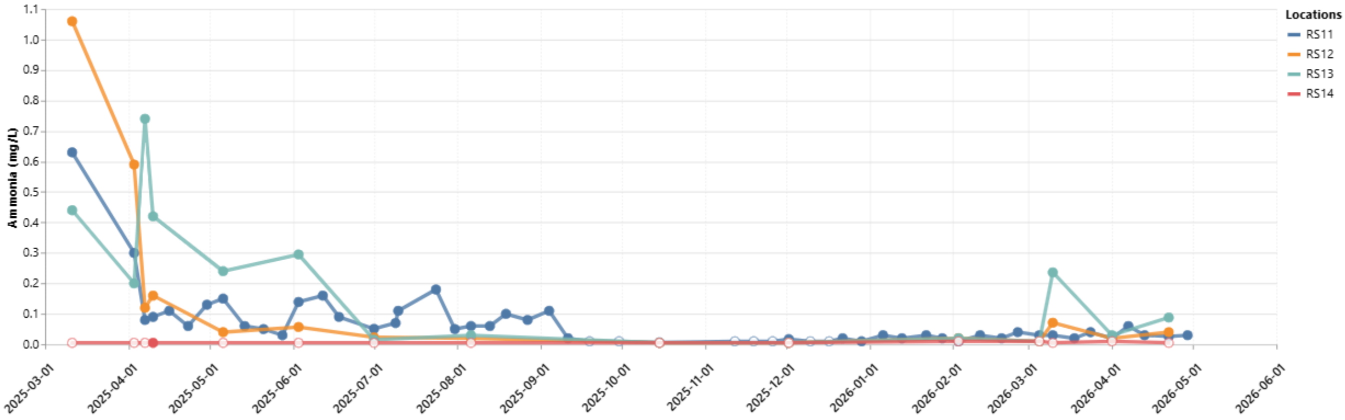

Figure 3.28 Ammoniacal-N concentrations in Kawarau River

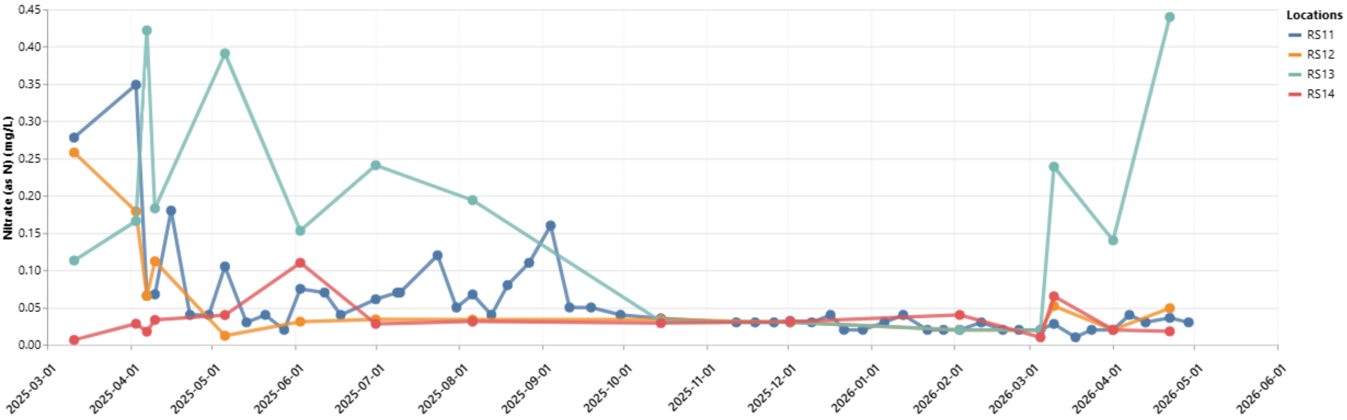

Figure 3.29 Nitrate-N concentrations in Kawarau River

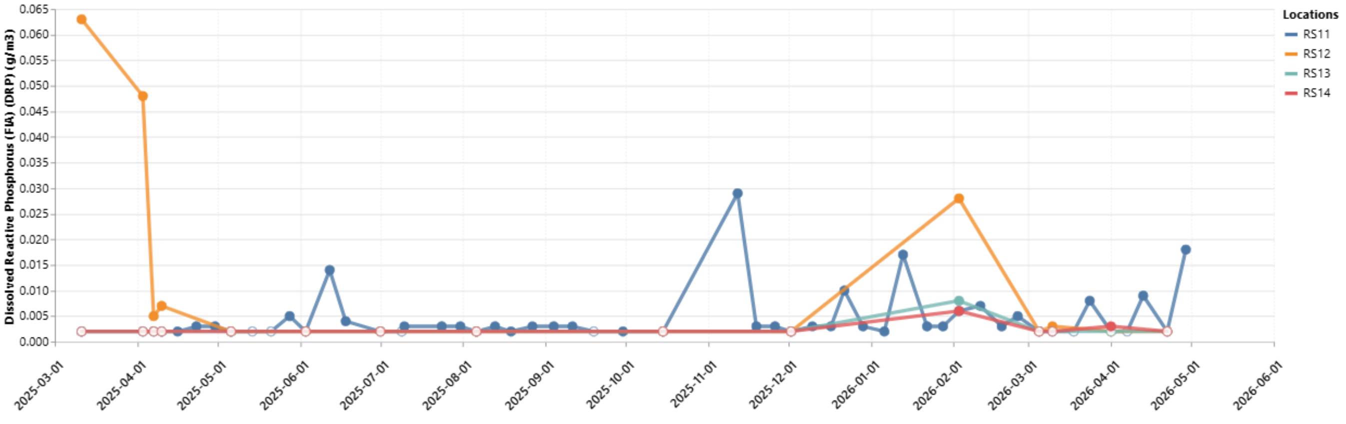

Figure 3.30 DRP concentrations in Kawarau River

Figure 3.28 provides the results of monitoring in March 2025 (when the DaD was still operating) and March 2026. Elevated nutrient concentrations are apparent in these river edge samples during periods of low river flow conditions. The flows in March 2025 were very low at 85 m^3/s compared to March 2026 at 129 m^3/s (Kawarau at Chard Rd).

During the March 2025 sampling event, shallow groundwater samples were also collected near the river edge by excavating a shallow hole within the gravels on the Kawarau River frontage and collecting the seepage waters. The are considered representative of groundwater discharging to the river. The results, against ammoniacal-N results from water samples in March 2025 and March 2026, are shown spatially on Figure 3.31. The water quality results for monitoring indicate the following:

- Nutrient concentrations in riverbank waters (e.g. RS12, RS13) of Kawarau River increase significantly relative to upstream water (RS14) quality, as river water flows past the Shotover Delta due to the influence of groundwater discharges.
- The influence of groundwater discharges to the Kawarau River water quality are greatest under low river flow conditions. Where low flow periods persisted for long periods (such as March-April 2025) ammoniacal concentrations likely exceeded national bottom line limits in riverbank waters.
- Impacts to groundwater quality from operation of the DaD, has resulted in effects to river water quality, which were likely unexpected at the time of consenting the discharge via the DaD.

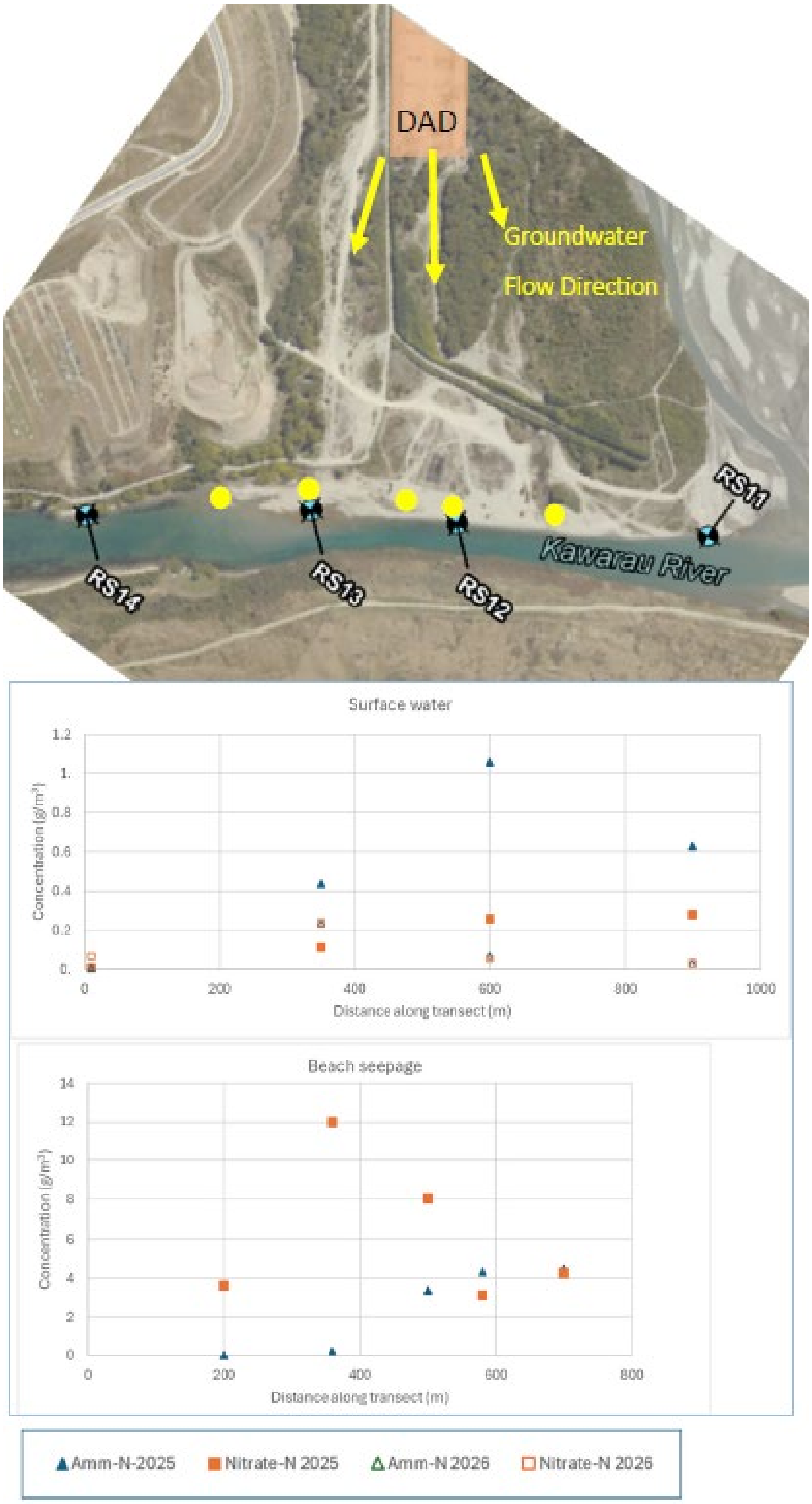

Figure 3.31 *Water quality results along Kawarau beach- March 2025 and March 2026. Graphs show relative concentration of Ammoniacal-N (triangle symbols) and Nitrate-N (square symbols).*

4. Groundwater assessment

4.1 Historical discharge effects

The operation of the dose and disposal field (DaD) introduced a significant volume of treated wastewater into the shallow aquifer of the Shotover Delta. As treatment provided at the time included ongoing use of oxidation ponds, the ammoniacal-N concentrations of the treated wastewater were high. This resulted in near equivalent concentrations of ammoniacal-N in shallow groundwater and groundwater to the Kawarau River. The mounding of groundwater levels at the DaD also resulted in a degree of radial flow, with the influence on groundwater quality evident more broadly than groundwater piezometric surface would otherwise suggest, such as evidence of high ammoniacal-N in groundwater monitoring wells BH3 and BH4.

With cessation of treated wastewater disposal via the DaD, progressive reductions in contaminant concentrations in shallow groundwater have been evident in monitoring results. No further discharge of treated effluent to groundwater is proposed, and this progressive improvement is expected to continue over time.

4.2 Treated wastewater calamity pond effects

Temporary storage of treated wastewater in the treated wastewater calamity pond will occur as part of normal operations at the Shotover WWTP. When the calamity pond is in use, some seepage through the base of the pond may occur. The rate of seepage is expected to be low due to the presence of a low permeability pond soil liner. However, this seepage has the potential to influence both the level and quality of groundwater in the vicinity of the pond.

The effects to groundwater levels are expected to be negligible given the low rates of seepage, infrequent and short-term storage of wastewater and the connection to, and influence of, river flows on groundwater levels.

While the effects to groundwater of historical use of oxidation ponds has not been characterised, it is expected that the effects of discharges from the treated wastewater calamity pond will be significantly less than historical conditions, for the following reasons:

- Improved wastewater treatment, with lower contaminant concentrations in wastewater than when Pond 3 was operated as an oxidation pond.
- Infrequent and short-term use of the calamity pond, with reduced rate of seepage through the liner due to lack of driving head.

Based on this, the effect on groundwater quality from calamity pond seepage is expected to be negligible.

5. Hydrology assessment

5.1 Proposed discharge structure

Other than the discharge structure, all infrastructure for conveyance of treated wastewater to the discharge location is proposed to be sub-surface. The positioning of the discharge structure on the true left bank of the Kawarau River and extending approximately 10 m into the river, is intended to allow discharge of treated wastewater into faster flowing parts of the river, even under low flow conditions.

The cross section provided as Figure 5.1, illustrates bathymetry at survey location CX3 during seasonal low flow conditions recorded in March 2026, and the proposed position of the discharge structure on the riverbank. The structure has the potential to influence the hydrology of the river by modifying the flow path for water flow adjacent to the left riverbank and by reducing the cross-sectional area of the river channel as a whole. As river levels rise during higher flow events, reductions in channel cross section may provide a damming effect that influences Lake Wakatipu water levels.

The WCO includes specific requirements for damming effects and maintaining return flow characteristics of the Kawarau River under flood conditions. Assessment of effects to hydrology considers both the change in river flow paths and these potential damming effects.

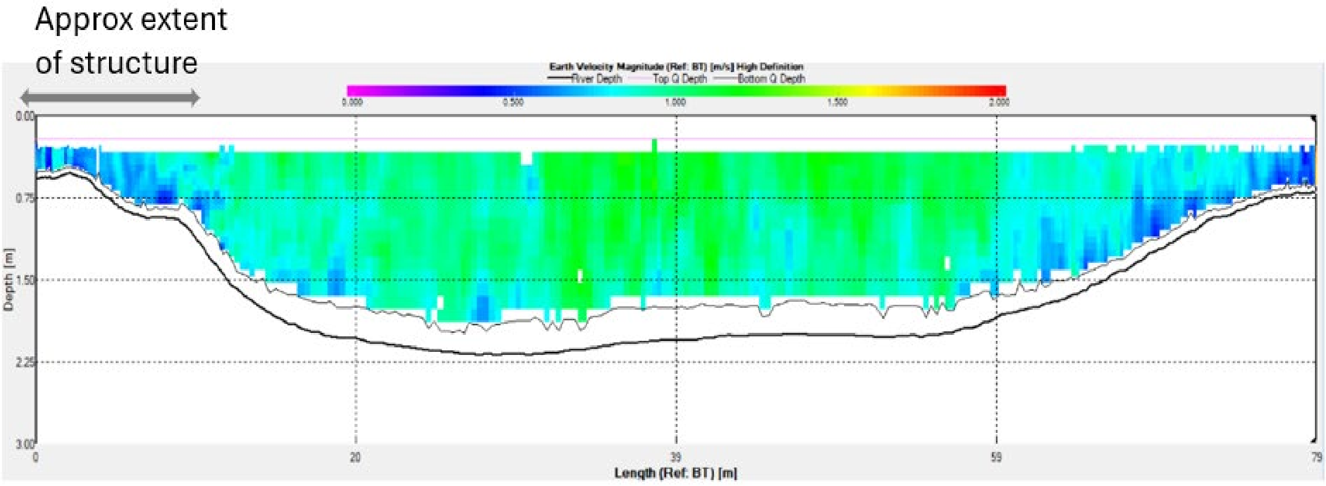

Figure 5.1 Cross section CX3 showing approximate extent of structure into Kawarau River

5.2 River channel modification

Under low flow conditions, the discharge structure will extend approximately 10 m into the river and be approximately 0.6 m higher than river levels in order to divert flow of shallow waters around the structure. This is intended to increase turbulence at the point of discharge and promote mixing of discharged treated wastewater with river water.

River conditions at the time of the March 2026 river survey were adopted for design purposes as representative of low flow conditions. Under these conditions, the structure is expected to reduce the cross-sectional area of the river channel by approximately 4.64 m^2, equating to 3.5% of the total channel area as summarised in Table 5.1.

Table 5.1 River channel modification at seasonal low flow conditions

Parameter	Value
River level at CX3 at time of survey (11 March 2026)	307.912 m RL (NZVD2016)
Cross sectional area of river at CX3	131.78 m^2
Cross sectional area of discharge structure underwater[1]	4.64 m^2
Percentage of river cross-sectional wetted area filled by structure.	3.5%
Note: [1]Assuming structure fills from base of river bed to water level, extending 10 m out	

The Kawarau River channel across the toe of the Delta has been highly variable over time. Surveys of the channel have been carried out approximately every 5 years to assist in understanding the river hydrodynamics and sediment impacts on flooding, and to support flood control works on the Delta.

In the vicinity of the proposed discharge structure, cross section CX3 was obtained during the ESNZ March 2026 survey. At approximately the same location, Transect 7-3 reported by Barnett and MacMurray (2006) to a reference elevation 408.510 mRL has had the cross sectional areas as illustrated in Figure 5.2 (reproduced from (Barnett and MacMurray, 2006))

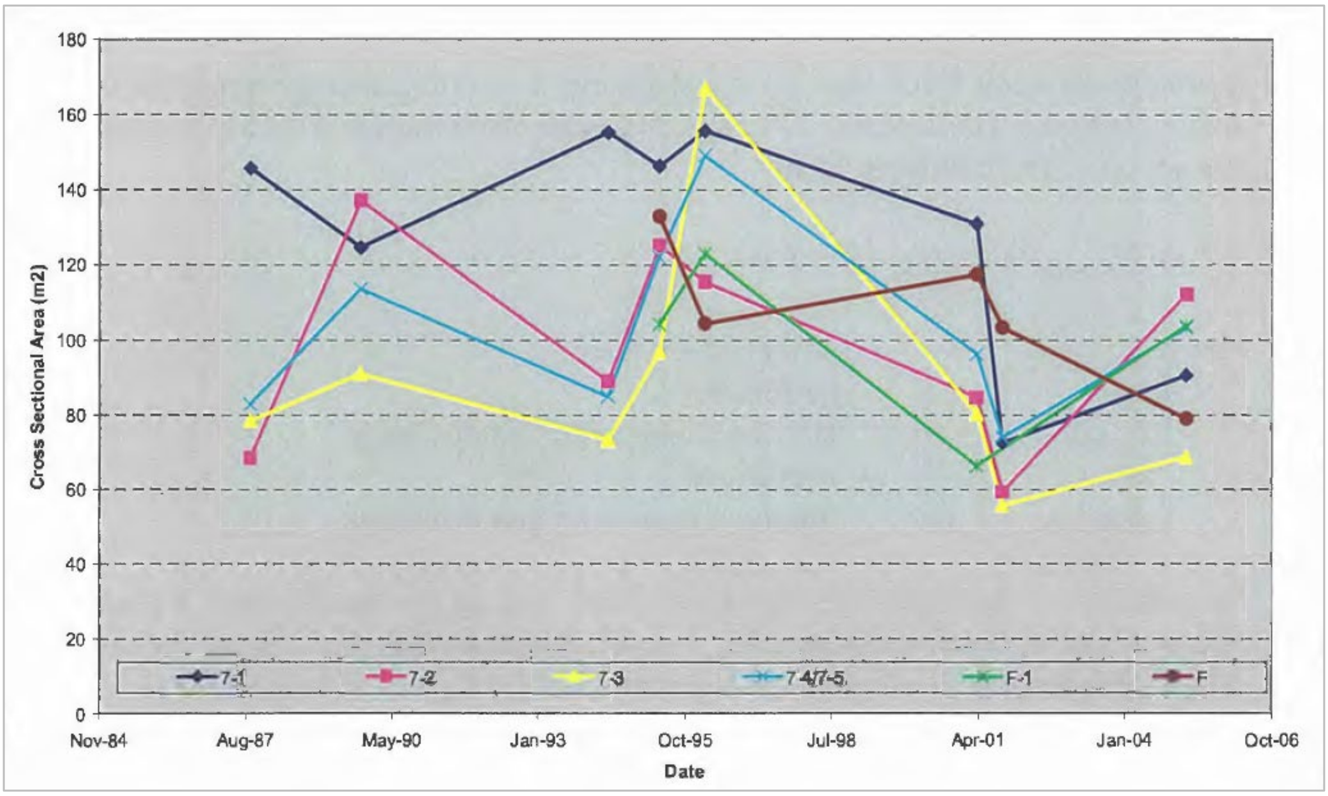

Figure 5.2 Cross section area of Kawarau River channel (reproduced from (Barnett and MacMurray, 2006))

Cross sectional areas of the channel in the vicinity of the discharge structure have varied by more than 100 m^2 over the period between 1987 and 2005. The channel cross section at this location is also discussed in the Haskoning (2026) report prepared for ORC, with figure reproduced from this report.

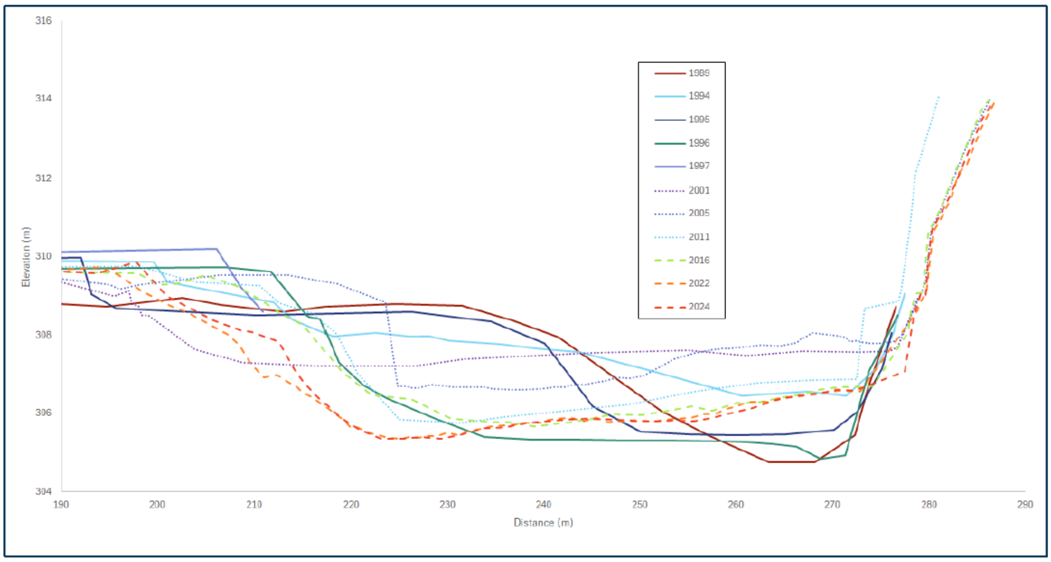

Figure 5.3 **Kawarau River channel cross section over time (Haskoning, 2025)**

Haskoning (2025) concludes '*The bed level has lowered by over 2m since the 2001 survey - the 2024 survey suggests that the channel has largely regained the cross-sectional area it had in 1996 and although slightly shallower than the earliest surveyed profile (1989) it also has appreciably more cross-section area.'*

With construction of the training line, the area of sediment deposition from the Shotover River is now limited to the remaining active parts of the Delta downstream of the proposed discharge structure location. The Kawarau River contributes relatively minimal sediment load to the delta area, and so in that area in the lee of the training line, progressive degradation of the channel appears to be progressively increasing the cross-sectional area.

Given historical variability or river channel dimensions and the significant increases in cross sectional area that have occurred since construction of the training line, the small change in area due to the construction of the discharge structure is expected to have a less than minor influence on river flow, as water is diverted around the structure. No measurable change in river level is expected to occur under these conditions.

5.3 Flood events

During flood events, the discharge structure is likely to be partially or fully submerged depending on the size of the flood event. For the purposes of this assessment a flood water level of 310 mRL was chosen to represent a typical flood level based on the data presented in Haskoning (2025) and shown below.

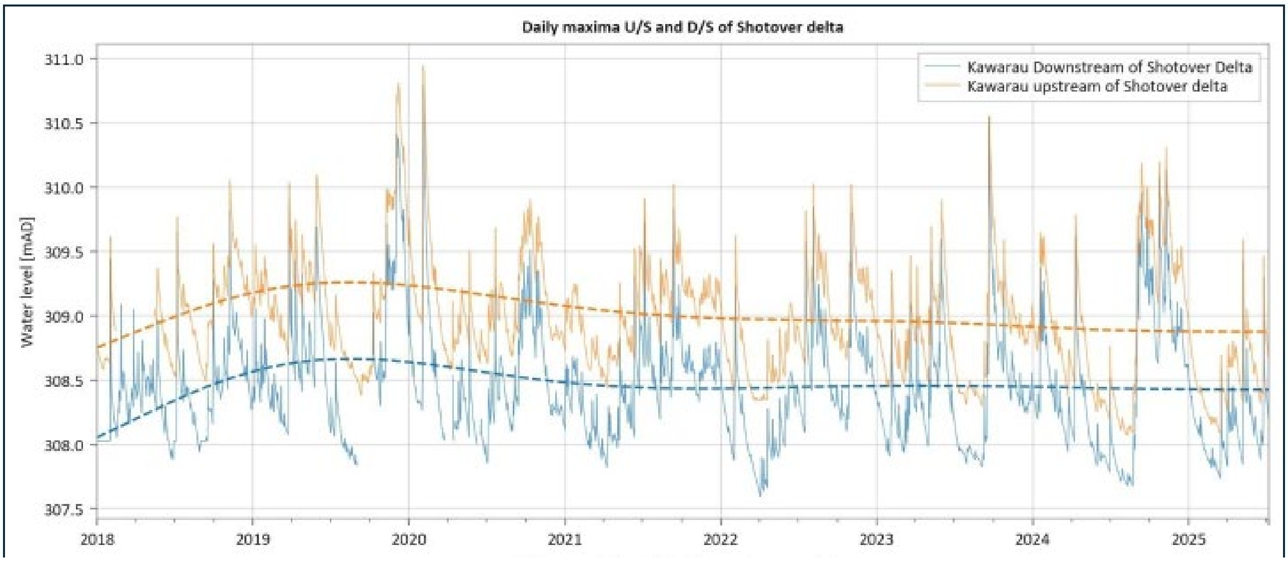

Figure 5.4 **Water level in Kawarau River upstream and downstream of Shotover Delta, exert from Haskoning 2026**

The discharge structure is proposed to extend above ground, back towards the main vehicle track, a distance of approximately 50 m from water. During high flow conditions the riverbank portion of the discharge structure will be partially submerged. A simple schematic is shown in Figure 5.5.

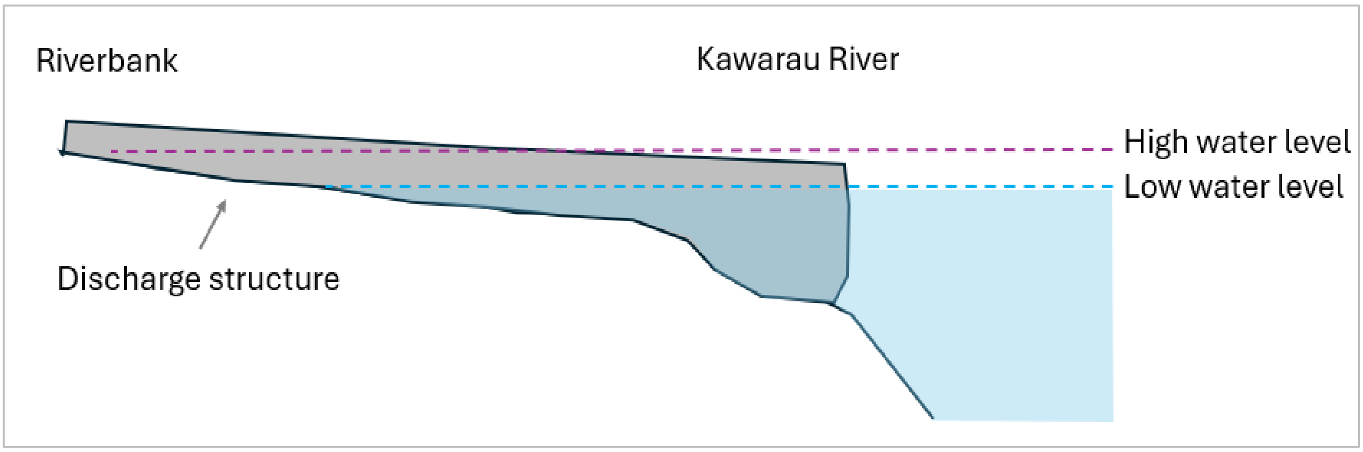

Figure 5.5 ***Schematic showing the change in cross sectional area submerged at high and low water levels***

Under flood conditions, the structure is expected to reduce the cross-sectional area of the river by 7%, as summarised in Table 5.2.

Table 5.2 ***River channel modification at seasonal high flow conditions***

Parameter	Value
Flood river level	310 m RL
Estimated cross sectional area of river at CX3[1]	321.8 m^2
Cross sectional area of discharge structure underwater[2]	22.5 m^2
Percentage of cross-sectional wetted area filled by structure	7%

Notes:
[1] Estimated from LiDAR and bathymetry survey
[2] Assumed height of structure above riverbank and low flow water level = 0.6 m

The assessment shows that a greater proportion of cross-sectional area is impacted during flood flow conditions. The change in channel area is considered to be small in the context of natural variation in the channel dimensions, with the channel area remaining greater than has been evident in recent years, including at the time of training line construction. The proposed changes are therefore considered unlikely to result in measurable damming effects, or effects on return flow as described by the WCO.

However, it is recommended that detailed design of the discharge structure include a detailed analysis of the effects of river cross section changes to confirm these conclusions, and that mitigations be introduced where needed. Such mitigations may include reduced landward extension or elevation of the discharge structure, or gravel removal from the Shotover Delta to offset cross section area losses. The discharge structure design is expected to be sufficiently flexible in concept to readily accommodate such mitigations.

6. Water quality assessment

6.1 Contaminants of Concern

Treated wastewater contains a range of contaminants and physiochemical characteristics that, when discharged to the Kawarau River, have the potential to adversely influence water quality. Effects on water quality may occur through changes to the abundance and diversity of aquatic life, disruption of key ecological processes, or a reduced ability for people to safely connect with and interact with the river environment.

The potential effects to water quality has been carried out considering the contaminants and parameters outlined below. Applicable water quality criteria relating to these and used in assessment are described in Section 5.2.

6.1.1 Ecotoxicity effects

The potential for ecotoxicity arising from treated wastewater discharges is primarily associated with concentrations of contaminants that may cause chronic (long-term) effects on sensitive aquatic species, and, at elevated concentrations, acute toxicity.

The contaminants of primary relevance to ecotoxicity include:

- **Inorganic nitrogen species**, including ammoniacal nitrogen (ammoniacal-N) and nitrate nitrogen (nitrate-N). Of these, ammoniacal-N, and in particular the un-ionised ammonia fraction (NH_3), is typically the most influential contaminant in determining ecotoxicity outcomes, due to its direct toxicity to aquatic organisms. The proportion present as NH_3 is strongly dependent on pH and temperature.
- **Metals**, including copper and zinc which have been measured in treated wastewater at concentrations above detection levels and are commonly associated with urban runoff and trade waste inputs. Aluminium is also expected to be present, owing to the proposed use of coagulants which contain this metal during treatment to remove phosphorus. These metals can cause toxic effects on aquatic organisms at relatively low concentrations.
- **Persistent and bioaccumulative contaminants**, including per- and polyfluoroalkyl substances (PFAS) and other trace organic compounds, which may be present at low concentrations but have the potential for chronic ecotoxicological effects due to persistence and limited degradation.

The magnitude of ecotoxicity effects is strongly influenced by receiving water conditions, including pH, temperature, hardness, and dissolved organic carbon, which affect contaminant speciation and bioavailability.

The Shotover WWTP is designed to reduce nutrient concentrations in treated effluent prior to discharge, with particular emphasis on ammoniacal nitrogen reduction to mitigate ecotoxicity risks.

6.1.2 Ecological process effects

The health of freshwater ecosystems is dependent on a range of interacting biological, chemical, and physical processes that maintain suitable habitat conditions for aquatic life. Elevated inputs of nutrients, organic matter, and suspended solids can disrupt these processes and lead to degradation of ecosystem function. Excessive nutrient enrichment may result in eutrophication, characterised by increased algal or macrophyte growth, fluctuations in dissolved oxygen, and changes in ecosystem structure and function.

The contaminants and representative parameters relevant to ecological process effects include:

- **Total nitrogen and total phosphorus**, representing the overall nutrient load. These parameters account for both immediately bioavailable forms and those that may be transformed over time through biogeochemical cycling into forms available for primary production.
- **Dissolved reactive phosphorus (DRP)**, representing the readily bioavailable fraction of phosphorus. Together with dissolved inorganic nitrogen species (nitrate-N and ammoniacal-N), DRP directly supports the growth of periphyton, phytoplankton, and macrophytes.

- **Biochemical oxygen demand (BOD)**, representing the oxygen required for microbial degradation of organic matter. Elevated BOD indicates the potential for oxygen consumption in the receiving environment following discharge.
- **Dissolved oxygen (DO)**, representing the concentration of oxygen available to support respiration of aquatic life, microbial and chemical processes. Depletion of DO due to elevated BOD and microbial activity can result in stress or mortality of fish and invertebrates.
- **Total suspended solids (TSS)** (or suspended sediment), which affect water clarity and light penetration through the water column, thereby influencing primary production. Deposition of suspended material can also alter benthic habitats and affect macroinvertebrate communities.

6.1.3 Human use of water

Wastewater treatment includes disinfection to substantially reduce the concentration of active human pathogens prior to discharge. However, residual pathogens may remain in treated wastewater, and contact with waters influenced by treated wastewater can result in elevated risk of infection if concentrations remain above acceptable thresholds.

The risk to human health during contact recreation in water is commonly assessed in relation to *Campylobacter* infection risk. Direct measurement of pathogens is typically impractical, and therefore faecal indicator bacteria (FIB) are used as a proxy indicator of faecal contamination and associated infection risk. For freshwater environments, *Escherichia coli* (*E. coli*) is used for this purpose.

Elevated concentrations of *E. coli* indicate an increased likelihood of the presence of pathogenic microorganisms (including bacteria, viruses, and protozoa), which may cause gastrointestinal illness and other health effects following exposure during recreational activities such as swimming or boating.

More targeted consideration of risk of infection and illness from pathogens, including from common human viruses such as norovirus, while not described in current regulation of water quality for recreational use, is often used to assess the risk to public health specific to municipal wastewater discharges. Section 6 provides a detailed description of the pathogens and risks considered in assessing the public health risk associated with the proposed discharge.

6.2 Water quality criteria

The water quality assessment has made use of various criteria to reflect the regulatory requirements for water quality and for comparison to indicate the level of effects to water quality. The specific standards and guidance used to source criteria include the following:

- Water Conservation (Kawarau) Order 1997 (New Zealand Government, 1997)
- National Policy Statement for Freshwater Management 2020 – Amended December 2025 (MfE, 2020 amended December 2025).
- ORC Regional Plan: Schedule 15, Receiving Water Group 2 criteria (Otago Regional Council (ORC), 2025)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG, 2018)
- PFAS National Environmental Management Plan (NEMP) Version 3.0 (HEPA, 2025)For reference, Table 6.8 below provides the criteria for values)

Relevant criteria are referenced for comparison to predicted water quality in Section 5.5.

6.2.1 Seasonal ammoniacal-N criteria

Low flow conditions can occur in the Kawarau River under both summer and winter conditions. Due to differences in temperature and pH between seasons, the equilibrium of ammonia-ammonium in water is expected to be different for each season, resulting in different potential ecotoxicity of ammoniacal-N. To accommodate these differences, season specific water quality criteria for ammoniacal-N, based on NPS FM attribute bands for ammonia toxicity, were developed for typical Kawarau River winter and summer water conditions. These made use of average pH and temperature measured at monitoring location RS10 during 2025 winter and 2026 summer periods.

Ammoniacal-N concentrations were converted to un-ionised ammonia (NH_3) using averaged seasonal temperatures and pH to determine ammonia/ammonium speciation. The resulting ammonium fractions (winter 1.9% and summer 2.95%) are consistent with published speciation tables (ANZECC & ARMCANZ, 2000) and reflect the higher relative proportion of the NH_3 at higher temperatures. Use of these criteria provides a more accurate reflection of potential toxicity in the receiving environment at different times.

As biological wastewater treatment processes, including nitrification, are less efficient at lower temperatures, elevated ammoniacal-N concentrations are more likely during winter conditions. To appropriately reflect the associated ecotoxicity risk, guideline values were adjusted for the seasonally measured river temperature and pH, which control ammonia speciation. This approach ensures that potential low-probability winter events are assessed against winter-specific toxicity criteria, providing a conservative evaluation of effects.

Table 6.1 Seasonal ammoniacal-N concentrations

Seasonal location RS10 Kawarau river conditions	pH	Temperature °C	Ammonia (NH_3) fraction (%)	Band A – NPS FM Median Values	Band A – NPS FM - 95%ile values
Winter (June – August 2025)	8.00	5.7	1.9	0.09*	0.15*
Summer (December 2025 – February 2026)	7.85	15.8	2.95	0.05**	0.09**

Notes:
*Ammoniacal-N toxicity equivalency for winter conditions
** Ammoniacal-N toxicity equivalency for summer conditions

6.2.2 Metals

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) provide Default Guideline Values (DGVs) for toxicants, including metals, to be protective of aquatic ecosystems. These criteria are derived using species sensitivity distributions and are threshold-based criteria set at different levels of species protection.

For the purpose of assessing impacts to Kawarau River water quality, the following application of the criteria is used:

1) Determination of the existing level of ecosystem sensitivity through comparison of upstream or background metal concentrations to ANZG (2018) criteria.
2) Comparison of the conservatively predicted water quality with the ANZG (2018) criteria to identify potential changes in the species protection level to identify meaningful change in toxicity.

Where possible, dissolved metal concentrations are used as indicative of the bioavailable fraction of metal present.

6.2.3 PFAS

The NEMP 3.0 (HEPA, 2025) guidelines provide the current industry recognised receiving environment criteria for PFAS in surface water environments and are referenced in the assessment of risk presented by PFAS to ecology and the risk to human health from recreational use of the water.

Of the many PFAS compounds, perfluoro-octane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have been identified as key indicators of risk to ecology and health, with criteria specific to these compounds available. The NEMP 3.0 specifies that the 99% species protection PFOS and PFOA DGV should be used for assessing toxicity in high conservation value ecosystems and assessing risks associated with bioaccumulation in slightly to moderately disturbed ecosystems.

Human health-based guideline values (HBGVs) for PFAS in recreational water are based on established toxicological thresholds and consider incidental ingestion and dermal contact associated with recreational use. The recreational HBGV provided in the NEMP 3.0 are based on an assumed recreational use of the freshwater body at 150 days/year.

6.3 Reasonable mixing zone

The mixing zone includes that area where the treated wastewater is dispersed through receiving waters and within which concentrations are less than the discharged treated wastewater but may be more than occurs for complete mixing of the discharge with the river.

The ORC Regional Plan: Water for Otago (Otago Regional Council (ORC), 2025) does not include a description of the extent of the reasonable mixing zone.

For the purpose of assessment, the reasonable mixing zone extent has not been identified based on a nominal distance, but has been determined through consideration of the following:

1) The point at which the effluent discharge is mixed with a reasonable percentage of river water. Consideration of this is suggested by Cook et al. (Cooke, Milne, & Rutherford, 2010) as being preferable for rivers.
2) The point prior to an identified commonly used public bathing location.
3) The point after which compliance with various water quality standards is considered reasonable as a means of controlling potential adverse effects to water quality and the environment.

The Kawarau River reach across the Shotover Delta is straight with a well-formed channel. In such environments, natural dispersion is limited, and long mixing zones commonly occur. With this in mind, a treated wastewater discharge near the true left riverbank is considered likely to remain in that general left area of the Kawarau River, until turbulence from changes in flow direction or other water inflows, results in more complete dispersion of the treated wastewater.

The proposed discharge structure and discharge location has been positioned close to the confluence with the Kimiākau/Shotover River to reduce potential adverse effects of the discharge. This positioning provides the following:

- Maximising the extent of Kawarau riverbank, upstream of the discharge, that can be returned to a natural state and be immediately available for public access and recreation.
- Makes best use of river turbulence caused by the Kimiākau/Shotover River entering the Kawarau River in dispersing the treated wastewater to minimise the overall extent of mixing.
- Limits the potential length of Kawarau River riverbank that may be impacted by elevated nutrient concentrations or toxicity effects due to elevated contaminant concentrations.

The braids of the active part of the Shotover Delta, in which the Kimiākau/Shotover River flows, are highly changeable, with the location of the confluence moving over time. Flow can be distributed across multiple smaller braids or concentrated into a single channel, with the latter particularly evident under low flow conditions. The flowing Kimiākau/Shotover River braid may be located anywhere from the true right of the Kimiākau/Shotover River (the likely dominant location) to the true left of the Kimiākau/Shotover River. The point at which the treated wastewater discharge mixes with the inflowing Kimiākau/Shotover River waters may therefore occur between approximately 100 m of the discharge location to the end of the Shotover Delta, approximately 800 m downstream.

This active length of the Shotover Delta undergoes continuous modification of the true left bank of the Kawarau River, with sediment deposition occurring rapidly during frequent high flow events in the Kimiākau/Shotover River, and erosion of deposited sediment subsequently occurring slowly with the relatively stable flows of the Kawarau River. The potential for significant periphyton growth on the river substrates in this area is therefore expected to be limited by to the frequently shifting sediments (refer (Boffa Miskel, 2026)).

Downstream of the Shotover Delta, the Kawarau River channel is more constrained and less dynamic. It is expected that there is greater potential for ecosystem sensitivity in this setting and maintenance of NPS FM Attribute Band A for the key treated wastewater contaminants, nitrate-N and ammoniacal-N, is considered to be appropriate in managing ecotoxicity effects.

Swimming is also not known to be a common occurrence in the active parts of the River confluence and delta, with this predominantly limited to areas such from the beach by the Twin Rivers Trail intersection, immediately following the River confluence and delta (refer Figure 6.1), where safe access to the Kawarau River can be made. It is considered appropriate that recreational water use criteria are achieved before this sensitive public bathing area.

Figure 6.1 Monitoring location RS10 looking upstream – Public bathing area

6.4 Methodology

Effects of the discharge on water quality of the Kawarau River has been carried out considering the future peak dry weather discharge rate (0.36 m^3/s) and the low-flow river state as measured during hydrological survey carried out in March 2026. The analysis has been carried out for the following influences on water quality:

1. Near-field mixing area analysis – this considers the location and extent of the likely immediate discharge mixing area, providing predictions of expected water quality in the Kawarau River and extent of reasonable mixing. Analysis has relied upon the findings of the March 2026 hydrological survey to provide detailed prediction of the mixing action using dispersion modelling.
2. Complete mixing analysis – this considers the influence of the discharge on downstream Kawarau River water quality after complete mixing within the river is achieved, with this expected to be approximately 4 km downstream of the discharge. The prediction makes use of the reported MALF for the Kawarau River near this downstream location (as measured at Chard Rd monitoring station). Predictions provided for this fully complete mixed analysis also provides the basis for considering potential effects to water quality of Lake Dunstan and surrounding groundwater resources.

The potential effects to aquatic ecology resulting from the predicted changes in water quality are assessed in the Ecological Impact Assessment Report (Boffa Miskel, 2026)

Potential effects to public health resulting from the presence of residual pathogens in treated wastewater discharged to the river are assessed in Section 7. Methodology of each component of the water quality assessment are described below.

6.4.1 Mixing analysis

Assessment of the discharge near-field mixing area and dispersion of contaminants within the mixing zone in the Kawarau River was undertaken using a hydrodynamic model developed in OpenFOAM 13, a 3D computational fluid dynamics (CFD) modelling software. This provides numerical simulation of water flow dynamics, such as turbulence resulting from interactions of flow with riverbanks. Contaminant transport simulation is also provided by the model, allowing for simulation of advection, dispersion and diffusion of contaminants with water flow.

Two OpenFOAM models, with different model extents and configurations, were developed to provide simulation of the proposed discharge and nearfield mixing of the discharge, and the downstream mixing of the discharge through the confluence with the Kimiākau/Shotover River. The latter model provides the prediction of dilution within the reasonable mixing zone. The models were developed to simulate peak dry weather discharge in 2060, and using the results of river bathymetry and hydrodynamics survey, carried out by ESNZ in March 2026 (ESNZ, 2026)(Appendix C). The model hydrodynamics reflects the river low flow conditions at the time. The configuration of each model is described below.

Model results are used to define dilution within the near-field mixing area, and to identify where measurement of water quality in the Kawarau River most appropriately reflects a mixed condition.

6.4.1.1 OpenFOAM discharge model

River cross section CX3 of the ESNZ survey was adopted as representative of the river bathymetry in the vicinity of the discharge, and 60 m upstream and 200 m downstream. The rock outfall structure was reflected within this cross section, as an infilled river area, extending out to 10 m from the left bank water line at the time of survey (as illustrated in Figure 5.1).

An unstructured mesh was developed as an extruded CX3 cross section with discharge structure geometry of the true left bank of the river. The mesh comprised an initial (Level 0) cell sizing of 0.5 m x 0.5 m x 0.2 m (x,y,z), this was refined along the left riverbank and in particular the vicinity of the discharge location, to as small as 0.125 m (Level 2 cell size).

Water velocities measured by ADCP survey were applied as the inflow from the upstream cross section, as illustrated in Figure 5.1, with these approximating typical seasonal low flow conditions. The wastewater discharge considered the proposed 2060 peak dry weather flow of 0.36 m^3/s, with this applied as an average water velocity of 0.225 m/s across the 4 m wide x 0.4 m tall core (area of 1.6 m^2) of the discharge structure. The discharge velocity does not take into consideration the porosity of the rock channel or piped discharge, where actual velocities would be significantly higher due to the smaller discharge area. As such, the dispersion predicted on discharge is considered to provide a conservative indication of mixing under the discharge volume and river flow conditions assessed.

A unit concentration of 100 (#/m^3) was applied to the discharge, such that in-stream concentrations are predicted as a percentage of treated wastewater quality.

6.4.1.2 OpenFOAM river confluence model

The river confluence model includes the Kawarau River stage across the active Shotover Delta, from CX3 to CX5, and includes the inflow of the Kimiākau/Shotover River on the true left bank of the Kawarau River. Transects CX3, CX4 and CX5 (Figure 3.18, Figure 3.19 and Figure 3.20 respectively) are positioned as per true left bank monitoring coordinate measurements, to provide accurate representation of the current bend in the Kawarau River in the vicinity of transect CX4.

A structured mesh approach was adopted for construction of the model, with bathymetry provided as a linear transition between each of the transects. Mesh refinement was provided on the true left riverbank, with further refinement at the adopted location for Kimiākau/Shotover River inflow.

Water velocities predicted by the OpenFOAM discharge model (Section 6.4.1.1) were interpolated as an input boundary condition for model cells of the upstream CX3 cross section. The concentration profile at the same location in the discharge model, representative of riverbank treated wastewater concentrations downstream of the discharge structure) was similarly applied as an input for the upstream CX3 cross section. This approach provides contaminant mass continuity and distribution of contaminant mass between the discharge model and the river confluence model. The results of the discharge model therefore represent the complete analysis of dispersion and dilution within the proposed reasonable mixing zone.

The Kimiākau/Shotover River confluence is represented as a single inflow on the true left bank of the Kawarau River, providing 14 m^3/s of inflow at 45° to the simulated Kawarau River flow. The flow is provided as a shallow water input, across a riverbank width of 21 m, generally consistent to the main braid discharge of the Kimiākau/Shotover River during typical low flow periods.

6.4.1.3 CORMIX model comparison

The industry recognised CORMIX discharge plume model, produced by the USEPA, was used to simulate near-field mixing of the discharge under simplified hydraulic conditions approximating those of the OpenFOAM discharge model, with a focus on predicting initial dilution levels rather than detailed plume geometry. Predicted dilution factors from CORMIX were produced to corroborate against those resolved by the OpenFOAM discharge model.

The CORMIX discharge model was developed as an above-surface jet discharge, equivalent to the predicted peak dry weather discharge rate at 2060 (0.36 m^3/s), through a protruding pipe with an equivalent discharge area of that 1.6 m^2, as assumed for channelised flow from the rock outfall structure.

In CORMIX, the receiving environment is idealised as a uniform "pool" with a single representative depth to enable simulation of near-field mixing and initial dilution, rather than explicitly resolving spatial variability. CORMIX relies on representative ambient conditions to characterise discharge/receiver interaction. A representative water depth (1 m) and velocity (0.79 m/s) was adopted based on the ESNZ bathymetry survey cross-section CX3. These inputs best approximate local hydraulic conditions at the point of discharge for estimating near-field dilution and comparison with OpenFOAM results.

6.4.2 Water quality prediction

6.4.2.1 Water quality within the near-field mixing area and after reasonable mixing

The reasonable mixing zone for the proposed discharge is assumed to extend downstream from the discharge location, to the end of the Shotover Delta 800m distant. This reasonable mixing zone encompasses the area where the Kawarau River and Kimiākau/Shotover River waters mix, with water quality after reasonable mixing considered to be represented by water quality at monitoring location RS10.

Receiving water concentrations after discharge of treated wastewater were estimated using dilution factors derived from dispersion modelling. The following scenarios were considered:

1) Within the near-field mixing area – representing the water quality achieved in the immediate vicinity of the discharge structure.
2) After reasonable mixing – representing water quality after mixing within the confluence of the Shotover and Kawarau River, and represented by monitoring location RS10.

Nutrients and *E. coli*

Where receiving environment criteria included 80th percentile (80%ile) criteria (Otago Regional Council (ORC), 2025), the corresponding treated wastewater statistic was estimated from a statistical distribution developed for the relevant parameters (refer Appendix D).

The below outlines the assumptions for prediction of water quality for the two mixing zone scenarios considered:

Treated wastewater discharge

- Proposed treated wastewater quality compliance limits.
- Dilution applied as a dimensionless flow ratio (20% fraction of treated wastewater for near-field mixing area and 2% fraction of treated wastewater for after reasonable mixing zone as derived from dispersion modelling)

Kawarau River

- Median concentration of Kawarau River water quality parameters, as measured at monitoring location RS14, upstream of the Shotover Delta.
- Dilution applied as a dimensionless flow ratio (80% for near-field mixing area and 98% for reasonable mixing zone as derived from dispersion modelling)

Temperature, pH and dissolved oxygen

The influence of the discharge on river temperature and pH was considered for predicted peak dry weather discharge rates in 2060, mixing with low-flow conditions assessed with dispersion modelling. A semi-quantitative approach has been adopted, taking into consideration the buffering effects of solids and alkalinity for temperature and pH respectively.

Dissolved oxygen was considered in a similar semi-quantitatively, taking into consideration dissolved organic carbon concentrations and the hydrological setting of the river.

Metals

The metals aluminium, copper and zinc have been identified as potential contaminants of concern regarding effects to river water quality. The toxicity of the metals is strongly dependent on chemical speciation, with the freely dissolved fraction representing the most bioavailable and therefore most toxic form. In contrast, metals associated with particulate minerology or present as strongly bound inorganic or organic complexes, are generally less bioavailable and contribute less to ecological toxicity. (ANZG, 2023) (ANZG, 2024).

– **Aluminium**: The geology of the Kimiākau/Shotover River catchment is dominated by schist, with mica (an aluminosilicate mineral) being a major mineral component of schist. The steep topography and high rainfall in the upper catchment result in high sediment loads in the river and the most likely source of the elevated background aluminium concentrations in the river. The speciation, solubility, and toxicity of aluminium are strongly controlled by pH.

  Elevated dissolved aluminium concentrations of up to approximately 0.6 mg/L (Krupińska, 2020) are generally only sustained under acidic conditions. This is not expected to occur in the treated wastewater or receiving environment, where sufficient alkalinity is present to buffer pH, and receiving river pH is typically in the range of approximately 7.5 to 8. Aluminium toxicity is primarily associated with dissolved ionic species (e.g. Al^{3+} and $Al(OH)^{2+}$), which are most prevalent under acidic conditions. Under near neutral pH conditions, toxicity is typically low, and the measured dissolved fraction may overestimate the bioavailable ionic forms due to the inclusion of very fine amorphous $Al(OH)_3$ particles.

  Elevated total aluminium concentrations measured in the Shotover and Kawarau Rivers (RS04B, RS06B, RS09 and RS10) during the April monitoring round (when alum dosing was not occurring) suggest that the magnitude of background total aluminium concentrations is attributable to the geology of the Kimiākau/Shotover River catchment rather than the discharge.

– **Copper and Zinc**: Treated wastewater concentrations and receiving environment concentrations for zinc and copper have been determined from monitoring for each contaminant. Treated wastewater concentration for copper and zinc were for treated wastewater was from the most recent monitoring event (April 2026) to align with surface water monitoring results.

– Two Kawarau River monitoring locations were tested for dissolved metals during the 22 April 2026 monitoring event (RS10 and RS11). RS11 results were adopted for this assessment as this location is located before the Kimiākau/Shotover River confluence, therefore is the most representative of the upstream Kawarau River receiving environment conditions. While location RS11 is more directly influenced by groundwater discharges from the DaD operation, any impact of this is unlikely to be significant enough to materially affect the assessment outcomes. However, if present, it would result in a more conservative assessment of copper and zinc concentrations. Dissolved copper and zinc concentrations in the Kawarau River as measured at RS11, are compliant with the ANZG 99% freshwater species protection criteria (ANZG, 2018).

PFAS

The potential downstream PFAS concentrations in water after reasonable mixing were predicted in the same manner as metals, with PFOS and PFOA selected for comparison to NEMP 3.0 criteria values for ecotoxicity and human health with recreational water use.

6.4.2.2 Complete mixing analysis

Complete mixing of the discharge within the Kawarau River is expected to occur approximately 3 km downstream of the reasonable mixing zone (4 km downstream of the discharge point), where river bends introduce significantly turbulence in channel flow. Complete mixing within the river is expected to be achieved prior to the river flowing into Lake Dunstan. A prediction of the mixed river water quality is therefore relevant to assessing the potential effects to the downstream Kawarau River and Lake Dunstan environments.

NPS FM and ORC Regional Plan: Water parameters

Water quality following complete mixing within the Kawarau Rover was predicted using a simplistic mass balance calculation (Appendix D), carried out by considering the following:

Treated wastewater discharge

1. Peak dry weather discharge rates for 2060 of 0.36 m^3/s.
2. Proposed treated wastewater quality compliance limits.

Kawarau River

3. Mean annual low flow for the Kawarau River of 88.6 m^3/s, as reported at the Chard Rd gauging station.
4. Median concentration of Kawarau River water quality parameters, as measured at monitoring location RS14, upstream of the Shotover Delta.

Water quality of the Kimiākau/Shotover River contribution to this mass balance is most significant during high flow events, when high sediment loads are contributed to the Kawarau River. Improvement in Kimiākau/Shotover River water quality is expected as wastewater discharge to the Kimiākau/Shotover River ceases. The concentrations following cessation of the discharge are assumed to be equivalent with those of the upstream Kawarau River.

Given the large flow of the Kawarau River relative to the discharge volume, the adopted concentrations of parameters for the river water quality are the primary influencer on downstream mixed water quality.

The analysis is considered to provide an upper bound for potential effects to Kawarau River water quality and Lake Dunstan after mixing, as periods of higher than MALF flow in the Kawarau River are not considered in the comparison of predicted water quality to annual percentile receiving water quality limits, and flows from Arrow River and Nevis River are not considered within the calculations.

Temperature, pH and dissolved oxygen

The same methodology has been applied as outlined in section 6.4.2.1.

Metals

The prediction of metal concentration in the Kawarau River after complete mixing has been undertaken using the complete mixing model proportions outlined above, and the same treated wastewater metal concentrations as described in the section 6.4.2.1. The predicted concentrations were compared against relevant ANZG (2018) criteria.

PFAS

As for metals, the prediction of PFAS concentrations in river water after complete mixing, has used the concentration assumptions as described in the section 6.4.2.1, with the relative contributions outlined above for complete mixing scenario.

6.5 Dispersion assessment results

Dispersion modelling undertaken provides a simplified representation of river hydrodynamics. Owing to the static flow inputs, and relatively uniform geometry of the modelled river stage, the results are considered to represent a pseudo steady state that likely underestimates the potential instream variability and turbulence which promotes mixing of waters. Predictions of treated wastewater dispersion and dilution are therefore expected to be conservatively low.

Dispersion modelling indicates that treated wastewater discharged to the Kawarau River remains near the true left-hand riverbank, mixing with river waters within the reasonable mixing zone in predominantly two areas:

1. At the point of initial discharge, where inflowing treated wastewater immediately mixes with river water in a relatively fast-flowing part of the Kawarau River and within the more turbulent water around the discharge structure.
2. At the Kimiākau/Shotover River confluence, where inflowing waters from the Kimiākau/Shotover River bisect the riverbank and mixes with waters on the true left-hand side of the Kawarau River.

6.5.1 Dispersion at discharge

Figure 6.2 and Figure 6.3 illustrate the water velocity flow field and the predicted wastewater concentration respectively, in the immediate vicinity of the wastewater discharge structure and where the downstream riverbank continues to the confluence with the Kimiākau/Shotover River.

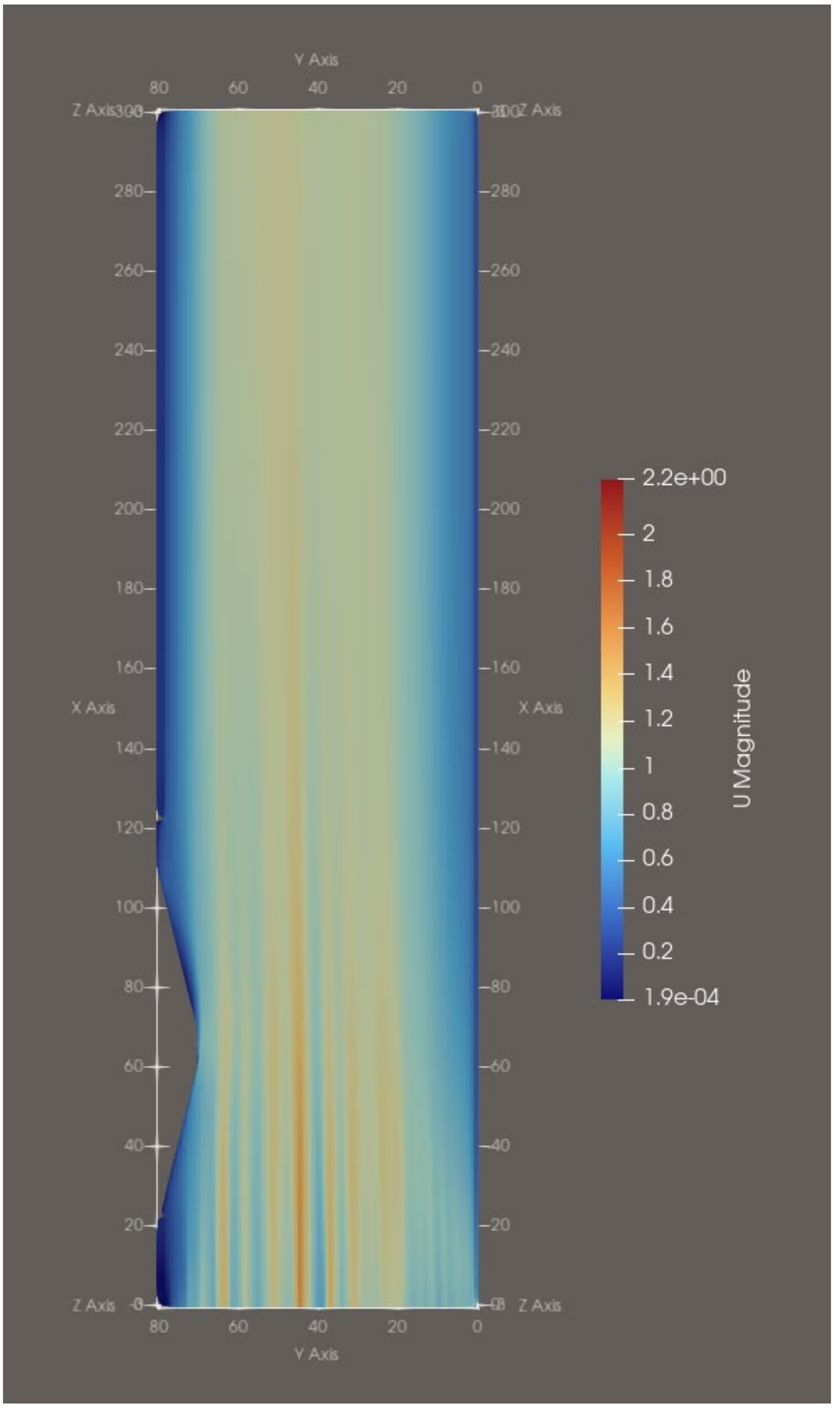

Figure 6.2 ***Discharge structure model – Predicted water velocity at surface. Note: colour indicating water velocity (total magnitude) at surface in m/s.***

At the point of discharge, an approximately 3-fold dilution is achieved immediately as treated wastewater enters the river. River flow around the discharge structure is predicted to draw the mixed waters toward the true left riverbank, with further mixing of treated wastewater achieved, such that a total of 5-fold mixing (20% residual) is predicted to occur by the downstream end of the discharge structure, approximately 40 m downstream of the discharge point.

The velocity of water at riverbanks is low relative to the central river channel, due to relatively high bed and riverbank friction which retards flow in the shallower waters. Where the riverbank is straight, with little change in bathymetry and riverbank geometry, riverbank waters undergo relatively limited mixing. The discharge model simulates such conditions, with limited further dispersion of the treated wastewater predicted to occur downstream of the discharge structure between the discharge structure and active channels of the Kimiākau/Shotover River.

Review of historical aerial photographs of the Shotover Delta, show the nearest active Kimiākau/Shotover River confluence to change location under different flow conditions and over time.

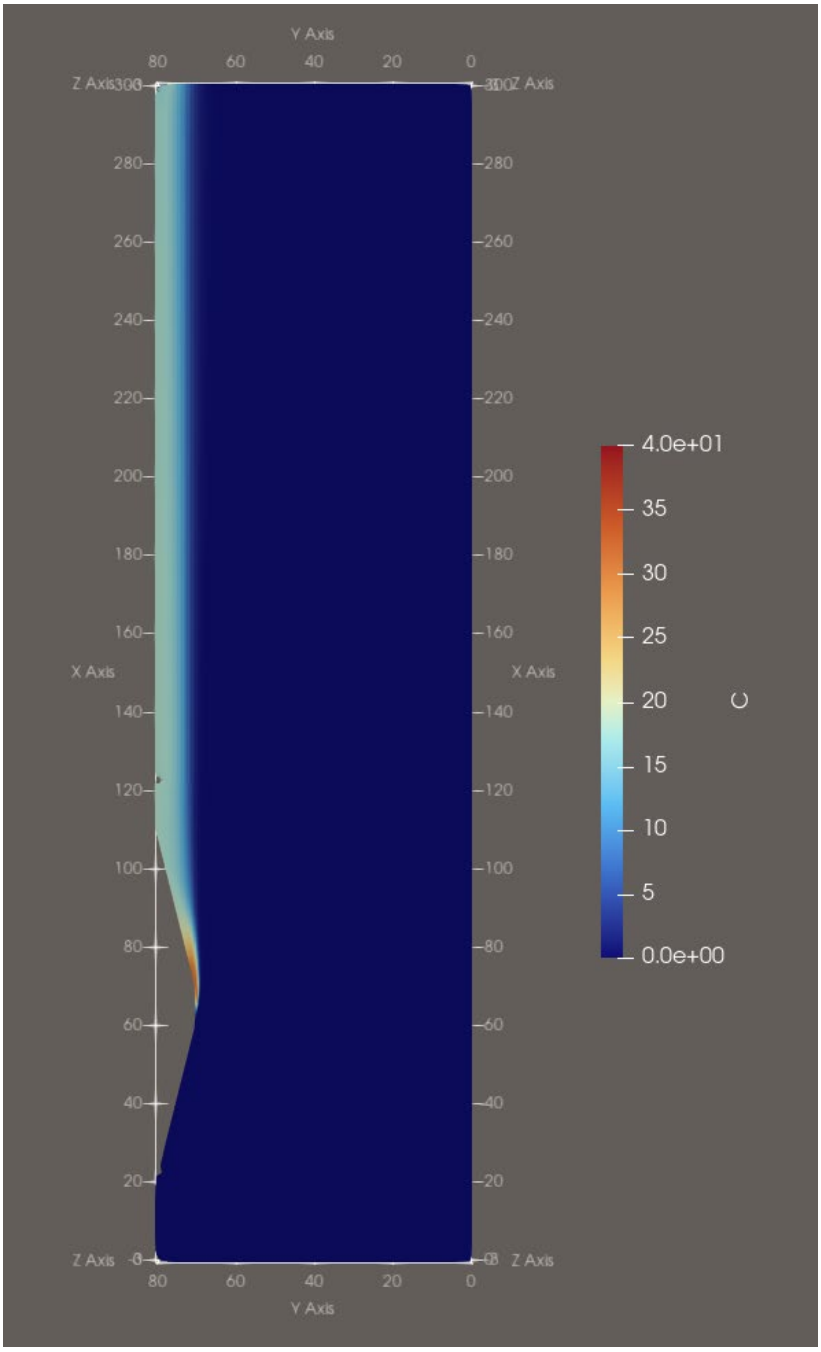

Figure 6.3 *Discharge structure model – Predicted concentration at surface. Note: colour indicating relative percentage of treated wastewater in surface water.*

6.5.2 Dispersion at Kimiākau/Shotover River confluence

The river braids through which the Kimiākau/Shotover River provides flow the Kawarau River vary in number and location over time. The simulation of the confluence provides a representation of flow contributing via a single 'main' channel. The general tendency for Kimiākau/Shotover River flows to influence the Kawarau River is evidenced in aerial photographs during periods of high flow, with sediment from the Kimiākau/Shotover River remaining entrained to the true left of the Kawarau River. The net influence on Kawarau River flow and with mixing of waters on the true left side of the Kawarau River is expected to be generally equivalent regardless of the number of Kimiākau/Shotover River braids providing flow.

Figure 6.4 and Figure 6.5 provide the predicted water velocity magnitude and the predicted wastewater concentration for the river confluence dispersion model respectively. While providing a simplified representation of the river confluence, riverbank and bed conditions, the predicted hydrodynamics are considered to be consistent with the generally observed river conditions. Most notably, that those contaminants present in the true left waters remain entrained to that area.

Taking the inflowing water velocity and quality predicted by the discharge dispersion model, further dispersion by the inflowing Kimiākau/Shotover River waters is predicted to occur, achieving a further 10-fold reduction in residual wastewater concentrations, from approximately 20% residual wastewater to approximately 2% residual wastewater after mixing with Kimiākau/Shotover River waters.

Some further dispersion, resulting from changes in river flow direction and river channel form also contribute to contaminant dispersion to a minor degree. As with the discharge dispersion model, the simplified geometry of the river confluence model is expected to provide conservative predictions of mixing achieved (underestimates of mixing).

The reasonable mixing zone is proposed to extend to the location of river transect CX5, with water quality represented by water quality at monitoring location RS10. The conservatively predicted contaminant concentrations at this location, under the flow conditions assessed are predicted to be at most 2% of those in treated wastewater.

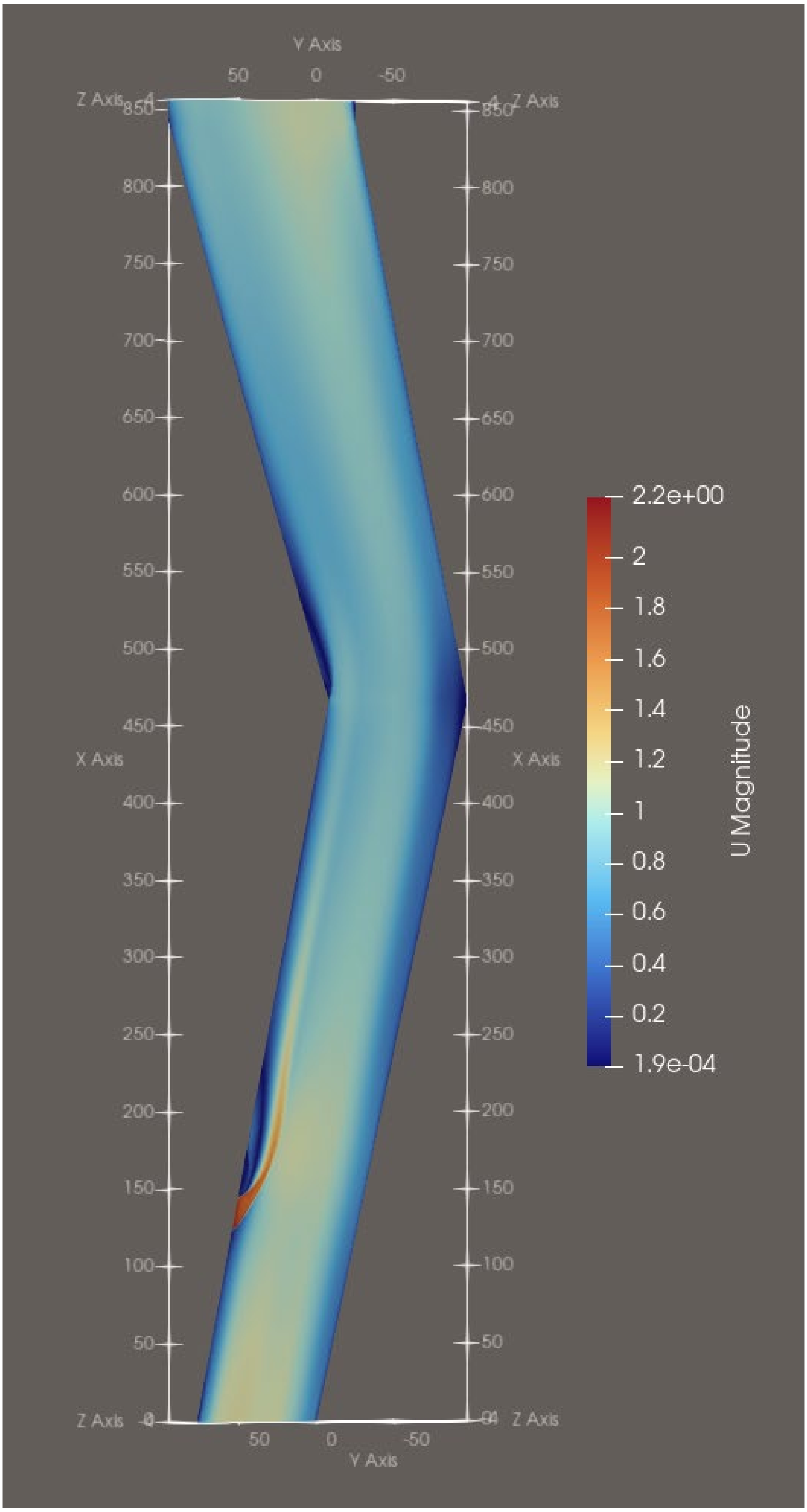

Figure 6.4 ***Near-field mixing area model results – Predicted water velocity at surface***

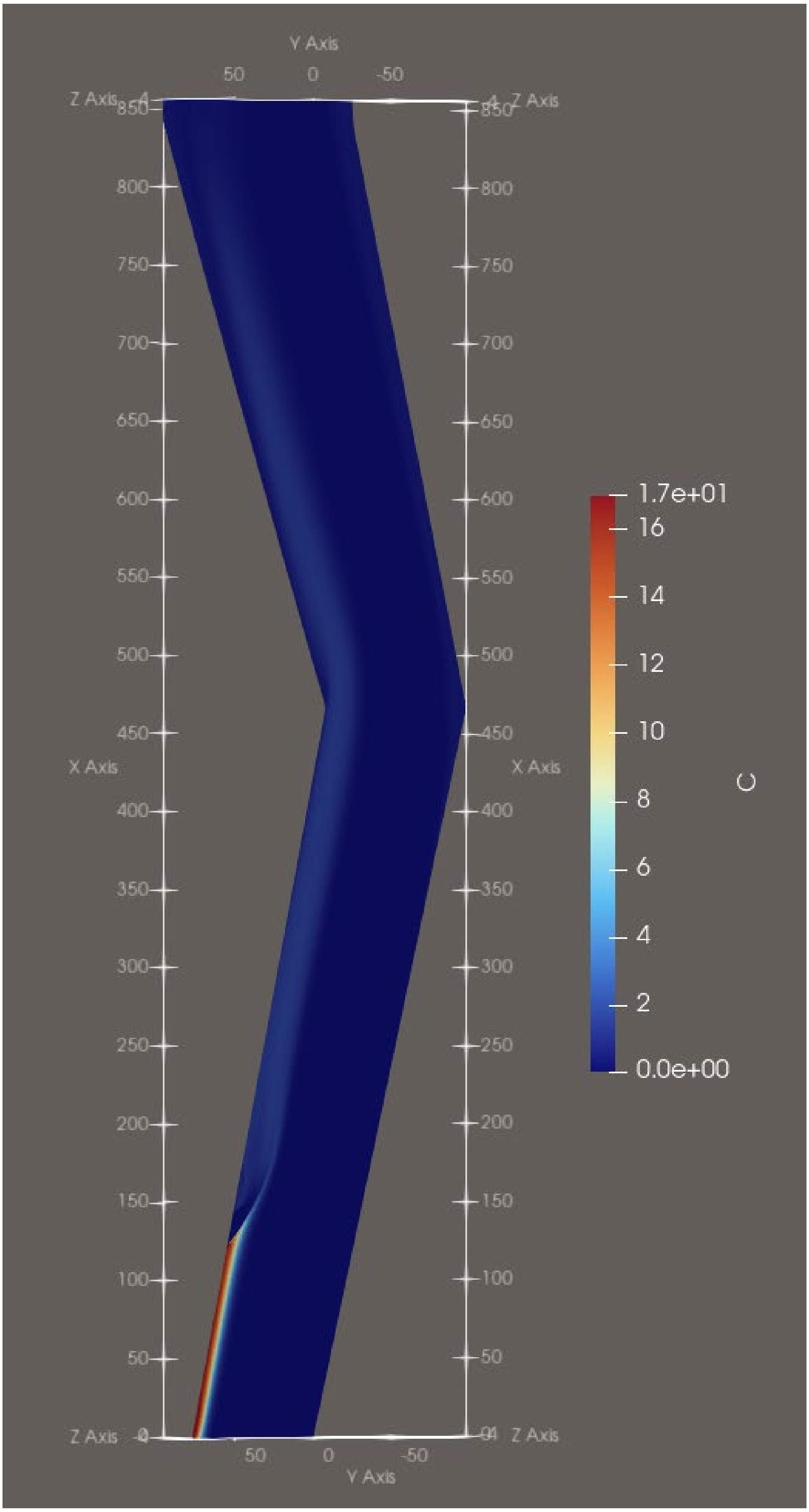

Figure 6.5 ***Near-field mixing area model results – Predicted concentration at surface***

6.5.3 CORMIX model comparison

Comparative modelling undertaken using CORMIX indicates greater initial dilution within the near-field region than that predicted by the OpenFOAM dispersion model. The CORMIX results suggest higher dilution immediately downstream of the discharge point, with a predicted dilution of 6 to 8 fold at the end of the predicted near-field region (NFR) of approximately 4 m distance from the discharge point (refer Figure 6.6 below).

The CORMIX model reflects a less conservative representation of near-field mixing processes. However, it is noted that CORMIX is primarily intended for near-field assessments and applies simplifying assumptions, including the use of a single representative depth and ambient velocity to characterise receiving environment conditions. Full CORMIX model specifications are included in Appendix D.

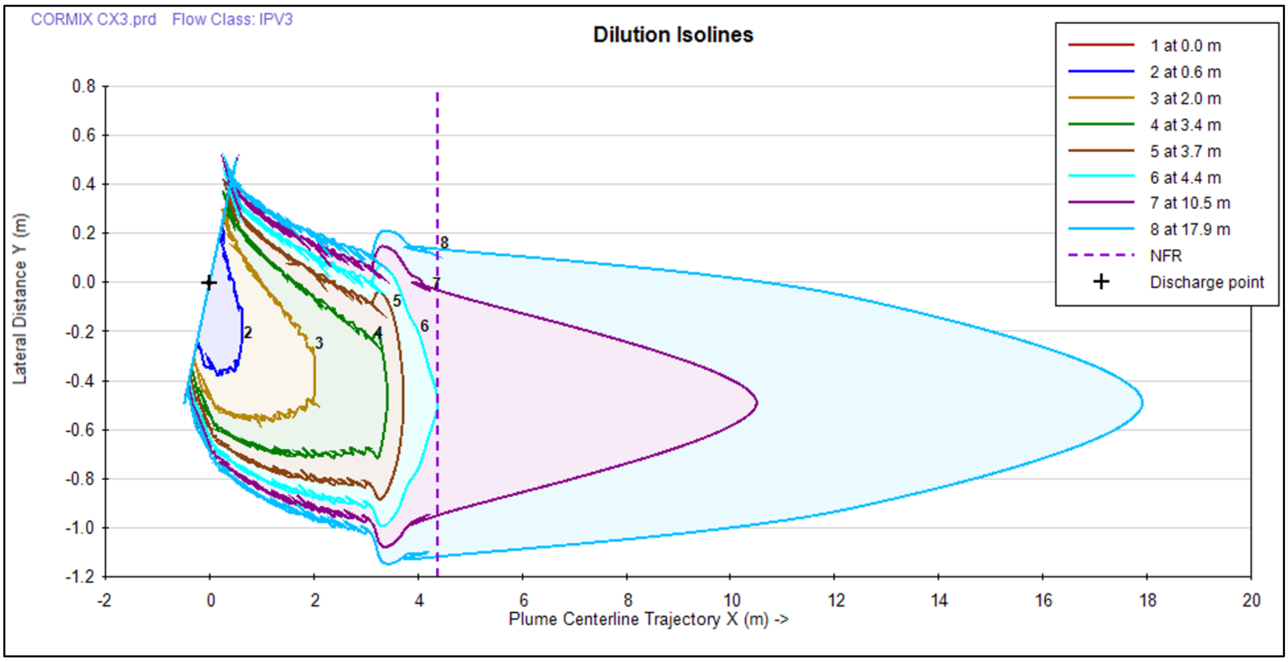

Figure 6.6 CORMIX model- Dilution vs Distance with dilution isolines

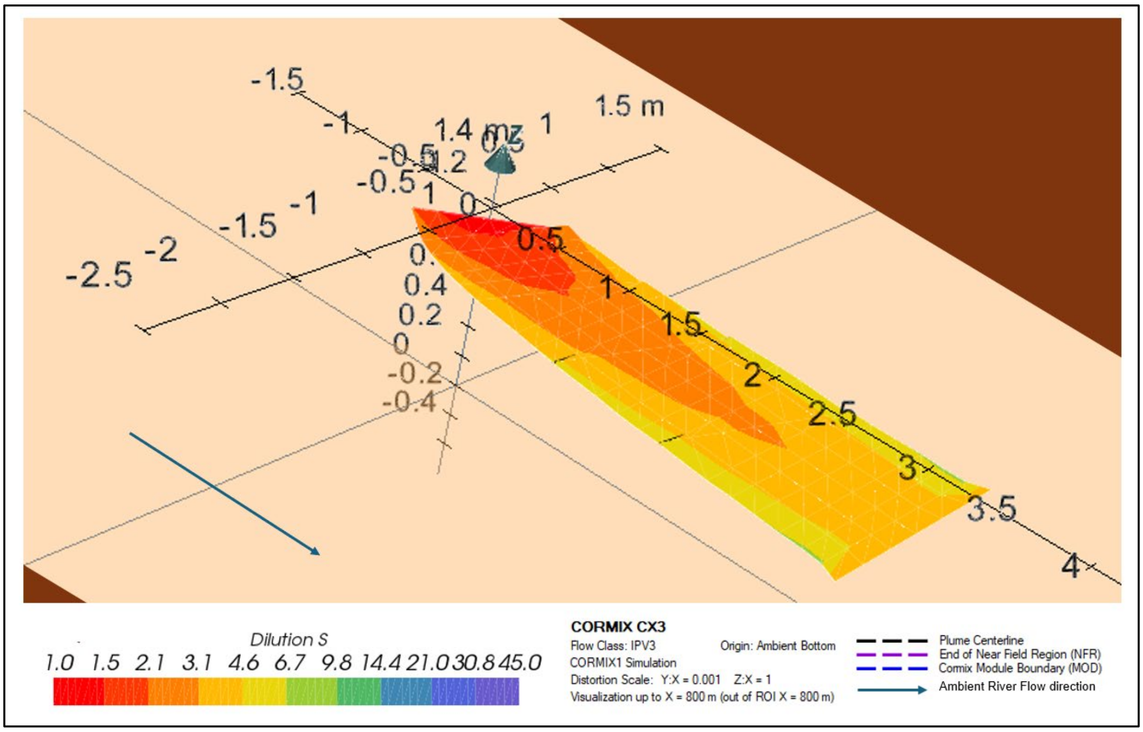

Figure 6.7 CORMIX CorVue - Plume Visualisation of the simulated discharge plume

The visual plume output generated using CORMIX CorVue is provided for illustrative purposes (Figure 6.7). The generated plume is not intended to be geometrically representative of the actual plume shape or spatial extent. The visualisations produced by CorVue are based on simplified near-field assumptions and are designed to assist in communicating predicted dilution and general plume behaviour. In Figure 6.7 below, the visual plume provides an indication of the extent and progression of dilution rather than as a precise representation of plume geometry and only serves to be interpreted qualitatively.

In contrast, the OpenFOAM modelling incorporates spatially varying hydrodynamics and provides a more comprehensive and conservative estimate of mixing behaviour. Notwithstanding these differences, both modelling approaches demonstrate consistent overall trends in plume behaviour, providing confidence in the predicted water velocity magnitude and the predicted wastewater concentration. The OpenFOAM discharge results have therefore been adopted as the primary basis for assessment due to a more conservative representation of the receiving hydraulic environment and more accurate portrayal of potential environmental effects.

6.5.4 Dispersion during wet weather discharges

The dispersion modelling considers peak dry weather discharge rates, into low flow conditions of the Kawarau and Kimiākau/Shotover Rivers. Higher rates of discharge are expected to occur during wet weather periods, as a result on inflow of stormwater into the wastewater network. These conditions are created during periods of significant stormwater and catchment run-off, and so coincide with periods when river flows are higher. This is particularly the case for the Kimiākau/Shotover River, where river response to significant rainfall events is rapid and results in flows many times greater than baseflow.

Rainfall and river flow measurements demonstrate that the flow of Kawarau and Kimiākau/Shotover Rivers respond rapidly during meaningful rain events. The additional Kimiākau/Shotover River flow in particular is expected to directly increase the dilution of treated wastewater contaminants at the river confluence. The potential increased wastewater discharge rates during wet weather are expected to be more than offset by increased Kimiākau/Shotover River flow at such times.

6.5.5 Fully mixed river conditions

Review of aerial imagery during periods of high Kimiākau/Shotover River sediment discharge to the Kawarau River indicates that complete mixing of river waters occurs where bends in the river downstream of the confluence results in significant turbulence. The calculation of complete mixing in the Kawarau River suggests a lower bound for dilution of the discharge under MALF conditions (dry weather) of approximately 245-fold dilution.

6.6 Water quality assessment results

6.6.1 Temperature, pH and dissolved oxygen

Treated wastewater is generally 5-6 degrees Celsius warmer than the receiving waters. Thermal energy is conserved in the mixing of waters with difference temperature and therefore the dilution rates and mixing models used for conservatively predicting contaminants concentration can be used to predict change in temperature. With a dilution in the order of 50-fold (2% residual) after reasonable mixing, the change in temperature of water influenced by the discharge is predicted to be in the order of 0.1 degrees Celsius warmer than the surrounding waters. Such a minor variation is considered to be within the natural range of variation throughout the river and seasonally, as a function of differences ambient temperature, sunlight received, river depth and wind exposures.

The pH of treated wastewater is expected to be near neutral, with a median in the order of pH 7. The Kawarau River pH is typically more alkaline and in the order of pH 7.7 – 8.0, with an alkalinity of 65 mg/l as $CaCO_3$ measured at monitoring location RS10. After reasonable mixing, with approximately 50-fold dilution, the influence of the treated wastewater pH is likely to be <0.05 and unlikely to be discernible with typical field monitoring equipment. Such a change is within the natural range seasonal range and within the variability between monitoring events which typically vary by 0.5 pH unit.

Dissolved oxygen in treated wastewater is in the order of 7-8 mg/L following completion of Stage 3 upgrade works, with water sufficiently aerated that even at the point of discharge, the concentrations are expected to remain consistent with the with monitoring at location RS10 indicating a typical range of 12-14 mg/l during winter and 10-

11 mg/L in summer. The direct dissolved oxygen reductions after reasonable mixing, assuming conservation of mass and dilution only, are in the order of 0.05 mg/L.

Introduced organic carbon can also contribute to reducing dissolved oxygen in receiving waters, by promoting greater oxygen depletion during microbial degradation of the organic compounds. Following completion of Stage 3 upgrades, treated wastewater $cBOD_5$ is very low with a median of 2.3 mg/L and a 95%ile of 4.6 mg/L. These concentrations are approaching the detection limit for laboratory reporting. If the full measure of $cBOD_5$ is realised as oxygen depletion in the river, the cumulative reduction in DO after reasonable mixing is calculated to be in the order of 0.1 mg/L. Taking into consideration the buffering of oxygen saturation with exposure to air and the relatively high turbulence of water across the Shotover River confluence, the reduction in DO is considered most likely to be less than conservatively calculated above, with any change expected to be negligible. Dissolved oxygen after reasonable mixing is predicted to remain within the NPS FM Attribute Band A.

Changes in temperature, pH and DO after complete mixing are predicted to be negligible.

6.6.2 Nutrients, *E. coli* and solids

Near-field mixing area water quality

The results of the mixing analysis, providing predicted concentrations in the vicinity of the discharge structure, are presented below in Table 6.2.

Concentrations predicted represent 2060 peak treated wastewater discharge under low-flow conditions, and so are not representative of annual conditions, which are expected to be significantly lower, as they take into consideration periods of higher flow. Actual annual water quality statistics, such as for comparison to NPS FM criteria (MfE, 2020 amended December 2025) would be significantly lower than those presented. The peak results presented are considered to be comparable to the measured water quality in the Kawarau River along the Shotover Delta riverbank (locations RS11, RS12 and RS13) when under low flow conditions.

Predicted ammoniacal-N concentrations within the near-field mixing area, are generally consistent or lower than those measured in the Kawarau River during March 2025 and March 2026.

Table 6.2 Water quality in the near-field mixing area– 2060 peak discharges under low river flow

Contaminants	Proposed compliance limits for treated wastewater discharge (g/m^3)		Kawarau River upstream concentration RS14 – median (g/m^3)	Predicted concentrations under low flow conditions (g/m^3)
Ammoniacal-N (g/m^3)	Median	1.25	0.0025	0.252
	95%ile	5	-	1.002
Total-N (g/m^3)	Median	10	0.05	2.04
	95%ile	20	-	4.04
Nitrate-N (g/m^3)	Median	7	0.03	1.42
	95%ile	10	-	2.02
Dissolved reactive phosphorus (g/m^3)	Median	1	0.001	0.201
	95%ile	4	-	0.801
Total phosphorus (g/m^3)	Median	1.5	0.0025	0.302
	95%ile	7	-	1.402
E. coli (cfu/100mL)	Median	-	27.1	-
	95%ile	100	-	41.7
	Max/Truncated	200	-	61.7
Total Suspended Solids (TSS) (g/m^3)	Median	5	3	3.4
	95%ile	10	-	4.4

Contaminants	Proposed compliance limits for treated wastewater discharge (g/m^3)		Kawarau River upstream concentration RS14 – median (g/m^3)	Predicted concentrations under low flow conditions (g/m^3)
BOD$_5$ (g/m^3)	Median	5	0.5	1.4
	95%ile	10	-	2.4
Notes: The Kawarau upstream concentration values are a median of the monitoring values from RS14 (March 2025 – March 2026) with values under detection limit taken at half limit of reporting (LOR)				

Water quality after reasonable mixing

Table 6.3 provides the predicted water quality after reasonable mixing (as measured at monitoring location RS10) provided against NPS FM attribute bands criteria for reference. As a predicted upper bound for effects to water quality, the predicted concentrations are considered to overestimate the annual median concentrations and provide an upper bound for potential effects to water quality.

Concentrations of ammoniacal-N and nitrate-N are predicted to meet NPS FM Attribute Band A criteria, including for the highly conservative consideration of annual median conditions. Similarly, predicted *E. coli* 95%ile concentrations are predicted to meet the NPS FM Attribute Band A criteria.

Dissolved reactive phosphorus concentrations are predicted to be elevated relative to the NPS FM 95%ile criteria, indicated a likely upper bound concentrations consistent with NPS FM Attribute Band D.

Based on the predicted results of the scenario assessed it is considered likely that water quality after reasonable mixing will meet the RPW Schedule 15 water group two criteria for ammoniacal-N and *E. coli*, but may not meet the criteria for nitrate-N and DRP.

Table 6.3 Nutrient concentrations after reasonable mixing

Contaminants	**Proposed compliance limits for treated wastewater discharge (g/m^3)**		**Kawarau River upstream concentration on RS14 – median (g/m^3)**	**Predicted concentration (g/m^3)**	**Band A – NPS FM (Summer*/ Winter**)**	**Band B – NPS FM at pH 8.0 and Temp. 20°C**	**Band C – NPS FM at pH 8.0 and Temp. 20°C**	**Schedule 15 (ORC Regional Plan)**
Ammoniacal-N (g/m^3)	Median	1.25	0.0025	0.027	0.05/ 0.09	0.24	1.3	-
	80%ile	-	-	0.044	-	-	-	0.1
	95%ile	5	-	0.102	0.09/ 0.15	0.40	2.2	-
Total-N (g/m^3)	Median	10	0.05	0.25	-	-	-	-
	95%ile	20	-	0.45	-	-	-	-
Nitrate-N (g/m^3)	Median	7	0.03	0.17	1.0	2.4	N/A	-
	80%ile	-	-	0.19	-	-	N/A	0.075
	95%ile	10	-	0.23	1.5	3.5	N/A	-
Dissolved reactive phosphorus (g/m^3)	Median	1	0.001	0.021	0.006	0.01		-
	80%ile	-	-	0.045	-	-	-	0.01
	95%ile	4	-	0.081	0.021	0.030	0.054	-
Total phosphorus (g/m^3)	Median	1.5	0.0025	0.032	-	-	-	-
	95%ile	7	-	0.142	-	-	-	-

Contaminants	**Proposed compliance limits for treated wastewater discharge (g/m^3)**		**Kawarau River upstream concentration on RS14 – median (g/m^3)**	**Predicted concentration (g/m^3)**	**Band A – NPS FM (Summer*/ Winter**)**	**Band B – NPS FM at pH 8.0 and Temp. 20°C**	**Band C – NPS FM at pH 8.0 and Temp. 20°C**	**Schedule 15 (ORC Regional Plan)**
E. coli (cfu/100mL)	Median	-	27.1	-	130***	130	N/A	-
	95%ile	100	-	28.6	540***	1000	N/A	260****
	Max	200	-	30.6	-	-	N/A	-
Total Suspended Solids (TSS) (g/m^3)	Median	5	3	3.0	-	-	-	-
	95%ile	10	-	3.1	-	-	-	-
Total $cBOD_5$ (g/m^3)	Median	5	0.5	0.59	-	-	-	-
	95%ile	10	-	0.69	-	-	-	-
Notes: **Ammoniacal-N toxicity equivalency for winter conditions* *** Ammoniacal-N toxicity equivalency for summer conditions* ***NPS FM National Bottom Line for *E. coli* **** *E. coli 80%ile values from Regional Plan - Schedule 15* (Otago Regional Council (ORC), 2025) The Kawarau upstream concentration values are a median of the monitoring values from RS14 (March 2025 – March 2026), with values under detection limit taken at half limit of reporting (LOR) Shading in **red** indicates exceedances against all relevant water quality criteria Shading in **green** indicates non exceedances of relevant water quality criteria								

Complete mixing – water quality

Predicted downstream water quality in the Kawarau River following complete mixing was calculated by using a mass balance calculation, the methodology of which is described in Section 6.4.2.Table 6.4 shows the predicted contaminant values compared against Attribute Band A criteria of the NPS FM (MfE, 2020 amended December 2025) and Schedule 15 water quality criteria in the ORC Regional Plan.

The predicted downstream concentrations for all assessed contaminants comply with the relevant NPS FM Band A attribute state criteria and Schedule 15 guideline values shown in Table 6.4. Modelled concentrations of nutrients (Ammoniacal-N, DRP, TN, TP, and nitrate-N) remain well below applicable guideline thresholds, indicating a likely low risk of adverse effects on ecosystem health under the complete-mixing scenario. Predicted *E. coli* concentrations are also below the Schedule 15 and NPS FM thresholds, consistent with conditions suitable for contact recreation and above the National Bottom Line (NPS FM). Overall, the predicted results demonstrate that downstream water quality is expected to remain within guideline values.

Table 6.4 Complete mixing water quality prediction PDWF Discharge under Kawarau River MALF

Contaminants	Proposed compliance limits for treated wastewater discharge (g/m^3)		Adopted discharge concentrations for assessment (g/m^3)	Kawarau River upstream concentration RS14 – median (g/m^3)	Predicted complete mixing concentration (g/m^3)	Band A NPS FM (g/m^3)	Schedule 15 (ORC Regional Plan) (g/m^3)
Ammoniacal-N	Median	1.25	1.25	0.0025	0.007	0.03	-
	80%ile	-	2.1	-	0.010	-	0.1
	95%ile	5	5	-	0.023	0.05	-

Contaminants	Proposed compliance limits for treated wastewater discharge (g/m^3)		Adopted discharge concentrations for assessment (g/m^3)	Kawarau River upstream concentration RS14 – median (g/m^3)	Predicted complete mixing concentration (g/m^3)	Band A NPS FM (g/m^3)	Schedule 15 (ORC Regional Plan) (g/m^3)
Total-N	Median	10	10	0.05	0.09	0.16**	-
	95%ile	20	20	-	0.13	-	-
Nitrate-N	Median	7	7	0.03	0.058	1.0	-
	80%ile	-	7.9	-	0.062	-	0.075
	95%ile	10	10	-	0.07	1.5	-
Dissolved Reactive Phosphorus	Median	1	1	0.001	0.005	0.006	-
	80%ile	-	2.2	-	0.01	-	0.01
	95%ile	4	4	-	0.017	0.021	-
Total Phosphorus	Median	1.5	1.5	0.0025	0.009	0.010**	-
	95%ile	7	7	-	0.03	-	-l
E. coli	Median	-	9 cfu/100mL	27.10	27.0	130	-
	80%ile	-	34.7 cfu/100mL	-	27.1	-	260
	95%ile	100	100 cfu/100mL	-	27.4	540*	-
	Max/Truncated	200	200 cfu/100mL	-	27.8	-	-
Total Suspended Solids (TSS) (g/m^3)	Median	5	5	3	3.0	-	-
	95%ile	10	10	-	3.0	-	-
BOD$_5$ (g/m^3)	Median	5	5	0.5	0.52	-	-
	95%ile	10	10	-	0.54	-	-

Notes:

- *NPS FM National Bottom Line for *E. coli*
- ** NPS FM Criteria for Lakes
- The median and 95%ile are the proposed compliance limits for the treated wastewater discharge (95% for *E. coli*)
- The median, 80%ile and truncated values were derived from a modelled statistical distribution of the proposed compliance limits. This was done to produce values to compare with the NPS FM (median) and the schedule 15 (80%) criteria
- The Kawarau upstream concentration values are a median of the monitoring values from RS14 (March 2025 – March 2026)
- Shading in **green** indicates water quality consistent with NPS FM Band A

6.6.3 Metals

Zinc, aluminium and copper are key trace metals in wastewater, resulting from trade waste and stormwater inflows, and treatment of wastewater with coagulants containing aluminium. These metals are recognised as toxicants, with high concentrations in freshwater associated with adverse effects on aquatic organisms.

The Australian and New Zealand Water Quality Guidelines (ANZG, 2018) provide threshold criteria developed to protect aquatic ecosystems at varying levels of species protection, notably 99% and 95%, which are the Default Toxicant Guideline values (DGV) used to in assessing predicted water quality results below.

Copper and zinc

A mass balance approach considering the peak dry weather discharge and dilution derived from dispersion modelling during low flow conditions, has been used to provide an estimate of copper and zinc concentrations after reasonable mixing. A similar mass balance approach assuming mean annual low flow for the Kawarau River at Chard Rd monitoring station has been used to predict complete mixing Predicted water quality results are presented against ANZG criteria (ANZG, 2018) in Table 6.7 below.

Aluminium, copper, and zinc concentrations are predicted to be slightly elevated relative to background following reasonable mixing; however, all concentrations (Table 6.6) are predicted to comply with the ANZG (2018) 99% freshwater species protection criteria.

Under complete mixing conditions (Table 6.7), concentrations of all three contaminants are predicted to approach background levels and are also predicted to comply with the ANZG (2018) 99% protection threshold, indicating minimal change to receiving environment water quality.

Improvements in filtration and the introduction of alum dosing is expected to result in a decrease in total copper and total zinc concentrations in treated wastewater, due to particulate removal and potential for increased adsorption of these minerals to aluminium mineral phases. The presented analysis is therefore considered to be conservative.

Table 6.5 Predicted metal concentrations – Water quality in the near-field mixing area

Contaminant	Kawarau River representative location	Kawarau River upstream concentration (g/m^3)	Treated wastewater concentration (g/m^3)	Predicted concentration (g/m^3)
Aluminium	RS11	0.007	0.6*	0.126
Copper	RS11	0.0007	0.0057**	0.0017
Zinc	RS11	0.0005	0.086	0.018

Note: * Concentration derived from estimated residual aluminium concentration post-alum dosing. (Krupińska, 2020)

** Concentrations are reported as total values and assumed to represent dissolved fractions for assessment purposes, resulting in a conservative estimate of potential effects.

Table 6.6 Predicted metal concentrations – Water quality after reasonable mixing

Contaminant	Kawarau River representative Location	Kawarau River upstream concentration (dissolved) (g/m^3)	Treated wastewater concentration (g/m^3)	Predicted concentration (g/m^3)	ANZG 2018 DGV - Protection of species (g/m^3)		
					99%	95%	80%
Aluminium	RS11	0.007	0.6*	0.019	0.027	0.055	0.080
Copper	RS11	0.0007	0.0057**	0.0008	0.001	0.0014	0.0025
Zinc	RS11	0.0005	0.086	0.0022	0.0024	0.008	0.031

Note:

* Concentration derived from estimated residual aluminium concentration post-alum dosing. (Krupińska, 2020)

** Concentrations is median total values and assumed to represent dissolved fractions for assessment purposes, resulting in a conservative estimate of potential effects.

Table 6.7 Predicted metal concentrations in the Kawarau River – water quality after complete mixing

Contaminant	Kawarau River representative Location	Kawarau River Upstream Concentration (dissolved) (g/m^3)	Treated wastewater concentration (g/m^3)	Predicted Concentration (g/m^3)	ANZG 2018 DGV -Protection of species (g/m^3)		
					99%	95%	80%
Aluminium	RS11	0.007	0.6*	0.009	0.027	0.055	0.080

Contaminant	Kawarau River representative Location	Kawarau River Upstream Concentration (dissolved) (g/m^3)	Treated wastewater concentration (g/m^3)	Predicted Concentration (g/m^3)	ANZG 2018 DGV -Protection of species (g/m^3)		
					99%	95%	80%
Copper	RS11	0.0007	0.0057**	0.0007	0.001	0.0014	0.0025
Zinc	RS11	0.0005	0.086	0.0008	0.0024	0.008	0.031

Note:

* Concentration derived from estimated residual aluminium concentration post-alum dosing. (Krupińska, 2020)

** Concentrations is median total values and assumed to represent dissolved fractions for assessment purposes, resulting in a conservative estimate of potential effects.

Aluminium

Kawarau River monitoring indicates dissolved aluminium concentrations of 0.007 mg/L at RS11 (22 April 2026). Concentrations following reasonable nearfield mixing are predicted to be approximately 0.019 mg/L. These values are comparable to measured background concentrations (e.g. 0.023 mg/L at RS10 on 22 April 2026), indicating that the discharge is unlikely to elevate aluminium levels above natural variability.

Under the near-neutral conditions of the Kawarau River, dissolved aluminium is expected to rapidly precipitate as amorphous $Al(OH)_3$ following discharge, limiting the persistence and downstream propagation of elevated dissolved concentrations. Accordingly, a complete-mixing assessment based on dissolved aluminium concentrations is considered conservative, as it is likely to overestimate the proportion of aluminium that remains in dissolved form in the receiving environment, given that precipitation of $Al(OH)_3$ is not explicitly accounted for.

On this basis, even where treated wastewater contains elevated aluminium concentrations, mixing within the receiving environment is expected to result in dissolved concentrations that remain below relevant guideline values((ANZG, 2018) 99% species protection value of 0.027 mg/L). Consequently, the discharge is not expected to result in a measurable increase above natural background variability, nor to notably alter aluminium concentrations in the receiving environment or increase the risk of adverse ecotoxicological effects in the Kawarau River.

6.6.4 PFAS

Predicted PFOS and PFOA concentrations considering rates of dilution derived by dispersion modelling and complete mixing calculations are substantially lower than the applicable human health-based guideline values (HBGVs) for recreational water exposure and well below the default guideline values (DGVs) for the protection of 99% of freshwater species (refer to Table 6.8 and Table 6.9).

Given the very low concentrations identified in treated wastewater, it is expected that river water concentrations immediately downstream of the discharge structure (within the near-field mixing area) will also readily meet the indicated recreational water use criteria for PFOS and PFOA.

Table 6.8 PFAS (PFOS & PFOA) – Water quality after reasonable mixing

Contaminant	Kawarau River Representative location	Kawarau River upstream concentration (µg/L)	Treated wastewater concentration (µg/L)	Predicted concentration (µg/L)	NEMP 3.0 Recreational water quality guideline (µg/L)	NEMP 3.0 99% species protection (µg/L) *
PFOS	RS11	N/A	0.00038	7.6×10^{-6}	2	0.00023
PFOA	RS11	N/A	0.0043	8.6×10^{-5}	10	19

Note - *Table 8 Ecological water quality guideline values for freshwater in NEMP 3.0. Sourced from Australian and New Zealand Guidelines for Fresh and Marine Water Quality – interim default guideline values for PFOS and PFOA (ANZG 2023).

Table 6.9 PFAS (PFOS & PFOA) – water quality after complete mixing

Contaminant	Kawarau River Representative Location	Kawarau River Upstream Concentration (µg/L)	Treated wastewater Concentration	Predicted Concentration (µg/L)	NEMP 3.0 Recreational water quality guideline (µg/L)	NEMP 3.0 99% species protection (µg/L) *
PFOS	RS11	N/A	0.00038	1.64×10^{-8}	2	0.00023
PFOA	RS11	N/A	0.0043	1.45×10^{-9}	10	19
Note - *Table 8 Ecological water quality guideline values for freshwater in NEMP 3.0. Sourced from Australian and New Zealand Guidelines for Fresh and Marine Water Quality – interim default guideline values for PFOS and PFOA (ANZG 2023).						

6.6.5 Microplastics

Wastewater treatment systems are recognised as a pathway for microplastics to enter aquatic environments, where ongoing degradation produces nanoplastics that can readily enter food chains. The environmental risk remains uncertain due to limited standardised methods and understanding of potential accumulation and toxicity. Acknowledging that there is a common public interest in such emerging contaminants, and potential exists for future regulation of discharges of these contaminants, testing of treated wastewater was carried out to provide a benchmark for the Shotover WWTP. This benchmark is intended to contribute to the body of knowledge regarding treatment of microplastics and treated wastewater discharges.

Figure 6.8 outlines the number, size range and composition of microplastics measured in the treated wastewater, with Table 6.10 providing the reported concentrations.

Table 6.10 Summary of microplastic concentrations (MPs/L) in treated wastewater sample collected October 2025

Polymer	**Particle diameter range (µm)**	**Particle count**
Polyamide (MPs/L)	20 -100	44
Polycarbonate (MPs/L)	20 -100	9
Polyethylene (MPs/L)	20 -100	<4*
Polyethylene Terephthalate (MPs/L)	20 -100	6
Polymethylmethacrylate (MPs/L)	20 -100	<4*
Polypropylene (MPs/L)	20 -100	14
Polystyrene (MPs/L)	20 -100	<4*
Polyurethane (MPs/L)	20 -100	17
Polyvinyl Chloride (MPs/L)	20 -100	<3*
Note: *Particle counts are at or below Limit of Reporting (LOR)		

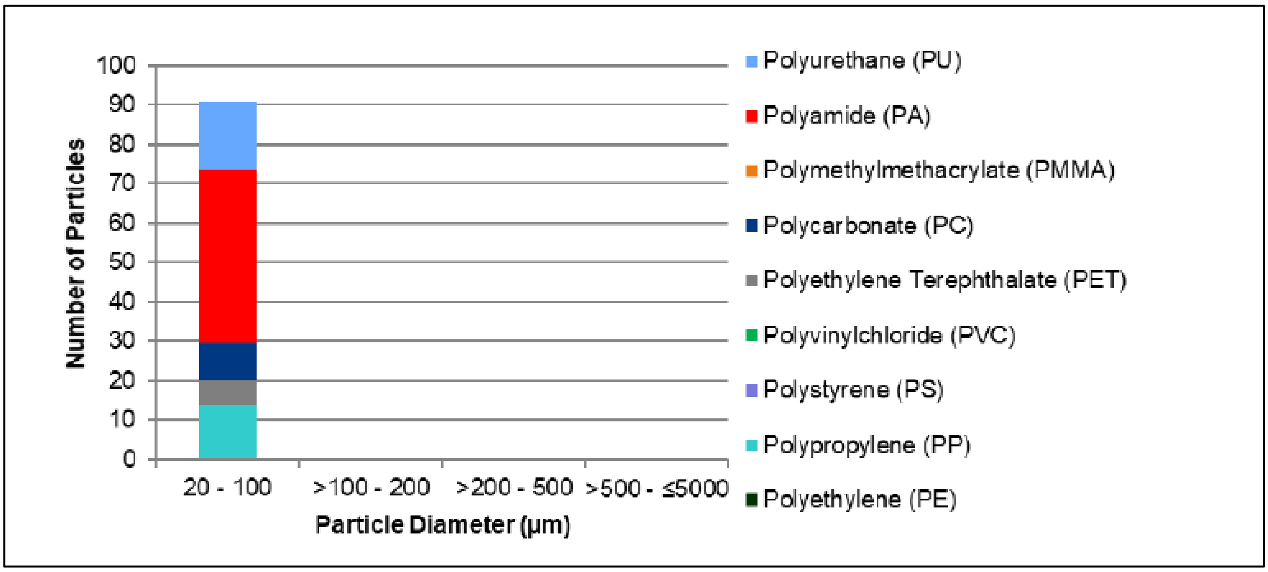

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Figure 6.8 Microplastic particle size distribution in the analysed effluent sample (M25-Oc0066478), October 2025. Source: Eurofins Environment Testing NZ Limited – Certificate of Analysis

The size of particles that could be quantified in the analysis of treated wastewater, was limited to greater than 20 µm, and so the quantum of smaller particles is not understood. The proposed improvements to the Shotover WWTP include tertiary filtration, which is expected to achieve removal of particles greater than 10 µm. The proposed upgrades are therefore expected to achieve reduction in microplastics discharges, such that the microplastics load detected in wastewater would be effectively removed.

7. Public health risk assessment

7.1 Risk to human health from wastewater

Wastewater contains microbial pathogens that can present a serious health risk if ingested (Hai, 2014). A range of protozoa, viruses and bacteria are included, with the majority of those pathogens of concern in wastewater being enteric, i.e. affecting the digestive system, and where exposure leads to ingestion can result in gastroenteritis. Respiratory illness can also result from inhalation of select of select pathogens, such as adenovirus.

While wastewater treatment typically achieves very high levels of disinfection of such pathogens, some limited risk to public may remain where public use of water or activities in water influenced by discharged treated wastewater, includes ingestion of water or food in contact with water, or inhalation water aerosols. The potential for public exposure to residual pathogens associated with the discharge of treated wastewater to the Kawarau River, has been considered in this public health risk assessment.

7.2 Hazard identification

Common pathogens in raw wastewater include:

- Bacteria, such as *Campylobacter* and *Salmonella*.
- Protozoa, such as *Cryptosporidium* and *Giardia*
- Viruses, such as norovirus, rotavirus, enterovirus and adenovirus

The potential risk of infection and illness resulting from the presence of these pathogens in treated wastewater depends on various conditions and influences, including:

1) Initial active concentration in wastewater. A background presence of pathogens is typically present in raw wastewater, varying over time due to illnesses circulating within the community and in other contributors to wastewater, including food wastes, trade waste and stormwater.
2) Residual active concentrations following treatment and disinfection. This is greatly dependent upon the treatment process and the susceptibility of the pathogen to inactivation.
3) The rate at which pathogens are further deactivated in the environment, with this influenced by the environmental conditions and the pathogen resilience.
4) The likelihood of the public undertaking an activity that brings people into contact with impacted water.
5) The nature of the activity and how much water may be consumed or aerosols inhaled.
6) The dose-response of the pathogen, which reflects the likelihood of an individual becoming infected based on pathogen dose received.
7) The likelihood of becoming ill, if pathogen infection occurs.

A unique characteristic of viral infections is that a high proportion of the exposed populations could be potentially affected, often leading to very high incidences of gastroenteritis that can then be spread by person-to-person contact to other individuals who were not directly exposed to the polluted waters (Patel, 2008) (Isakbaeva, 2005)

For environmental waters impacted by treated wastewater, pathogens typically considered for human risk assessment are:

- *Campylobacter*, due to its common presence in wastewater and relatively robust relationship with indicator bacteria such as *E. coli*, and
- The viruses: norovirus for enteric infections and illness resulting from ingestion, and adenovirus for respiratory infection and illness resulting from inhalation (McBride, 2016a) (McBride, 2016b).

Due to the relatively low dose of norovirus and adenovirus required to result in illness, and where there is concern that indicator bacteria, such as faecal coliforms and *Enterococci,* do not provide sufficient relationship to viral infection risk for activities such as consumption of shellfish, these viruses are the commonly assessed pathogens of interest in QMRA for wastewater discharges (McBride, 2011) (McBride, 2012) (McBride, 2016a) (McBride, 2016b).

7.3 Faecal indicators and management of risk

Because the tests for pathogens are time-consuming and expensive, such testing cannot be implemented on a routine basis. Instead, regulatory bodies support testing for faecal indicator bacteria (FIB) (e.g. enterococci and *E. coli*) as a cost-effective means to assessing the presence of faecal contamination and the quality of treated wastewater.

The outcome of research and quantitative microbial risk assessment have been used in the development of national guidance for drinking water, making use of *E. coli* and for recreational use of water (MfE, 2003), with this providing direction on the use of *E. coli* as an indicator of potential faecal contamination and management of risks to health in freshwater environments. The correlation between risk of *Campylobacter* infection and *E. coli* concentrations was adopted as representative of risk of infection from pathogens derived from faecal contamination.

In 2017, the Ministry for the Environment commissioned a work to identify appropriate rivers for sampling, to review microbial methods, QMRA components and to design a survey and national level QMRA. To support this initiative 1,041 samples were collected from 71 rivers across New Zealand between February 2020 and June 2024. This work, carried out by PHF Science (PHF Science, 2025) significantly expanded the available New Zealand specific data set for assessing the reliability of FIB and viral indicators as tools for managing risks to recreational users of waters. A key advantage of the newer dataset is that the collected water samples provide the indicator, pathogen, and microbial source tracking (MST) marker information for the same sample of water, meaning no assumptions need to be made about the fate or survival of the pathogens in the water before a swimmer ingests the water.

This study, which included extensive literature review as well as monitoring of rivers knowingly influenced by wastewater, provides describes the relationships in New Zealand rivers between a range of microbial indicators and pathogens and an updated simulation model for estimating the risk to swimmers for gastrointestinal pathogens. While the findings of this programme of work are yet to be incorporated into national policy or guidance, the updated understanding of pathogen risk and use of faecal indicators for assessing risks from norovirus, is considered to be relevant in assessing risks to the recreational water users of the Kawarau River.

Comprehensive assessment carried out by PHF using this newer data set included, but is not limited to, the following:

1) More detailed analysis of correlations between FIB and notable pathogens.
2) A refined national level QMRA for recreational water use, that showed that concentrations of the indicator *E. coli* in freshwater can be used to define changes in the percentage of swims resulting in *Campylobacter* infection or illness.
3) Analysis of the relationship between human MST marker CrAssphage and norovirus concentrations in raw wastewater, and demonstration of the use of CrAssphage as a viral indictor of norovirus concentration.
4) Demonstration of the relationship between CrAssphage and *E. coli*, which while showing poor correlation, does show a high degree of sensitivity, such that an upper bound for CrAssphage concentration can be estimated from *E. coli* concentration.

7.4 Water Conservation Order and level of risk

The Water Conservation Order (Kawarau) outlines qualitatively the requirements for water quality of the Kawarau River to remain suitable for bathing (refer Section 2.4.3), while the RPW Schedule 15 (Otago Regional Council (ORC), 2025) and NPS FM outline the quantitative metrics for determining whether this is achieved. The faecal indicator bacteria *E. coli* is referenced in the RPW as a measure of potential pathogen impact in the waters to be protective of adverse effects for water quality users. The *E. coli* limit of 80th percentile of 260 cfu/100 ml is provided for the Kawarau River for this purpose. The NPS FM (MfE, 2020 amended December 2025) national bottom line for primary contact sites in lakes and rivers is *E. coli* 95%ile of 540 /100 ml, with this corresponding to the Fair attribute band and estimated risk of *Campylobacter* infection of up to 5% occurrence, 95% of the time.

7.5 Exposure pathways

Recreational activities identified in the Kimiākau/Shotover River and Kawarau River which may result in exposure to pathogens from treated wastewater include the following:

Ingestion

- Primary contact activities, where immersion of the head and direct ingestion of pathogen impacted water is expected - such as swimming and kayaking (with immersion).
- Secondary contact activities, where immersion of the head does not occur, but indirect ingestion of pathogens is possible - such as wading, kayaking (without immersion) and boating.

Inhalation

- With disturbance of water and close proximity of the head to water, during swimming and boating.

Of the recreational use exposure pathways and activities identified, ingestion of impacted water during swimming is expected to provide the primary risk of infection and illness, due to the relatively higher dose that can be received from direct ingestion over a period of time swimming.

Swimming is not known to be a common occurrence along the active confluence of the Shotover and Kawarau Rivers (within the reasonable mixing zone), with the nearest frequently used bathing site with safe water access identified as the beach by the Twin Rivers Trail intersection, immediately following the River confluence and delta (refer Figure 6.1). Use of this area for bathing, including by children, is considered to be a primary contact location.

Activities resulting in immersion within the reasonable mixing zone are assumed to be most likely undertaken by adults.

In addition to the above exposure for recreational water use, potential exists for Kawarau River water, downstream of the Shotover River to be used for potable supply, as a permitted activity water take. While no such water takes have been identified during the course of this assessment, for conservatism they have been considered as potentially occurring.

7.6 Wastewater treatment and residual pathogens

Both the secondary wastewater treatment processes, including the MLE process, filtration and UV treatment of the Shotover WWTP have an influence on the residual active pathogen concentration in treated wastewater. Current performance of the Shotover WWTP in treating pathogens provides a baseline for considering how proposed upgrades to the treatment plant will further reduce residual pathogen levels.

7.6.1 Current Shotover WWTP pathogen treatment performance

Treated wastewater is routinely tested for *E. coli* as a FIB to confirm the level of disinfection achieved by treatment. Concentrations of *E. coli* and the change in concentrations since completion of the Stage 3 upgrades is outlined in Section 2.3.3.

7.6.1.1 Water and wastewater *E. coli* results

E. coli results for the following sites are shown in Figure 7.1 and Table 7.1:

- EFF: treated effluent
- RS04B: Kimiākau/Shotover River upstream of effects from the Shotover WWTP
- RS10: Kawarau River downstream of the confluence
- RS14: Kawarau River upstream of the confluence

E. coli results downstream of the Shotover WWTP includes the discharge effects but also catchment influences. As shown in Figure 7.1, the upstream Shotover River site (RS04B) over January – March 2026 has often been considerably higher than that of the effluent discharge (EFF). RS14, upstream in the Kawarau River, has also had *E. coli* results that exceed those of the treated effluent from mid-March to May 2026.

Higher *E. coli* concentrations at upstream sites can reflect local catchment influences such as diffuse inputs from land use, stock access, wildlife and bird activity, and tributary inflows, rather than point-source discharges. At RS04B, these local sources can drive elevated concentrations during certain periods. In contrast, *E. coli* concentrations in the effluent (EFF) are generally low and/or non-detectable, indicating effective removal of faecal indicator bacteria through the wastewater treatment, particularly from October 2025 onwards.

At monitoring location RS10, downstream of the River confluence, concentrations of *E. coli* reflect the contribution from both the Kimiākau/Shotover River (RS04B) and the upstream Kawarau River (RS14). The relative contribution of flow at this location from the Kimiākau/Shotover River expected to be low during low-flow periods and increase during high flow periods.

Review of monitoring results indicates that *E. coli* concentrations at RS10 are typically a subdued expression of those at RS04B i.e. a diluted expression of the fluctuations in *E. coli* concentration at RS04B. This suggests that the most significant influence on *E. coli* concentrations at monitoring location RS10 is the Kimiākau/Shotover River catchment upstream of RS04B and upstream of the current treated wastewater discharge to the Kimiākau/Shotover River.

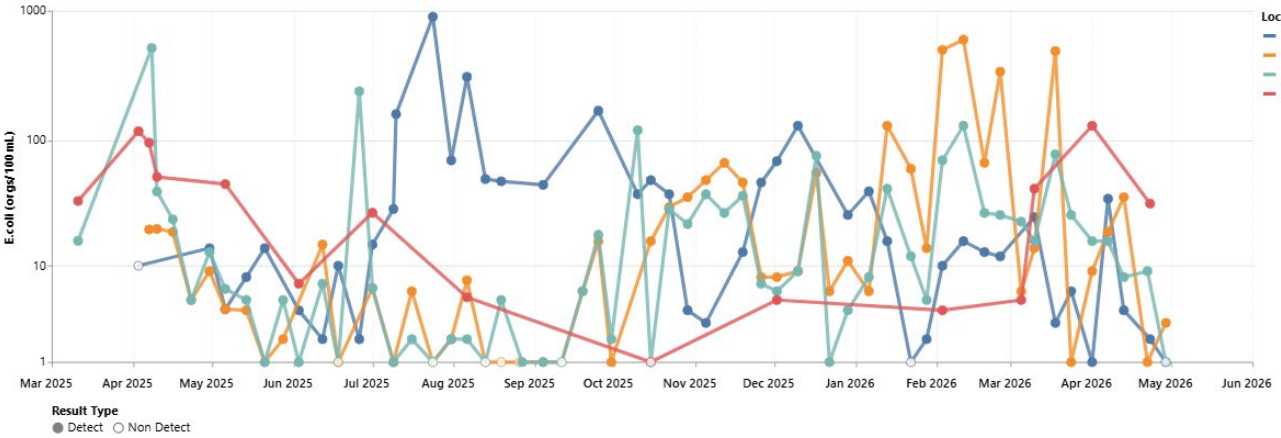

Figure 7.1 Water and wastewater E. coli results

Table 7.1 shows the *E. coli* monitoring summary statistics over the past year for the sites listed previously. When comparing the treated effluent with the concentrations upstream in the Kimiākau/Shotover River, the results are not dissimilar. The 95Ile at RS04B is much higher than EFF, RS10 or RS14, showing that water quality upstream likely has a larger influence than the effluent discharge. When comparing the 95%ile to the NPS FM human health risk criteria, sites EFF and RS04B fall into the "Fair" criteria for primary contact sites, while RS10 and RS14 fall into the "Excellent" criteria[7].

Table 7.1 E. coli result summary

Location	Date range	Median	95%ile
		E. coli (cfu/100ml)	*E. coli* (cfu/100ml)
EFF Treated effluent	3/04/2025 - 29/04/2026	16*	275*
RS04B Upstream Shotover	7/04/2025 - 29/04/2026	11	445
RS10 Downstream Kawarau	11/03/2025 - 29/04/2026	9	124

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[7] NPS FM, Appendix 2A, Table 22. "Fair" = Estimated risk of *Campylobacter* infection has a 1 – 5% occurrence, 95% of the time. Concentrations > 260 - < 500 cfu/100ml. "Excellent" = Estimated risk of *Campylobacter* infection has a < 0.1% occurrence, 95% of the time. Concentrations < 130.

Location	Date range	Median	95%ile
		E. coli (cfu/100ml)	*E. coli* (cfu/100ml)
RS14 Upstream Kawarau	11/03/2025 - 23/04/2026	32.8	122.1
Notes: RS14 statistics are based on fewer monitoring results (n=14) compared to the other sites (average of n=52) Statistics exclude results below lab detection limits * EFF median and 95%ile values derived from GHD sampling, excluding operational plant data			

7.6.1.2 Virus testing results

Results of virus testing of treated wastewater testing on 15 October 2025, are summarised in Table 7.2. The equivalent sample provided an *E. coli* concentration of 49 cfu/100 ml.

Table 7.2 Treated Wastewater virus concentrations

Test	**Concentration by culture[2] (Infectious Units (IU)/L)**	**Concentration by PCR[2] (Genome copies/ L)**
Adenovirus	30	31,000
Enterovirus	<1	<100
Norovirus GI	-[1]	1,700
Norovirus GII	-[1]	8,900

The measured virus concentrations by culture assay reflects a concentration of active virions (infectious viral particles). This differs from PCR methodologies which quantify the total number of individual virus copies present (total genomic copies), including both inactive from active virus copies. Laboratory testing for norovirus is currently only available using PCR methodologies and as such, norovirus concentrations include both inactive and active copies of the virus. This makes it difficult to determine norovirus inactivation rates due to treatment and infectious concentrations in the environment. Other pathogens for which infectious virions can be quantified, such as enterovirus, adenovirus, and viral indicators, are instead used as proxies to reflect the likely rate of norovirus inactivation (Doré B, 2013). Murine norovirus, which can be assessed by culture assay for infectivity, has also been used as a surrogate for human norovirus in assessing inactivation by UV treatment (Rönnqvist M, 2014)

7.6.1.3 Current WWTP virus removal

A range of variables influence the effectiveness of UV treatment, including UV wavelength, sediment load and UV transmittance, specific pathogen and conditions after treatment amongst others. Comparison to the findings of other studies, such as presented by (Stantec and Connect Water, 2020), suggests that norovirus is more resilient through secondary treatment than other enteric viruses, but more susceptible to inactivation through UV treatment than other viruses, such as enterovirus and adenovirus.

Table 7.3 presents referenced log removals rates by secondary treatment (without UV disinfection) for various enteric viruses (Stantec and Connect Water, 2020), while Table 7.4 presents published UV doses to achieve 1 log inactivation of norovirus (Stantec and Connect Water, 2020) and enterovirus (Malayeri, 2016)

Table 7.3 Assumed log removals of norovirus, enterovirus and adenovirus in the Porirua WWTP during average and at 1500 L/s flows (Stantec & Connect Water, 2020)

Treatment	**Norovirus**	**Enterovirus**	**Adenovirus**
Secondary treatment	2.1[1]	3.2[2]	2.7[3]
1) Median result obtained for Porirua WWTP, UK study with limited sampling provides results of $\log_{10}$ 1.38 and $\log_{10}$ 2.57, Swedish study provides $\log_{10}$ 1.5 removal. Based on virus removal and not inactivation. 2) Median result obtained for the Porirua WWTP, Mangere WWTPD data (2002-2016) provides results of $\log_{10}$ 3.66. 3) Average result for the Oxley Creek, Brisbane WWTP, other Brisbane WWTP provided results of $\log_{10}$ 2.91 and $\log_{10}$ 3.08, and Mangere WWTP data (2002 – 2016) provides results of $\log_{10}$ 3.23.			

Table 7.4 UV dose sensitivity for norovirus, enterovirus and rotavirus

Virus / type	Dose for 1 log removal (mJ/cm^2)	Reference
Norovirus	7.6[1] 9.1[2]	1- (Stantec and Connect Water, 2020) 2- (Rönnqvist M, 2014)
Enterovirus	8 (Coxsackievirus B3) 6.9 & 9.8 (Coxsackievirus B5 8 (Echovirus I) 7 (Echovirus II)	(Malayeri, 2016)
Adenovirus	40 (Adenovirus Type 2)	(Vazquez Bravo, 2011)

Current Shotover WWTP UV system is designed to provide a UV dose of 27 mJ/cm^2, with this expected to provide in the order of 2-3 log removal for norovirus and enterovirus, and half log removal for adenovirus. A cumulative 4-log removal and inactivation of these viruses by the current Shotover WWTP is considered likely to be occurring. In the context of the measured virus concentrations in treated wastewater, residual norovirus is likely to be present at concentrations below that of adenovirus, due to the greater resistance adenovirus shows to UV treatment.

7.6.2 Proposed Shotover WWTP improvements

Tertiary filtration is proposed to be introduced before UV treatment, further removing solids from the treated wastewater before UV irradiation. This has the following benefits for pathogen removal:

- Improved filtration provides for greater removal of organic particles and the microbial communities that are bound to them.
- Improved filtration will result in lower sediment content and greater UV light transmittance of treated wastewater. Improved transmittance allows for a greater dose of UV energy to be delivered by the UV lamps, with this in turn, increasing the amount of pathogen deactivation prior to discharge of treated wastewater.

Given these benefits, a further improvement in pathogen removal can be expected to be realised with completion of upgrades.

The addition of further UV treatment is currently being considered, to provide a further 1-2 log deactivation of viruses. This will provide for potential opportunities for re-use of treated wastewater, and provide further surety that exceptionally high level of disinfection is achieved prior to treated wastewater entering the environment. It is expected that with such additional treatment, residual infectious pathogens would be below analytical detection levels.

7.7 Health risk assessment

Responding to the identified exposure pathways, enteric pathogens have been identified as being primarily of concern with *Campylobacter* and norovirus identified as the pathogens of primary interest.

7.7.1 Risk of illness from *Campylobacter*

The risk of *Campylobacter* infection and illness from recreational use of the Kawarau River is assessed by comparison of predicted *E. coli* concentrations with regional plan and NPS FM (2025) requirements for water quality suitable for bathing.

The predicted concentrations are outlined in Section 5 and reproduced here as Table 7.5.

Table 7.5 Predicted E. coli concentrations in the near-field mixing area and after reasonable mixing.

E. coli concentration statistic	Within near-field mixing area – predicted *E. coli* concentration (#/100ml)	After reasonable mixing *E. coli* concentration (#/100ml)	NPS FM (2025) *E. coli* primary contact sites – National bottom line (#/100 ml)	RPW – Schedule 15 – 80th percentile *E. coli* (#/100 ml)
95%ile	42	29	540	260
Max/Truncated	62	31		

Comparison to NPS FM (2025) Attribute Bands for *E. coli* concentrations at primary contact sites in lakes and rivers (during bathing season), indicates that the predicted *E. coli* concentrations immediately after discharge are significantly lower than the national bottom line for swimming at freshwater bathing sites. The attribute band for predicted *E. coli* concentrations is consistent with Attribute Band 'Excellent' (Table 22 of NPS FM), reflecting a very low *Campylobact*er individual infection risk (0.1%) of infection, with this excluding the influences of the Shotover River. When the influence of the Shotover River is included, introducing the periods of high catchment *E. coli* contribution, the concentrations is are precited to be consistent with Attribute Band 'Fair'. Both with and without the consideration of the Shotover River contributions, the downstream water quality after reasonable mixing is predicted to meet Attribute Band A (Blue) for Human contact (Table 9 of the NPS FM). The Shotover River is considered to be the primary driver for periods of elevated *E. coli* concentrations in the Kawarau River downstream of the discharge.

The more recently developed correlation of campylobacteriosis risk from swimming with *E. coli* concentration developed by (PHF Science, 2025) suggests an individual infection risk in the order of 1% for *E. coli* concentrations of less than 100 MPN/100 ml. The risk of *Campylobacter* infection and illness immediately beyond the discharge structure and after reasonable mixing is therefore interpreted to be low.

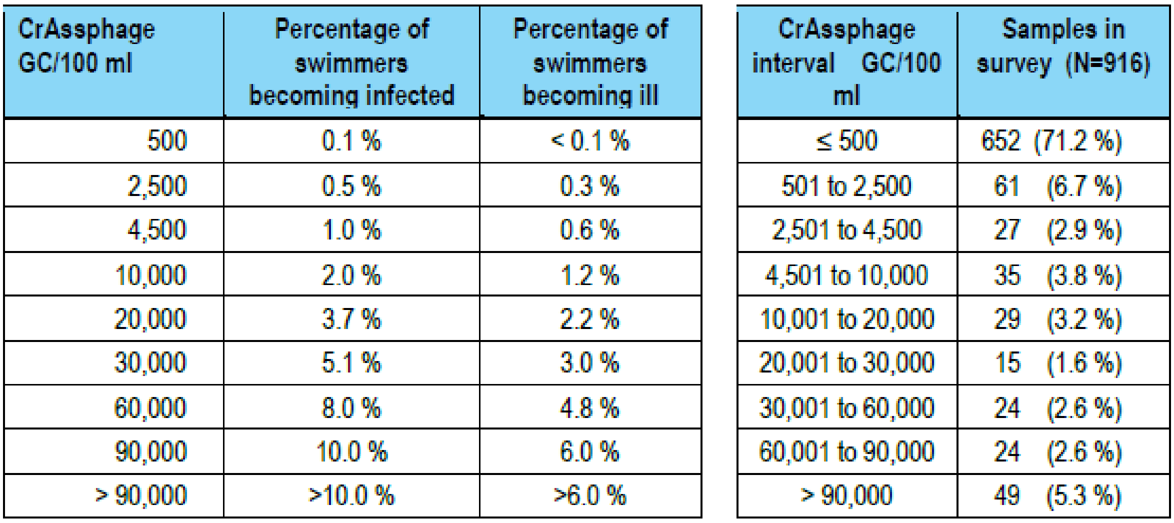
7.7.2 Risk of illness from norovirus

PHF Science (2025) provided a generic QMRA for norovirus, using the following:

- Developed correlations between norovirus and CrAssphage in raw wastewater.
- Literature sourced estimates of the distribution of norovirus and CrAssphage in raw wastewater (Ahmed W, 2024).
- Literature sourced estimates for swimming time and water ingestion for children aged 6-12.
- A conservative norovirus dose-response relationship, commonly applied during QMRA.

This analysis made the assumption that the distribution of norovirus and CrAssphage wouldn't change with dilution in the freshwater environment and that the discharge of wastewater was sufficiently fresh that no die-off had occurred. Table 7.6 is reproduced from PHF Science (Table 50, (PHF Science, 2025)) and outlines the risk of infection calculated from copies of CrAssphage.

Table 7.6 Risk of infection calculated from copies of CrAssphage, reproduced from PHF Science (2025)



CrAssphage GC/100 ml	Percentage of swimmers becoming infected	Percentage of swimmers becoming ill
500	0.1 %	< 0.1 %
2,500	0.5 %	0.3 %
4,500	1.0 %	0.6 %
10,000	2.0 %	1.2 %
20,000	3.7 %	2.2 %
30,000	5.1 %	3.0 %
60,000	8.0 %	4.8 %
90,000	10.0 %	6.0 %
> 90,000	>10.0 %	>6.0 %

CrAssphage interval GC/100 ml	Samples in survey (N=916)
≤ 500	652 (71.2 %)
501 to 2,500	61 (6.7 %)
2,501 to 4,500	27 (2.9 %)
4,501 to 10,000	35 (3.8 %)
10,001 to 20,000	29 (3.2 %)
20,001 to 30,000	15 (1.6 %)
30,001 to 60,000	24 (2.6 %)
60,001 to 90,000	24 (2.6 %)
> 90,000	49 (5.3 %)

PHF Science (2025) also reported survey data for water samples with greater than 100 GC CrAssphage/100 ml plotted against *E. coli*, with this shown in Figure 7.2. The *E. coli* concentration does show a relationship with the observed range of CrAssphage concentrations. Increasing *E. coli* corresponding to an increasing upper bound of observations of CrAssphage concentrations. While *E. coli* has a low specificity for CrAssphage, it has a very high sensitivity (PHF Science, 2025) in that an upper bound for CrAssphage can be estimated for a given *E. coli* concentration.

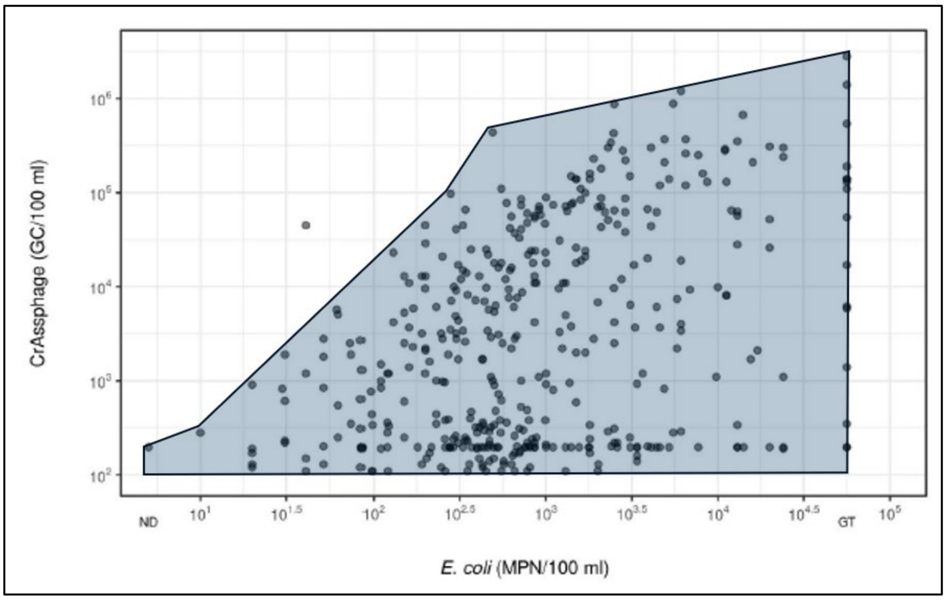


Figure 7.2 CrAssphage vs E. coli concentration in natural waters, reproduced from PHF Science, 2025.

This relationship suggests that *E. coli* can be used as an indicator of when the norovirus risk-based threshold may be exceeded, and similarly allows the risk of norovirus infection to be estimated.

Adopting a norovirus individual infection risk threshold of 5%, as applied in NPS FM national bottom line for *Campylobacter* infection from recreational use of bathing sites (Table 22, (MfE, 2020 amended December 2025)), correlates to a CrAssphage concentration of 30,000 gene copies/100 ml, with this equating to a maximum *E. coli* concentration of approximately 100 MPN/100ml. The predicted concentrations for *E. coli* within the reasonable near-field mixing area are below this threshold, suggesting an upper bound individual infection risk in the order of 2%, with actual risk more than 95% of the time being significantly lower than this. In this context it is considered that the norovirus individual infection risk to recreational use of the Kawarau River immediately beyond the discharge structure and after reasonable mixing is low.

7.7.3 Potential drinking water use

The Water Service (Drinking Water Standards of New Zealand) Regulations 2022 (DWSNZ), provide maximum acceptable values for microbiological determinants as follows:

- *E. coli* maximum allowable value (MAV) of <1 cfu/100 mL.
- Total pathogenic protozoa MAV of <1 infectious oocysts/100 mL.

These water quality criteria are to be achieved following treatment, with surface water supplies requiring some level of pathogen reduction in order to meet DWSNZ levels.

The current Kawarau River water quality, as indicated at all monitoring locations, does not meet the DWSNZ requirements due to the presence of *E. coli* above detection levels. Some level of water treatment to remove or deactivate pathogens can therefore be expected to be needed in order to provide a safe drinking water supply.

The proposed wastewater treatment is highly effective at protozoa and bacteria removal, and following complete mixing of the discharge with river water the predicted maximum changes are relatively small in the context of natural variability in *E. coli* concentrations due to catchment sources and response to stormwater events. This variability is most evident in the Shotover River and its microbiological contribution to the Kawarau River.

Assuming appropriate disinfection is carried out for safe water supply from the Kawarau River, it is considered unlikely that residual pathogens introduced by the proposed WWTP discharge would meaningfully increase risk to water users. Potential effect to users of downstream waters for potable supply, assuming these water supplies are appropriately managed to meet water quality consistent with the DWSNZ are considered to be less than minor.

7.8 Refined health risk assessment

To provide further surety of the public health risk assessment, microbial monitoring of wastewater and river water is being broadened for a period of time to provide a dataset specific to the Kawarau and Kimiākau/Shotover Rivers. Based on the results of monitoring a location and discharge specific QMRA will be carried out to refine the estimates of risk to recreational users of the water. This will also take into consideration any refinements to the discharge structure design during detailed design, to enhance dilution.

Refinements will likely include improved understanding of the concentration of residual active pathogens in treated wastewater, exposure assumptions appropriate to the river setting, such as shorter swim times than typical reported for beach settings, potential for downstream untreated water supplies, and consideration of a number of dose-response models.

As outlined in Section 7.6.2, the findings of this monitoring and assessment will be used to inform the need for and specification of additional UV treatment to achieve robust management of risk to public health. Improvements in filtration and additional UV treatment are expected to be able to achieve up to 2-log further deactivation of viruses in treated wastewater, over the existing levels of treatments achieved, if it is needed. Such significant amounts of net disinfection are considered to address residual uncertainty in the assessment of risk to public health provided, and to mitigate levels of residual risk to negligible levels.

8. Assessment of effects

8.1 Effects to groundwater

With cessation of treated wastewater disposal via the DaD, progressive reductions in contaminant concentrations in shallow groundwater have been evident in monitoring results. No direct discharge of treated effluent to groundwater is proposed, and this progressive improvement is expected to continue over time.

The effect of seepage from the treated water calamity pond on groundwater is expected to be significantly less than historically occurring from the oxidation ponds. The effects to groundwater quality and groundwater levels are expected to be negligible due to the intermittent and short term use of the calamity pond, low permeability pond base and improved treated wastewater quality.

Discharge of treated wastewater to the Kawarau River is not expected to result in effects to the shallow groundwater in the vicinity of the Shotover Delta, beyond the improvements which are otherwise experienced with ceasing wastewater discharge to ground and groundwater.

The influence of the proposed discharge on wider groundwater resources and potential for potable use of water, such as in the vicinity of Lake Dunstan, is limited by the potential for significant change in Kawarau River and Lake Dunstan surface water quality. Of the contaminants assessed, concentrations of nitrate-N and pathogens are considered to be risk limiting in terms of potable use. Nitrate-N concentrations in fully mixed river water remains well below Drinking Water Standards of New Zealand limit for potable water use. Long travel times and filtration of pathogens through aquifers typically provides significant die-off of residual pathogen concentrations in groundwater. Given the high degree of treatment received prior to discharge, low residual concentrations in reasonably mixed river water and the most likely long transport times for water to influence groundwater resources it is considered that the potential for adverse effects to downgradient groundwater resources is negligible.

8.2 Effects to hydrology

The positioning of the discharge structure on the true left bank of the Kawarau River and extending approximately 10 m into the river, is intended to allow discharge of treated wastewater into faster flowing parts of the river, even under low flow conditions. The proposed design is for the discharge structure to divert flow of shallow waters around the structure, with the discharge occurring below the low-level water surface. Extension of the discharge point into the river provides for greater river water velocity at the point of discharge and improves downstream mixing. At higher river levels, a greater proportion of the discharge structure will be submerged.

The structure has the potential to influence the hydrology of the river to some degree by diverting shallow waters around the end of the structure (change in flow path) and by modifying the cross-sectional area of the river channel.

The change in river flow paths is considered to be minimal, with the discharge structure design to divert flow, rather than significantly disrupt flow. Hydrodynamic assessment demonstrates that riverbank flow continues downstream of the structure. Effects to river flow paths are therefore considered to be less than minor.

The river channel at the location of the proposed discharge structure has experienced significant changes since regular channel surveys commenced in the 1980's, with past floods depositing significant sediment loads to the area. Surveyed channel cross sections show that since construction of the training line, this area in the lee of the training line has experienced progressive erosion of the channel resulting in area increasing by more than 100 m^2 from previous surveys. The current cross-sectional area is now relatively large and in the absence of further deposition in this area, due to the training line, is expected to remain so.

The proposed discharge structure design is estimated to reduce the river channel cross sectional area by approximately 3.5% under low flow conditions and an estimated 7% during flood flows up to a level of 310 mRL. These changes, in the order of 22.5 m^2 are small relative to the variability seen historically and the channel area would continue to remain large relative to historical conditions. These small changes in area are therefore considered unlikely to result in damming effect or influence return flow, beyond the natural state that has existed in the past. As such, the requirements of the WCO regarding damming effects and return flow are considered to be met.

Taking into consideration the minor diversion of river flow around the structure, the overall effects to hydrology are expected to be limited, with these assessed as being a no more than minor effect.

However, it is recommended that more detailed analysis is undertaken during detailed design of the discharge structure, to confirm that the structure is designed in such a way as to mitigate any significant risk of damming or flooding. Given the flexibility provided in the concept design for finished levels, it is considered that refinements through detailed design can adequately mitigate the potential risk, where it is greater than identified at concept level.

8.3 Effects to water quality

The Kawarau River has been the receiving surface water body for wastewater discharges from Queenstown since construction of the Shotover WWTP, and indirectly since settlement of Queenstown. The completion of Stage 2 and Stage 3 upgrades at the Shotover WWTP represents a significant milestone in the effective reduction of contaminant load to the Kawarau River, as follows:

- The ammoniacal-N concentrations are predicted to be reduced by approximately 2 orders of magnitude over that achieved prior to 2019 and at least 1 order of magnitude lower than that achieved prior to recent completion of the Stage 3 upgrades. The load of ammoniacal-N into the Kawarau River will therefore be significantly reduced relative to historical conditions, even when including increased discharge volumes due to growth.
- The additional treatment for phosphorus proposed to be implemented is expected to result in reduction of phosphorus levels to many times less than previously being discharged prior to 2019, and significantly lower than the current discharge to the Kimiākau/Shotover River. A net reduction in total phosphorus load to the Kawarau River is expected even when including increased discharge volumes due to growth.
- Reductions in the sediment and organic matter concentrations in treated wastewater, due to cessation of oxidation pond use and the proposed introduction of tertiary filtration, are expected to significantly improve the visual appearance of the discharge, such that it is not conspicuous even at the point of discharge. While historically discharged amounts of organic matter are expected to have had limited influence on the BOD and dissolved oxygen levels of the Kawarau River, these further reductions expected to be achieved are considered likely to provide benefits in shallow and lower flow areas of the River, such as where groundwater impacted by the DaD has been discharging.

The above changes are expected to result in a net improvement to Kawarau River water quality over the term of the proposed consent.

8.3.1 Water quality within the near-field mixing area

The location of the discharge structure allows for relatively rapid mixing due to its proximity to the confluence of the Kawarau and Kimiākau/Shotover rivers. An approximate 5-fold dilution of treated wastewater is predicted to be achieved by the end of the discharge structure under the conservative conditions assessed.

Discharged treated wastewater is predicted to be rapidly mixed with river water at discharge and in the vicinity of the discharge structure. Water quality immediately downstream of the discharge structure, and for the 2060 peak discharge during low flow conditions, is predicted to have ammoniacal-N and nitrate-N concentrations generally similar to those that have been experienced in the Kawarau River under low flow conditions due to operation of the DaD. Owing to the location of the proposed discharge, the extent of Kawarau riverbank likely to be influenced in this manner is, however, expected to be significantly less than has resulted due to the discharge of nutrient impacted groundwater.

As water mixes with inflowing Kimiākau/Shotover River water through the river confluence, a further approximate10 fold dilution is predicted to occur under the low flow conditions assessed. Low concentrations of ammoniacal-N and nitrate-N and high water turbulence in this area is expected to reduce the potential for adverse ecological outcomes, with these assessed in detail in the assessment of effects to ecology (Boffa Miskell, 2026).

TSS and cBOD concentrations are also predicted to remain low and a measurable change is DO is considered unlikely to result, given this low organic content and degree of turbulence in the downstream area.

8.3.2 Water quality after reasonable mixing

Reasonable mixing zone is proposed to encompass that downstream area that includes the confluence of the Kawarau with the Kimiākau/Shotover River, where turbulence in the river promotes mixing. The monitoring location RS10 is proposed as the monitoring point for water quality after reasonable mixing.

When considering potential effects to water quality after reasonable mixing in the absence of historical wastewater discharges, the influence of the proposed peak dry weather discharge predicted for 2060 occurring at a time of river low-flow conditions has been assessed, with this considered to provide an upper bound for likely effects to the river water quality. Discharges under other conditions, including during wet weather events, are expected to receive significantly greater dilution due to either reduced discharge volumes and/or greater flow in the Kimiākau/Shotover River resulting in more dilution in the reasonable mixing zone.

The change in Kawarau River water quality after reasonable mixing is expected to be no more than minor. Notably, concentrations of ammoniacal-N and nitrate-N remain within the NPS FM attribute Band A, indicating minimal increase in ecotoxicity risk.

Potential changes in temperature, pH and DO resulting from the discharge are expected to be negligible, due to treated wastewater having properties not significantly dissimilar from river water. The limited addition of organic matter and the relative high turbidity of Kawarau River water through and downstream of the confluence with the Kimiākau/Shotover River is also expected to contribute to mitigating effects. Similarly, effects to colour or clarity of river water after reasonable mixing are expected to be negligible, due to the significant removal of sediments in wastewater through the treatment process.

Locally elevated DRP is predicted after reasonable mixing, and while considered to be minor in nature due to the lack of ecotoxicity effects and localised area influence, elevated phosphorus concentrations do have the potential to promote periphyton growth and increased algal biomass. The occurrence of such ecological outcomes and potential for adverse effects to ecology are discussed in detail in the assessment of effects to ecology (Boffa Miskell, 2026).

Some small increase in metal concentrations is predicted after reasonable mixing, relative to background Kawarau River water quality. However, for the metals identified as warranting consideration (aluminium, copper and zinc) all remain at levels below the ANZG 99% species protection criteria. This indicates that it is unlikely that any increases in concentration resulting from the discharge would meaningfully increase the ecotoxicity risk after reasonable mixing. The potential ecological effects associated with metals are considered in further in the assessment of effects to ecology (Boffa Miskell, 2026).

Concentrations of PFAS, a particularly persistent and mobile contaminant present in wastewater are low. The ecotoxicity effects and risk to recreational users of the river from these substances is considered to be negligible.

As the predicted water quality represents a potential minimum dilution scenario and upper bound for short term change in water quality, the effects of the discharge on water quality are, to a great extent, considered to be less than minor, with potential for increases during future low flow conditions to result in effects to water quality that are no more than minor in nature.

8.3.3 Water quality after complete mixing

The treated wastewater is expected to be fully mixed within the Kawarau River further downstream of the confluence with the Kimiākau/Shotover River and before flowing into Lake Dunstan. The mass balance calculations to predict water quality after complete mixing apply the peak dry weather discharge predicted for 2060 (0.36 m^3/s) to calculated MALF of the Kawarau River at Chard Rd monitoring station (88.6 m^3/s).

Water quality after complete mixing, is expected to reflect small change in nitrogen and phosphorus concentrations, however water quality is predicted to continue to meet NPS FM Attribute A bands for rivers and lakes, for all parameters except for suspended sediment resulting from natural erosion in the Kimiākau/Shotover River catchment. The RPW schedule 15 criteria for Group Two waters are also predicted to be met.

Trace metal concentrations are expected to be generally consistent with upstream concentrations, or where greater to a small degree, readily meet the ANZG 99% freshwater species protection criteria.

Dissolved oxygen levels, water colour and water clarity, are expected to be indistinguishable from background levels, with no discernible influence of the treated wastewater discharge.

While a change of water quality relative to upstream water quality is likely to result under future low-flow conditions, the overall change is considered to be no more than minor in nature, with water quality remaining consistent with the applicable water quality criteria. Potential effects to fully mixed water quality are therefore considered to be no more than minor.

When considered in the context of historical discharges to the river, the improved treatment provided with the proposed discharge, and typical discharge and river flow conditions, it is expected realised effects to water quality will be less than minor or some level of improvement.

8.3.4 Cumulative effects on water quality

The assessment has focused on the effects of the proposed discharge (including future population growth) on the downstream water quality. However, the receiving environment is also influenced by the historical and current wastewater discharges. This includes the effect of groundwater discharges to the Kawarau River as affected by the DaD discharge and the short-term discharge to Kimiākau/Shotover River.

As described in Section 3.6.1 the cessation of the DaD discharge has resulted in an improvement in groundwater quality. While the data shows elevated nutrient concentrations in groundwater and in the Kawarau River as it flows past the Shotover Delta, the concentration of ammoniacal-N has halved over the past year in many of groundwater monitoring wells. This trend is expected to continue with reducing mass flux in groundwater discharges to the Kawarau River.

The recent Stage 3 upgrades to the Shotover WWTP have resulted in an improvement in effluent quality as shown by Figure 3.25. The water quality represented by downstream sample location RS10 is indicative of the cumulative discharges from both the DaD and Kimiākau/Shotover River discharge. While there may be a small increase in nutrient concentration relative to the upstream sample point (RS14), this is not statistically significant. An effect to water quality at the downstream water monitoring location (Chard Rd) is not apparent, with water quality meeting Attribute Band A, with the exception of Clarity due to the natural high sediment load in the river.

With the implementation of the proposed discharge to the Kawarau River, the short-term discharge to the Kimiākau/Shotover River will cease. Therefore, when considering cumulative effects from the previous discharge activities, only the groundwater discharges are expected to contribute to water quality in the Kawarau River. Due to the small volume of groundwater, relative to river flow, and improving water quality, the effect of the groundwater discharges on downstream water quality are expected to be negligible.

Further downstream, the Kawarau River flows into Lake Dunstan near Bannockburn. Monitoring of Lake Dunstan at Dead Mans Point near Cromwell, indicates that the lake has an attribute status of A[8] with regards to total phosphorus, total nitrogen and ammoniacal-nitrogen. As shown in section 6.6.1, the complete mixing assessment shows that the discharge meets the Band A attribute status for Lakes. This assessment does not take into account further dilution from tributaries such as Roaring Meg before entering the lake. Therefore, it is considered that the discharge will not have a meaningful impact on the water quality of Lake Dunstan.

8.4 Effects to public health

The Kawarau River is commonly used for recreational activities that result in water contact, such as wading, and ingestion of water, such as during swimming. The need for water to be suitable for bathing, after reasonable mixing of the treated wastewater discharge, is reflected in the WCO. The need for robust wastewater disinfection is reflected in the low compliance limits proposed for *E. coli* proposed (*E. coli* 95%ile concentration in treated wastewater of 100 cfu/100ml), with this more stringent than those imposed by the WEPS for discharges to even the smallest of freshwater environments.

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[8] **Land, Air, Water Aotearoa (LAWA) - Lake Dunstan at Dead Mans Point**

These limits are also expected to limit any increases in concentrations of *E. coli* after complete mixing of the discharge with river water to less than typical analytical detection levels (<1 cfu/100mL).

The current Shotover WWTP processes include secondary treatment and a tertiary UV disinfection process, which achieves significant reductions in pathogens, as indicated by typically very low *E. coli* concentrations. Residual concentrations of active pathogens, such as adenovirus, have been detected in the treated wastewater, indicating that there is potential for elevated risk to health where the public is exposed to the treated wastewater. The tertiary filtration proposed to be added to the treatment train, prior to wastewater receiving UV disinfection, is expected to achieve further removal of pathogens by filtration of organic particles, and allow for improved deactivation by the current UV system due to improvements in wastewater transmittance.

The risk to recreational water uses has been considered through assessment of risk during swimming, with the ingestion of water during bathing considered likely to result in the greatest pathogens dose (if water quality is impacted), of the potential activities expected to be undertaken. Of the range of potential pathogens which may be present *Campylobacter* and norovirus were considered for assessment. *Campylobacter* is a common pathogen in wastewater and due to the relatively strong correlation with *E. coli* concentrations which are readily measured, is considered in regulating water quality (this including the RPW and NPS FM (2025)). Norovirus is commonly present at detectable levels in wastewater, has high resilience to deactivation and has very high infectivity relative to other pathogens in wastewater. Norovirus is commonly the pathogen of concern when considering enteric illness from wastewater discharges to the marine environment.

Concentrations of *E. coli* in river water immediately downstream of the discharge structure and after reasonable mixing are predicted to be low (95%ile of 29 cfu/100 ml) relative to the criteria of NPS FM (2025) and the RPW Schedule 15 criteria for water group two, which reflect the risk Campylobacter infection from bathing and recreational water use. The *E. coli* concentrations after reasonable mixing are predicted to achieve Attribute Band A (Blue) for human contact.

When considering a typical simulation of norovirus infection risk from swimming in impacted waters, as outlined in the recently released PHF Science (2025) report, the predicted concentrations of *E. coli* also indicate a relatively low risk to swimmers from norovirus. It is therefore concluded that the risk to public health resulting from recreational use of the Kawarau river waters after reasonable mixing are low and within the range considered acceptable for bathing sites. On this basis, the water quality is considered to meet the requirements of the WCO, in maintaining a standard suitable for bathing after reasonable mixing.

The increase in risk to downstream users of surface water for potable supply, after complete mixing, is considered to be very small, assuming that current users of water would implement appropriate disinfection in order to provide water that meets DWSNZ microbiological MAVs. Effects to such water users are therefore considered to be less than minor.

Ongoing monitoring and assessment is proposed to be progressed, to further refine this assessment and develop a location specific QMRA to allow key assumptions, such as the duration of swimming likely to occur in the Kawarau River and level of UV dose required, to be tested. The results of the refined assessment will be used to inform detailed design of the discharge structure and determine the specification of any further UV disinfection up to an additional 2-log virus removal, to address residual uncertainty in predictions of infection and illness risk.

The significant additional improvements in pathogen reduction, from improved filtration and enhanced UV treatment, if needed, are considered to provide a high degree of confidence that risks to public health can be effectively managed as part of the plant upgrade detailed design process. With limited residual risk, and the expected exposure scenarios, it is considered the potential effects to public health associated with the discharge are less than minor. This is particularly the case in the context of existing water quality effects from the Shotover River Catchment.

9. Conclusions

Overall, the proposed upgrade to the Shotover WWTP and discharge to the Kawarau River represents a substantial improvement on historical wastewater management practices, with most potential effects to water quality, groundwater and hydrology assessed as negligible or no more than minor. Public health risk is interpreted to be low relative to acceptable risk indicated by regulatory guidance, and waters of the Kawarau River are predicted to be suitable for bathing after reasonable mixing, consistent with the requirements of the WCO.

The discharge structure is not expected to result in measurable damming effects of the Kawarau River, or have a measurable influence on return flow, as required by the WCO. This due to the small size of the structure relative to the recent increases in channel area and overall relatively large channel size compared to historical conditions.

Table 9.1 outlines the findings of the assessment undertaken with regards to effects to water and public health, and regulatory requirements.

Table 9.1 Summary of effects

Category	Description
Effects to groundwater	- Ceasing use of the Dose and Drain field is resulting in progressive improvements in groundwater quality, and improvements in surface water quality where impacted groundwater discharge to the riverbanks of the Shotover and Kawarau Rivers. Effects of the proposed discharge to the Kawarau River on groundwater quality are predicted to be negligible. - Seepage rates and contaminant discharge from the treated wastewater calamity pond are expected to be limited, particularly in the context of the historical oxidation pond conditions. The effects of this discharge are predicted to be negligible.
Effects to hydrology	- Construction of the discharge structure in the bed and on the bank of the Kawarau River is expected to results in a small reduction in channel cross-sectional area at the proposed location. However, given the much larger variability of channel area over time, the current relatively large area of the channel and reduced potential for sediment aggregation in the lee of the training line, the structure is not expected to result in damming effects or changes in return flow beyond those that have existed in the past. The effects on river hydrology are considered to be less than minor. It is considered that the requirements of the WCO are met in this regard. - The diversion of river water around the discharge structure is considered to have limited influence on river hydrology, with shallow water flow continuing downstream of the structure. The effects to flow paths are therefore considered to be less than minor.
Effects to water quality	- Effects to water quality after reasonable mixing are assessed as being predominantly less than minor. With ecotoxicity effects considered to be less than minor, and negligible change in temperature, pH and DO are expected. Water quality is predicted to remain consistent with a high quality of water, as indicated by NPS FM and ANZG criteria, with the exception of phosphorus. - Potential periodic increases in phosphorus concentrations under low flow conditions are expected to be limited in duration and unlikely to result in more than minor effect on water quality or an increase in primary production at such times (refer Boffa Miskell (2026)). With further mixing downstream of the reasonable mixing zone (complete mixing), phosphorus concentrations are predicted to meet NPS FM attribute band A - Cumulative effects on water quality, and downstream effects of the discharge on water resources, such as Lake Dunstan, are considered to be no more than minor, with water remaining consistent with NPS FM attribute band A, and meeting the Schedule 15 Water Group two criteria. after complete mixing

Category	Description
Effects to public health	- A high level of treatment wastewater currently receives and further improvements, including improved filtration and enhanced UV treatment, if needed, are predicted to limit the potential risk of wastewater derived pathogens to public health downstream of the discharge structure. Water quality is considered to remain suitable for bathing downstream of the discharge structure and at the primary contact site identified. - The requirements of the WCO in regard to water quality suitable for contact recreation are assessed as being met, with water quality predicted to be consistent with Attribute Band A (Blue) after reasonable mixing. - Effects to public health from recreational water use are considered to be less than minor, with improved treatment expected to result in water quality with very low levels of additional risk of infection. - Effects to downstream users of water for potable supply are considered to be less than minor, in the context of the existing catchment impacts on Kawarau River water quality and the existing need for disinfection to provide a water supply consistent with the DWSNZ microbiological MAVs.

A number of specific refinement activities are proposed during detailed design, including:

3. Analysis of the discharge structure influence on upstream water levels under specific flood conditions, to confirm the limited impact of the structure on flood events and return flow.
4. Extended microbiological monitoring of wastewater and river water, and refinement of the public health risk assessment via location specific QMRA.

The findings of these refined assessments will be used to direct detailed design decisions, providing a high degree of confidence that the designs will achieve the required outcomes. This will include potential changes to the discharge structure, such as elevations, and inclusion of additional UV treatment, to further improve management of public health risks in the sensitive Kawarau River environment.

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Appendices

Appendix A

Site investigation data – logs and groundwater levels

Paper Size ISO A4
Scale: 1:12,000

0 0.1 0.2 0.3 0.4 0.5

Kilometers
Map Projection: Transverse Mercator
Horizontal Datum: NZGD 2000
Grid: NZGD 2000 New Zealand Transverse Mercator

N

Queenstown Lakes District Council
REMP Shotover Delta

Surface Water Monitoring

Project No.	**12645246**
Revision No.	**0**
Date	**29/04/2025**

FIGURE 2

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Map Projection: Transverse Mercator
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Grid: NZGD 2000 New Zealand Transverse Mercator

Queenstown Lakes District Council
Shotover bore consent

Bore Locations - Overview

Project No.	**12645246**
Revision No.	**0**
Date	**8/05/2025**

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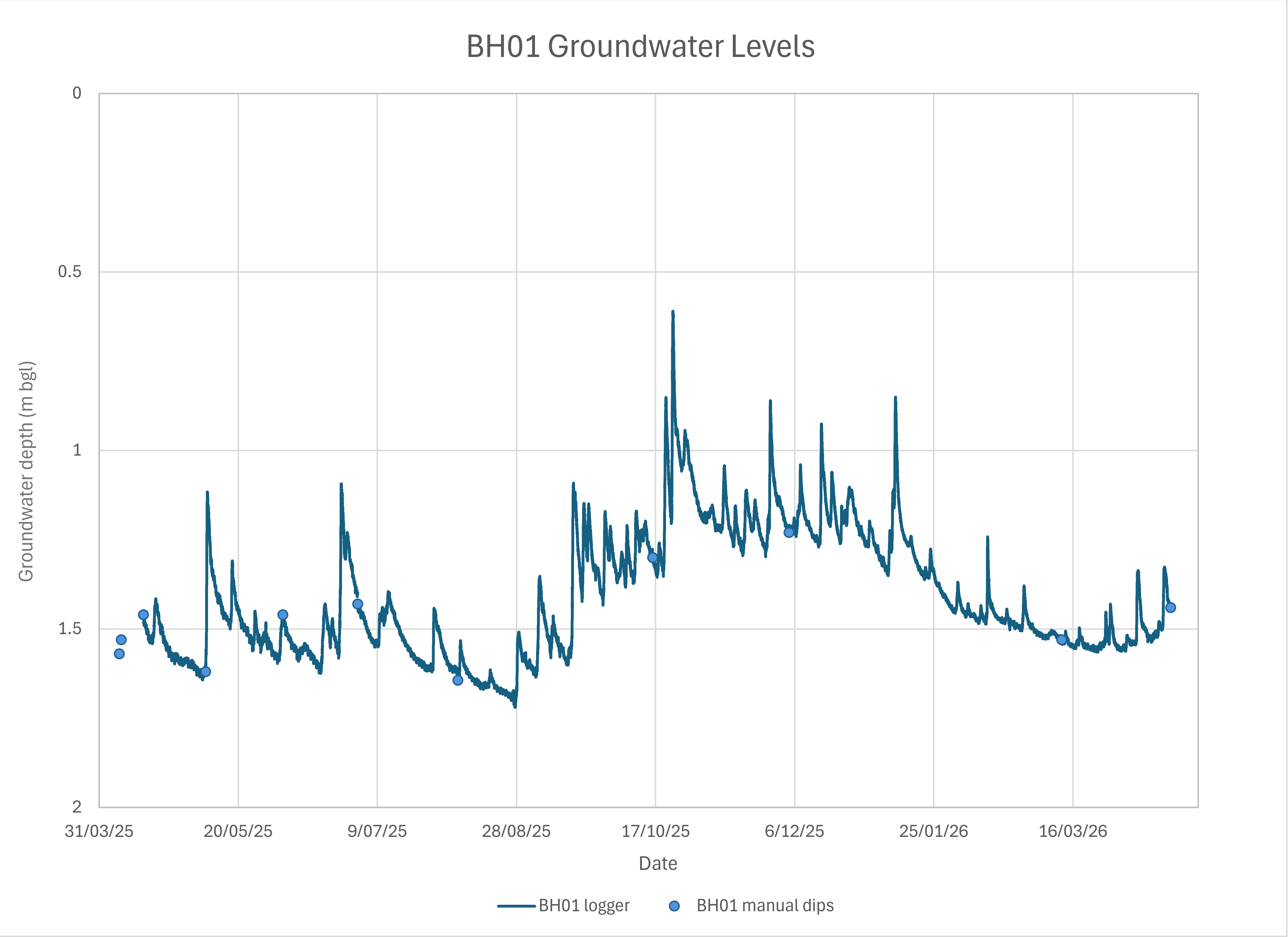
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25/01/26
16/03/26
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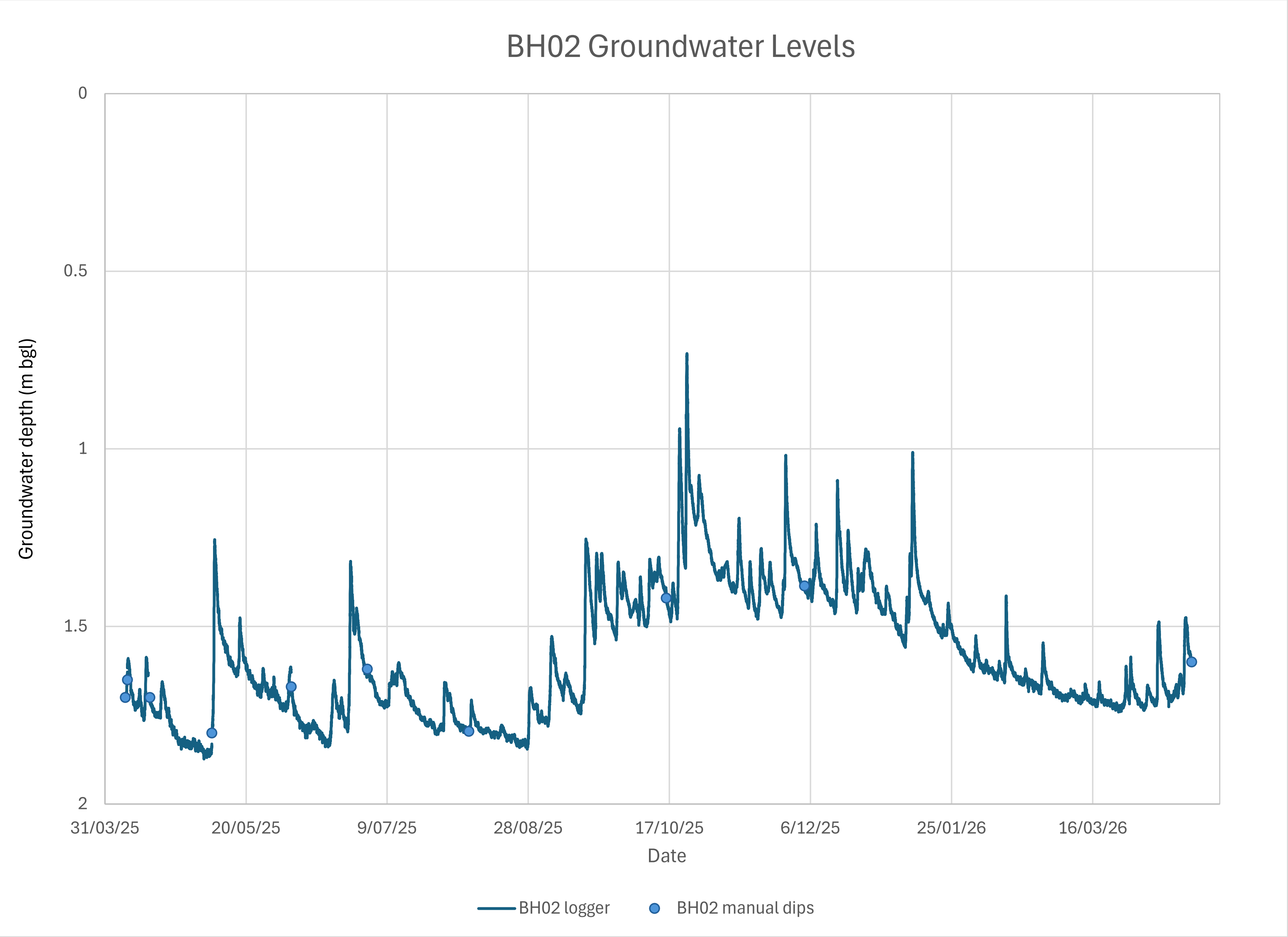
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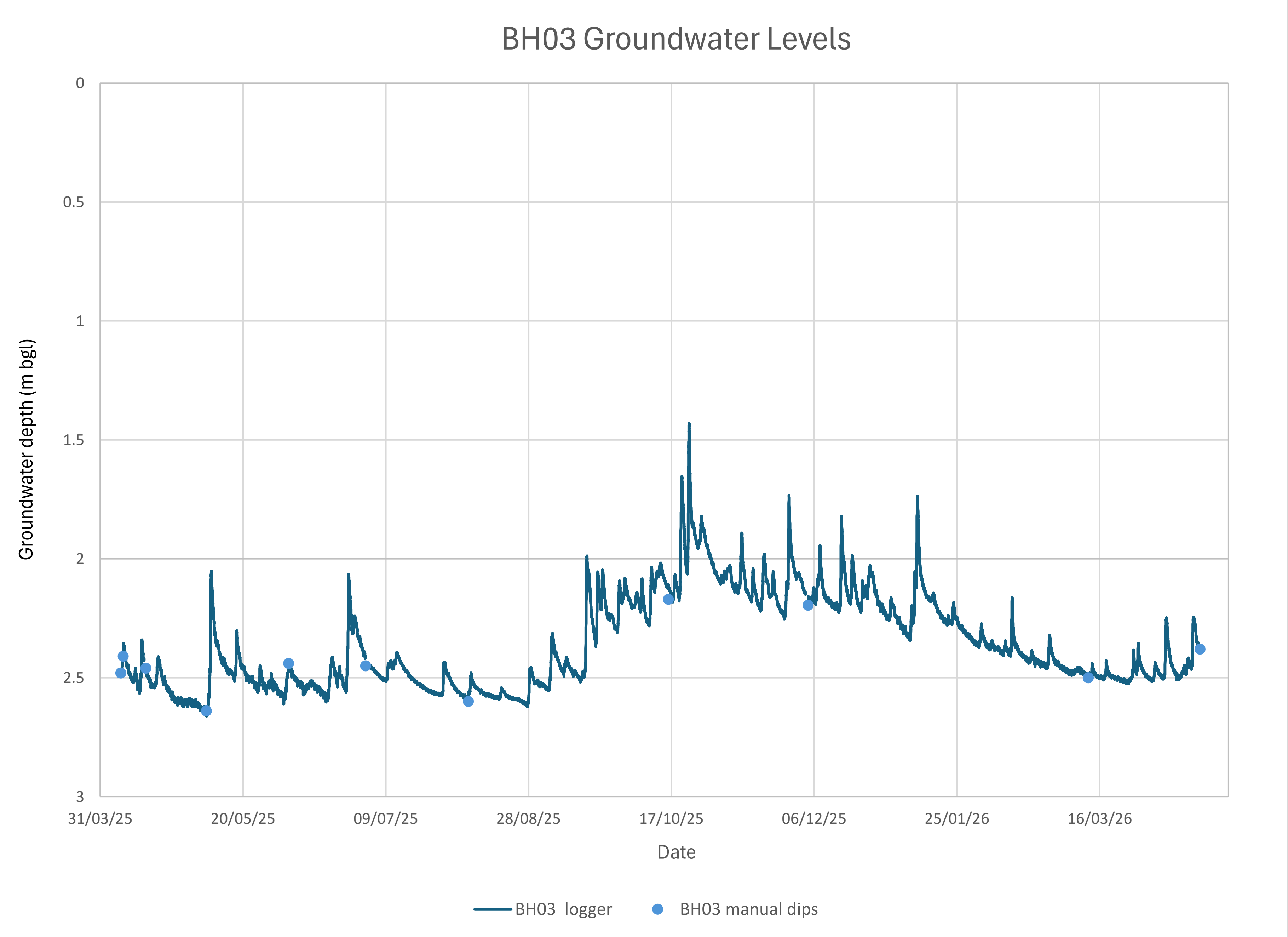
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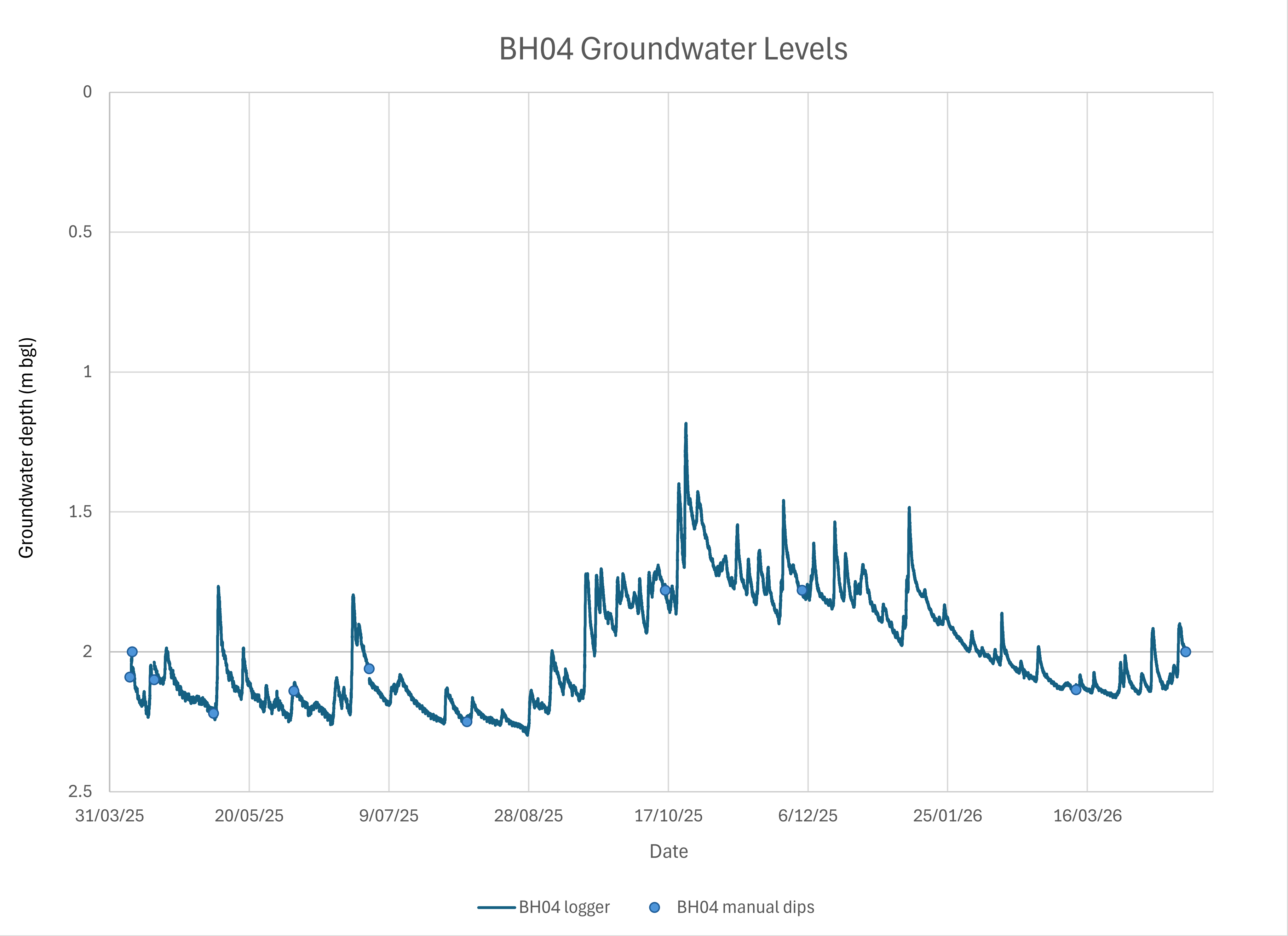
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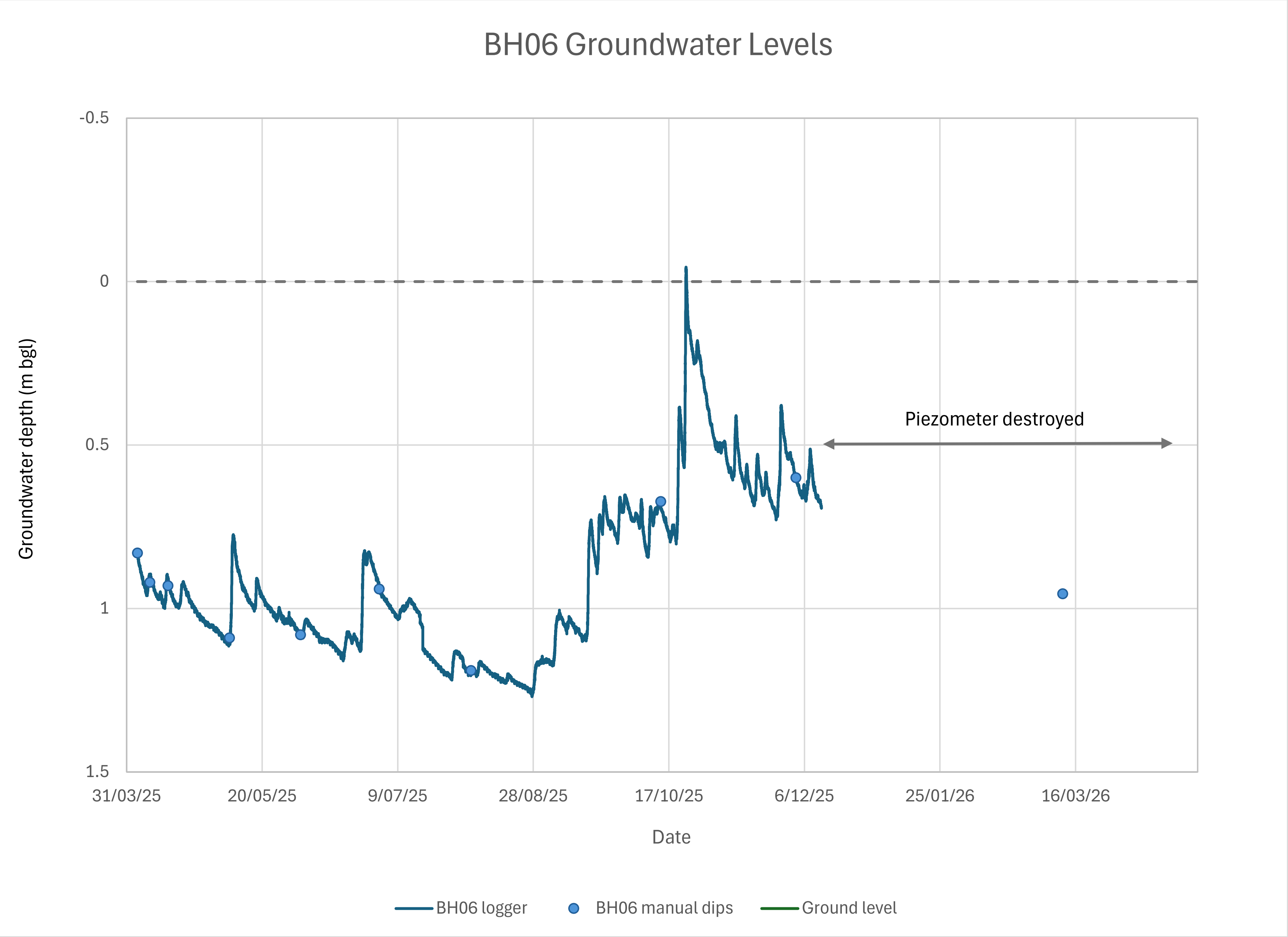

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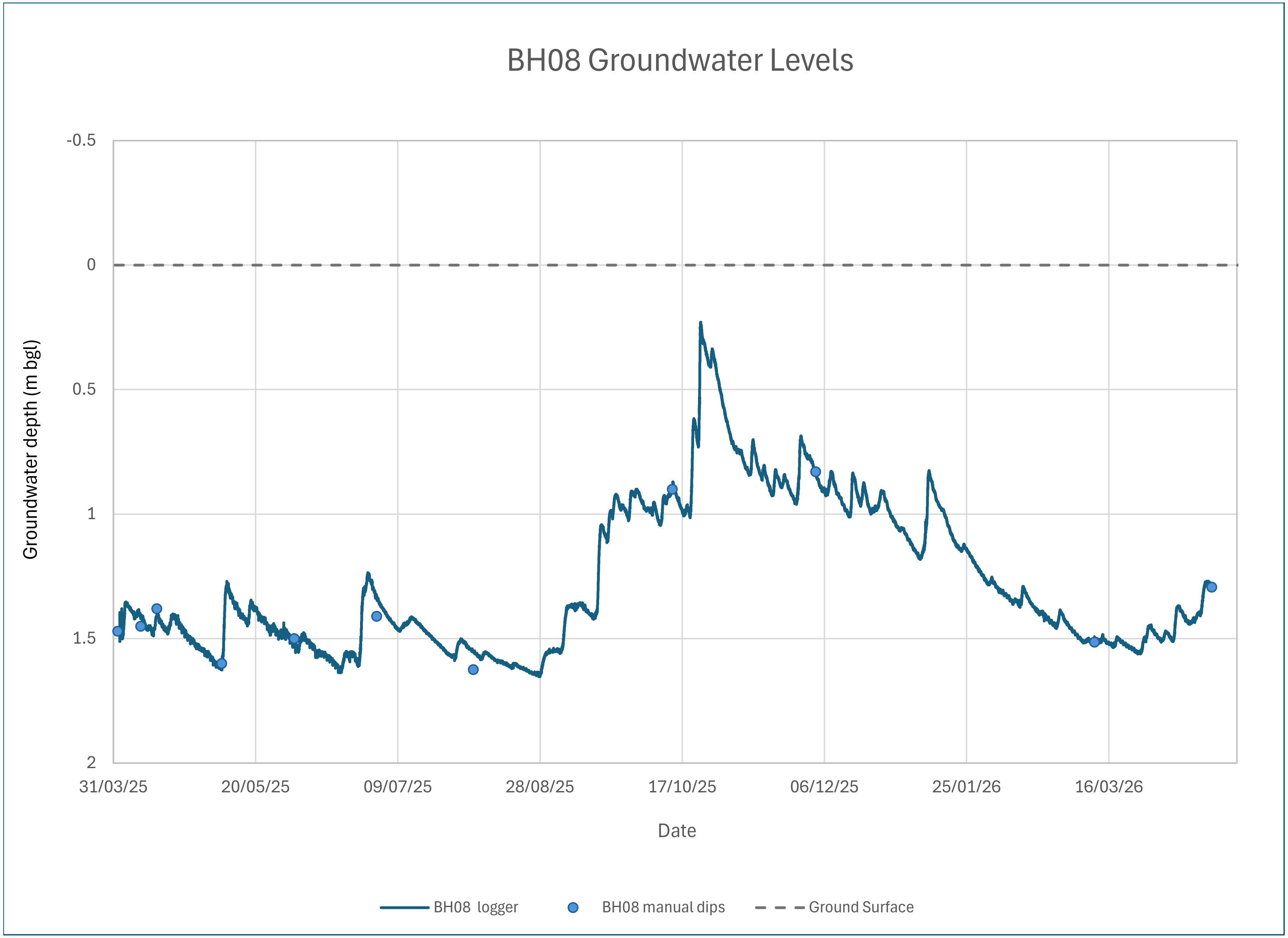
Ground level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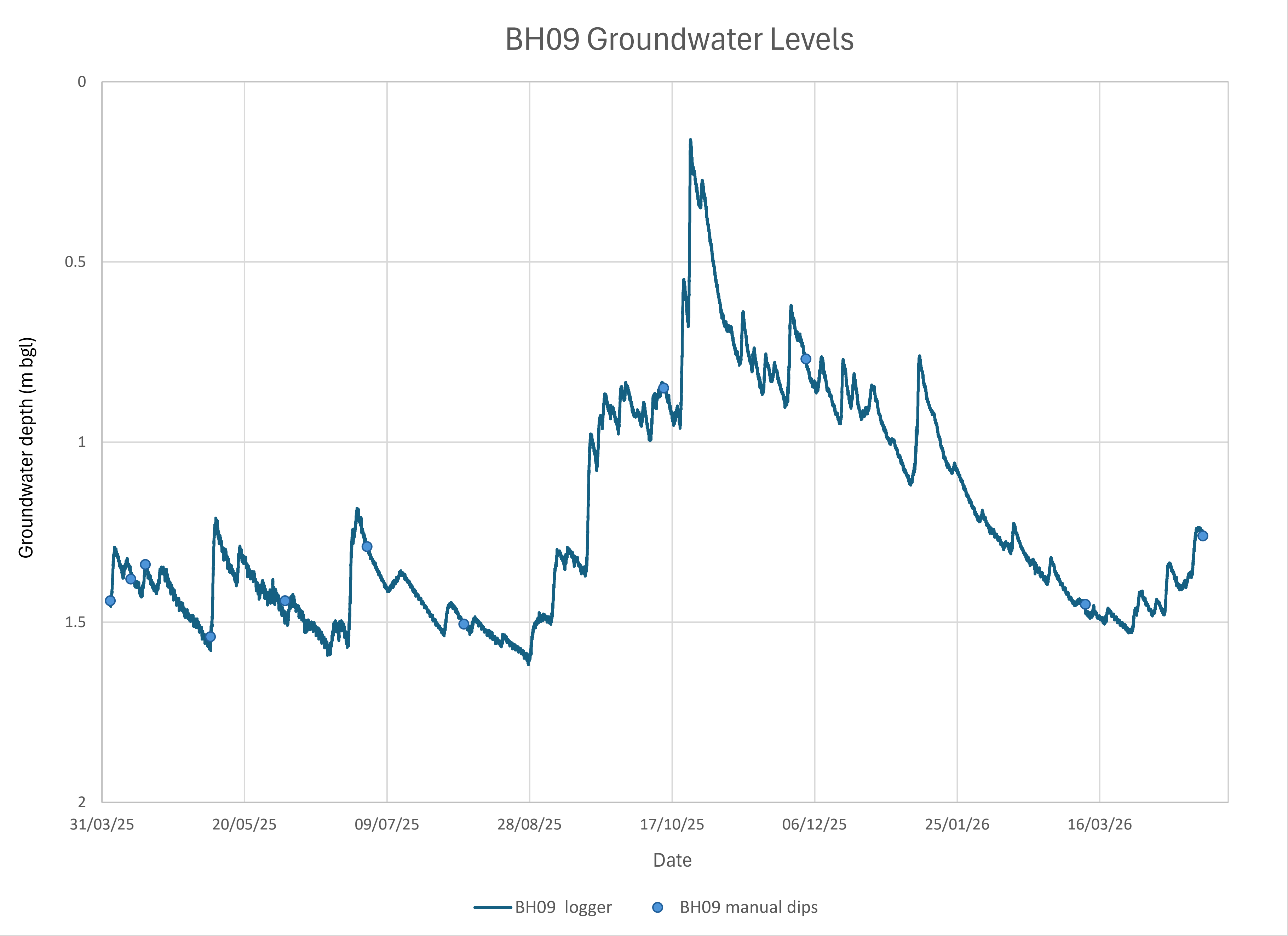BH09 Groundwater Levels
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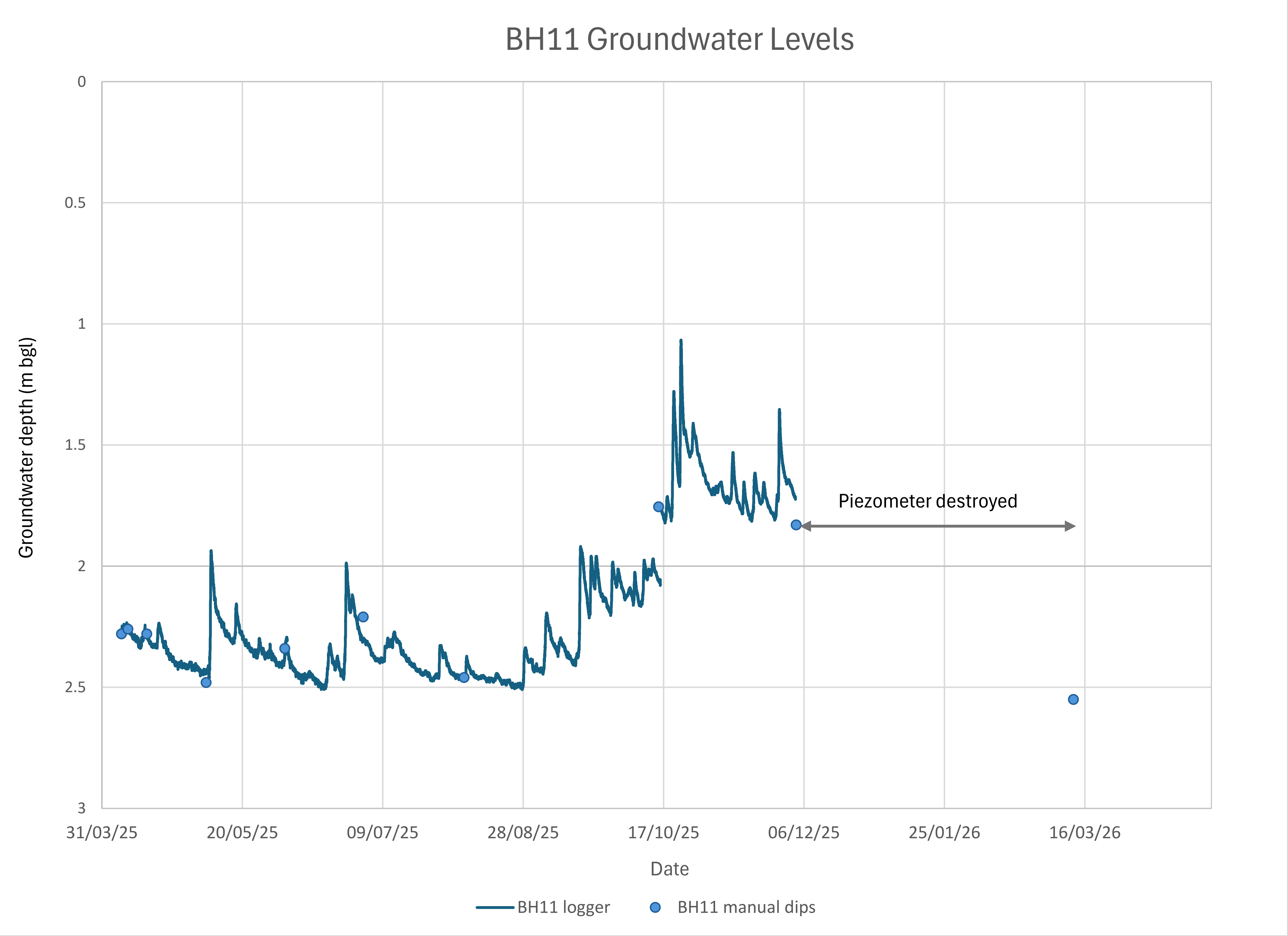
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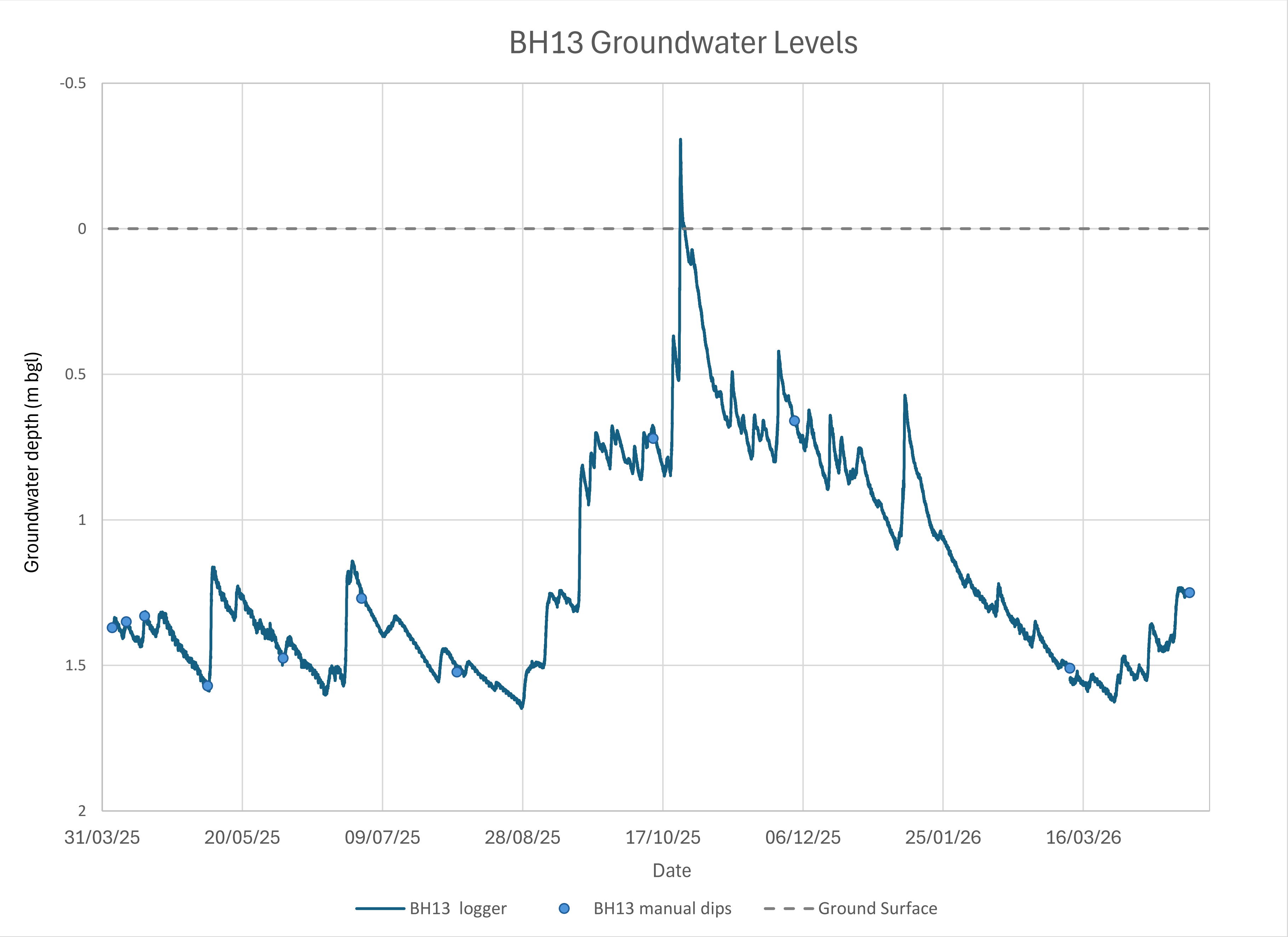
BH11 manual dips

BH13 Groundwater Levels
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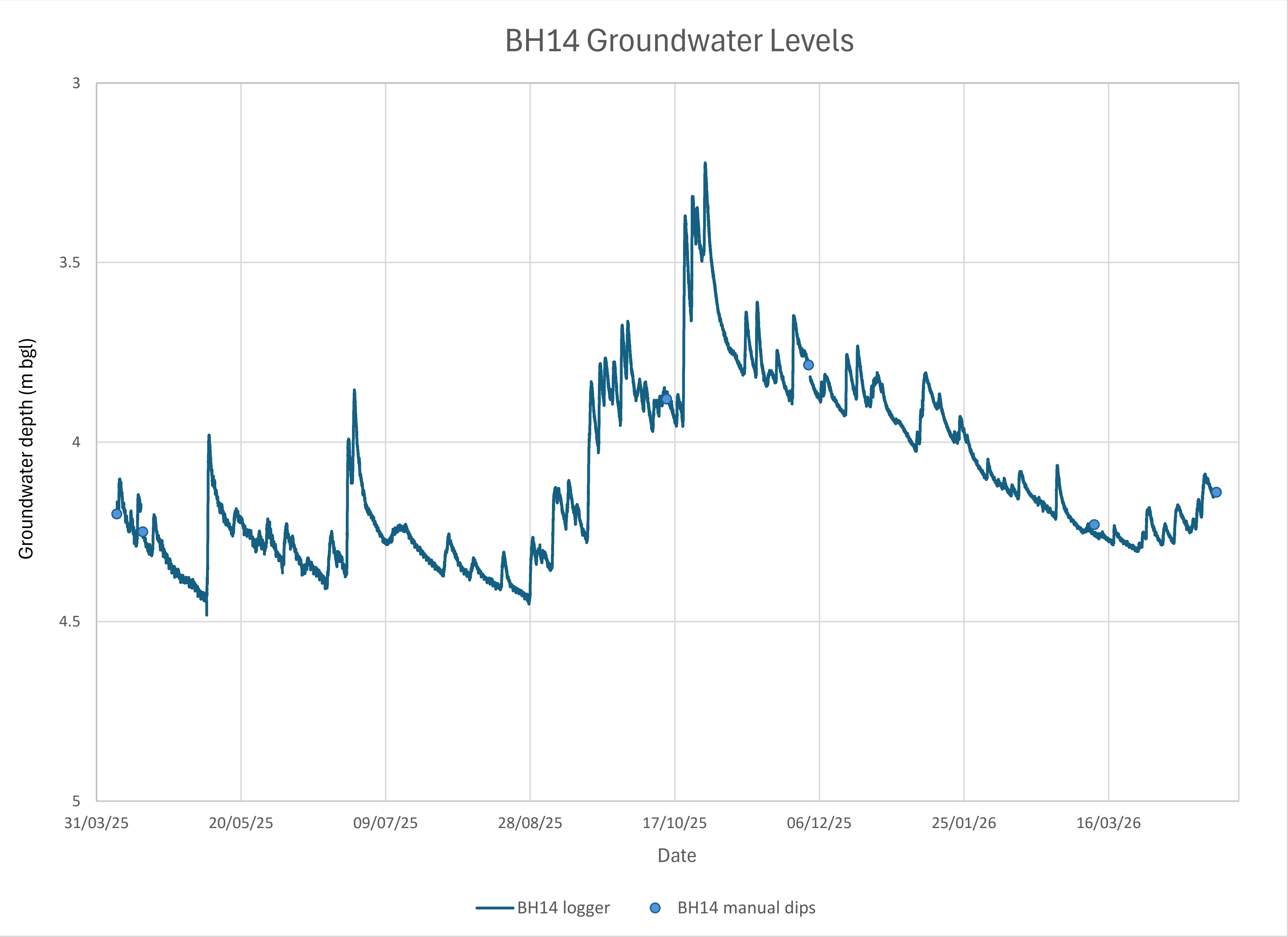
Ground Surface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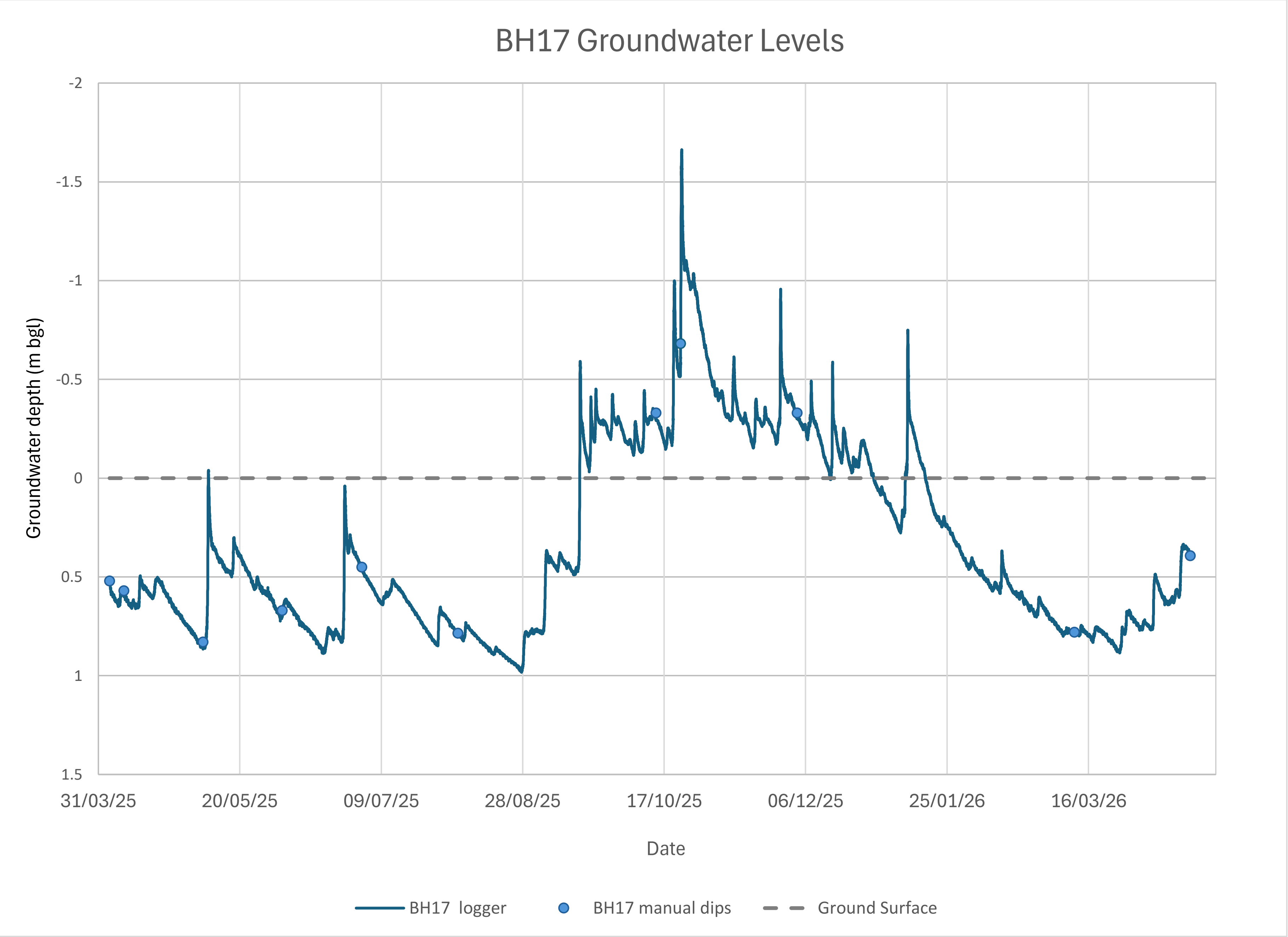
Date
BH14 logger
BH14 manual dips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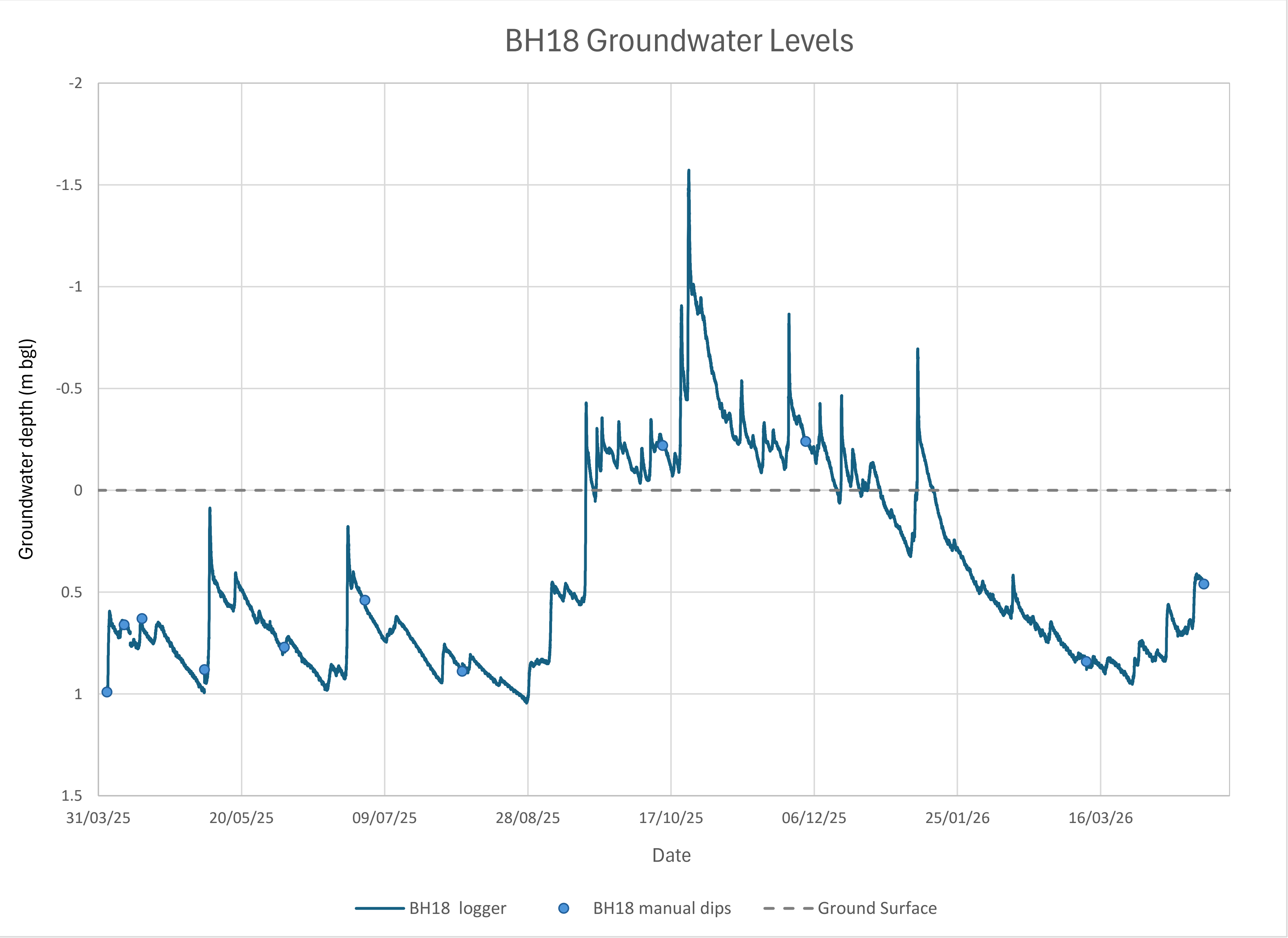
BH17 manual dips
Ground Surface

BH18 Groundwater Levels
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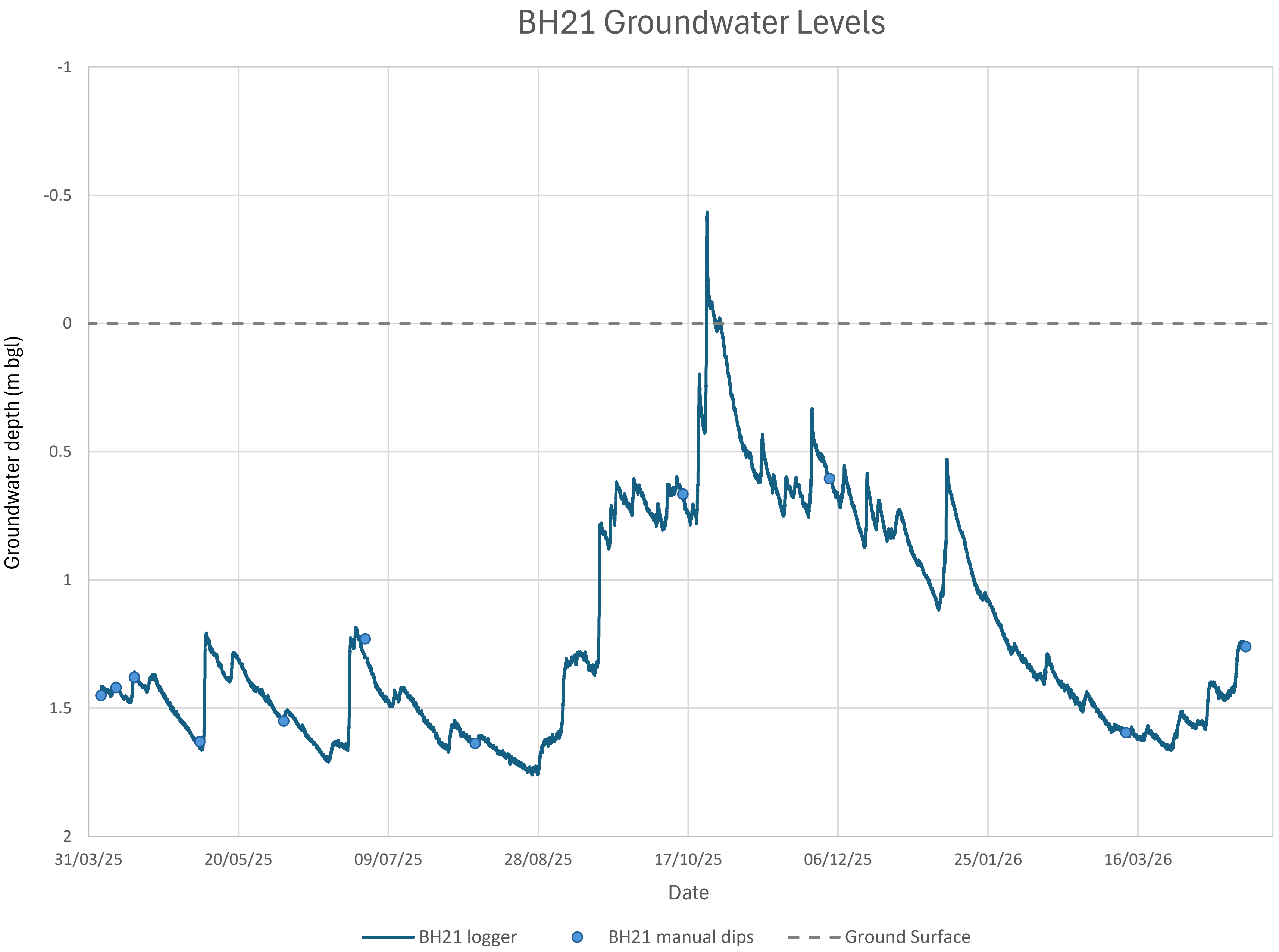
Ground Surface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Date
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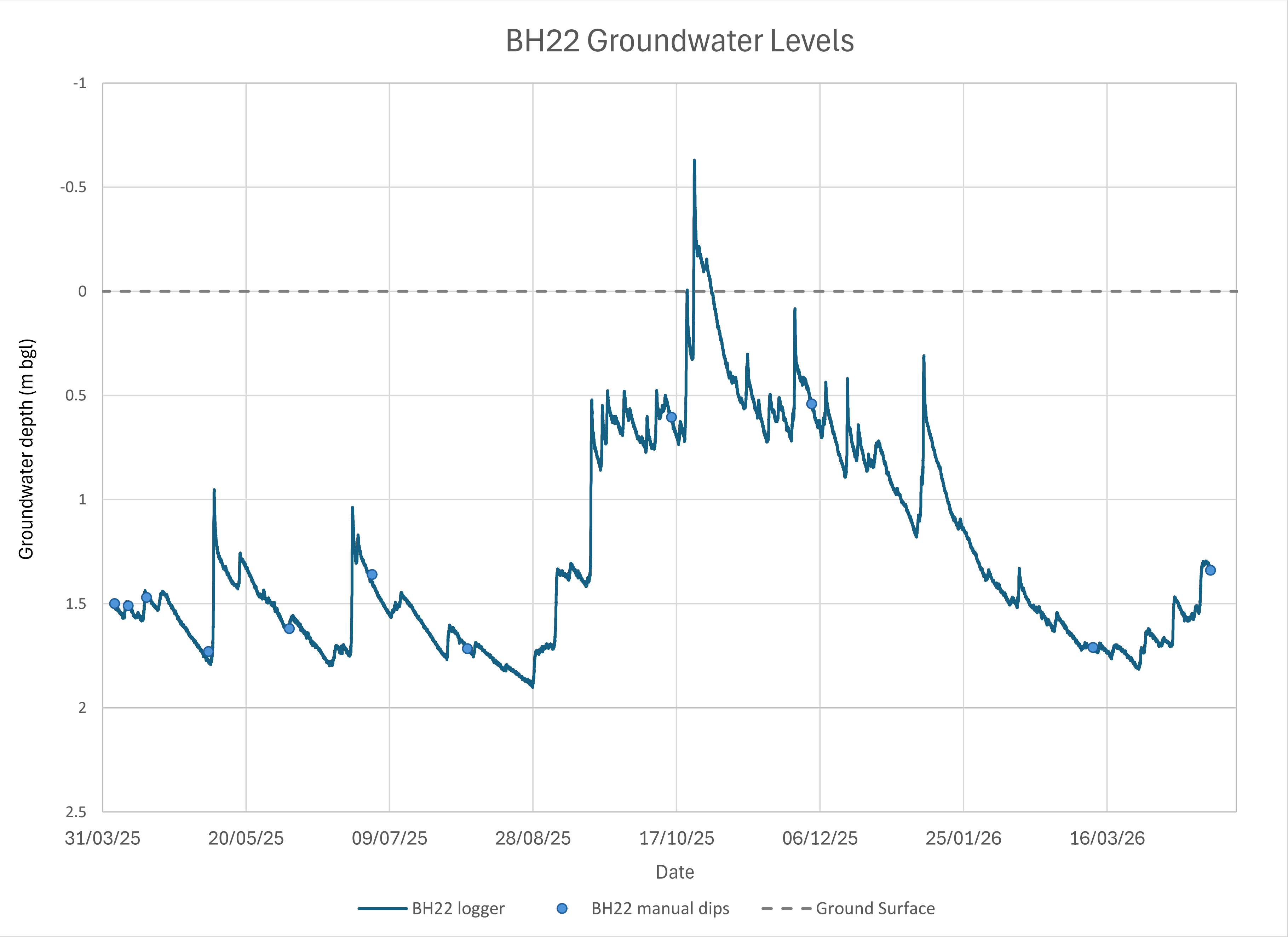
BH21 manual dips
Ground Surface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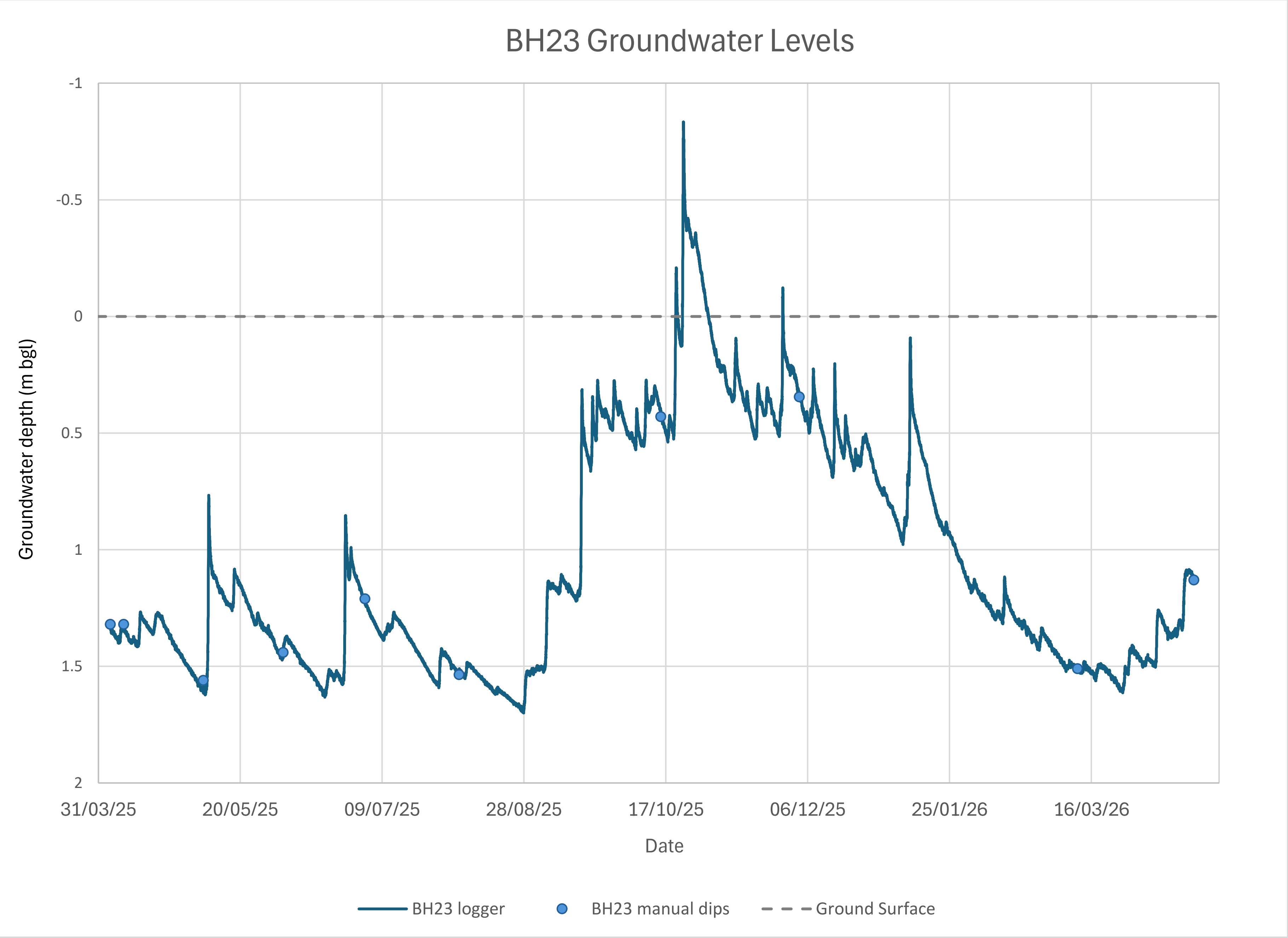
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16/03/26
Date
BH23 logger
BH23 manual dips
Ground Surface

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 1/04/2025
Completed: 1/04/2025

Hole No. : BH01
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1265913.72
Northing: 5007121.8
System: NZTM2000
RL: 312.86 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
	0		Gravelly fine to coarse SAND with trace rootlets; dark grey. Moist.		M					SNC				TCR: 100			
	1.6		Gravelly medium to coarse SAND with minor cobbles; dark grey with some white, orange, and brown gravel. Wet. 1.62 m Ground Water Level		W					SNC				TCR: 100			1-04-2025
	3		End of Hole @ 3m,														

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	00:00	1.62	3

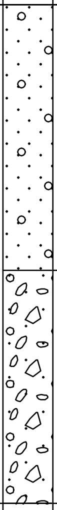
Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 1/04/2025
Completed: 1/04/2025

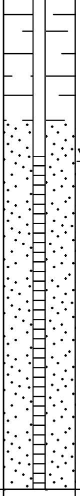
Hole No. : BH02
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1265968.29
Northing: 5007058.06
System: NZTM2000
RL: 312.82 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Material Description	Moisture condition	Method	TCR RQD SCR (%)	Water level
	0	Gravelly fine to coarse SAND; dark grey. Moist. 0.50 - 1.60 Minor cobbles; grey; sand, medium to coarse. 1.00 m Groundwater Level	M	SNC	TCR: 100	1-04-2025
	1.6	Sandy fine to coarse GRAVEL with minor cobbles; grey. Saturated.	S	SNC	TCR: 100	
	3	End of Hole @ 3m,				

RL (m); Depth (m); Graphic; Material Description; Geological Unit; Moisture condition; Consistency / Relative Density; Sample: Number / Type, Result; Casing; Method; Flush Return (%) 25 50 75; Weathering EW HW MW SW FR; Estimated Strength (MPa) EW VW W MS S VS ES; TCR RQD SCR (%); Defect Spacing (mm) 20 60 200 600 2000; Instrumentation Installation; Water level





Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

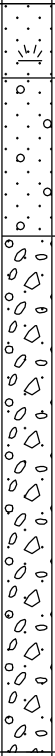
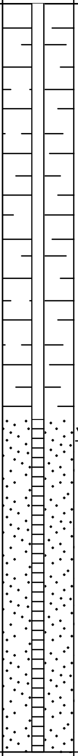
Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	16:30	1	3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 3/04/2025
Completed: 3/04/2025

Hole No. : BH03
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

Easting: 1266059.7
Northing: 5007012.24
System: NZTM2000
RL: 313.11m
Datum: DVD1958
Method: SURVEY

Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
0 – 0.45		TOPSOIL: Silty fine SAND with minor organic; grey. Moist; organics, rootlets.		M					SNC (0 – 1.5)				TCR: 100			
0.45 – 1.4		Fine to medium SAND with trace gravel; grey. Moist; gravel, fine to medium, subrounded to subangular, schist. 1.20 Becomes gravelly														
1.4 – 4.5		Sandy fine to coarse GRAVEL; brownish grey. Moist; gravel, subrounded to subangular; schist; sand, fine to coarse. 2.60 Becomes grey. Wet		W (from 2.6)					SNC (1.5 – 3.0) SNC (3.0 – 4.5)				TCR: 100 TCR: 100			∇ 3-04-2025 (2.6)
4.5		End of Hole @ 4.5m,														

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
03/04/25	11:20	2.6	4.5

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP,
Job Number:	12645246
Commenced: 3/04/2025	Completed: 3/04/2025

Hole No.	: BH04
Sheet	: 1 of 1
Hole Length	: 4.5
Scale @ A4	: 1:45
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1266109.87
Northing: 5006934.47
System: NZTM2000
RL: 312.73 m
Datum: DVD1958
Method: SURVEY

Depth (m)	Material Description	Moisture condition	Method	TCR RQD SCR (%)	Water level
0 – 0.45	Fine to medium SAND with minor gravel; grey. Moist; gravel, subrounded to subangular, schist.	M	SNC	TCR: 100	
0.45 – 4.5	Sandy fine to coarse GRAVEL; brownish grey. Moist; gravel, subrounded to subangular.				
2.20	2.20 Becomes wet	W	SNC	TCR: 100	3-04-2025
3.00	3.00 Becomes grey		SNC	TCR: 100	
4.5	End of Hole @ 4.5m,				

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Notes and Comments:

End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
03/04/25	13:15	2.2	4.5

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP,
Job Number:	12645246
Commenced:	1/04/2025
Completed:	1/04/2025

Hole No.	: BH05
Sheet	: 1 of 1
Hole Length	: 3
Scale @ A4	: 1:45
Logged	: CS
Processed	: MG
Checked	: DB

Easting: 1265874.15 Northing: 5006942 System: NZTM2000

RL: 312.81 m Datum: DVD1958 Method: SURVEY

Depth (m)	Material Description	Moisture condition	Method	TCR RQD SCR (%)	Water level
0	Fine to medium SAND with trace gravel and rootlets; grey. Moist; gravel, fine.	M	SNC	TCR: 100	
0.5	Fine SAND; light grey. Dry.	D			
1.4	Gravelly fine to medium SAND; brownish grey. Moist; gravel, fine.	M			
1.6	Sandy fine to coarse GRAVEL with minor cobbles; light grey, with some white, brown and orange gravels. Saturated. 1.68 m Groundwater Level	S	SNC	TCR: 100	1-04-2025
3	End of Hole @ 3m,				

Notes and Comments:

End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	00:00	1.68	3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 4/04/2025 Completed: 4/04/2025

Hole No.	: BH06
Sheet	: 1 of 1
Hole Length	: 4.5
Scale @ A4	: 1:45
Logged	: CS
Processed	: MG
Checked	: DB

Easting: 1266339.36 Northing: 5006669.72 System: NZTM2000
RL: 310.67 m Datum: DVD1958 Method: SURVEY

Depth (m)	Material Description	Moisture condition	Method	TCR RQD SCR (%)	Water level
0	Gravelly fine to coarse SAND; grey. Moist.	M	SNC	TCR: 100	
1.5	Fine to coarse GRAVEL with minor cobbles; grey, with some white, brown and orange gravels. Wet. 2.10 m Groundwater Level	W	SNC	TCR: 100	4-04-2025
3.2	Sandy fine to coarse GRAVEL; grey, with some white, brown and orange gravels. Moist.	M	SNC	TCR: 100	
4.3	Fine to coarse SAND with minor gravel; grey. Moist.				
	End of Hole @ 4.5m,				

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
04/04/25	00:00	2.1	4.5

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 27/03/1900
Completed: 27/03/2025

Hole No. : BH07
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266039.33
Northing: 5006657.48
System: NZTM2000
RL: 311.85 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
	0	Gravelly SAND with minor cobbles; light grey. Moist.		M					SNC				TCR: 100			
	1.4	1.37 m Groundwater Level														28-02-2025
		Sandy GRAVEL with minor cobbles; light grey with some white, orange and brown gravels. Saturated		S					SNC				TCR: 100			
	3	End of Hole @ 3m,														

RL (m): 311, 310, 309, 308, 307, 306, 305, 304, 303
Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Notes and Comments:

End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

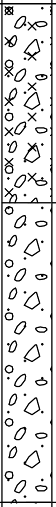
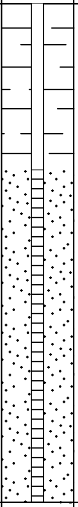
Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/02/25	00:00	1.37	3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 1/04/2025
Completed: 1/04/2025

Hole No. : BH08
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

Easting: 1266282.03
Northing: 5006538.17
System: NZTM2000
RL: 311.05 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
311.05	0		Sandy fine to coarse GRAVEL with trace silt; brown. Moist; gravel, subrounded to subangular, schist; sand, fine to coarse.		M					SNC				TCR: 100			
	1.2		Sandy fine to coarse GRAVEL; grey. Wet; subrounded to subangular, schist; sand, fine to coarse.		W												
	1.5									SNC				TCR: 100			
308	3		End of Hole @ 3m,														

Notes and Comments:
End of Hole @ 3m
Ground water was not observed
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)

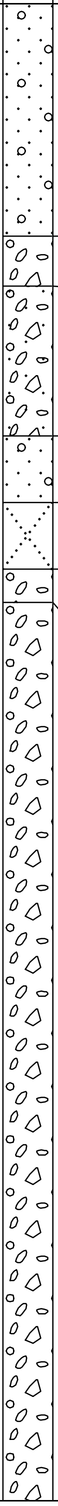
Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 31/03/2025
Completed: 3/03/2025

Hole No. : BH09
Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266283.06
Northing: 5006537.07
System: NZTM2000
Method: SURVEY
RL: 310.97 m
Datum: DVD1958

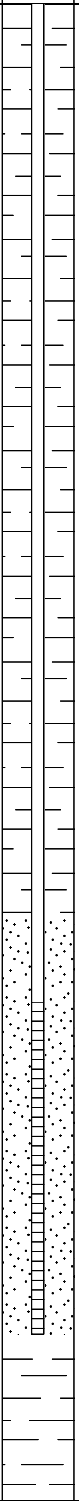
RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density
310.97	0	Gravelly SAND with some rootlets and trace bark; greyish brown. Moist. Slight organic smell.		M	
	1.4	Coarse GRAVEL; dark grey, white, black. Moist. Slight organic smell.			
	1.7	sandy fine to coarse GRAVEL; dark grey, black. Saturated.		S	
	2.6	Gravelly coarse SAND; dark grey. Wet. Slight organic smell.		W	
	3	Coreless			
	3.4	Coarse GRAVEL; dark grey, with some white, orange and brown gravels. Wet. Slight organic odour.			
	3.6	Gravelly medium to coarse SAND; dark grey. Wet. Slight organic odour. 4.50 m no odour			

End of Hole @ 9m,



Depth (m)	Method	TCR RQD SCR (%)
0 – 1.5	SNC	TCR: 100
1.5 – 3.0	SNC	TCR: 100
3.0 – 4.5	SNC	TCR: 73
4.5 – 6.0	SNC	TCR: 100
6.0 – 7.5	SNC	TCR: 100
7.5 – 9.0	SNC	TCR: 100

Sample: Number / Type, Result; Casing; Flush Return (%) 25 50 75; Weathering EW HW MW SW FR; Estimated Strength (MPa) VW W MS S VS ES; Defect Spacing (mm) 20 60 200 600 2000; Instrumentation Installation; Water level



Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 31/03/2025
Completed: 31/03/2025

Hole No. : BH10
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266436
Northing: 5006521.69
System: NZTM2000
RL: 310.48 m
Datum: DVD1958
Method: SURVEY

Depth (m)	Material Description	Moisture condition	Method	TCR RQD SCR (%)
0 – 0.2	Silty SAND with some rootlets; dark grey. Moist.	M	SNC	TCR: 100
0.2 – 1.5	Sandy fine to coarse GRAVEL with some cobbles; grey with some white, orange and brown gravels.. Saturated.	S		
1.5 – 1.8	Coreless		SNC	TCR: 100
1.8 – 2	Coarse GRAVEL; grey, orange, brown,white, greenish gray. Wet.	W		
2 – 3	Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels.. Saturated.	S		
3	End of Hole @ 3m,			

RL (m), Depth (m), Graphic, Material Description, Geological Unit, Moisture condition, Consistency / Relative Density, Sample (Number / Type, Result), Casing, Method, Flush Return (%) (25 50 75), Weathering (EW VW W MW SW FR), Estimated Strength (MPa) (VW W MS S VS ES), TCR RQD SCR (%), Defect Spacing (mm) (20 60 200 600 2000), Instrumentation Installation, Water level

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)

GHD

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 28/03/2025
Completed: 28/03/2025

Hole No. : BH11
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266178.04
Northing: 5006463.39
System: NZTM2000
RL: 311.93 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
	0	Silty medium to coarse SAND; dark grey. Moist.		M					SNC				TCR: 100			
	0.2	Fine to medium SAND with some gravel; light grey. Dry; gravel, fine to coarse.		D												
	1.4	Sandy fine to coarse GRAVEL; dark grey with some white, orange and brown gravels.. Saturated; sand, fine to coarse.		S												
	1.5								SNC				TCR: 100			
	2.3															28-03-2025
	3.0								SNC				TCR: 67			
	3.5	Coreless														
	4	Sandy fine to coarse GRAVEL; dark grey with some white, orange and brown gravels.. Saturated; sand, fine to coarse.														
	4.5	End of Hole @ 4.5m,														

RL scale: 311, 310, 309, 308, 307, 306, 305, 304, 303
Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Flush Return (%): 25 50 75
Estimated Strength (MPa): EW VW W MS S VS ES
Defect Spacing (mm): 20 60 200 600 2000

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/03/25	00:00	2.3	4.5

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 31/03/2025
Completed: 31/03/2025

Hole No. : BH13
Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266402.01
Northing: 5006429.6
System: NZTM2000
RL: 310.6 m
Datum: DVD1958
Method: SURVEY

Depth (m)	Material Description	Moisture condition
0.10	Silty SAND with some rootlets; dark grey. Moist.	M
0.4	Fine to medium SAND; dark grey. Moist.	
1.5	Gravelly medium to coarse SAND; light grey. Dry.	D
3.8	Sandy fine to coarse GRAVEL; dark grey with some white, orange and brown gravels. Dry. 1.50 m Groundwater Level	S
	Gravelly medium to coarse SAND; dark grey. Moist.	M

End of Hole @ 9m,

Method	TCR RQD SCR (%)
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100

Water level: 31-03-2025

Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	00:00	1.5	9

GHD

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 2/04/2025
Completed: 2/04/2025

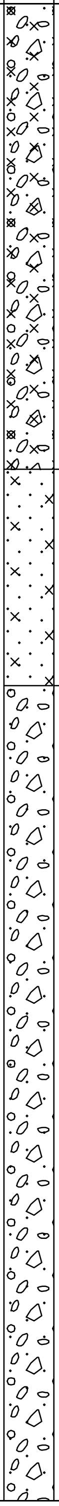
Hole No. : BH14
Sheet : 1 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : VM
Processed : MG
Checked : DB

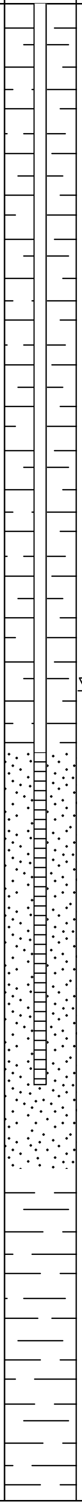
Easting: 1265826.97
Northing: 5006719.89
System: NZTM2000
RL: 315.04 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing
	0	FILL: Silty, sandy fine to coarse GRAVEL; brown. Moist; subangular; schist; sand, fine to coarse.		M				
	2.8	Fine SAND with minor silt; grey. Moist; mica and roots in top 250 mm.						
	4.1	Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; subrounded to subangular; schist and quartz; sand, fine to coarse.		W				

Depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
RL scale (m): 314 (1 m), 313 (2 m), 312 (3 m), 311 (4 m), 310 (5 m), 309 (6 m), 308 (7 m), 307 (8 m)

Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)
SNC				TCR: 100	
SNC				TCR: 100	
SNC				TCR: 100	
SNC				TCR: 100	
SNC				TCR: 100	
SNC				TCR: 100	





Water level: 2-04-2025 (4.1 m)

Notes and Comments:

End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	00:00	4.1	10.5

Project : Shotover WWTP Disposal Field Alternative Discharge Client : Queenstown Lakes District Council Site : Shotover WWTP, Job Number: 12645246		Hole No.	: BH14
		Sheet	: 2 of 2
		Hole Length	: 10.5
		Scale @ A4	: 1:45
Commenced: 2/04/2025	Completed: 2/04/2025	Logged	: VM
Easting: 1265826.97 RL: 315.04 m	Northing: 5006719.89 Datum: DVD1958	Processed	: MG
	System: NZTM2000 Method: SURVEY	Checked	: DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
305	10		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; subrounded to subangular; schist and quartz; sand, fine to coarse. *(continued from layer starting at 4.1m)*							SNC				TCR: 100			
304	11		End of Hole @ 10.5m,														
303	12																
302	13																
301	14																
300	15																
299	16																
298	17																

Notes and Comments:

End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical

Orientation:

Contractor: Speights Drilling

Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	00:00	4.1	10.5

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: BH16
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP,	Hole Length	: 3
Job Number: 12645246		Scale @ A4	: 1:45
Commenced: 28/03/2025	Completed: 28/03/2025	Logged	: CS
Easting: 1266626.94	Northing: 5006381.18	System: NZTM2000	Processed : MG
RL: 309.74 m	Datum: DVD1958	Method: SURVEY	Checked : DB

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
	0–0.10		Silty SAND with some rootlets; dark grey. Wet.		W												
	0.10–3		Sandy fine to coarse GRAVEL with some cobbles; grey with some white, orange and brown gravels. Moist.		M					SNC				TCR: 100			
	1.26		1.26 m Groundwater Level														28-03-2002
										SNC				TCR: 100			
	3		End of Hole @ 3m,														

Notes and Comments:

End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

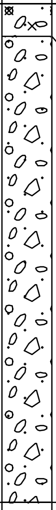
Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/03/02	00:00	1.26	3

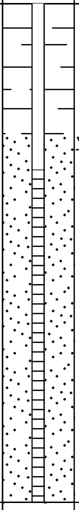
Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP,
Job Number: 12645246	
Commenced: 27/03/2025	Completed: 27/03/2025

Hole No.	: BH17
Sheet	: 1 of 1
Hole Length	: 3
Scale @ A4	: 1:45
Logged	: CS
Processed	: MG
Checked	: DB

Easting: 1266532.92	Northing: 5006287.44	System: NZTM2000
RL: 309.24 m	Datum: DVD1958	Method: SURVEY



RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Water level
309	0 – 0.2	Sandy fine to coarse GRAVEL with minor silt and rootlets; dark grey. Moist.		M											
	0.2 – 3	Sandy fine to coarse GRAVEL with some cobbles; dark grey. Moist. 0.85 m Groundwater Level							SNC (0 – 1.5) SNC (1.5 – 3)				TCR: 100 TCR: 100		27-03-2025 (0.85)
306	3	End of Hole @ 3m,													



Instrumentation Installation

Notes and Comments:

End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	0.85	3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 27/03/2025
Completed: 27/03/2025

Hole No. : BH18
Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266535.82
Northing: 5006286.32
System: NZTM2000
RL: 309.36 m
Datum: DVD1958
Method: SURVEY

Depth (m)	Material Description	Moisture condition
0.10	Fine to medium SAND; light grey. Wet.	W
1.5	Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Wet 0.95 m Groundwater Level	W
4.2	Fine to coarse GRAVEL with some sand; grey with some white, orange and brown gravels. Saturated.	S
9.00	Fine SAND; dark grey. Moist. 4.20 - 9.00 (Low Permeability) 5.00 m becomes Wet	M W

Method	TCR RQD SCR (%)
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100

Water level: 27-03-2025

End of Hole @ 9m,

Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

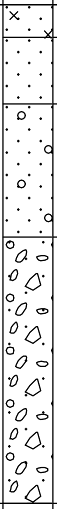
Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	0.95	9

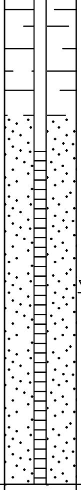
Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 27/03/2025
Completed: 27/03/2025

Hole No. : BH19
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266401.85
Northing: 5006233.66
System: NZTM2000
RL: 310.34 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0	Silty fine to coarse SAND with trace roots; dark grey. Moist.		M												
	0.2	Medium SAND; light grey. Dry.		D												
	0.6	Gravelly coarse SAND; light grey. Dry; gravel, fine to coarse.		D					SNC				TCR: 100			
309	1.4	Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Saturated. 1.82 m Groundwater Level		S					SNC				TCR: 100			27-03-2025
307	3	End of Hole @ 3m,														





Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	1.82	3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 27/03/2025 Completed: 27/03/2025

Hole No. : BH20
Sheet : 1 of 1
Hole Length : 9
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266403.73 Northing: 5006230.86 System: NZTM2000
RL: 310.25 m Datum: DVD1958 Method: SURVEY

Depth (m)	Material Description	Moisture condition
0	Medium to coarse SAND; dark grey. Moist.	M
0.5	Gravelly fine to coarse SAND; light grey. Dry; gravel, fine to coarse.	D
1.5	Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Saturated. 1.72 m Groundwater Level	S
3.3	Coarse SAND with minor gravel; grey. Wet	W
3.5	Coreless	
4	Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels. Saturated.	S
4.5	Coreless	
5	Fine to coarse GRAVEL with some sand; grey with some white, orange and brown gravels. Wet.	W
6.8	Fine SAND; light grey. Moist.	M

End of Hole @ 9m,

Depth (m)	Method	TCR RQD SCR (%)
0–1.5	SNC	TCR: 100
1.5–3	SNC	TCR: 100
3–4.5	SNC	TCR: 67
4.5–6	SNC	TCR: 67
6–7.5	SNC	TCR: 100
7.5–9	SNC	TCR: 100

Water level: 27-03-2025

Notes and Comments:
End of Hole @ 9m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speights Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	1.72	9

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 28/03/2025
Completed: 28/03/2025

Hole No. : BH21
Sheet : 1 of 1
Hole Length : 3
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266326.33
Northing: 5006297.09
System: NZTM2000
RL: 310.42 m
Datum: DVD1958
Method: SURVEY

RL (m)	Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Casing	Method	Flush Return (%)	Weathering	Estimated Strength (MPa)	TCR RQD SCR (%)	Defect Spacing (mm)	Instrumentation Installation	Water level
310	0	Silty medium SAND with trace rootlets and minor gravel and trace rootlets; dark grey. Wet; gravel, fine.		W					SNC				TCR: 100			
	0.5	Gravelly fine to coarse SAND; light grey. Dry.		D												
309	1.4	Sandy fine to coarse GRAVEl with minor Cobble; grey with some white, orange and brown gravels. Saturated. 2.00 m Groundwater Level		S					SNC				TCR: 100			28-03-2025
307	3	End of Hole @ 3m,														

Notes and Comments:
End of Hole @ 3m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
28/03/25	00:00	2	3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 26/03/2025
Completed: 26/03/2025

Hole No. : BH22
Sheet : 1 of 1
Hole Length : 4.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266311.49
Northing: 5006167.57
System: NZTM2000
RL: 310.24 m
Datum: DVD1958
Method: SURVEY

Depth (m)	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density
0	Sandy SILT; dark grey. Moist.		M	
0.2	Silty fine to coarse SAND with some gravel; dark grey		D	"
0.6	Gravelly fine to coarse SAND; light grey. Dry.			
1.4	Coreless			
1.6	Sandy fine to coarse GRAVEL; grey with some white, orange and brown gravels.. Wet. 1.68 m Groundwater Level		W	
3	Coreless			
4	Fine to coarse GRAVEl; grey with some white, orange and brown gravels.. Wet.		W	
	End of Hole @ 4.5m,			

Method	TCR RQD SCR (%)
SNC	TCR: 93
SNC	TCR: 93
SNC	TCR: 67

Water level: 26-03-2025

Notes and Comments:
End of Hole @ 4.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	00:00	1.68	4.5

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 26/03/2025 Completed: 26/03/2025

Hole No. : BH23
Sheet : 1 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266312.54 Northing: 5006165.17 System: NZTM2000
RL: 310.06 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Material Description	Moisture condition
310	0	Sandy SILT: dark grey. Moist.	M
	0.2	Silty fine to coarse SAND with some gravel; dark grey. Moist; gravel, fine.	
	0.6	Gravelly fine to coarse SAND; light grey. Dry.	D
309	1		
	1.4	Sandy fine to coarse GRAVEL; grey, brown, orange, white, greenish grey. Wet. 1.62 m Groundwater Level	W
308	2		
307	3	Coreless	
	3.2	Sandy fine to coarse GRAVEL with minor cobbles; grey with some white, orange and brown gravels. Wet.	W
306	4		
305	5		
304	6		
	6.2	Fine SAND; dark grey. Moist.	M
303	7		
302	8		

Method	TCR RQD SCR (%)
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 87
SNC	TCR: 100
SNC	TCR: 100
SNC	TCR: 100

Water level: 26-03-2025

Notes and Comments:
End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:
Contractor: Speight Drilling
Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	00:00	1.62	10.5

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP,
Job Number: 12645246
Commenced: 26/03/2025 Completed: 26/03/2025

Hole No. : BH23
Sheet : 2 of 2
Hole Length : 10.5
Scale @ A4 : 1:45
Logged : CS
Processed : MG
Checked : DB

Easting: 1266312.54 Northing: 5006165.17 System: NZTM2000
RL: 310.06 m Datum: DVD1958 Method: SURVEY

RL (m)	Depth (m)	Graphic	Material Description	Geological Unit	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Casing	Method	Flush Return (%) 25 50 75	Weathering EW HW MW SW FR	Estimated Strength (MPa) VW W MS S VS ES	TCR RQD SCR (%)	Defect Spacing (mm) 20 60 200 600 2000	Instrumentation Installation	Water level
30	9		Fine SAND; dark grey. Moist. *(continued from layer starting at 6.2m)*							SNC				TCR: 100			
	10.5		End of Hole @ 10.5m,														

RL (m)	Depth (m)
30	9
300	10
299	11
298	12
297	13
296	14
295	15
294	16
293	17
	18

Notes and Comments:

End of Hole @ 10.5m
Target depth achieved.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: Sonic Rig

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	00:00	1.62	10.5

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 2/04/2025
Completed: 2/04/2025

Hole No.	: TP01
Sheet	: 1 of 1
Hole Length	: 3.3
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1265814
Northing: 5006820
System: NZTM2000
RL: 314.1 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT308
Contractor: Speight Drilling
Operator: Duncan
Length: 3m
Width: 1.5m
Orientation: 320°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
314	0	▨	FILL: Sandy fine to coarse GRAVEL with some cobbles and refuse; grey. Dry; sand, fine to coarse, refuse consists of concrete.	D					
313	1								
	1.65		Fine SAND; light grey. Dry.			1.65 B- 2.10			
312	2								
	2.1		Sandy fine to coarse GRAVEL; light grey. Dry; sand, fine to coarse.						
			2.60 Becomes moist.	M					
			2.80 Becomes wet.	W					
311	3							▽ 2-04-2025	
			End of Hole @ 3.3m, C						

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 3.3m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT308

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	03:50	3.2	3.3

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP
Job Number: 12645246	
Commenced: 2/04/2025	Completed: 2/04/2025

Hole No.	: TP02
Sheet	: 1 of 1
Hole Length	: 3.2
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1265921	Northing: 5006650	System: NZTM2000
RL: 313.6 m	Datum: NZVD2016	Method: GPSH

Equipment: CAT308
Contractor: Speight Drilling
Operator: Duncan
Length: 3.2m
Width: 1.5m
Orientation: 107°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
313	0		FILL: Silty fine to coarse GRAVEL with some sand, with minor cobbles and trace boulders and refuse; brown. Dry; refuse consists of tree roots, concrete, and obsolete piping. 0.30 Becomes moist.	D M					
312	1								
	2		BURIED TOPSOIL: SILT with tree rootlets; brown. Moist						
311	2.2		Fine SAND with trace silt and organic; grey. Moist.						
	2.6		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; sand fine to coarse.	W		2.60 B- 2 bags 3.20		∇ 2-04-2025	
310	3.2		End of Hole @ 3.2m, C						

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 3.2m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT308

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
02/04/25	14:30	3.1	3.2

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP
Job Number: 12645246	
Commenced: 1/04/2025	Completed: 1/04/2025

Hole No.	: TP03
Sheet	: 1 of 1
Hole Length	: 1.7
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1265988
Northing: 5006734
System: NZTM2000
RL: 312.1 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator: Alistair
Length: 3m
Width: 1.3m
Orientation:
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
312	0 – 0.2		TOPSOIL: Fine to coarse SAND with minor gravel; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist.	M					
			Sandy fine to coarse GRAVEL with minor cobbles; grey. Moist; subrounded to subangular; schist; sand, medium to coarse.			B- 0.50 – 0.80			
311	1		1.10 - 1.20 Brown band, 100mm thick						
			1.50 Becomes saturated	S				▽ 1-04-2025	
			End of Hole @ 1.7m, C						
310	2								
309	3								

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:
End of Hole @ 1.7m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	14:00	1.6	1.7

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 1/04/2025
Completed: 1/04/2025

Hole No. : TP04
Sheet : 1 of 1
Hole Length : 1.8
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266034
Northing: 5006666
System: NZTM2000
RL: 311.7 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator: Alistair
Length: 4.5m
Width: 1.8m
Orientation:
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
	0 – 0.2		TOPSOIL: Silty fine to medium SAND with some organic; brown. Moist.	D					
311			Sandy fine to coarse GRAVEL with trace cobbles; grey. Dry; subrounded to subangular, schist; sand, fine to coarse.						
	1		1.10 Becomes moist. 1.10 - 1.80 Brown banding.	M					
310			1.60 Becomes saturated	S				▽ 1-04-2025	
	2		End of Hole @ 1.8m, C						
309	3								
308									

Notes and Comments:
End of Hole @ 1.8m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	14:45	1.7	1.8

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 1/04/2025
Completed: 1/04/2025

Hole No. : TP05
Sheet : 1 of 1
Hole Length : 1.4
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266063
Northing: 5006589
System: NZTM2000
RL: 311.2 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator: Alistair
Length: 3m
Width: 1.3m
Orientation: 212°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample		Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
						Number / Type	Result		0 2 4 6 8 10 12 14 16 18 20
311	0.10		TOPSOIL: Silty fine to medium SAND with some organic; brown. Moist.	M					0
			Sandy fine to coarse GRAVEL with some cobbles; grey. Moist; subrounded to subangular; schist; sand, medium to coarse. 0.60 - 0.80 Brown banding, 50mm thick. 0.80 - 1.00 Brown banding, 200mm thick.			B- 0.60 1.00			
310	1 1.2		Medium to coarse SAND with some gravel and trace cobbles; grey. Wet; gravel and cobbles, fine to coarse, subrounded to subangular; schist.	W				▽ 1-04-2025	1
			Sandy fine to coarse GRAVEL with some cobbles; grey. Saturated; subrounded to subangular; schist; sand, medium to coarse.	S					
			End of Hole @ 1.4m, C						
309	2								
308	3								

Notes and Comments:

End of Hole @ 1.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	12:45	1.2	1.4

GHD

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 1/04/2025
Completed: 1/04/2025

Hole No. : TP06
Sheet : 1 of 1
Hole Length : 2
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266119
Northing: 5006479
System: NZTM2000
RL: 311.5 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3m
Width: 1.2m
Orientation: 240°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals (0 2 4 6 8 10 12 14 16 18 20)
311	0		Fine to coarse SAND with minor gravel; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist.	D		BLK- 1 Bag 0.00–0.50			
	0.5		Sandy fine to coarse GRAVEL with minor cobbles; light grey. Dry; gravel, subrounded to subangular, schist; sand, fine to coarse.	D					
310	0.8		Gravelly fine to coarse SAND with trace cobbles; light grey. Dry; gravel, subrounded to subangular, schist.	D					
	1		1.20 m becomes moist	M					
			1.80 m Becomes wet	W				▽ 1-04-2025	
309	2		1.90 Becomes saturated	S					
			End of Hole @ 2m, C						
308	3								

Notes and Comments:

End of Hole @ 2m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	11:30	1.9	2

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP
Job Number:	12645246
Commenced:	1/04/2025
Completed:	1/04/2025

Hole No.	: TP07
Sheet	: 1 of 1
Hole Length	: 1.8
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1266157
Northing: 5006393
System: NZTM2000
RL: 310.5 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3m
Width: 1.4m
Orientation: 260°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
	0 – 0.2		TOPSOIL: Organics fine to medium SAND; light grey. Dry; organics, fibrous, roots.	D					
310 309	0.2 – 1.8		Sandy fine to coarse GRAVEL with minor cobbles; grey. Dry; gravel, subrounded to subangular, schist gravel; sand, fine to coarse. 0.60 Becomes moist 0.60 - 0.90 Brown banding 1.60 becomes saturated	D M S				⊽ 1-04-2025	
308 307	1.8 – 3		End of Hole @ 1.8m, C						

Notes and Comments:

End of Hole @ 1.8m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
01/04/25	00:00	1.6	1.8

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 31/03/2025
Completed: 31/03/2025

Hole No. : TP08
Sheet : 1 of 1
Hole Length : 1.5
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266219
Northing: 5006289
System: NZTM2000
RL: 310.2 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3m
Width: 1.2m
Orientation: 264°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals (0 2 4 6 8 10 12 14 16 18 20)
310	0		Sandy fine to coarse GRAVEL; light grey. Dry; gravel, subrounded to subangular, schist gravel; sand, fine to coarse.	D					
309	0.4 1		Sandy fine to coarse GRAVEL with trace of cobbles; grey with orange banding. Moist; gravel, subrounded to subangular, schist gravel; sand, coarse. 1.00 No orange banding 1.30 Becomes saturated	M S		0.50 BLK- 2 bags 1.00		▽ 31-03-2025	
308 307	2 3		End of Hole @ 1.5m, C						

Notes and Comments:

End of Hole @ 1.5m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	16:10	1.3	1.5

Project : Shotover WWTP Disposal Field Alternative Discharge		Hole No. : TP09
Client : Queenstown Lakes District Council		Sheet : 1 of 1
Site : Shotover WWTP		Hole Length : 1.4
Job Number: 12645246		Scale @ A4 : 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged : VM
Easting: 1266274 Northing: 5006311	System: NZTM2000	Processed : MG
RL: 309.8 m Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310 Contractor: Speight Drilling Operator:

Length: 3m Width: 1.2m Orientation: 135° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level
	0 – 0.3		Fine to coarse SAND with some gravel; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist gravel.	D		0.00 – 1.40 BLK- No sample recovered		
309	0.3 – 1.1		Sandy fine to coarse GRAVEL with trace cobbles; light grey. Moist; gravel, subangular, schist; sand, fine.	M				
	1.1 – 1.4		Fine to coarse GRAVEL with some sand; grey. Wet; gravel, subrounded to subangular, schist; sand, medium to coarse.	W				∇ 31-03-2025
308	1.4		End of Hole @ 1.4m, C					

Dynamic Cone Penetrometer Blows per 100mm intervals

0 2 4 6 8 10 12 14 16 18 20

Notes and Comments:

End of Hole @ 1.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	15:50	1.2	1.4

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP10
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 2.2
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 26/03/2025	Completed: 26/03/2025	Logged	: VM
Easting: 1266293	Northing: 5006224	System: NZTM2000	Processed : MG
RL: 310.9 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310
Length: 3.5m Width: 1.1m Orientation: 355°
Contractor:
Shear Vane Id:
Operator:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals (0 2 4 6 8 10 12 14 16 18 20)
	0		Fine to medium SAND with trace roots; light grey. Dry.	D					
310	0.7 1		Sandy fine to coarse GRAVEL; grey. Moist; gravel, subrounded to subangular, schist gravel; sand, medium to coarse.	M					
309	2		1.90 Becomes saturated	S		2.00 BLK- 2 bags 2.20		26-03-2025	
308	3		End of Hole @ 2.2m, C						
307									

Notes and Comments:

End of Hole @ 2.2m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	12:25	1.9	2.2

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP
Job Number: 12645246	
Commenced: 26/03/2025	Completed: 26/03/2025

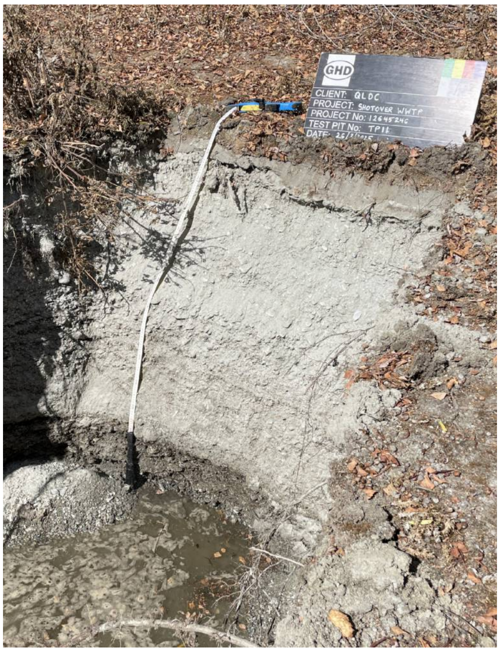
Hole No.	: TP11
Sheet	: 1 of 1
Hole Length	: 1.4
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1266389 Northing: 5006224 System: NZTM2000
RL: 309.6 m Datum: NZVD2016 Method: GPSH

Equipment: CAT 310 Contractor: Speight Drilling Operator:
Length: 3.5m Width: 1.1m Orientation: 155° Shear Vane Id: Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
	0.150		TOPSOIL: SAND with some organics; light grey. Dry; organics, roots.	D					
309			Sandy fine to coarse GRAVEL with trace cobbles: light grey. Dry; gravel and cobbles, subrounded to subangular, schist gravel; sand, fine to coarse. Lenses of gravelly sand.						
	1		1.10 m becomes wet	W		BLK: 2 bags 1.30 1.40			
308			1.35 Becomes saturated	S				▽ 26-03-2025	
			End of Hole @ 1.4m, C						
	2								
307									
	3								
306									

DCP scale: 0 2 4 6 8 10 12 14 16 18 20



Notes and Comments:

End of Hole @ 1.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	13:30	1.35	1.4

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 31/03/2025
Completed: 31/03/2025

Hole No. : TP12
Sheet : 1 of 1
Hole Length : 2.4
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266357
Northing: 5006463
System: NZTM2000
RL: 311.4 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 2.5m
Width: 1.2m
Orientation: 184°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
311	0		Fine to coarse SAND with trace organic and gravel; light grey. Dry; gravel, subrounded to subangular, schist; organics, roots.	D					
310	1.1		Gravelly fine to coarse SAND; grey. Moist; gravel, fine to coarse. 1.80 Brown banding	M		1.20 BLK- 2 bags 1.60			
309	2.2		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; gravel, subrounded to subangular, schist gravel; sand, fine to coarse.	W				31-03-2025	
308	2.4		End of Hole @ 2.4m, C						

Notes and Comments:
End of Hole @ 2.4m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	11:05	2.4	2.4

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP
Job Number: 12645246	
Commenced: 31/03/2025	Completed: 31/03/2025

Hole No.	: TP13
Sheet	: 1 of 1
Hole Length	: 1
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1266454
Northing: 5006422
System: NZTM2000
RL: 309.7 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT310
Contractor: Speight Drilling
Operator:
Length: 3.2m
Width: 1.4m
Orientation: 243°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
	0 – 0.2		Silty fine SAND; light grey. Dry.	D					
309	0.2		Sandy fine to coarse GRAVEL with trace cobbles; grey. Moist. 0.50 Dark brown banding	M		BLK- 0.80 – 1.00		31-03-2025	
			0.90 Becomes saturated	S					
	1		End of Hole @ 1m, C						
308	2								
307	3								
306									

Notes and Comments:

End of Hole @ 1m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	10:10	0.8	1

Project	: Shotover WWTP Disposal Field Alternative Discharge
Client	: Queenstown Lakes District Council
Site	: Shotover WWTP
Job Number: 12645246	
Commenced: 27/03/2025	Completed: 27/03/2025

Hole No.	: TP14
Sheet	: 1 of 1
Hole Length	: 1.5
Scale @ A4	: 1:50
Logged	: VM
Processed	: MG
Checked	: DB

Easting: 1266409
Northing: 5006338
System: NZTM2000
RL: 309.9 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3.2m
Width: 1.1m
Orientation: 120°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals (0 2 4 6 8 10 12 14 16 18 20)
	0		Sandy fine to coarse GRAVEL with trace cobbles: light grey. Dry; gravel, subrounded to subangular, schist; sand, fine to coarse, micaceous.	D					
309									
	1		1.00 Brown banding.						
			1.40 Becomes saturated	S				27-03-2025	
			End of Hole @ 1.5m, C						
308									
	2								
307									
	3								
306									

Notes and Comments:

End of Hole @ 1.5m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	09:15	1.4	

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 26/03/2025
Completed: 26/03/2025

Hole No. : TP15
Sheet : 1 of 1
Hole Length : 1.3
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266525
Northing: 5006359
System: NZTM2000
RL: 309.5 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3.5m
Width: 1.1m
Orientation: 272°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
309	0 – 1.15		Sandy fine to coarse GRAVEL; light grey. Dry; subrounded to subangular, schist; sand, medium to coarse. 0.60 Moist 0.60 - 1.15 Becomes mottled orange	D M					
308	1.15 – 1.30		Medium to coarse SAND with trace gravel; grey. Wet; gravel, subrounded to subangular, schist; sand, micaceous.	W		BLK-1 bag-SAND 1.15 – 1.30		▽ 26-03-2025	
307 306	2 3		Observed at the base of pit: Sandy fine to coarse GRAVEL; light grey. Saturated; gravel, subrounded to subangular, schist gravel; sand, medium to coarse. End of Hole @ 1.3m, C	S					

Notes and Comments:

End of Hole @ 1.3m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	15:15	1.2	1.3

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 26/03/2025
Completed: 26/03/2025

Hole No. : TP16
Sheet : 1 of 1
Hole Length : 0.6
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266459
Northing: 5006252
System: NZTM2000
RL: 308.6 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3.5m
Width: 1.1m
Orientation: 150°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Graphic	Material Description	Moisture condition	Consistency / Relative Density	Sample: Number / Type	Sample: Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
	0		Sandy fine to coarse GRAVEL; light grey. Dry; subrounded to subangular, schist gravel; sand, fine to coarse.	D					
308			0.40 Becomes saturated	S				▽ 26-03-2025	
			End of Hole @ 0.6m, C						
307	1								
306	2								
305	3								

Notes and Comments:

End of Hole @ 0.6m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
26/03/25	02:30	0.4	0.6

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP17
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 1
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 31/03/2025	Completed: 31/03/2025	Logged	: VM
Easting: 1266360	Northing: 5006653	System: NZTM2000	Processed : MG
RL: 310.1 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310

Contractor: Speight Drilling

Operator:

Length: 3m

Width: 1.2m

Orientation: 70°

Shear Vane Id:

Calibration:

RL (m)	Depth (m)	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
310	0 – 0.150	TOPSOIL: Fine to medium SAND with minor organic; grey. Moist; organics, roots.	M					
	0.150 – 0.7	Fine to medium SAND with some gravel; grey. Moist; gravel, fine to medium, subrounded to subangular, schist gravel.			0.30 – 0.70 B- 2 bags			
309	0.7 – 1	Fine to coarse GRAVEL with minor sand; grey. Wet; subrounded to subangular, schist gravel, sand, medium to coarse.	W				⊻ 31-03-2025	
	1	End of Hole @ 1m, C						
308	2							
307	3							

Notes and Comments:

End of Hole @ 1m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical

Orientation:

Contractor: Speight Drilling

Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
31/03/25	12:40	0.8	1

Project	: Shotover WWTP Disposal Field Alternative Discharge	Hole No.	: TP18
Client	: Queenstown Lakes District Council	Sheet	: 1 of 1
Site	: Shotover WWTP	Hole Length	: 2.6
Job Number: 12645246		Scale @ A4	: 1:50
Commenced: 27/03/2025	Completed: 27/03/2025	Logged	: VM
Easting: 1266650	Northing: 5006530	System: NZTM2000	Processed : MG
RL: 311.3 m	Datum: NZVD2016	Method: GPSH	Checked : DB

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3m
Width: 3.1m
Orientation: 285°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
311.3	0	Fine to medium SAND with some gravel; light grey. Dry.	D		0.30 – 1.55 BLK- 1 bag			
309.75	1.55	Sandy fine to medium GRAVEL with trace cobbles; light grey. moist.	M					
	2.40	2.40 Becomes Wet	W				▽ 27-03-2025	
	2.6	End of Hole @ 2.6m, C						

Notes and Comments:

End of Hole @ 2.6m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	2.55	2.6

GHD

Project : Shotover WWTP Disposal Field Alternative Discharge
Client : Queenstown Lakes District Council
Site : Shotover WWTP
Job Number: 12645246
Commenced: 27/03/2025
Completed: 27/03/2025

Hole No. : TP19
Sheet : 1 of 1
Hole Length : 2.8
Scale @ A4 : 1:50
Logged : VM
Processed : MG
Checked : DB

Easting: 1266620
Northing: 5006468
System: NZTM2000
RL: 311.3 m
Datum: NZVD2016
Method: GPSH

Equipment: CAT 310
Contractor: Speight Drilling
Operator:
Length: 3.5m
Width: 1.1m
Orientation: 286°
Shear Vane Id:
Calibration:

RL (m)	Depth (m)	Material Description	Moisture condition	Consistency / Relative Density	Sample Number / Type	Sample Result	Water level	Dynamic Cone Penetrometer Blows per 100mm intervals
311	0.10	TOPSOIL: Fine to coarse SAND with some gravel and trace organic; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist gravel; organic, roots.	D		BLK-0.00			
310 309	2.5	Gravelly fine to coarse SAND; light grey. Dry; gravel, fine to coarse, subrounded to subangular, schist. 0.70 Becomes moist	D M					
308		Sandy fine to coarse GRAVEL with trace cobbles; grey. Wet; subrounded to subangular, schist; sand, medium to coarse. 2.60 Becomes saturated	W S				∇ 27-03-2025	
		End of Hole @ 2.8m, C						

Notes and Comments:

End of Hole @ 2.8m
Hole terminated due to hole collapsed below ground water level.

Refer to explanation sheets for abbreviation and symbols.
Shear Vane values are corrected.

Inclination: Vertical
Orientation:
Contractor: Speight Drilling
Equipment: CAT 310

Ground Water Level

Date	Time	Reading (mbgl)	Hole depth (mbgl)
27/03/25	00:00	2.7	2.8

Appendix B

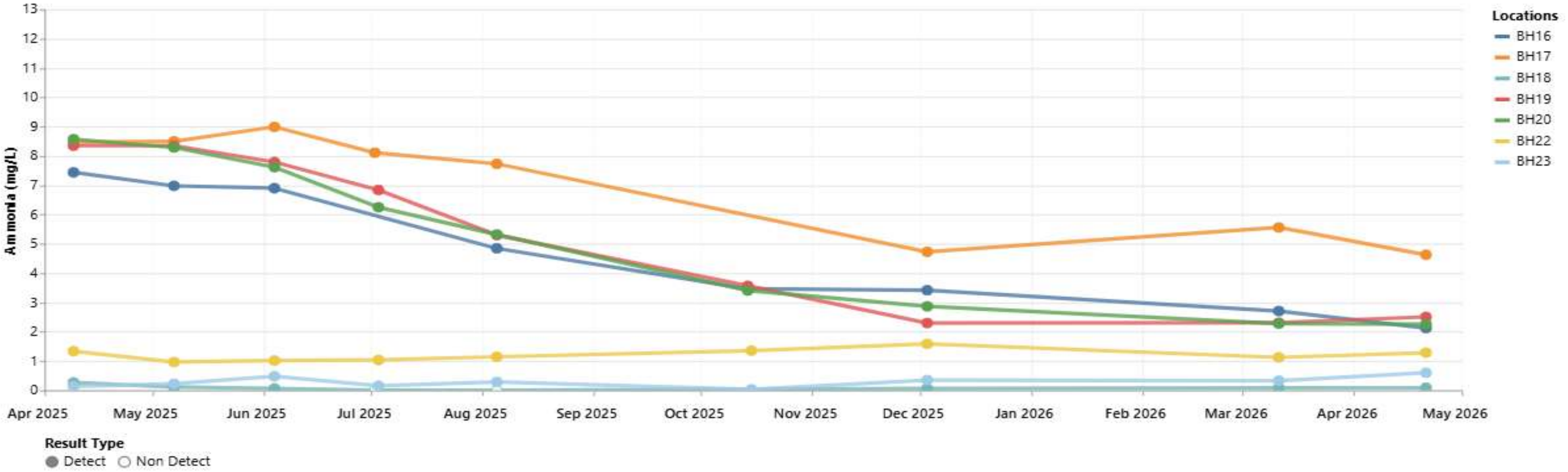
Water Quality Results

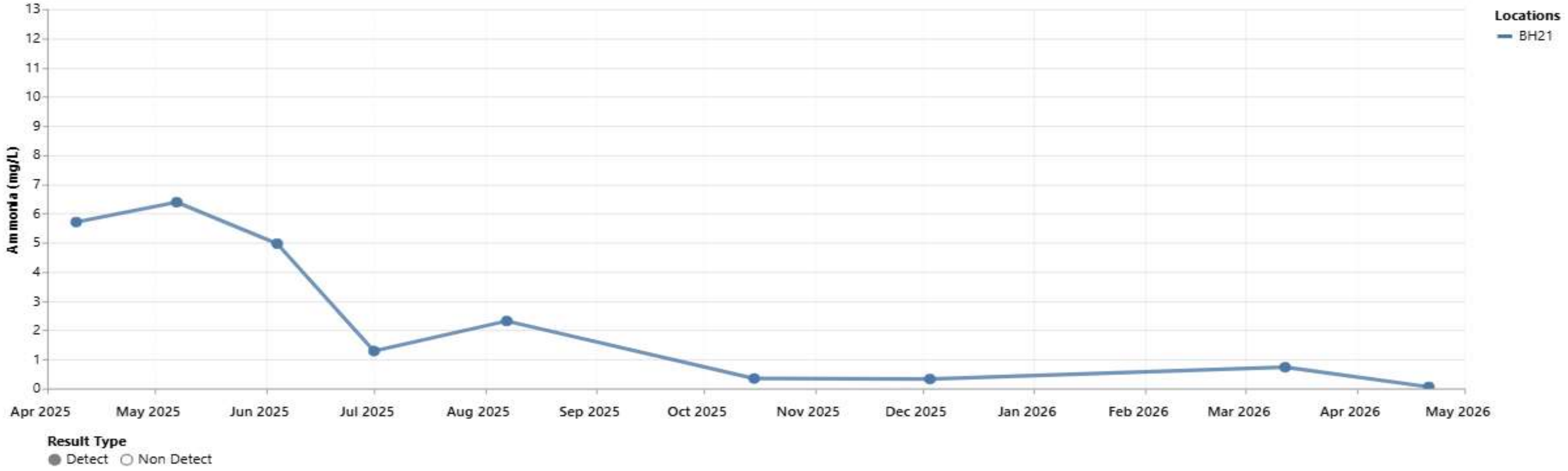
Ammoniacal nitrogen

Shotover WWTP - Groundwater

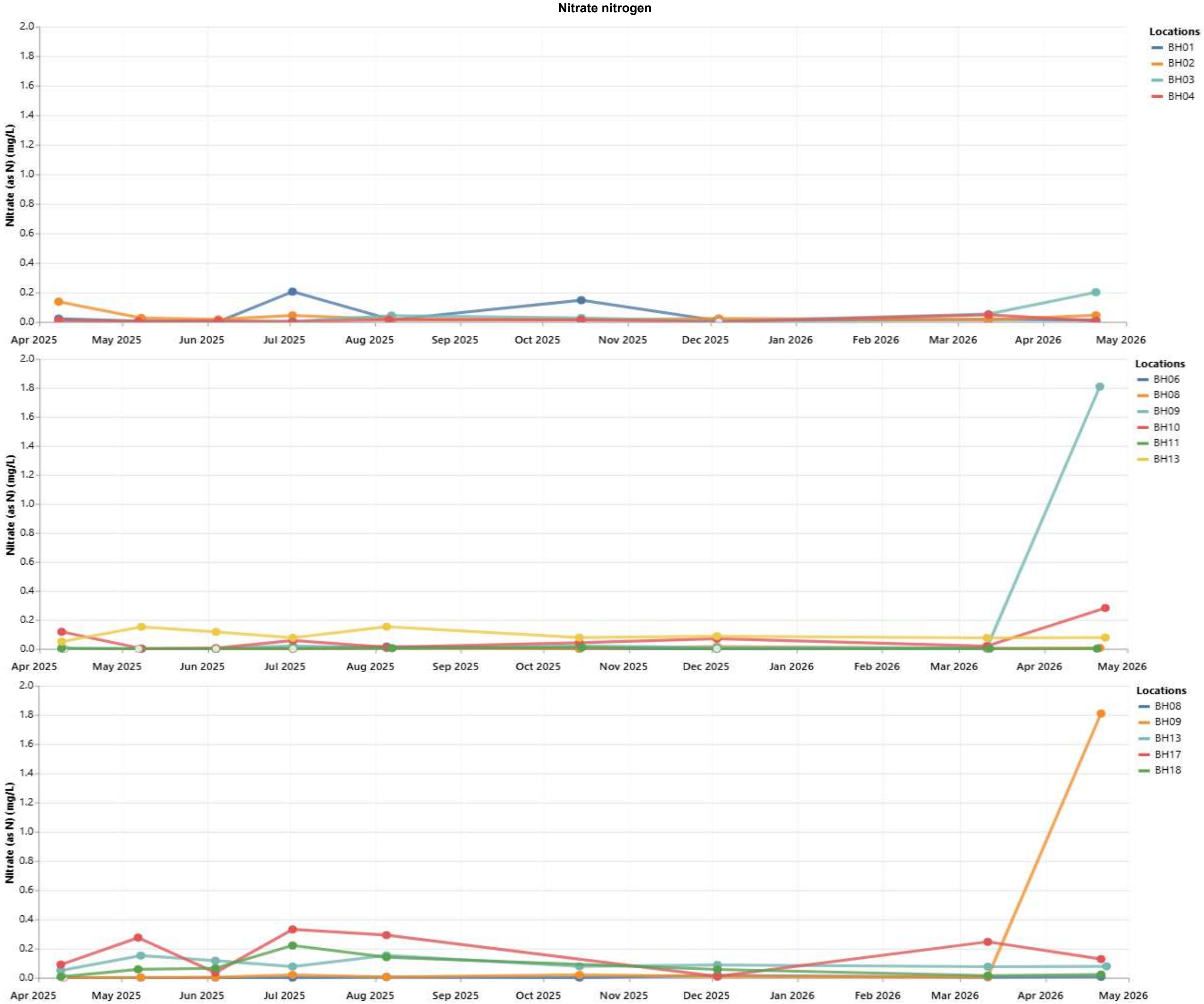
Project no.
12645246

Ammoniacal nitrogen





Shotover WWTP - Groundwater	**Project no.** **12645246**	GHD

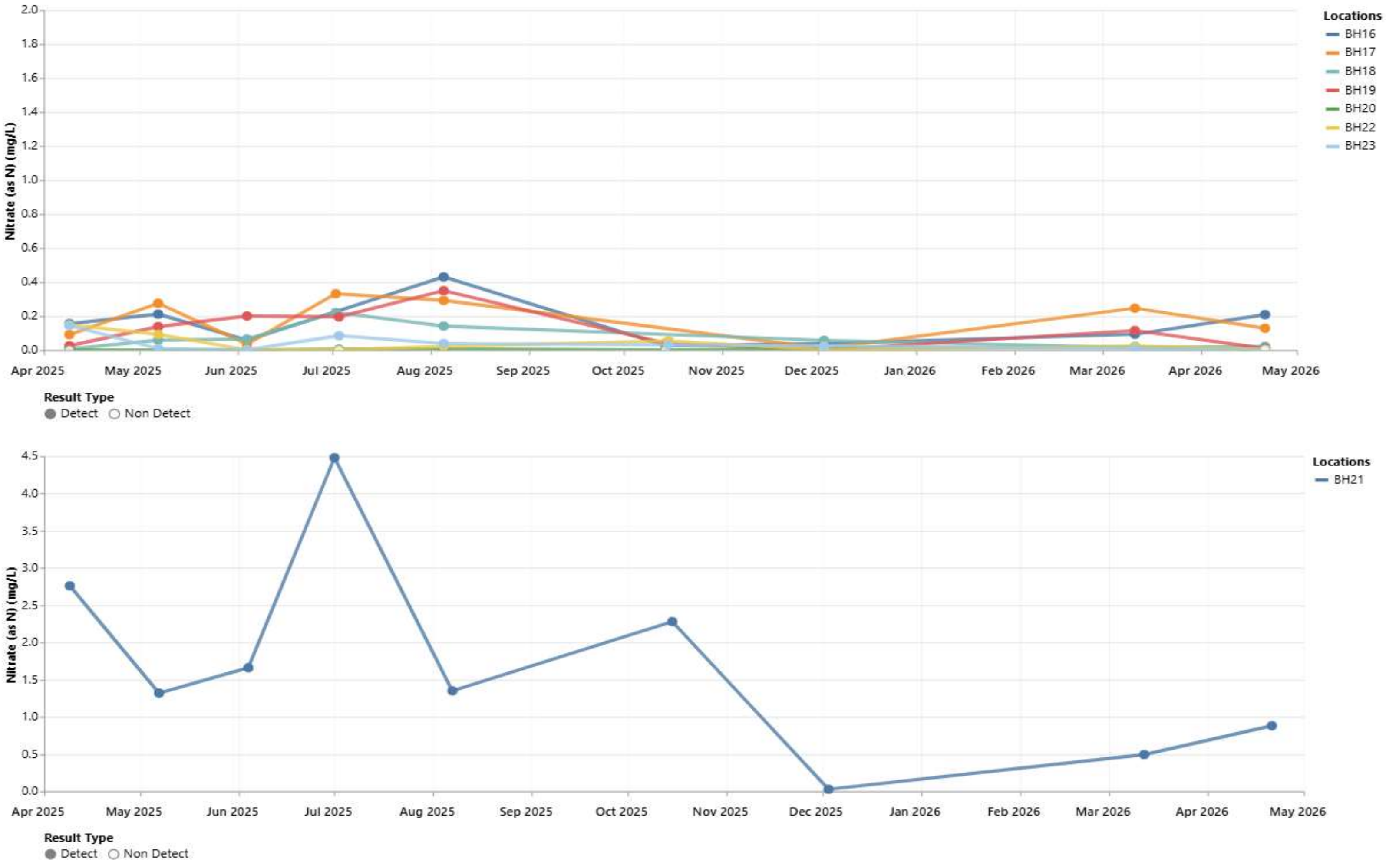


Nitrate nitrogen

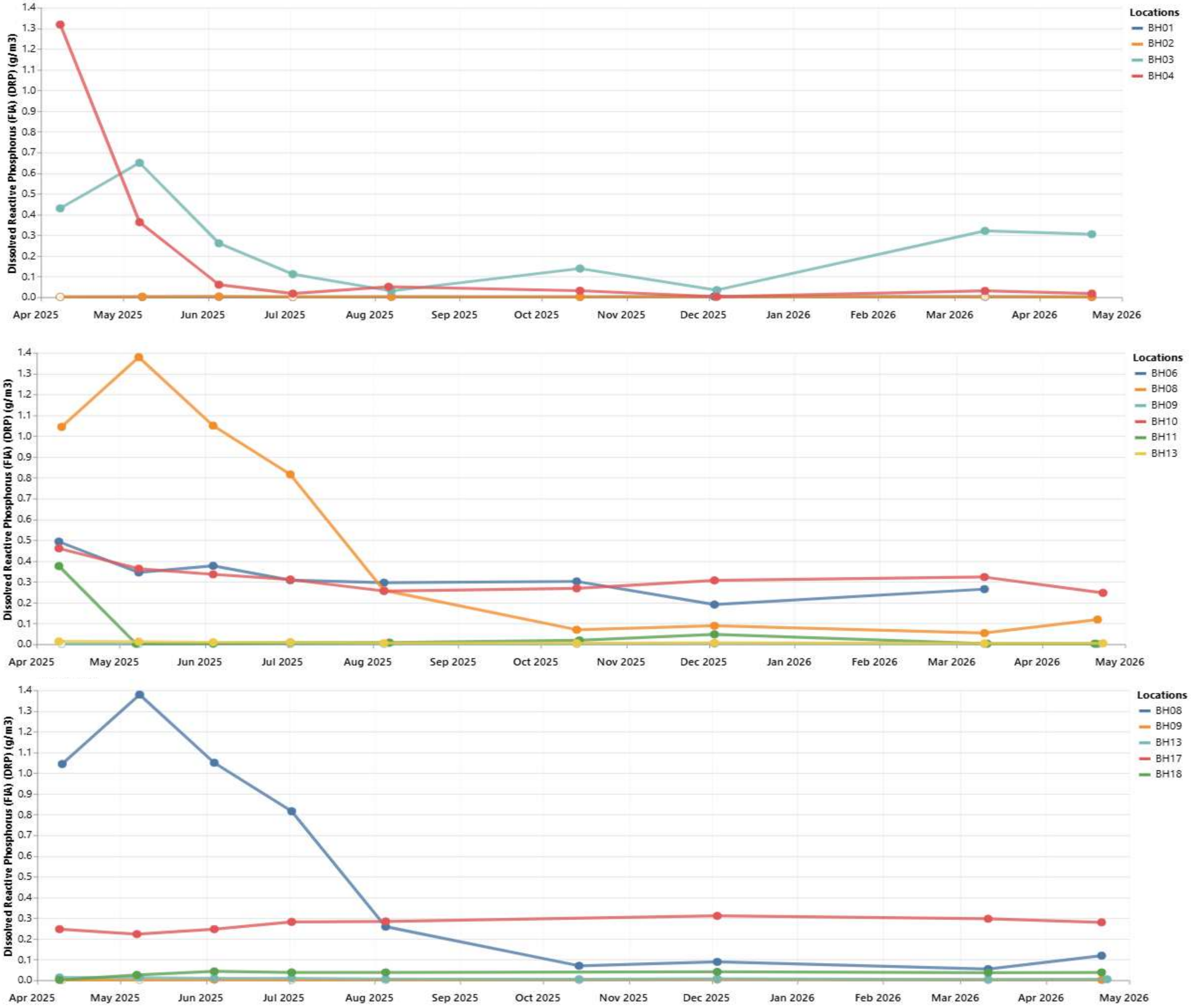
Shotover WWTP - Groundwater

Project no.
12645246

Nitrate nitrogen



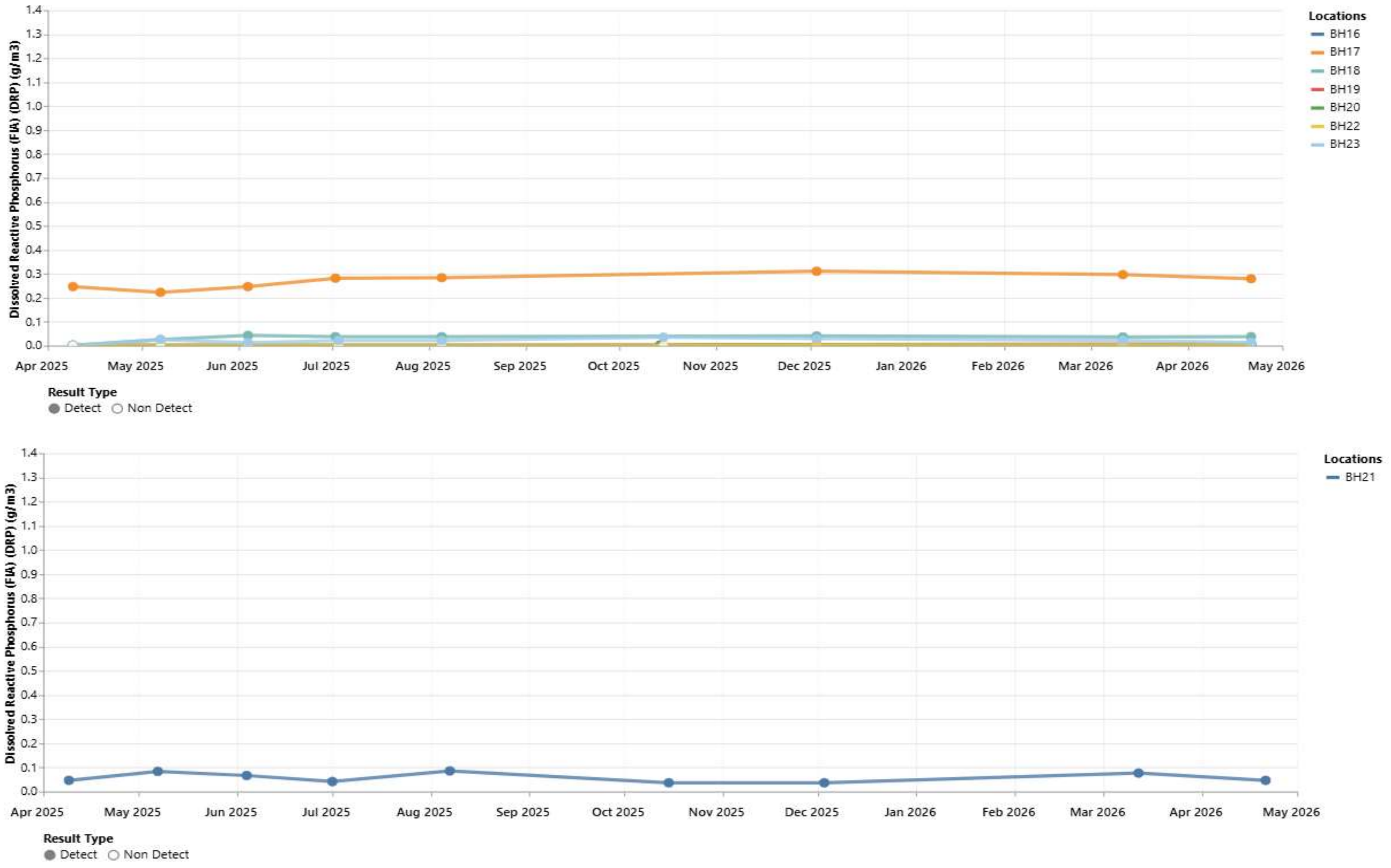
Dissolved Reactive Phosphorus



Shotover WWTP - Groundwater

Project no.
12645246

Dissolved Reactive Phosphorus



Shotover WWTP - Groundwater

Project no.
12645246

Groundwater results

			Field Parameters									Laboratory		Biological		Acidity & Alkalinity	Organic Indicators
			Purge SWL (mbTOC) (field)	pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	TDS (Field)	pH (Lab)	Electrical conductivity (lab)	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			m bTOC	pH units	µS/cm	mg/L	mg/L	%S	mV	°C	mg/L	pH units	µS/cm	orgs/100mL	orgs/100mL	g CaCO3/m3	g/m3
EQL												1	0.2		1	1	1
Location	**Date**	**Time**															
BH01	07 Apr 2025	17:15:00	2.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH01	08 Apr 2025	8:59:00	2.05	7.73	176.6	-	-	6.79	115.5	13.1	114.4	-	-	>2,420	4.1	-	-
BH01	08 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	184	-	-	77.0	-
BH01	08 May 2025	8:50:00	2.21	7.76	146.4	9.86	9.86	90.7	20.4	10	-	-	-	56	1	-	-
BH01	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH01	05 Jun 2025	11:28:00	1.98	7.78	140.6	9.62	9.62	84	53.3	7	-	-	-	200.5	1	-	-
BH01	02 Jul 2025	9:54:00	1.95	7.39	206.7	11.54	-	87.1	0.8	2.6	-	-	-	-	-	-	-
BH01	02 Jul 2025	9:54:00	1.95	7.39	206.7	11.54	11.54	87.1	0.8	2.6	-	-	-	-	-	-	-
BH01	07 Aug 2025	9:59:00	2.164	7.8	134.6	10	10	78.9	-249.8	4	-	-	-	-	-	-	-
BH01	16 Oct 2025	8:56:00	1.82	7.47	192.3	8	8	71.3	58.7	8.7	-	-	-	-	<1	-	-
BH01	04 Dec 2025	10:06:00	1.75	7.49	184.7	4.75	4.75	48.5	76.8	14.3	-	-	-	-	<1	-	-
BH01	12 Mar 2026	11:48:00	2.05	7.67	167.6	5.04	5.04	52.2	63.9	14.9	-	-	-	<1	<1	-	-
BH01	20 Apr 2026	13:37:00	1.96	7.71	162.8	7.35	7.35	72.7	118.5	13.3	-	-	-	<1	<1	-	-
BH02	07 Apr 2025	17:00:00	2.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH02	08 Apr 2025	10:04:00	2.02	7.34	249	-	-	1.11	98.5	13.6	101.85	-	-	1,299.7	<1	-	-
BH02	08 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	262	-	-	117	-
BH02	08 May 2025	8:49:00	2.17	7.69	154.2	-	-	73.7	97.6	11.8	-	-	-	32.4	<1	-	-
BH02	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH02	05 Jun 2025	11:00:00	2.04	7.8	143.3	8.17	8.17	72.8	47.5	7.7	-	-	-	4.2	<1	-	-
BH02	02 Jul 2025	10:05:00	1.99	7.6	182.9	9.75	-	77.1	-47.2	4.4	-	-	-	-	-	-	-
BH02	02 Jul 2025	10:05:00	1.99	7.6	182.9	9.75	9.75	77.1	-47.2	4.4	-	-	-	-	-	-	-
BH02	07 Aug 2025	9:49:00	2.165	7.78	142.9	9.01	9.01	72.7	-16.9	4.4	-	-	-	-	-	-	-
BH02	16 Oct 2025	9:11:00	1.79	7.53	180.1	8.64	8.64	75	49.4	7.5	-	-	-	-	<1	-	-
BH02	04 Dec 2025	9:32:00	1.756	7.19	258.9	4.04	4.04	37.5	-5.1	10.2	-	-	-	-	<1	-	-
BH02	12 Mar 2026	11:57:00	2.09	7.34	151.1	5.28	5.28	51.5	7	12.3	-	-	-	68	1	-	-
BH02	20 Apr 2026	14:13:00	1.97	7.31	183.7	4.85	4.85	46.3	114.4	11.8	-	-	-	14	<1	-	-
BH03	07 Apr 2025	16:30:00	2.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03	08 Apr 2025	11:17:00	2.81	7.1	446.7	-	-	0.57	-67.1	14.8	290.55	-	-	648.8	14.6	-	-
BH03	08 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.6	473	-	-	119	-
BH03	07 May 2025	15:37:00	3.04	7.15	263.2	1.19	1.19	11.2	98.1	15.1	-	-	-	1	<1	-	-
BH03	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH03	05 Jun 2025	10:09:00	2.84	7.27	204.1	3.24	3.24	30.5	100.3	10.1	-	-	-	16.4	<1	-	-
BH03	02 Jul 2025	9:14:00	2.85	7.33	163.3	5	-	0.59	-32.6	6.8	-	-	-	-	-	-	-
BH03	02 Jul 2025	9:14:00	2.85	7.33	163.3	5	5	0.59	-32.6	6.8	-	-	-	-	-	-	-
BH03	07 Aug 2025	9:15:00	3	7.23	207	0.4	0.4	3.8	-46.5	7.2	-	-	-	-	-	-	-
BH03	16 Oct 2025	9:59:00	2.55	6.99	213	1.84	1.84	16.7	86.4	9.6	-	-	-	-	<1	-	-
BH03	04 Dec 2025	9:06:00	2.595	7.03	269.8	1.05	1.05	10	-1.9	11.5	-	-	-	-	<1	-	-
BH03	12 Mar 2026	11:06:00	2.9	7.23	173.5	0.34	0.34	3.3	-22.3	13.8	-	-	-	1	<1	-	-
BH03	20 Apr 2026	15:04:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03	20 Apr 2026	15:05:00	2.78	7.17	214.5	1.13	1.13	11	99.5	12.9	-	-	-	8	<1	-	-
BH04	07 Apr 2025	16:15:00	2.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH04	08 Apr 2025	13:51:00	2.59	7.02	470.6	-	-	0.53	-130.9	17.7	306.15	-	-	488.4	10.9	-	-
BH04	08 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.5	486	-	-	161	-
BH04	07 May 2025	16:36:00	2.85	7.06	359.7	-	-	12.1	111.8	16.8	-	-	-	16.4	<1	-	-
BH04	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH04	05 Jun 2025	10:15:00	2.73	7.19	278.1	1.13	1.13	11.1	117.5	12.9	-	-	-	11.1	<1	-	-
BH04	02 Jul 2025	9:17:00	2.65	6.89	246.6	2.25	-	20.1	27.9	9.5	-	-	-	-	-	-	-

Groundwater results

			Field Parameters									Laboratory		Biological		Acidity & Alkalinity	Organic Indicators
			Purge SWL (mbTOC) (field)	pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	TDS (Field)	pH (Lab)	Electrical conductivity (lab)	Total Coliforms (Collert)	E.coli	Total Alkalinity (CaCO3)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			m bTOC	pH units	µS/cm	mg/L	mg/L	%S	mV	°C	mg/L	pH units	µS/cm	orgs/100mL	orgs/100mL	g CaCO3/m3	g/m3
EQL												1	0.2		1	1	1
Location	**Date**	**Time**															
BH01	07 Apr 2025	17:15:00	2.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH04	02 Jul 2025	9:18:00	2.65	6.89	246.6	2.25	2.25	20.1	27.9	9.5	-	-	-	-	-	-	-
BH04	06 Aug 2025	8:49:00	2.84	7.2	235.6	1.21	1.21	10.4	-97.2	8.1	-	-	-	<1	<1	-	-
BH04	16 Oct 2025	9:50:00	2.37	7.11	295	0.95	0.95	8.8	-51.2	9.1	-	-	-	-	<1	-	-
BH04	04 Dec 2025	8:58:00	2.37	6.95	329.5	1.62	1.62	15.1	-64.2	10.2	-	-	-	-	<1	-	-
BH04	12 Mar 2026	11:06:00	2.725	7.06	254.2	2.86	2.86	28	67.2	12.6	-	-	-	12	<1	-	-
BH04	20 Apr 2026	16:02:00	2.59	7.09	266.9	1.3	1.3	12.6	49.9	12.5	-	-	-	<1	<1	-	-
BH05	07 Apr 2025	10:10:00	2.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH05	08 Apr 2025	14:50:00	2.25	7.18	452.7	-	-	0.54	29.9	12.7	294.45	-	-	387.3	<1	-	-
BH05	08 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.7	495	-	-	125	-
BH05	12 Mar 2026	10:20:00	2.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH05	22 Apr 2026	16:55:00	2.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH06	04 Apr 2025	10:30:00	1.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH06	09 Apr 2025	14:35:00	1.32	7.22	503	0.94	0.94	-	182	17.9	-	-	-	13.2	<1	-	-
BH06	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	521	-	-	184	-
BH06	08 May 2025	10:18:00	1.49	7.21	498.8	1.04	1.04	11	107.7	16.4	-	-	-	19.2	3.1	-	-
BH06	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH06	03 Jun 2025	15:30:00	1.48	7.26	507	0.77	0.77	7.9	161.5	15.8	-	-	-	<1	<1	-	-
BH06	02 Jul 2025	15:25:00	1.24	7.25	463.3	0.54	0.54	5.2	-39.2	11.9	-	-	-	13.7	<1	-	-
BH06	05 Aug 2025	11:32:00	1.59	7.28	433.1	0.88	0.88	8	-52.2	10.7	-	-	-	1	<1	-	-
BH06	14 Oct 2025	11:46:00	1.081	7.18	407.8	1.33	1.33	13	110.3	12.5	-	-	-	-	<1	-	-
BH06	03 Dec 2025	9:07:00	1	7.13	506.7	1.5	1.5	15.7	-56.7	12.8	-	-	-	-	<1	-	-
BH06	11 Mar 2026	17:03:00	0.955	7.19	364.5	2.37	2.37	24.3	94.8	14.7	-	-	-	27	1	-	-
BH07	07 Apr 2025	10:45:00	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH07	12 Mar 2026	10:15:00	2.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH07	23 Apr 2026	12:00:00	1.97	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH08	02 Apr 2025	15:15:00	1.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH08	10 Apr 2025	14:15:00	1.82	7.07	483.7	0.46	0.46	-	-132	16.9	314.6	-	-	727	6.3	-	-
BH08	10 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.7	500	-	-	165	-
BH08	08 May 2025	12:12:00	2	7.11	503	1.05	1.05	11.1	132.2	16.5	-	-	-	9.9	1	-	-
BH08	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH08	03 Jun 2025	15:23:00	1.9	7.11	526	-	-	26.3	138.2	15.5	-	-	-	>201	<1	-	-
BH08	02 Jul 2025	11:29:00	1.73	6.97	475	1.35	-	12.6	35.4	10.9	-	-	-	-	-	-	-
BH08	02 Jul 2025	11:29:00	1.73	6.97	475	1.35	1.35	12.6	35.4	10.9	-	-	-	-	-	-	-
BH08	05 Aug 2025	10:26:00	1.97	7.19	506.4	0.9	0.9	8.3	-124.3	9.8	-	-	-	5.3	<1	-	-
BH08	14 Oct 2025	10:50:00	1.301	7.07	439.4	1.6	1.6	15.2	114.2	11.1	-	-	-	-	<1	-	-
BH08	03 Dec 2025	8:56:00	1.23	7.14	443.7	0.83	0.83	8.3	-122.3	13.3	-	-	-	-	<1	-	-
BH08	11 Mar 2026	10:40:00	1.914	7.09	438	2.1	2.1	21.2	104.8	14.6	-	-	-	<1	<1	-	-
BH08	21 Apr 2026	16:18:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH08	21 Apr 2026	16:18:00	1.693	7.18	442.6	1.78	1.78	17.6	77	13.8	-	-	-	<1	<1	-	-
BH09	03 Apr 2025	9:08:00	1.96	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH09	10 Apr 2025	14:54:00	1.9	7.42	509.9	0.4	0.4	-	-0.8	17.9	331.5	-	-	290.9	3.1	-	-
BH09	10 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.9	541	-	-	202	-
BH09	08 May 2025	11:40:00	2.06	7.34	512	1.13	1.13	12.2	112.6	17.2	-	-	-	23.8	1	-	-
BH09	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH09	03 Jun 2025	16:07:00	1.96	7.36	536	-	-	20.3	119.7	15.5	-	-	-	1	<1	-	-
BH09	02 Jul 2025	11:13:00	1.81	7.4	542	0.57	-	5.4	-37	11.7	-	-	-	-	-	-	-

Groundwater results

			Field Parameters									Laboratory		Biological		Acidity & Alkalinity	Organic Indicators
			Purge SWL (mbTOC) (field)	pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	TDS (Field)	pH (Lab)	Electrical conductivity (lab)	Total Coliforms (Collilert)	E.coli	Total Alkalinity (CaCO3)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			m bTOC	pH units	µS/cm	mg/L	mg/L	%S	mV	°C	mg/L	pH units	µS/cm	orgs/100mL	orgs/100mL	g CaCO3/m3	g/m3
EQL												1	0.2		1	1	1
Location	**Date**	**Time**															
BH01	07 Apr 2025	17:15:00	2.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH09	02 Jul 2025	11:13:00	1.81	7.4	542	0.57	0.57	5.4	-37	11.7	-	-	-	-	-	-	-
BH09	05 Aug 2025	10:16:00	2.025	7.41	532.7	0.48	0.48	4.6	152.8	11.7	-	-	-	<1	<1	-	-
BH09	14 Oct 2025	10:46:00	1.37	7.37	485.6	0.52	0.52	5.1	95.2	12	-	-	-	-	<1	-	-
BH09	03 Dec 2025	9:33:00	1.289	7.33	501	0.91	0.91	9.1	-0.4	13.3	-	-	-	-	<1	-	-
BH09	11 Mar 2026	10:53:00	1.97	7.38	487.4	0.74	0.74	7.5	46	14.6	-	-	-	<1	<1	-	-
BH09	20 Apr 2026	16:35:00	1.78	7.36	484	1.4	1.4	14.2	97	14.7	-	-	-	>80	35	-	-
BH10	04 Apr 2025	11:45:00	1.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH10	09 Apr 2025	3:22:00	-	-	-	-	-	-	-	-	-	-	-	313	1	-	-
BH10	09 Apr 2025	15:02:00	1.9	7.07	480.9	0.45	0.45	-	-14.3	17.4	312.65	-	-	-	-	-	-
BH10	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	507	-	-	176	-
BH10	08 May 2025	10:20:00	1.89	7.03	499.6	-	-	6	188.6	16.1	-	-	-	1	<1	-	-
BH10	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH10	04 Jun 2025	9:11:00	1.83	7.12	496.7	0.86	0.86	9	151	14	-	-	-	165.2	<1	-	-
BH10	03 Jul 2025	13:22:00	1.646	6.83	447.4	1.35	1.35	12.5	44.5	10.7	-	-	-	45.3	<1	-	-
BH10	05 Aug 2025	11:16:00	1.85	7.07	436.7	0.42	0.42	3.7	118.5	9	-	-	-	<1	<1	-	-
BH10	14 Oct 2025	11:30:00	1.165	7.05	443.9	7.31	7.31	69.8	80.6	11.6	-	-	-	-	<1	-	-
BH10	03 Dec 2025	10:02:00	1.076	7.04	546.1	1.09	1.09	10.9	4.1	13.3	-	-	-	-	<1	-	-
BH10	11 Mar 2026	16:16:00	1.83	7.06	383.2	2.31	2.31	23.7	8.8	14.9	-	-	-	<1	<1	-	-
BH10	23 Apr 2026	9:59:00	1.615	7.11	359	2.41	2.41	21.3	93.3	8.9	-	-	-	>80	<1	-	-
BH11	07 Apr 2025	11:10:00	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH11	09 Apr 2025	4:35:00	-	-	-	-	-	-	-	-	-	-	-	<1	<1	-	-
BH11	09 Apr 2025	16:35:00	2.64	7.2	484	3.6	3.6	-	-116.5	18.7	314.6	-	-	-	-	-	-
BH11	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	509	-	-	171	-
BH11	07 May 2025	13:32:00	2.86	7.17	480.1	1.58	1.58	14.5	125.2	16.7	-	-	-	129.8	3.1	-	-
BH11	04 Jun 2025	14:51:00	2.72	7.14	423.1	2.25	2.25	22.4	136.3	12.3	-	-	-	<1	<1	-	-
BH11	02 Jul 2025	12:32:00	2.59	6.96	375.2	1.34	-	12.1	17.4	9.5	-	-	-	-	-	-	-
BH11	02 Jul 2025	12:32:00	2.59	6.96	375.2	1.34	1.34	12.1	17.4	9.5	-	-	-	-	-	-	-
BH11	07 Aug 2025	10:44:00	2.84	7.24	310.8	0.8	0.8	7.2	-319.8	9.5	-	-	-	-	-	-	-
BH11	15 Oct 2025	16:54:00	2.135	7.19	349.5	1.87	1.87	17.4	101.1	10.6	-	-	-	<1	<1	-	-
BH11	03 Dec 2025	16:09:00	2.21	7.25	301	0.49	0.49	4.9	-91.7	12.8	-	-	-	<1	<1	-	-
BH11	12 Mar 2026	9:31:00	2.93	7.24	369.7	0.56	0.56	5.3	-88.6	12	-	-	-	<1	<1	-	-
BH11	20 Apr 2026	17:19:00	2.71	7.1	434	1.21	1.21	11.6	29.1	11.7	-	-	-	2	<1	-	-
BH13	04 Apr 2025	10:55:00	1.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH13	09 Apr 2025	14:27:00	1.89	8.23	257.8	0.4	0.4	-	-92.3	16.7	167.4	-	-	261.3	9.4	-	-
BH13	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.7	271	-	-	65.7	-
BH13	08 May 2025	11:30:00	2.11	7.93	262.1	1.75	1.75	19	130.7	17.5	-	-	-	3.1	<1	-	-
BH13	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1.00
BH13	04 Jun 2025	9:02:00	2.015	7.99	264.5	-	-	36.5	55.1	14.5	-	-	-	1	<1	-	-
BH13	02 Jul 2025	12:53:00	1.81	8.01	275.8	0.54	-	5.4	56.5	13.9	-	-	-	-	-	-	-
BH13	02 Jul 2025	12:53:00	1.81	8.01	275.8	0.54	0.54	5.4	56.5	13.9	-	-	-	-	-	-	-
BH13	05 Aug 2025	11:52:00	2.063	7.95	270.8	2.66	2.66	25.6	66.1	12.8	-	-	-	2	<1	-	-
BH13	14 Oct 2025	12:10:00	1.26	7.97	257	0.43	0.43	4.1	11.8	12.5	-	-	-	-	<1	-	-
BH13	03 Dec 2025	10:51:00	1.2	8.08	260.7	0.53	0.53	5.4	12.6	13.5	-	-	-	-	<1	-	-
BH13	11 Mar 2026	17:04:00	2.05	7.96	254.9	0.36	0.36	3.6	40.8	14.7	-	-	-	31	<1	-	-
BH13	23 Apr 2026	9:10:00	1.79	7.87	258.6	2.98	2.98	28.4	31	12.7	-	-	-	2	<1	-	-
BH14	07 Apr 2025	11:40:00	4.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Groundwater results

			Field Parameters									Laboratory		Biological		Acidity & Alkalinity	Organic Indicators
			Purge SWL (mbTOC) (field)	pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	TDS (Field)	pH (Lab)	Electrical conductivity (lab)	Total Coliforms (Collilert)	E.coli	Total Alkalinity (CaCO3)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			m bTOC	pH units	µS/cm	mg/L	mg/L	%S	mV	°C	mg/L	pH units	µS/cm	orgs/100mL	orgs/100mL	g CaCO3/m3	g/m3
EQL												1	0.2		1	1	1
Location	**Date**	**Time**															
BH01	07 Apr 2025	17:15:00	2.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH14	12 Mar 2026	12:10:00	4.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH14	22 Apr 2026	16:40:00	4.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH16	04 Apr 2025	14:00:00	1.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH16	09 Apr 2025	13:13:00	1.53	7.13	470.3	0.45	0.45	-	81.7	14.1	305.5	-	-	42.6	<1	-	-
BH16	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	501	-	-	181	-
BH16	07 May 2025	11:36:00	1.76	7.13	473.2	1.13	1.13	11.6	149.2	14.9	-	-	-	94.5	3.1	-	-
BH16	04 Jun 2025	10:02:00	1.84	7.27	476.3	0.66	0.66	6.6	156.3	13.4	-	-	-	<1	<1	-	-
BH16	01 Jul 2025	16:43:00	1.4	6.95	459.8	1.49	1.49	13.7	90.8	10.6	-	-	-	-	-	-	-
BH16	05 Aug 2025	14:52:00	1.706	7.23	422.3	0.48	0.48	4.5	105.6	11.8	-	-	-	<1	<1	-	-
BH16	14 Oct 2025	12:46:00	0.713	7.16	391.5	1.66	1.66	15.8	109.6	11.2	-	-	-	-	<1	-	-
BH16	03 Dec 2025	10:27:00	0.671	7.21	396.4	0.65	0.65	6.5	30.3	13.1	-	-	-	-	<1	-	-
BH16	11 Mar 2026	11:47:00	1.72	7.26	371.9	2.12	2.12	20.5	99.4	12.5	-	-	-	<1	<1	-	-
BH16	21 Apr 2026	10:18:00	1.37	7.32	373.6	1.45	1.45	13.5	67.4	11	-	-	-	<1	<1	-	-
BH17	04 Apr 2025	9:45:00	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH17	09 Apr 2025	10:58:00	0.95	7.18	467	0.54	0.54	-	60	16.5	303.55	-	-	410.6	<1	-	-
BH17	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	489	-	-	168	-
BH17	07 May 2025	11:21:00	1.21	7.14	487	0.6	0.6	-	193.1	16.1	-	-	-	200.5	<1	-	-
BH17	04 Jun 2025	11:12:00	1.05	7.12	496.8	2.53	2.53	25.3	135.9	13.2	-	-	-	3.1	<1	-	-
BH17	02 Jul 2025	13:22:00	0.83	6.9	475.3	1.21	1.21	11.8	33.7	12.8	-	-	-	<1	<1	-	-
BH17	05 Aug 2025	12:56:00	1.165	7.14	471	1.1	1.1	10.3	134.7	11.8	-	-	-	1	<1	-	-
BH17	03 Dec 2025	12:19:00	0.05	7.21	362.7	0.37	0.37	4.4	4.3	17	-	-	-	-	1	-	-
BH17	11 Mar 2026	12:29:00	1.16	7.13	457.1	0.5	0.5	5	94.3	14.9	-	-	-	<11	<1	-	-
BH17	21 Apr 2026	12:06:00	0.772	7.32	431.9	4.23	4.23	39.7	83.9	11.7	-	-	-	8	<1	-	-
BH18	03 Apr 2025	11:40:00	1.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH18	09 Apr 2025	11:59:00	1.27	8.4	197.2	0.37	0.37	-	-2.5	15.4	128.05	-	-	378.4	<1	-	-
BH18	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.9	210	-	-	91.7	-
BH18	07 May 2025	12:01:00	1.5	7.98	178.7	0.55	0.55	-	144.6	16	-	-	-	88.5	8.7	-	-
BH18	06 Jun 2025	10:15:00	1.25	8.07	107.2	2.27	2.27	22.7	44.4	13.4	-	-	-	6.4	<1	-	-
BH18	02 Jul 2025	13:58:00	1.02	7.69	175.9	2.98	2.98	28.3	-24.7	11.8	-	-	-	4.2	1	-	-
BH18	05 Aug 2025	13:26:00	1.396	7.94	169.9	2.4	2.4	22.3	69.1	11.8	-	-	-	<1	<1	-	-
BH18	03 Dec 2025	12:23:00	0.24	7.99	157.8	0.84	0.84	9	-9.5	16.6	-	-	-	-	1	-	-
BH18	11 Mar 2026	13:47:00	1.32	8.12	155.1	0.29	0.29	3	-119.7	14.8	-	-	-	<1	<1	-	-
BH18	21 Apr 2026	12:02:00	0.94	8.08	155.1	1.29	1.29	12.2	8.4	12	-	-	-	<1	<1	-	-
BH19	04 Apr 2025	16:15:00	2.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH19	09 Apr 2025	10:50:00	2.18	7.21	459.3	0.8	0.8	-	182.4	16.6	-	-	-	178.5	<1	-	-
BH19	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	486	-	-	162	-
BH19	07 May 2025	10:16:00	2.3	7.17	460.9	1.27	1.27	12.1	141	16.2	-	-	-	200.5	11.1	-	-
BH19	06 Jun 2025	12:20:00	2.14	7.17	457.4	2.22	2.22	22.3	142.8	13.3	-	-	-	<1	<1	-	-
BH19	03 Jul 2025	10:22:00	1.93	6.94	417.4	1.33	1.33	12.6	48.9	11.3	-	-	-	<1	<1	-	-
BH19	05 Aug 2025	13:01:00	2.24	7.13	410.6	0.53	0.53	4.9	81.1	11.3	-	-	-	<1	<1	-	-
BH19	14 Oct 2025	14:02:00	1.125	7.2	320.3	0.26	0.26	2.7	76.3	12.9	-	-	-	-	<1	-	-
BH19	03 Dec 2025	15:08:00	1.09	7.18	308.1	0.45	0.45	4.5	67.9	13.5	-	-	-	<1	<1	-	-
BH19	11 Mar 2026	13:38:00	2.23	7.23	347.2	0.21	0.21	2.1	40.8	13.4	-	-	-	2	<1	-	-
BH19	21 Apr 2026	13:05:00	1.84	7.23	371.4	2.43	2.43	23.1	77.1	11.9	-	-	-	<1	<1	-	-
BH20	04 Apr 2025	16:00:00	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH20	09 Apr 2025	9:30:00	2.02	7.27	433.2	1.01	1.01	-	184.2	14.7	-	-	-	920.8	<1	-	-

Groundwater results

			Field Parameters									Laboratory		Biological		Acidity & Alkalinity	Organic Indicators
			Purge SWL (mbTOC) (field)	pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	TDS (Field)	pH (Lab)	Electrical conductivity (lab)	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			m bTOC	pH units	µS/cm	mg/L	mg/L	%S	mV	°C	mg/L	pH units	µS/cm	orgs/100mL	orgs/100mL	g CaCO3/m3	g/m3
EQL												1	0.2		1	1	1
Location	**Date**	**Time**															
BH01	07 Apr 2025	17:15:00	2.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH20	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.9	459	-	-	163	-
BH20	07 May 2025	9:41:00	2.28	7.32	432	1.69	1.69	15.9	118.9	15.4	-	-	-	200.5	<1	-	-
BH20	04 Jun 2025	12:59:00	2.095	7.28	418.1	2.05	2.05	20.4	143.6	13	-	-	-	<1	<1	-	-
BH20	03 Jul 2025	9:38:00	1.905	7.1	376.3	1.78	1.78	16.6	52.1	10.5	-	-	-	<1	<1	-	-
BH20	05 Aug 2025	13:32:00	2.233	7.27	380.1	0.53	0.53	5.1	40.4	12.8	-	-	-	<1	<1	-	-
BH20	14 Oct 2025	13:47:00	1.084	7.28	296.7	1.48	1.48	14.7	101.4	12.9	-	-	-	-	<1	-	-
BH20	03 Dec 2025	14:30:00	1.07	7.25	304.1	0.6	0.6	6.2	74.8	14.9	-	-	-	2	1	-	-
BH20	11 Mar 2026	13:38:00	2.12	7.32	295	3.32	3.32	33.7	84.3	14.5	-	-	-	2	<1	-	-
BH20	21 Apr 2026	13:12:00	1.82	7.45	353.6	5.3	5.3	49.8	75.2	11.6	-	-	-	<1	<1	-	-
BH21	04 Apr 2025	14:50:00	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH21	09 Apr 2025	12:05:00	1.87	6.97	465.9	0.9	0.9	-	185.3	16.3	-	-	-	1,299.7	<1	-	-
BH21	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.7	487	-	-	159	-
BH21	07 May 2025	13:34:00	2.08	7.05	457.9	0.47	0.47	-	191.8	16.8	-	-	-	17.8	<1	-	-
BH21	04 Jun 2025	14:51:00	2	7.02	417.2	0.8	0.8	7.9	150	13.1	-	-	-	3.1	<1	-	-
BH21	01 Jul 2025	17:00:00	1.68	6.93	430.7	0.82	0.82	7.5	111.4	10.2	-	-	-	-	-	-	-
BH21	07 Aug 2025	10:48:00	2.087	7.02	364.2	0.33	0.33	3.4	50.3	10.6	-	-	-	-	-	-	-
BH21	15 Oct 2025	16:46:00	1.115	7.02	352.6	0.35	0.35	3.4	98.7	11.1	-	-	-	1	<1	-	-
BH21	03 Dec 2025	14:50:00	1.055	7.13	335.4	0.41	0.41	4.4	66.3	16.1	-	-	-	1	<1	-	-
BH21	12 Mar 2026	9:55:00	2.045	7.04	297.9	2.58	2.58	25	60.1	11.9	-	-	-	15	<1	-	-
BH21	21 Apr 2026	10:56:00	1.71	7.01	387.3	2.42	2.42	22.6	48.9	11.1	-	-	-	1	<1	-	-
BH22	04 Apr 2025	15:30:00	2.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH22	09 Apr 2025	9:50:00	2.03	7.29	309.9	0.41	0.41	-	74.1	11.1	201.5	-	-	17.3	<1	-	-
BH22	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	7.8	330	-	-	150	-
BH22	07 May 2025	9:15:00	2.25	7.13	369.3	0.77	0.77	-	152	11	-	-	-	3.1	<1	-	-
BH22	04 Jun 2025	12:46:00	2.14	7.21	378.8	0.81	0.81	7.6	112.6	10.3	-	-	-	<1	<1	-	-
BH22	03 Jul 2025	9:50:00	1.88	7.1	380.4	0.58	0.58	5	-4.6	7.8	-	-	-	<1	<1	-	-
BH22	05 Aug 2025	15:04:00	2.24	7.1	383.4	0.46	0.46	4	61.4	9.4	-	-	-	<1	<1	-	-
BH22	15 Oct 2025	17:14:00	1.125	6.95	378.1	1.54	1.54	14.4	91	10.7	-	-	-	4.2	<1	-	-
BH22	03 Dec 2025	13:26:00	1.061	7.02	403.4	0.87	0.87	8.9	75.7	14.3	-	-	-	-	<1	-	-
BH22	11 Mar 2026	14:27:00	2.23	7.03	349.2	1.94	1.94	19.1	75.1	13.3	-	-	-	10	<1	-	-
BH22	21 Apr 2026	14:03:00	1.86	7.09	362.6	1.08	1.08	9.9	65.2	10.7	-	-	-	<1	<1	-	-
BH23	04 Apr 2025	15:30:00	1.77	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH23	09 Apr 2025	8:56:00	1.77	8.08	279.5	0.72	0.72	-	73	10.7	182	-	-	>2,420	1	-	-
BH23	09 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	8.0	295	-	-	115	-
BH23	07 May 2025	10:02:00	2.02	7.97	275.3	1.43	1.43	-	151.3	11.7	-	-	-	144.5	<1	-	-
BH23	04 Jun 2025	13:26:00	1.89	7.62	316.1	0.8	0.8	7.7	116.1	10.3	-	-	-	30.6	<1	-	-
BH23	03 Jul 2025	10:25:00	1.66	7.68	296.7	0.59	0.59	5.1	19.4	7.6	-	-	-	25.4	1	-	-
BH23	05 Aug 2025	14:30:00	1.987	7.66	300.7	0.32	0.32	3.1	85.9	9.6	-	-	-	3.1	<1	-	-
BH23	15 Oct 2025	17:29:00	0.88	8.06	272.9	0.45	0.45	4.4	69.2	12.8	-	-	-	2	<1	-	-
BH23	03 Dec 2025	13:36:00	0.795	7.68	295.5	0.76	0.76	7.7	-7.5	14.1	-	-	-	-	1	-	-
BH23	11 Mar 2026	14:26:00	1.96	7.76	276.9	0.52	0.52	5.3	-20.9	14.9	-	-	-	<14	<1	-	-
BH23	21 Apr 2026	14:09:00	1.58	7.57	293.1	2.85	2.85	26	60	10.2	-	-	-	<1	<1	-	-

Groundwater results

			Major Ions								Nutrients								Metals		
			Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride (filtered)	Sulfate (filtered)	Cations Total	Anions Total	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Iron (filtered)	Manganese (filtered)	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.05	0.01	0.05	0.01	0.5	0.15	0.01	0.01	0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	0.005	0.0005	0.001
Location	**Date**	**Time**																			
BH01	08 Apr 2025	0:00:00	33.9	1.30	0.94	1.44	0.51	8.27	1.88	1.74	<0.002	0.0229	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<0.0050	<0.00050	<0.0010
BH01	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.002	0.0054	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	-	-	-
BH01	05 Jun 2025	11:30:00	-	-	-	-	-	-	-	-	<0.002	0.002	-	0.103	<0.1	<0.001	<0.005	0.006	-	-	-
BH01	02 Jul 2025	9:54:00	-	-	-	-	-	-	-	-	<0.002	0.206	-	0.307	<0.1	<0.001	<0.005	<0.005	-	-	-
BH01	07 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0158	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	-	-	-
BH01	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.148	-	0.33	0.18	<0.0010	<0.005	<0.0050	-	-	-
BH01	03 Dec 2025	10:06:00	-	-	-	-	-	-	-	-	0.004	0.011	0.011	<0.1	<0.1	<0.001	<0.005	0.005	-	-	-
BH01	12 Mar 2026	11:48:00	-	-	-	-	-	-	-	-	0.003	0.018	-	<0.1	<0.1	<0.001	<0.005	<0.005	-	-	-
BH01	20 Apr 2026	13:37:00	-	-	-	-	-	-	-	-	0.002	0.014	-	<0.1	<0.1	<0.001	<0.005	<0.005	-	-	-
BH02	08 Apr 2025	0:00:00	51.2	1.15	0.53	2.49	1.23	6.61	2.77	2.54	<0.002	0.138	-	0.14	<0.10	<0.0010	<0.005	<0.0050	<0.0050	0.0017	0.0014
BH02	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.003	0.0279	-	<0.10	<0.10	<0.0010	<0.005	0.0096	-	-	-
BH02	05 Jun 2025	11:00:00	-	-	-	-	-	-	-	-	0.004	0.018	-	0.119	<0.1	<0.001	<0.005	0.020	-	-	-
BH02	02 Jul 2025	10:05:00	-	-	-	-	-	-	-	-	<0.002	0.045	-	0.146	<0.1	<0.001	<0.005	<0.005	-	-	-
BH02	07 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.003	0.0177	-	<0.10	<0.10	<0.0010	<0.005	0.0062	-	-	-
BH02	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.002	0.0149	-	<0.10	<0.10	<0.0010	<0.005	0.0054	-	-	-
BH02	04 Dec 2025	9:32:00	-	-	-	-	-	-	-	-	0.003	0.024	0.024	<0.1	<0.1	<0.001	<0.005	<0.005	-	-	-
BH02	12 Mar 2026	11:57:00	-	-	-	-	-	-	-	-	<0.002	0.015	-	0.7	0.6	<0.001	<0.005	<0.005	-	-	-
BH02	20 Apr 2026	14:13:00	-	-	-	-	-	-	-	-	0.002	0.046	-	<0.1	<0.1	<0.001	<0.005	<0.005	-	-	-
BH03	08 Apr 2025	0:00:00	30.8	2.68	17.1	45.7	36.5	35.8	4.60	4.18	0.430	<0.0020	-	5.0	5.01	0.0035	4.70	0.97	1.60	0.724	0.0063
BH03	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.650	<0.0020	-	3.1	3.06	0.0031	2.89	1.60	-	-	-
BH03	05 Jun 2025	10:10:00	-	-	-	-	-	-	-	-	0.261	0.003	-	1.91	1.9	0.007	1.53	0.935	-	-	-
BH03	02 Jul 2025	9:14:00	-	-	-	-	-	-	-	-	0.112	0.005	-	0.81	0.8	0.005	0.723	0.454	-	-	-
BH03	07 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.031	0.0436	-	1.2	1.19	0.0109	1.14	0.45	-	-	-
BH03	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.139	0.0277	-	1.4	1.33	0.0048	1.01	0.94	-	-	-
BH03	04 Dec 2025	9:06:00	-	-	-	-	-	-	-	-	0.035	0.006	0.007	0.3	0.3	0.002	0.082	1.16	-	-	-
BH03	12 Mar 2026	11:06:00	-	-	-	-	-	-	-	-	0.321	0.054	-	0.2	0.2	0.002	0.058	0.605	-	-	-
BH03	20 Apr 2026	15:04:00	-	-	-	-	-	-	-	-	0.305	0.202	-	0.2	<0.1	0.026	0.012	0.639	-	-	-
BH04	08 Apr 2025	0:00:00	25.8	3.69	16.1	44.8	35.6	7.15	4.91	4.40	1.318	0.0116	-	9.7	9.64	0.0035	9.81	3.44	6.21	0.897	0.0050
BH04	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.363	0.0057	-	6.2	6.17	0.0132	5.85	2.44	-	-	-
BH04	05 Jun 2025	10:15:00	-	-	-	-	-	-	-	-	0.061	0.009	-	3.813	3.8	0.004	3.64	2.04	-	-	-
BH04	02 Jul 2025	9:18:00	-	-	-	-	-	-	-	-	0.018	0.003	-	2.405	2.4	0.002	2.38	1.79	-	-	-
BH04	06 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.051	0.0161	-	2.5	2.48	0.0038	2.29	5.73	-	-	-
BH04	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.032	0.0155	-	2.4	2.41	0.0038	1.98	5.24	-	-	-
BH04	04 Dec 2025	8:58:00	-	-	-	-	-	-	-	-	0.003	<0.002	0.003	1.3	1.3	0.001	1.12	0.795	-	-	-
BH04	12 Mar 2026	11:06:00	-	-	-	-	-	-	-	-	0.031	0.049	-	1.7	1.7	0.004	1.45	1.03	-	-	-
BH04	20 Apr 2026	16:02:00	-	-	-	-	-	-	-	-	0.018	0.007	-	1.6	1.6	0.002	1.61	0.991	-	-	-
BH05	08 Apr 2025	0:00:00	55.6	1.89	4.5	36.3	32.1	28.7	4.81	4.51	0.037	6.95	-	9.7	2.74	0.00782	2.34	0.060	0.023	0.480	0.0061
BH06	09 Apr 2025	0:00:00	37.2	3.95	13.6	45.1	38.9	6.78	5.29	4.95	0.493	<0.0020	-	9.4	9.36	<0.0010	9.36	0.59	0.841	2.72	0.0092
BH06	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.345	<0.0020	-	8.0	8.02	0.0041	7.87	0.53	-	-	-
BH06	04 Jun 2025	15:30:00	-	-	-	-	-	-	-	-	0.377	<0.002	-	8.405	8.4	0.003	8.26	0.639	-	-	-
BH06	02 Jul 2025	15:26:00	-	-	-	-	-	-	-	-	0.308	0.009	-	6.914	6.9	0.005	6.69	0.784	-	-	-
BH06	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.296	0.0173	-	5.8	5.78	0.0050	5.84	0.90	-	-	-
BH06	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.302	<0.0020	-	5.0	4.97	<0.0010	4.99	0.42	-	-	-
BH06	03 Dec 2025	9:07:00	-	-	-	-	-	-	-	-	0.191	0.003	0.003	5.6	5.6	<0.001	5.70	0.477	-	-	-
BH06	11 Mar 2026	17:03:00	-	-	-	-	-	-	-	-	0.265	0.004	-	4.6	4.6	0.001	4.44	0.360	-	-	-
BH08	10 Apr 2025	0:00:00	35.2	5.83	18.3	49.6	40.3	9.08	5.73	4.66	1.044	<0.0020	-	9.3	9.32	0.0020	9.38	2.75	4.16	1.26	0.0030
BH08	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	1.379	<0.0020	-	11	11.3	0.0018	11.9	2.97	-	-	-
BH08	04 Jun 2025	15:23:00	-	-	-	-	-	-	-	-	1.05	<0.002	-	12.404	12.4	0.002	12.4	2.76	-	-	-

Groundwater results

			Major Ions								Nutrients								Metals		
			Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride (filtered)	Sulfate (filtered)	Cations Total	Anions Total	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Iron (filtered)	Manganese (filtered)	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.05	0.01	0.05	0.01	0.5	0.15	0.01	0.01	0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	0.005	0.0005	0.001
Location	**Date**	**Time**																			
BH08	02 Jul 2025	11:29:00	-	-	-	-	-	-	-	-	0.816	0.003	-	12.506	12.5	0.003	13	2.2	-	-	-
BH08	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.259	0.0064	-	12	12.2	0.00595	12.9	2.63	-	-	-
BH08	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.070	0.0025	-	8.8	8.74	0.0041	8.59	5.45	-	-	-
BH08	03 Dec 2025	8:56:00	-	-	-	-	-	-	-	-	0.089	0.017	0.023	8.4	8.4	0.006	7.80	8.46	-	-	-
BH08	11 Mar 2026	10:40:00	-	-	-	-	-	-	-	-	0.054	0.005	-	6.8	6.8	0.003	6.89	1.64	-	-	-
BH08	21 Apr 2026	16:18:00	-	-	-	-	-	-	-	-	0.119	0.008	-	7.3	7.3	0.007	6.48	8.18	-	-	-
BH09	10 Apr 2025	0:00:00	53.3	4.32	13.5	41.0	37.7	5.68	5.56	5.26	<0.002	<0.0020	-	5.2	5.15	<0.0010	5.51	0.023	0.014	0.689	0.0037
BH09	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0035	-	5.2	5.10	0.0880	4.72	0.0080	-	-	-
BH09	04 Jun 2025	16:07:00	-	-	-	-	-	-	-	-	0.003	0.004	-	4.635	4.6	0.031	4.41	0.021	-	-	-
BH09	02 Jul 2025	11:13:00	-	-	-	-	-	-	-	-	<0.002	0.021	-	4.529	4.5	0.008	4.45	0.013	-	-	-
BH09	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0067	-	5.3	5.30	0.0049	5.64	0.0068	-	-	-
BH09	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0208	-	6.5	6.42	0.00675	6.43	0.013	-	-	-
BH09	03 Dec 2025	9:33:00	-	-	-	-	-	-	-	-	0.004	0.011	0.016	6.1	6.1	0.005	6.41	0.010	-	-	-
BH09	11 Mar 2026	10:38:00	-	-	-	-	-	-	-	-	<0.002	0.007	-	6.7	6.7	0.004	6.72	0.025	-	-	-
BH09	21 Apr 2026	16:35:00	-	-	-	-	-	-	-	-	0.002	1.81	-	5.8	4.0	0.040	3.14	0.024	-	-	-
BH10	09 Apr 2025	0:00:00	31.0	3.52	14.7	43.8	37.8	3.44	4.91	4.70	0.461	0.119	-	9.4	9.28	0.00616	9.57	0.49	0.12	2.86	0.0097
BH10	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.363	0.0034	-	8.4	8.41	0.0142	8.36	0.46	-	-	-
BH10	04 Jun 2025	9:11:00	-	-	-	-	-	-	-	-	0.336	0.006	-	7.516	7.5	0.010	7.42	0.534	-	-	-
BH10	02 Jul 2025	15:23:00	-	-	-	-	-	-	-	-	0.311	0.059	-	7.269	7.2	0.01	6.78	0.593	-	-	-
BH10	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.256	0.0119	-	5.9	5.84	0.00565	5.71	0.65	-	-	-
BH10	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.269	0.0438	-	5.4	5.31	0.0110	4.87	1.07	-	-	-
BH10	03 Dec 2025	10:02:00	-	-	-	-	-	-	-	-	0.307	0.071	0.098	7.1	7.0	0.026	6.98	2.16	-	-	-
BH10	11 Mar 2026	16:16:00	-	-	-	-	-	-	-	-	0.323	0.020	-	3.8	3.8	0.004	3.62	0.388	-	-	-
BH10	23 Apr 2026	9:59:00	-	-	-	-	-	-	-	-	0.247	0.283	-	3.2	2.9	0.097	2.58	0.538	-	-	-
BH11	09 Apr 2025	0:00:00	29.7	3.40	14.0	43.5	37.9	6.71	4.99	4.67	0.376	0.0066	-	11	11.0	<0.0010	11.2	1.04	2.01	2.72	0.0021
BH11	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.003	<0.0020	-	11	11.1	<0.0010	11.2	0.72	-	-	-
BH11	04 Jun 2025	14:51:00	-	-	-	-	-	-	-	-	0.004	<0.002	-	7.803	7.8	<0.001	7.45	0.518	-	-	-
BH11	02 Jul 2025	12:32:00	-	-	-	-	-	-	-	-	0.008	<0.002	-	6.504	6.5	0.002	6.36	0.495	-	-	-
BH11	07 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.008	0.0059	-	5.5	5.51	0.0032	5.37	0.75	-	-	-
BH11	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.019	0.0113	-	4.9	4.90	0.0128	4.58	1.24	-	-	-
BH11	03 Dec 2025	16:09:00	-	-	-	-	-	-	-	-	0.048	<0.002	0.003	3.7	3.7	0.001	3.89	0.424	-	-	-
BH11	12 Mar 2026	9:31:00	-	-	-	-	-	-	-	-	0.003	0.003	-	2.7	2.7	0.001	2.60	0.404	-	-	-
BH11	20 Apr 2026	17:19:00	-	-	-	-	-	-	-	-	0.003	0.003	-	3.5	3.5	0.001	3.32	0.406	-	-	-
BH13	09 Apr 2025	0:00:00	39.8	2.23	1.8	8.94	28.7	16.1	2.62	2.47	0.014	0.0511	-	0.34	0.23	0.0628	0.15	0.022	0.037	0.154	0.0043
BH13	08 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.013	0.153	-	0.15	<0.10	<0.0010	0.02	0.015	-	-	-
BH13	04 Jun 2025	9:02:00	-	-	-	-	-	-	-	-	0.010	0.118	-	0.22	<0.1	0.002	0.038	0.021	-	-	-
BH13	02 Jul 2025	12:53:00	-	-	-	-	-	-	-	-	0.01	0.078	-	0.28	0.2	0.002	0.15	0.021	-	-	-
BH13	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.006	0.154	-	0.15	<0.10	<0.0010	<0.005	0.017	-	-	-
BH13	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.005	0.0790	-	0.21	0.13	<0.0010	<0.005	0.024	-	-	-
BH13	03 Dec 2025	10:51:00	-	-	-	-	-	-	-	-	0.007	0.089	0.090	0.2	0.1	0.002	<0.005	0.007	-	-	-
BH13	11 Mar 2026	17:04:00	-	-	-	-	-	-	-	-	0.004	0.077	-	<0.1	<0.1	<0.001	<0.005	0.007	-	-	-
BH13	23 Apr 2026	9:10:00	-	-	-	-	-	-	-	-	0.005	0.079	-	<0.1	<0.1	0.001	<0.005	0.012	-	-	-
BH16	09 Apr 2025	0:00:00	40.9	3.49	12.4	39.8	35.8	4.70	5.05	4.78	<0.002	0.156	-	8.0	7.78	0.0229	7.44	<0.0050	0.011	4.04	0.0026
BH16	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.212	-	7.3	7.11	0.00572	6.98	0.0069	-	-	-
BH16	04 Jun 2025	10:02:00	-	-	-	-	-	-	-	-	<0.002	0.058	-	7.173	7.1	0.015	6.90	0.007	-	-	-
BH16	01 Jul 2025	16:43:00	-	-	-	-	-	-	-	-	-	-	-	-	5.1	-	-	-	-	-	-
BH16	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.431	-	5.4	4.98	0.00545	4.85	<0.0050	-	-	-
BH16	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0275	-	3.7	3.64	0.0115	3.47	0.023	-	-	-

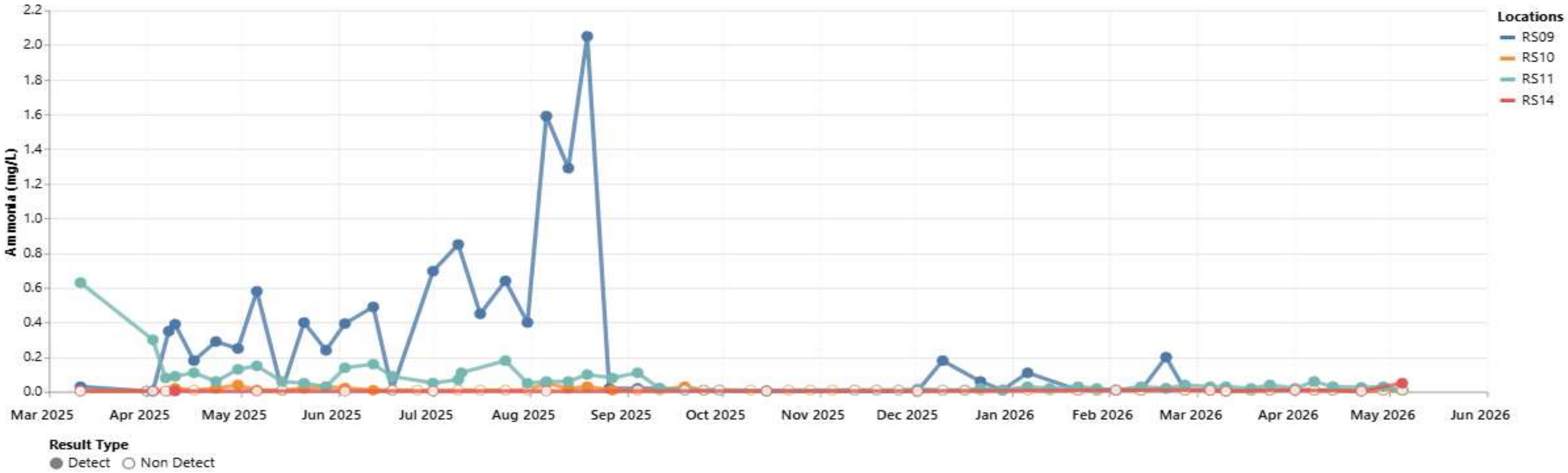
Groundwater results

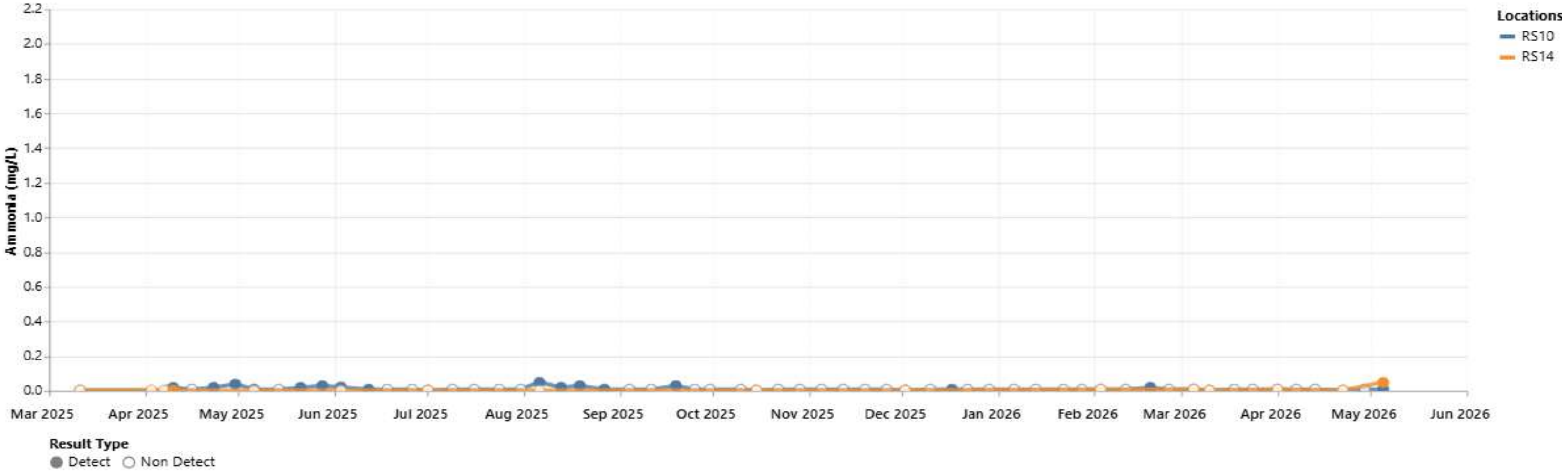
			Major Ions								Nutrients								Metals		
			Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride (filtered)	Sulfate (filtered)	Cations Total	Anions Total	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Iron (filtered)	Manganese (filtered)	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.05	0.01	0.05	0.01	0.5	0.15	0.01	0.01	0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	0.005	0.0005	0.001
Location	**Date**	**Time**																			
BH16	03 Dec 2025	10:27:00	-	-	-	-	-	-	-	-	0.004	0.039	0.048	3.4	3.4	0.009	3.42	0.007	-	-	-
BH16	11 Mar 2026	11:53:00	-	-	-	-	-	-	-	-	0.002	0.094	-	2.8	2.7	0.011	2.71	0.090	-	-	-
BH16	21 Apr 2026	10:18:00	-	-	-	-	-	-	-	-	0.002	0.209	-	2.6	2.3	0.007	2.13	0.035	-	-	-
BH17	09 Apr 2025	0:00:00	34.2	3.47	14.1	42.9	37.0	7.45	4.93	4.60	0.247	0.0915	-	8.9	8.84	0.00736	8.47	0.23	0.020	2.89	0.0054
BH17	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.223	0.276	-	8.9	8.62	0.0020	8.50	0.24	-	-	-
BH17	04 Jun 2025	11:12:00	-	-	-	-	-	-	-	-	0.247	0.036	-	9.058	9.0	0.022	8.99	0.276	-	-	-
BH17	02 Jul 2025	13:22:00	-	-	-	-	-	-	-	-	0.282	0.332	-	9.142	8.8	0.01	8.11	0.303	-	-	-
BH17	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.284	0.293	-	8.1	7.79	0.0124	7.73	0.32	-	-	-
BH17	03 Dec 2025	12:19:00	-	-	-	-	-	-	-	-	0.311	0.010	0.013	4.6	4.6	0.003	4.73	0.283	-	-	-
BH17	11 Mar 2026	11:47:00	-	-	-	-	-	-	-	-	0.297	0.247	-	6.0	5.8	0.004	5.56	0.299	-	-	-
BH17	21 Apr 2026	12:06:00	-	-	-	-	-	-	-	-	0.280	0.129	-	4.7	4.6	0.004	4.63	0.281	-	-	-
BH18	09 Apr 2025	0:00:00	9.49	1.36	1.9	31.1	1.83	15.3	2.03	2.23	0.002	0.0077	-	8.7	8.65	0.0016	0.27	3.31	0.599	0.0500	0.0053
BH18	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.026	0.0590	-	0.86	0.80	0.0027	0.12	0.50	-	-	-
BH18	04 Jun 2025	10:15:00	-	-	-	-	-	-	-	-	0.043	0.066	-	0.37	0.3	0.004	0.066	0.170	-	-	-
BH18	02 Jul 2025	13:58:00	-	-	-	-	-	-	-	-	0.038	0.222	-	0.323	0.1	<0.001	<0.005	0.145	-	-	-
BH18	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.038	0.142	-	0.31	0.17	<0.0010	<0.005	0.19	-	-	-
BH18	03 Dec 2025	12:23:00	-	-	-	-	-	-	-	-	0.041	0.058	0.062	0.2	0.2	0.003	0.064	0.074	-	-	-
BH18	11 Mar 2026	12:29:00	-	-	-	-	-	-	-	-	0.037	0.016	-	0.2	0.2	0.004	0.092	0.080	-	-	-
BH18	21 Apr 2026	12:02:00	-	-	-	-	-	-	-	-	0.038	0.023	-	0.2	0.1	0.004	0.094	0.117	-	-	-
BH19	09 Apr 2025	0:00:00	32.8	3.15	12.9	41.5	34.1	9.52	4.78	4.43	<0.002	0.0261	-	8.7	8.66	0.0024	8.35	0.016	0.022	4.19	0.0049
BH19	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.139	-	8.2	8.05	0.0015	8.35	0.010	-	-	-
BH19	04 Jun 2025	12:20:00	-	-	-	-	-	-	-	-	0.002	0.201	-	8.005	7.8	0.004	7.79	0.010	-	-	-
BH19	03 Jul 2025	10:22:00	-	-	-	-	-	-	-	-	<0.002	0.196	-	7.098	6.9	0.002	6.84	0.005	-	-	-
BH19	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.002	0.350	-	5.6	5.26	0.0012	5.30	0.0074	-	-	-
BH19	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.003	0.0409	-	3.8	3.76	<0.0010	3.57	0.013	-	-	-
BH19	03 Dec 2025	15:08:00	-	-	-	-	-	-	-	-	0.005	0.002	0.002	2.4	2.4	<0.001	2.30	0.012	-	-	-
BH19	11 Mar 2026	13:47:00	-	-	-	-	-	-	-	-	0.007	0.116	-	2.7	2.6	<0.001	2.31	0.016	-	-	-
BH19	21 Apr 2026	13:05:00	-	-	-	-	-	-	-	-	0.006	0.010	-	3.2	3.1	<0.001	2.51	0.061	-	-	-
BH20	09 Apr 2025	0:00:00	31.7	3.06	12.1	37.6	30.8	5.13	4.58	4.27	<0.002	<0.0020	-	8.8	8.77	<0.0010	8.57	0.020	0.10	4.93	0.0064
BH20	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	<0.0020	-	8.0	7.95	<0.0010	8.29	0.0087	-	-	-
BH20	04 Jun 2025	12:59:00	-	-	-	-	-	-	-	-	<0.002	<0.002	-	8.106	8.1	0.004	7.62	0.006	-	-	-
BH20	03 Jul 2025	9:38:00	-	-	-	-	-	-	-	-	<0.002	0.006	-	6.856	6.8	0.05	6.25	<0.005	-	-	-
BH20	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0074	-	5.4	5.39	0.0048	5.32	0.0066	-	-	-
BH20	14 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.002	<0.0020	-	3.5	3.48	0.0013	3.41	0.0078	-	-	-
BH20	03 Dec 2025	14:30:00	-	-	-	-	-	-	-	-	0.005	0.012	0.024	2.7	2.7	0.012	2.87	0.006	-	-	-
BH20	11 Mar 2026	13:38:00	-	-	-	-	-	-	-	-	0.004	0.020	-	2.6	2.6	0.003	2.28	0.017	-	-	-
BH20	21 Apr 2026	13:09:00	-	-	-	-	-	-	-	-	0.003	0.002	-	2.3	2.3	<0.001	2.26	0.011	-	-	-
BH21	09 Apr 2025	0:00:00	36.6	3.33	14.2	44.4	38.7	4.40	4.86	4.58	0.047	2.76	-	9.5	6.71	0.0265	5.71	0.049	0.013	1.62	0.0039
BH21	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.084	1.32	-	7.7	6.41	0.00542	6.39	0.096	-	-	-
BH21	04 Jun 2025	14:51:00	-	-	-	-	-	-	-	-	0.067	1.66	-	6.799	5.1	0.039	4.97	0.079	-	-	-
BH21	01 Jul 2025	17:00:00	-	-	-	-	-	-	-	-	0.042	4.48	-	6.129	1.6	0.049	1.29	0.048	-	-	-
BH21	07 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.086	1.35	-	3.9	2.56	0.0323	2.32	0.098	-	-	-
BH21	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.037	2.28	-	2.8	0.46	0.0270	0.35	0.047	-	-	-
BH21	03 Dec 2025	14:50:00	-	-	-	-	-	-	-	-	0.037	0.029	0.034	0.6	0.6	0.005	0.332	0.048	-	-	-
BH21	12 Mar 2026	9:55:00	-	-	-	-	-	-	-	-	0.077	0.495	-	1.5	1.0	0.003	0.737	0.064	-	-	-
BH21	21 Apr 2026	10:56:00	-	-	-	-	-	-	-	-	0.047	0.882	-	1.1	0.2	0.002	0.063	0.044	-	-	-
BH22	09 Apr 2025	0:00:00	56.1	2.80	3.4	6.54	4.69	4.97	3.52	3.28	<0.002	0.149	-	1.7	1.58	<0.0010	1.34	<0.0050	0.010	0.503	0.0028
BH22	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0934	-	1.2	1.15	<0.0010	0.97	0.0056	-	-	-

Groundwater results

			Major Ions								Nutrients								Metals		
			Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride (filtered)	Sulfate (filtered)	Cations Total	Anions Total	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Iron (filtered)	Manganese (filtered)	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.05	0.01	0.05	0.01	0.5	0.15	0.01	0.01	0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	0.005	0.0005	0.001
Location	**Date**	**Time**																			
BH22	04 Jun 2025	12:46:00	-	-	-	-	-	-	-	-	<0.002	<0.002	-	1.203	1.2	<0.001	1.02	<0.005	-	-	-
BH22	03 Jul 2025	9:51:00	-	-	-	-	-	-	-	-	<0.002	<0.002	-	1.103	1.1	0.001	1.04	0.047	-	-	-
BH22	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0225	-	1.4	1.37	<0.0010	1.15	0.082	-	-	-
BH22	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	<0.002	0.0551	-	1.6	1.57	0.0012	1.36	0.096	-	-	-
BH22	03 Dec 2025	13:26:00	-	-	-	-	-	-	-	-	0.004	<0.002	<0.002	1.7	1.7	<0.001	1.59	<0.005	-	-	-
BH22	11 Mar 2026	14:27:00	-	-	-	-	-	-	-	-	0.004	0.024	-	1.3	1.2	0.001	1.13	0.010	-	-	-
BH22	21 Apr 2026	14:03:00	-	-	-	-	-	-	-	-	0.003	0.004	-	1.2	1.2	<0.001	1.29	0.013	-	-	-
BH23	09 Apr 2025	0:00:00	36.4	4.49	3.8	33.3	8.32	14.8	3.75	2.89	<0.002	0.146	-	0.49	0.29	0.0599	0.14	0.021	0.013	0.379	0.0062
BH23	07 May 2025	0:00:00	-	-	-	-	-	-	-	-	0.026	0.0100	-	0.38	0.36	0.0100	0.23	0.029	-	-	-
BH23	04 Jun 2025	13:26:00	-	-	-	-	-	-	-	-	0.013	0.003	-	0.505	0.5	0.002	0.483	0.022	-	-	-
BH23	03 Jul 2025	10:25:00	-	-	-	-	-	-	-	-	0.022	0.085	-	0.502	0.4	0.017	0.162	0.039	-	-	-
BH23	05 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	0.022	0.0393	-	0.32	0.28	0.00665	0.29	0.036	-	-	-
BH23	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	0.036	0.0317	-	0.23	0.19	0.0031	0.04	0.068	-	-	-
BH23	03 Dec 2025	13:36:00	-	-	-	-	-	-	-	-	0.030	0.025	0.025	0.4	0.4	<0.001	0.353	0.053	-	-	-
BH23	11 Mar 2026	14:26:00	-	-	-	-	-	-	-	-	0.023	0.011	-	0.3	0.3	<0.001	0.335	0.035	-	-	-
BH23	21 Apr 2026	14:09:00	-	-	-	-	-	-	-	-	0.014	<0.002	-	0.6	0.6	<0.001	0.604	0.022	-	-	-

Ammoniacal nitrogen

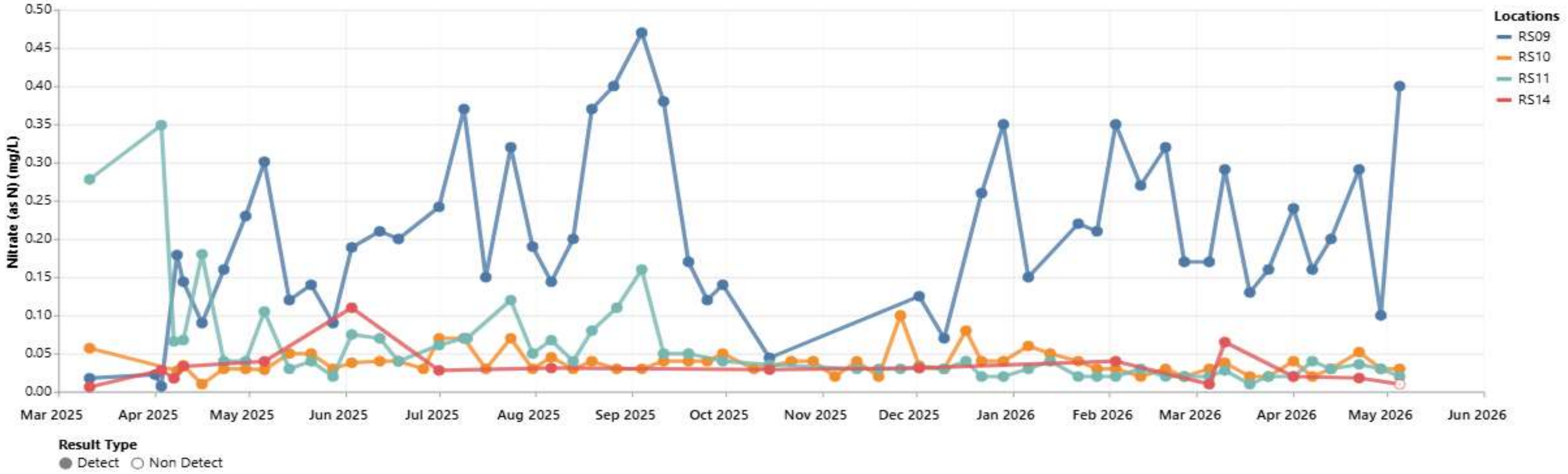


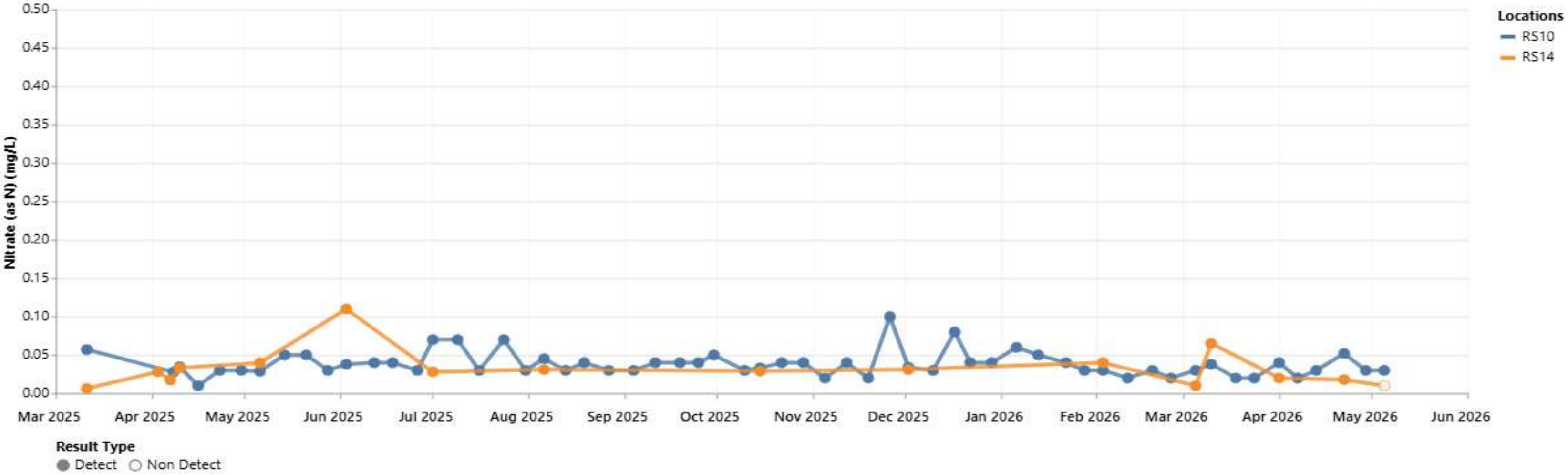


Shotover WWTP - Surface water

Project no.
12645246

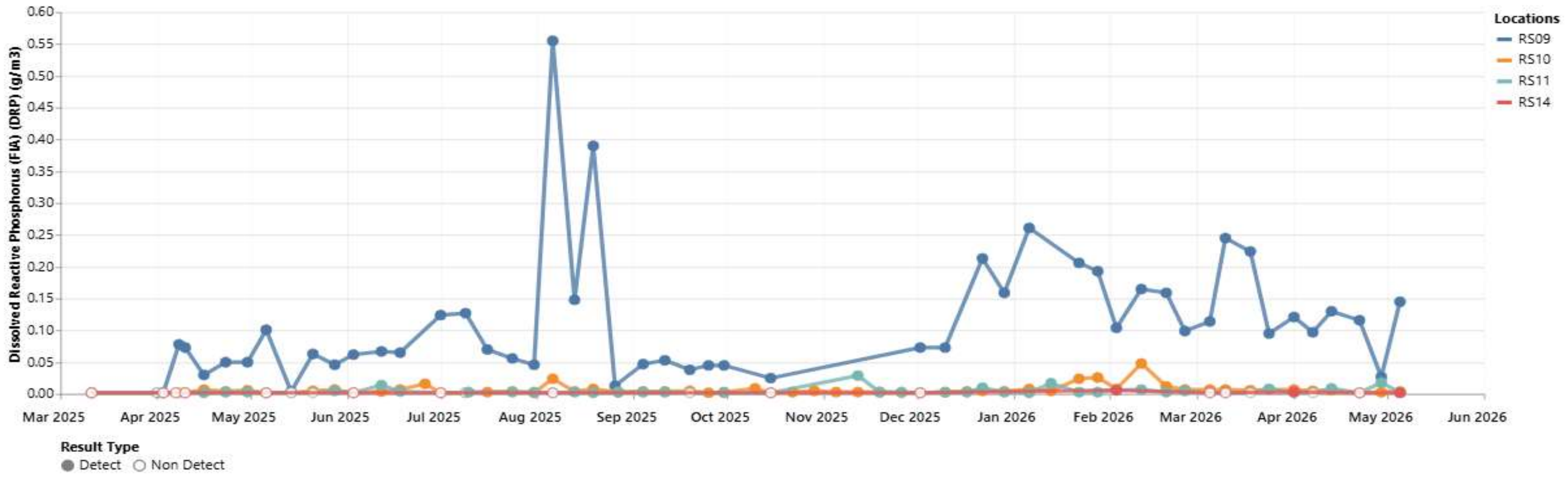
Nitrate nitrogen

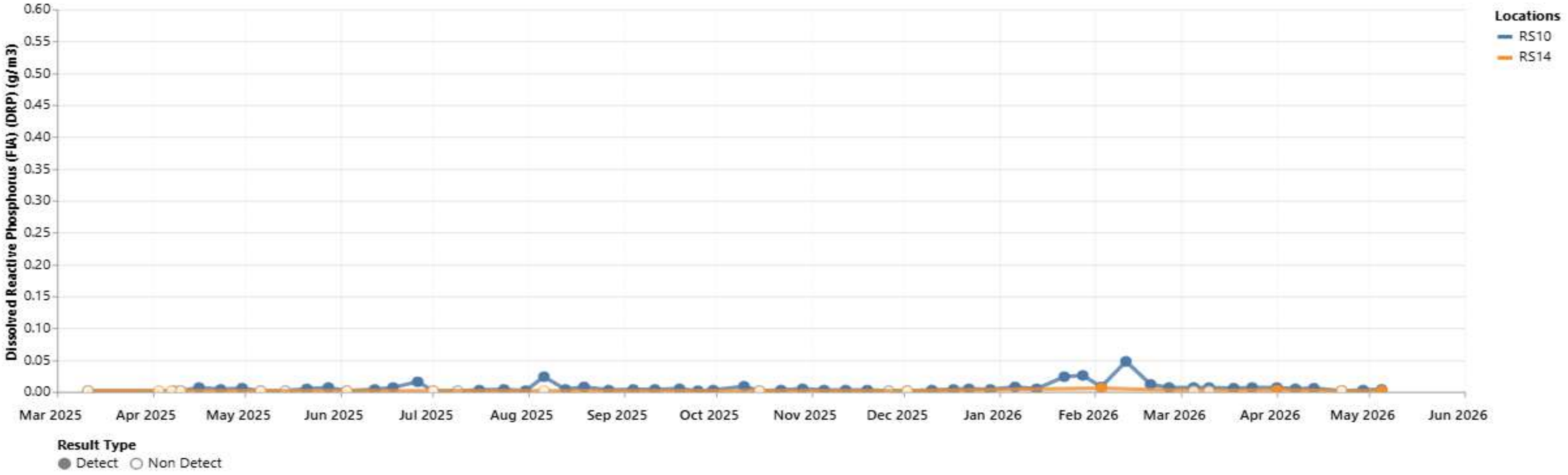




Shotover WWTP - Surface water	Project no. 12645246	GHD

Dissolved Reactive Phosphorus





Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Collert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS01	10 Mar 2025	12:45:00	8.12	139	9.17	9.17	-	-	14.9	-	-	-	-	-	-	547.5	3.1	-
RS01	10 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	138	-	-	-	57.5
RS01	11 Mar 2025	8:45:00	7.11	307	1.82	-	-	-	13.8	-	-	-	-	-	-	410.6	33.6	-
RS01	08 Apr 2025	13:10:00	7.84	104.1	-	-	104.2	104.9	9.4	70.2	-	15	-	-	-	770.1	129.6	-
RS01	10 Apr 2025	9:08:00	7.94	111.7	13.3	13.3	-	91.4	7.4	-	72.8	67	-	-	-	-	-	-
RS01	06 May 2025	14:46:00	7.89	126.3	-	-	102.2	106.7	6.9	-	-	>120	-	-	-	52.8	<1	-
RS01	03 Jun 2025	12:35:00	7.9	120.5	-	-	99.3	101.3	6.4	5.21	-	>120	-	-	-	-	1	-
RS01	01 Jul 2025	14:37:00	7.75	104	-	-	127	13.07	3	-	-	42	-	-	-	83.1	2	-
RS01	06 Aug 2025	13:03:00	7.8	112.3	12.5	12.5	96.2	21.8	3.3	-	-	-	-	-	-	16.4	<1	-
RS01	15 Oct 2025	14:27:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
RS01	02 Dec 2025	13:34:00	7.77	85.3	10.71	10.71	-	80.9	11.6	58.1	-	7	-	-	-	-	10	-
RS01	02 Dec 2025	13:34:00	-	-	-	-	-	-	-	-	-	-	-	-	178	-	-	-
RS01	03 Feb 2026	10:45:00	7.9	98	11.1	11.1	-	-	12	-	-	-	-	-	-	-	60	-
RS01	05 Mar 2026	10:45:00	8.1	123	10.8	10.8	-	-	13.4	-	-	-	-	-	-	-	10	-
RS01	10 Mar 2026	16:10:00	7.96	119.7	-	-	9.83	81.2	13.5	4.25	-	>120	-	-	-	47.3	1	-
RS01	01 Apr 2026	11:15:00	8	130	11.6	11.6	-	-	11.1	-	-	-	-	-	-	-	11	-
RS01	22 Apr 2026	14:00:00	7.84	103.4	11.57	11.57	98	18.9	7.2	7.29	-	47	-	-	-	-	2	-
RS02	10 Mar 2025	13:18:00	8.06	139	9.76	9.76	-	-	15.1	-	-	-	-	-	-	461.1	12.2	-
RS02	10 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	139	-	-	-	56.6
RS02	11 Mar 2025	9:15:00	6.64	451	4.6	-	-	-	12.5	-	-	-	-	-	-	313	16.1	-
RS02	08 Apr 2025	10:10:00	7.88	113.1	-	-	103.2	105.9	9.6	19.03	-	40	-	-	-	816.4	62.4	-
RS02	06 May 2025	13:40:00	7.93	126.1	-	-	104.2	108	6.9	-	-	>120	-	-	-	117.5	14.6	-
RS02	06 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS02	03 Jun 2025	12:15:00	7.81	119.6	-	-	89.9	94.5	6	-	-	>120	-	-	-	-	1	-
RS02	03 Jun 2025	12:15:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS02	01 Jul 2025	14:02:00	7.57	103.4	-	-	142.1	13.1	3.2	-	-	60	-	-	-	200.5	4.2	-
RS02	01 Jul 2025	14:02:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS02	06 Aug 2025	10:55:00	7.35	43.4	12.53	12.53	94.6	51.7	2.7	-	-	-	-	-	-	23.8	3.1	-
RS02	06 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS02	15 Oct 2025	12:10:00	7.55	83.9	12.83	12.83	-	43	6.5	-	-	17	-	-	-	-	10	-
RS02	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS02	02 Dec 2025	11:26:00	7.8	82	11.04	11.04	-	23.7	9.7	87.44	-	7	-	-	-	-	20	-
RS02	02 Dec 2025	11:14:00	-	-	-	-	-	-	-	-	-	-	-	-	246	-	-	-
RS02	03 Feb 2026	11:25:00	7.8	98	11	11	-	-	13	-	-	-	-	-	-	-	90	-
RS02	05 Mar 2026	12:55:00	8	128	10.6	10.6	-	-	15.8	-	-	-	-	-	-	-	2	-
RS02	10 Mar 2026	14:20:00	7.95	117.4	-	-	10.04	87.04	13	3.27	-	120	-	-	-	-	27	-
RS02	01 Apr 2026	12:15:00	7.9	120	11.4	11.4	-	-	12.6	-	-	-	-	-	-	-	6	-
RS02	22 Apr 2026	13:25:00	7.84	103	11.88	11.88	98.7	14.7	6.4	12.78	-	42	-	-	-	-	6	-
RS04 B	07 Apr 2025	14:40:00	7.92	123.1	-	-	183.8	137.3	12.4	-	-	75	-	-	-	290.9	19.9	-
RS04 B	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	125	-	-	-	51.0
RS04 B	10 Apr 2025	11:45:00	-	-	-	-	-	-	-	-	-	-	-	-	-	122.4	20.1	-
RS04 B	16 Apr 2025	10:35:00	7.8	78.5	11.5	11.5	-	129.1	10.3	-	-	61	-	-	-	-	19	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Collilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS04 B	23 Apr 2025	11:54:00	8.1	88	11.6	11.6	-	-	11.4	-	-	-	-	-	-	-	5	-
RS04 B	30 Apr 2025	10:02:00	7.9	90	11.4	11.4	-	-	10.1	-	-	-	-	-	-	-	9	-
RS04 B	06 May 2025	13:15:00	7.9	126.2	-	-	102.9	109.2	6.7	-	-	>120	-	-	-	34.5	4.1	-
RS04 B	14 May 2025	12:30:00	8	76	12.3	12.3	-	-	8.7	-	-	-	-	-	-	-	4	-
RS04 B	21 May 2025	12:43:00	7.9	73	13.2	13.2	-	-	6.9	-	-	-	-	-	-	-	<1	-
RS04 B	28 May 2025	12:15:00	8	114	12.9	12.9	-	-	6.1	-	-	-	-	-	-	-	2	-
RS04 B	12 Jun 2025	9:58:00	8.2	74	13	13	-	-	4.8	-	-	-	-	-	-	-	15	-
RS04 B	18 Jun 2025	11:39:00	8	78	13.5	13.5	-	-	3.2	-	-	-	-	-	-	-	1	-
RS04 B	01 Jul 2025	14:14:00	7.74	104.2	-	-	128.5	12.94	3.2	-	-	43	-	-	-	>201	6.4	-
RS04 B	09 Jul 2025	12:34:00	8.1	74	13.1	13.1	-	-	4.5	-	-	-	-	-	-	-	1	-
RS04 B	16 Jul 2025	10:15:00	8.2	69	12.9	12.9	-	-	6.7	-	-	-	-	-	-	-	6	-
RS04 B	24 Jul 2025	11:17:00	8.3	74	13.7	13.7	-	-	3.5	-	-	-	-	-	-	-	<1	-
RS04 B	31 Jul 2025	12:28:00	8.2	66	12.8	12.8	-	-	7	-	-	-	-	-	-	-	2	-
RS04 B	06 Aug 2025	9:53:00	7.88	114	12.7	12.7	95.7	27.6	2.5	-	-	-	-	-	-	19.2	7.5	-
RS04 B	13 Aug 2025	12:15:00	8.2	74	13.2	13.2	-	-	5.6	-	-	-	-	-	-	-	<1	-
RS04 B	19 Aug 2025	13:21:00	8.2	75	12.6	12.6	-	-	6.6	-	-	-	-	-	-	-	<1	-
RS04 B	26 Aug 2025	0:00:00	7.9	81	12.9	12.9	-	-	6.8	-	-	-	-	-	-	-	<1	-
RS04 B	04 Sep 2025	12:00:00	8	73	12.5	12.5	-	-	6.9	-	-	-	-	-	-	-	<1	-
RS04 B	11 Sep 2025	13:30:00	7.9	66	13.1	13.1	-	-	6.5	-	-	-	-	-	-	-	<1	-
RS04 B	19 Sep 2025	9:27:00	-	-	-	-	-	-	-	-	-	-	7.7	87	-	-	6	-
RS04 B	25 Sep 2025	11:15:00	7.9	58	13	13	-	-	7.6	-	-	-	-	-	-	-	16	-
RS04 B	30 Sep 2025	13:48:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
RS04 B	15 Oct 2025	11:54:00	7.65	83.1	12.77	12.77	-	34.8	6.5	-	-	17	-	-	-	-	16	-
RS04 B	22 Oct 2025	12:07:00	8	52	12.7	12.7	-	-	7.7	-	-	-	-	-	-	-	30	-
RS04 B	29 Oct 2025	12:45:00	8	59	12.7	12.7	-	-	8	-	-	-	-	-	-	-	36	-
RS04 B	05 Nov 2025	0:00:00	7.6	60	11.7	11.7	-	-	11.6	-	-	-	-	-	-	-	49	-
RS04 B	12 Nov 2025	11:32:00	7.9	58	11.6	11.6	-	-	10.3	-	-	-	-	-	-	-	67	-
RS04 B	19 Nov 2025	13:40:00	7.9	52	11.5	11.5	-	-	11.5	-	-	-	-	-	-	-	47	-
RS04 B	26 Nov 2025	12:24:00	8	89	11.3	11.3	-	-	13.4	-	-	-	-	-	-	-	8	-
RS04 B	02 Dec 2025	11:41:00	7.57	84.1	11.76	11.76	-	48.8	10	65.19	-	7	-	-	-	-	8	-
RS04 B	02 Dec 2025	11:26:00	-	-	-	-	-	-	-	-	-	-	-	-	248	-	-	-
RS04 B	10 Dec 2025	12:19:00	8	65	11.3	11.3	-	-	11.8	-	-	-	-	-	-	-	9	-
RS04 B	17 Dec 2025	11:35:00	8	86	11.7	11.7	-	-	11.9	-	-	-	-	-	-	-	56	-
RS04 B	22 Dec 2025	12:19:00	7.8	95	11.3	11.3	-	-	11.7	-	-	-	-	-	-	-	6	-
RS04 B	29 Dec 2025	12:05:00	7.8	92	11.2	11.2	-	-	12.4	-	-	-	-	-	-	-	11	-
RS04 B	06 Jan 2026	11:18:00	7.8	94	10.8	10.8	-	-	14.7	-	-	-	-	-	-	-	6	-
RS04 B	13 Jan 2026	11:36:00	7.8	68	11.3	11.3	-	-	11.9	-	-	-	-	-	-	-	130	-
RS04 B	22 Jan 2026	12:50:00	7.8	92	9.9	9.9	-	-	17.2	-	-	-	-	-	-	-	60	-
RS04 B	28 Jan 2026	12:00:00	8	109	10.5	10.5	-	-	15.6	-	-	-	-	-	-	-	14	-
RS04 B	03 Feb 2026	12:35:00	7.9	101	10.7	10.7	-	-	13.5	-	-	-	-	-	-	-	500	-
RS04 B	11 Feb 2026	13:40:00	8	106	10.6	10.6	-	-	16.8	-	-	-	-	-	-	-	600	-
RS04 B	19 Feb 2026	11:45:00	8.2	124	10.6	10.6	-	-	17.1	-	-	-	-	-	-	-	67	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS04 B	25 Feb 2026	12:00:00	8	120	10.4	10.4	-	-	17.9	-	-	-	-	-	-	-	340	-
RS04 B	05 Mar 2026	12:40:00	8	123	10.7	10.7	-	-	16.1	-	-	-	-	-	-	-	6	-
RS04 B	10 Mar 2026	13:55:00	7.93	117.8	-	-	10.26	92.7	12.3	4.07	-	120	-	-	-	47.3	14	-
RS04 B	18 Mar 2026	12:15:00	8	126	10.3	10.3	-	-	16.5	-	-	-	-	-	-	-	490	-
RS04 B	24 Mar 2026	12:40:00	7.9	129	10.9	10.9	-	-	14	-	-	-	-	-	-	-	1	-
RS04 B	01 Apr 2026	12:50:00	8.1	122	10.9	10.9	-	-	14.4	-	-	-	-	-	-	-	9	-
RS04 B	07 Apr 2026	12:00:00	8	123	11.1	11.1	-	-	13.3	-	-	-	-	-	-	-	19	-
RS04 B	13 Apr 2026	13:35:00	8	118	11.1	11.1	-	-	11.4	-	-	-	-	-	-	-	36	-
RS04 B	22 Apr 2026	12:13:00	7.75	103.5	11.61	11.61	96.4	16.9	6.4	12.99	-	43	-	-	-	-	1	-
RS04 B	29 Apr 2026	13:00:00	8	108	-	11.9	-	-	11	-	-	-	-	-	-	-	3	-
RS06 B	11 Mar 2025	12:00:00	8	140.5	10.02	10.02	-	-	14.5	-	-	-	-	-	-	>579.4	>40.5	-
RS06 B	11 Mar 2025	12:00:00	8	140.5	10.02	10.02	-	-	14.5	-	-	-	-	-	-	-	-	-
RS06 B	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	140	-	-	-	57.6
RS06 B	01 Apr 2025	11:30:00	7.93	138.6	-	-	115.8	115.8	12.5	-	-	-	-	-	-	290.9	46.4	-
RS06 B	03 Apr 2025	13:50:00	7.88	144.8	-	-	105.4	136.3	13.3	-	-	-	-	-	-	-	-	-
RS06 B	04 Apr 2025	13:30:00	7.61	104.7	-	-	104.7	131.5	13.1	132.6	-	-	-	-	-	2,419.6	410.6	-
RS06 B	07 Apr 2025	13:45:00	7.89	135.6	-	-	97.3	132.3	13.3	-	-	97.3	-	-	-	461.1	36.8	-
RS06 B	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	140	-	-	-	53.5
RS06 B	10 Apr 2025	10:55:00	7.84	115.7	0.56	0.56	-	137.8	9	-	75.4	68	-	-	-	435.2	18.7	-
RS06 B	16 Apr 2025	11:49:00	7.94	91.2	11.27	11.27	-	128.5	12	-	-	69	-	-	-	-	11	-
RS06 B	23 Apr 2025	12:48:00	7.9	116	11.4	11.4	-	-	12.5	-	-	-	-	-	-	-	8	-
RS06 B	30 Apr 2025	11:23:00	7.9	120	11.3	11.3	-	-	10.9	-	-	-	-	-	-	-	20	-
RS06 B	06 May 2025	12:15:00	7.86	156	-	-	106.2	136.7	7.6	-	-	>120	-	-	-	547.5	7.5	-
RS06 B	14 May 2025	13:20:00	8	84	12.3	12.3	-	-	8.3	-	-	-	-	-	-	-	5	-
RS06 B	21 May 2025	13:26:00	8	86	12.7	12.7	-	-	7	-	-	-	-	-	-	-	<1	-
RS06 B	28 May 2025	13:05:00	7.9	89	12.7	12.7	-	-	6.9	-	-	-	-	-	-	-	3	-
RS06 B	03 Jun 2025	11:16:00	7.7	146.5	-	-	90.1	115.8	6.2	-	-	116	-	-	-	-	2	-
RS06 B	12 Jun 2025	10:27:00	8	97	12.9	12.9	-	-	5.1	-	-	-	-	-	-	-	13	-
RS06 B	18 Jun 2025	12:00:00	8	142	13.9	13.9	-	-	3.6	-	-	-	-	-	-	-	1	-
RS06 B	01 Jul 2025	12:44:00	7.7	129.3	-	-	127.8	12.88	4.1	-	-	50	-	-	-	>201	13.7	-
RS06 B	09 Jul 2025	12:54:00	8	101	12.9	12.9	-	-	5.2	-	-	-	-	-	-	-	13	-
RS06 B	16 Jul 2025	10:40:00	8.1	88	12.9	12.9	-	-	6.4	-	-	-	-	-	-	-	30	-
RS06 B	24 Jul 2025	11:55:00	7.9	103	13.7	13.7	-	-	5	-	-	-	-	-	-	-	130	-
RS06 B	31 Jul 2025	12:58:00	7.9	93	12.2	12.2	-	-	8.7	-	-	-	-	-	-	-	10	-
RS06 B	06 Aug 2025	10:31:00	7.63	155	11.86	11.86	92.9	84.6	3.7	-	-	-	-	-	-	165.2	16.4	-
RS06 B	13 Aug 2025	13:04:00	8	101	12.6	12.6	-	-	6.6	-	-	-	-	-	-	-	25	-
RS06 B	19 Aug 2025	13:48:00	7.8	115	7.9	7.9	-	-	6.9	-	-	-	-	-	-	-	5	-
RS06 B	26 Aug 2025	0:00:00	7.8	117	12.3	12.3	-	-	9	-	-	-	-	-	-	-	25	-
RS06 B	04 Sep 2025	11:15:00	7.8	102	12.3	12.3	-	-	7.8	-	-	-	-	-	-	-	25	-
RS06 B	11 Sep 2025	13:00:00	7.7	96	12.6	12.6	-	-	8.8	-	-	-	-	-	-	-	17	-
RS06 B	19 Sep 2025	9:43:00	-	-	-	-	-	-	-	-	-	-	7.6	102	-	-	12	-
RS06 B	25 Sep 2025	11:27:00	7.8	66	12.9	12.9	-	-	7.9	-	-	-	-	-	-	-	20	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Collert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS06 B	30 Sep 2025	14:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-
RS06 B	10 Oct 2025	13:33:00	7.8	50	12.3	12.3	-	-	8.4	-	-	-	-	-	-	-	330	-
RS06 B	15 Oct 2025	10:37:00	7.68	88.5	13.54	13.54	-	24.2	6.3	-	-	19	-	-	-	-	30	-
RS06 B	22 Oct 2025	12:24:00	7.9	58	12.8	12.8	-	-	7.7	-	-	-	-	-	-	-	28	-
RS06 B	29 Oct 2025	12:20:00	7.9	95	12.3	12.3	-	-	8	-	-	-	-	-	-	-	32	-
RS06 B	05 Nov 2025	0:00:00	7.7	70	11.7	11.7	-	-	12.4	-	-	-	-	-	-	-	47	-
RS06 B	12 Nov 2025	11:58:00	7.9	64	11.8	11.8	-	-	9.7	-	-	-	-	-	-	-	42	-
RS06 B	19 Nov 2025	14:00:00	7.8	56	11.4	11.4	-	-	12	-	-	-	-	-	-	-	29	-
RS06 B	26 Nov 2025	12:49:00	8	95	11.3	11.3	-	-	14.8	-	-	-	-	-	-	-	41	-
RS06 B	02 Dec 2025	10:34:00	7.08	9.41	10.95	10.95	-	14	9.7	66.51	-	6.5	-	-	-	-	34	-
RS06 B	02 Dec 2025	10:03:00	-	-	-	-	-	-	-	-	-	-	-	-	220	-	-	-
RS06 B	10 Dec 2025	12:33:00	7.9	76	11	11	-	-	13.4	-	-	-	-	-	-	-	27	-
RS06 B	17 Dec 2025	11:50:00	7.8	105	11.7	11.7	-	-	12.9	-	-	-	-	-	-	-	74	-
RS06 B	22 Dec 2025	11:46:00	7.4	120	11.1	11.1	-	-	13	-	-	-	-	-	-	-	42	-
RS06 B	29 Dec 2025	11:40:00	7.5	126	10.9	10.9	-	-	13.1	-	-	-	-	-	-	-	35	-
RS06 B	06 Jan 2026	10:50:00	7.6	116	10.6	10.6	-	-	15.7	-	-	-	-	-	-	-	33	-
RS06 B	13 Jan 2026	11:52:00	7.5	90	11.2	11.2	-	-	12.7	-	-	-	-	-	-	-	50	-
RS06 B	22 Jan 2026	13:12:00	7.7	102	10.2	10.2	-	-	16.2	-	-	-	-	-	-	-	70	-
RS06 B	28 Jan 2026	11:15:00	7.8	131	10.6	10.6	-	-	11.2	-	-	-	-	-	-	-	58	-
RS06 B	03 Feb 2026	12:10:00	7.7	125	11	11	-	-	13.8	-	-	-	-	-	-	-	120	-
RS06 B	11 Feb 2026	13:00:00	7.8	124	10.7	10.7	-	-	16.8	-	-	-	-	-	-	-	240	-
RS06 B	19 Feb 2026	11:50:00	7.7	160	10.5	10.5	-	-	15.8	-	-	-	-	-	-	-	170	-
RS06 B	25 Feb 2026	12:40:00	7.8	157	10.4	10.4	-	-	16.9	-	-	-	-	-	-	-	50	-
RS06 B	05 Mar 2026	12:55:00	8	127	10.5	10.5	-	-	14.8	-	-	-	-	-	-	-	18	-
RS06 B	10 Mar 2026	13:05:00	7.64	151	-	-	10.69	124.3	13.3	4.75	-	120	-	-	-	-	110	-
RS06 B	18 Mar 2026	11:35:00	7.6	156	10.5	10.5	-	-	16.3	-	-	-	-	-	-	-	250	-
RS06 B	24 Mar 2026	11:45:00	7.7	162	10.7	10.7	-	-	14.3	-	-	-	-	-	-	-	140	-
RS06 B	01 Apr 2026	12:30:00	7.7	113	11.2	11.2	-	-	13	-	-	-	-	-	-	-	43	-
RS06 B	07 Apr 2026	11:35:00	7.9	143	10.9	10.9	-	-	13.6	-	-	-	-	-	-	-	33	-
RS06 B	13 Apr 2026	13:00:00	7.7	150	10.7	10.7	-	-	12.5	-	-	-	-	-	-	-	200	-
RS06 B	22 Apr 2026	12:48:00	7.56	135.7	11.58	11.58	100.1	50.7	8	8.2	-	40	-	-	-	-	33	-
RS06 B	29 Apr 2026	11:45:00	7.8	131	-	11.9	-	-	9.9	-	-	-	-	-	-	-	11	-
RS09	11 Mar 2025	12:00:00	8.13	141	9.9	9.9	-	-	14.7	-	-	-	-	-	-	>2,420	>2,420	-
RS09	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	140	-	-	-	56.5
RS09	01 Apr 2025	9:30:00	7.87	134.6	-	-	122.8	122.8	12.1	-	-	-	-	-	-	727	435.2	-
RS09	03 Apr 2025	13:15:00	7.94	103.5	-	-	103.6	119.6	13.2	-	-	-	-	-	-	613.1	128.1	-
RS09	08 Apr 2025	8:45:00	7.84	131.5	-	-	105.5	126.4	9.5	12.1	-	45	-	-	-	1,986.3	435.2	-
RS09	10 Apr 2025	10:55:00	7.77	126.9	-	-	103	123.9	9.2	8.12	-	80	-	-	-	307.6	20.3	-
RS09	16 Apr 2025	12:34:00	7.86	90.6	11.24	11.24	-	149.5	11.9	-	-	59	-	-	-	-	15	-
RS09	23 Apr 2025	13:35:00	8	103	11.1	11.1	-	-	12.8	-	-	-	-	-	-	-	14	-
RS09	30 Apr 2025	12:01:00	8	105	11.3	11.3	-	-	10.5	-	-	-	-	-	-	-	20	-
RS09	06 May 2025	12:10:00	8.15	155	-	-	107.5	67.5	7.3	-	-	>120	-	-	-	579.4	13.5	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS09	14 May 2025	14:10:00	7.9	81	11.8	11.8	-	-	9.5	-	-	-	-	-	-	-	7	-
RS09	21 May 2025	12:20:00	7.8	125	12.8	12.8	-	-	8	-	-	-	-	-	-	-	1	-
RS09	28 May 2025	12:07:00	7.9	82	12.9	12.9	-	-	6.5	-	-	-	-	-	-	-	6	-
RS09	03 Jun 2025	11:15:00	7.87	138.9	-	-	95.1	117.5	6.1	2.4	-	115	-	-	-	-	3	-
RS09	12 Jun 2025	10:56:00	8.1	85	12.9	12.9	-	-	5.1	-	-	-	-	-	-	-	12	-
RS09	18 Jun 2025	12:28:00	8.2	78	14.6	14.6	-	-	3.7	-	-	-	-	-	-	-	1	-
RS09	01 Jul 2025	12:30:00	7.7	129.3	-	-	133	12.8	3.9	-	-	34	-	-	-	144.5	9.9	-
RS09	09 Jul 2025	13:18:00	7.9	89	12.8	12.8	-	-	5.4	-	-	-	-	-	-	-	15	-
RS09	16 Jul 2025	11:11:00	7.9	82	13.1	13.1	-	-	6.1	-	-	-	-	-	-	-	21	-
RS09	24 Jul 2025	12:36:00	7.9	91	13.9	13.9	-	-	4.6	-	-	-	-	-	-	-	69	-
RS09	31 Jul 2025	13:30:00	7.9	86	12.6	12.6	-	-	8.4	-	-	-	-	-	-	-	7	-
RS09	06 Aug 2025	10:20:00	7.58	150.9	12.44	12.44	95.6	51.5	3.6	-	-	-	-	-	-	144.5	19.2	-
RS09	13 Aug 2025	13:16:00	8	99	12.8	12.8	-	-	7	-	-	-	-	-	-	-	24	-
RS09	19 Aug 2025	13:55:00	7.9	113	12.7	12.7	-	-	6.6	-	-	-	-	-	-	-	<1	-
RS09	26 Aug 2025	0:00:00	7.8	114	12.7	12.7	-	-	8.8	-	-	-	-	-	-	-	20	-
RS09	04 Sep 2025	11:10:00	7.9	105	12.7	12.7	-	-	8.2	-	-	-	-	-	-	-	48	-
RS09	11 Sep 2025	13:10:00	7.7	91	13.1	13.1	-	-	7.7	-	-	-	-	-	-	-	16	-
RS09	19 Sep 2025	9:49:00	-	-	-	-	-	-	-	-	-	-	7.6	100	-	-	38	-
RS09	25 Sep 2025	11:35:00	7.9	66	12.8	12.8	-	-	8.6	-	-	-	-	-	-	-	37	-
RS09	30 Sep 2025	14:05:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-
RS09	15 Oct 2025	10:56:00	7.69	88.4	12.96	12.96	-	29	6.5	-	-	19	-	-	-	-	18	-
RS09	02 Dec 2025	10:03:00	7.75	92.2	10.54	10.54	-	19	9.8	56.37	-	7	-	-	-	-	39	-
RS09	02 Dec 2025	9:45:00	-	-	-	-	-	-	-	-	-	-	-	-	178	-	-	-
RS09	10 Dec 2025	12:38:00	7.9	78	10.8	10.8	-	-	14.7	-	-	-	-	-	-	-	29	-
RS09	22 Dec 2025	11:59:00	7.5	130	10.3	10.3	-	-	13.6	-	-	-	-	-	-	-	34	-
RS09	29 Dec 2025	11:55:00	7.6	122	11.1	11.1	-	-	13.4	-	-	-	-	-	-	-	35	-
RS09	06 Jan 2026	11:05:00	7.7	115	10.8	10.8	-	-	15.3	-	-	-	-	-	-	-	22	-
RS09	22 Jan 2026	13:18:00	8.5	110	10.2	10.2	-	-	19.7	-	-	-	-	-	-	-	40	-
RS09	28 Jan 2026	11:40:00	7.9	106	11	11	-	-	15.3	-	-	-	-	-	-	-	25	-
RS09	03 Feb 2026	12:20:00	7.7	124	10.9	10.9	-	-	13.3	-	-	-	-	-	-	-	160	-
RS09	11 Feb 2026	12:45:00	8	135	10.8	10.8	-	-	18.5	-	-	-	-	-	-	-	360	-
RS09	19 Feb 2026	11:40:00	7.9	140	10.6	10.6	-	-	15.6	-	-	-	-	-	-	-	120	-
RS09	25 Feb 2026	12:20:00	7.9	138	10.5	10.5	-	-	16.6	-	-	-	-	-	-	-	58	-
RS09	05 Mar 2026	12:45:00	7.9	137	10.5	10.5	-	-	15.4	-	-	-	-	-	-	-	71	-
RS09	10 Mar 2026	12:55:00	7.83	133	-	-	10.51	106.9	13.1	5.35	-	120	-	-	-	-	35	-
RS09	18 Mar 2026	11:45:00	7.7	147	10.4	10.4	-	-	16.4	-	-	-	-	-	-	-	250	-
RS09	24 Mar 2026	12:00:00	7.9	143	11	11	-	-	13.6	-	-	-	-	-	-	-	110	-
RS09	01 Apr 2026	12:40:00	7.6	142	11.2	11.2	-	-	13.1	-	-	-	-	-	-	-	30	-
RS09	07 Apr 2026	11:45:00	8	108	11.1	11.1	-	-	13.5	-	-	-	-	-	-	-	22	-
RS09	13 Apr 2026	13:15:00	7.8	141	10.9	10.9	-	-	12	-	-	-	-	-	-	-	52	-
RS09	22 Apr 2026	13:00:00	7.74	129.6	11.57	11.57	100.5	44.2	8.4	7.38	-	42	-	-	-	-	19	-
RS09	29 Apr 2026	11:30:00	7.8	114	-	12	-	-	9	-	-	-	-	-	-	-	7	-

Surface water results

			Field Parameters												Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Collilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS10	11 Mar 2025	13:15:00	8	157	9.35	9.35	-	-	16.4	-	-	-	-	-	-	313	16.1	-
RS10	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	157	-	-	-	64.8
RS10	08 Apr 2025	14:00:00	7.8	105.5	-	-	104.7	108.8	10.2	57.2	-	19	-	-	-	1,203.3	517.2	-
RS10	10 Apr 2025	10:04:00	7.87	105.9	12.06	12.06	-	106	9.9	-	68.9	52	-	-	-	137.4	39.9	-
RS10	16 Apr 2025	13:45:00	7.79	56.6	10.45	10.45	-	164.6	14.4	-	-	120	-	-	-	-	24	-
RS10	23 Apr 2025	14:43:00	8	83	10.9	10.9	-	-	13.1	-	-	-	-	-	-	-	5	-
RS10	30 Apr 2025	12:50:00	8	78	10.9	10.9	-	-	11.7	-	-	-	-	-	-	-	13	-
RS10	06 May 2025	15:00:00	7.85	96.5	-	-	103.8	106.2	11	-	-	>120	-	-	-	50.4	6.3	-
RS10	14 May 2025	14:44:00	8	79	12	12	-	-	8.2	-	-	-	-	-	-	-	5	-
RS10	21 May 2025	13:56:00	7.6	76	12.4	12.4	-	-	7.6	-	-	-	-	-	-	-	1	-
RS10	28 May 2025	11:30:00	8.1	109	12.4	12.4	-	-	8.1	-	-	-	-	-	-	-	5	-
RS10	03 Jun 2025	13:06:00	7.78	110.2	-	-	90.4	92.4	7.7	-	-	>120	-	-	-	-	1	-
RS10	12 Jun 2025	11:23:00	8.2	74	12.9	12.9	-	-	5.1	-	-	-	-	-	-	-	7	-
RS10	18 Jun 2025	12:58:00	8.2	69	13.6	13.6	-	-	4.5	-	-	-	-	-	-	-	<1	-
RS10	26 Jun 2025	13:45:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240	-
RS10	01 Jul 2025	15:07:00	7.77	108.2	-	-	120.6	12.8	3.9	-	-	34	-	-	-	88.5	6.4	-
RS10	09 Jul 2025	13:52:00	8.1	78	12.7	12.7	-	-	5.6	-	-	-	-	-	-	-	1	-
RS10	16 Jul 2025	11:31:00	5.9	68	12.9	12.9	-	-	5.9	-	-	-	-	-	-	-	2	-
RS10	24 Jul 2025	13:17:00	8	83	13.3	13.3	-	-	5.7	-	-	-	-	-	-	-	<1	-
RS10	31 Jul 2025	14:00:00	8	66	12.6	12.6	-	-	7.3	-	-	-	-	-	-	-	2	-
RS10	06 Aug 2025	13:30:00	7.79	104.8	11.73	11.73	94.4	-19.3	5.1	-	-	-	-	-	-	27.1	2	-
RS10	13 Aug 2025	13:45:00	8.3	74	12.4	12.4	-	-	6.7	-	-	-	-	-	-	-	<1	-
RS10	19 Aug 2025	10:52:00	8.3	73	12.9	12.9	-	-	5.7	-	-	-	-	-	-	-	5	-
RS10	27 Aug 2025	12:25:00	8	116	12.8	12.8	-	-	5	-	-	-	-	-	-	-	1	-
RS10	04 Sep 2025	13:56:00	7.9	76	12.3	12.3	-	-	8.1	-	-	-	-	-	-	-	1	-
RS10	11 Sep 2025	14:30:00	7.9	71	12.8	12.8	-	-	8	-	-	-	-	-	-	-	<1	-
RS10	19 Sep 2025	10:32:00	-	-	-	-	-	-	-	-	-	-	7.6	91	-	-	6	-
RS10	25 Sep 2025	12:18:00	7.9	61	12.6	12.6	-	-	8.7	-	-	-	-	-	-	-	18	-
RS10	30 Sep 2025	14:31:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
RS10	10 Oct 2025	14:02:00	7.9	45	12.1	12.1	-	-	10.7	-	-	-	-	-	-	-	120	-
RS10	15 Oct 2025	14:08:00	7.51	89.1	14.6	14.6	-	52.9	8.2	-	-	14	-	-	-	-	1	-
RS10	22 Oct 2025	13:04:00	7.9	132	12.6	12.6	-	-	7.6	-	-	-	-	-	-	-	29	-
RS10	29 Oct 2025	13:30:00	8	63	12.3	12.3	-	-	8.5	-	-	-	-	-	-	-	22	-
RS10	05 Nov 2025	0:00:00	7.7	73	11.1	11.1	-	-	13.5	-	-	-	-	-	-	-	38	-
RS10	12 Nov 2025	12:31:00	7.9	65	11.4	11.4	-	-	10.3	-	-	-	-	-	-	-	27	-
RS10	19 Nov 2025	13:04:00	7.8	56	11.5	11.5	-	-	11.6	-	-	-	-	-	-	-	37	-
RS10	26 Nov 2025	11:37:00	7.8	142	9.9	9.9	-	-	16.7	-	-	-	-	-	-	-	7	-
RS10	02 Dec 2025	14:02:00	7.76	93.9	10.18	10.18	-	76.7	14.7	42.82	-	-	-	-	-	-	6	-
RS10	02 Dec 2025	14:04:00	-	-	-	-	-	-	-	-	-	-	-	-	86	-	-	-
RS10	10 Dec 2025	13:17:00	8.1	94	9.6	9.6	-	-	21.9	-	-	-	-	-	-	-	9	-
RS10	17 Dec 2025	10:45:00	8.2	96	11	11	-	-	13.3	-	-	-	-	-	-	-	76	-
RS10	22 Dec 2025	10:50:00	7.3	113	10.6	10.6	-	-	13.5	-	-	-	-	-	-	-	1	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS10	29 Dec 2025	10:55:00	7.7	110	10.6	10.6	-	-	14.2	-	-	-	-	-	-	-	4	-
RS10	06 Jan 2026	9:45:00	7.8	137	9.9	9.9	-	-	15.8	-	-	-	-	-	-	-	8	-
RS10	13 Jan 2026	12:40:00	7.7	93	10.4	10.4	-	-	16.8	-	-	-	-	-	-	-	42	-
RS10	22 Jan 2026	14:06:00	7.9	120	9.5	9.5	-	-	18.5	-	-	-	-	-	-	-	12	-
RS10	28 Jan 2026	13:05:00	7.8	98	10.5	10.5	-	-	17.8	-	-	-	-	-	-	-	5	-
RS10	03 Feb 2026	10:15:00	7.9	102	10.7	10.7	-	-	13.1	-	-	-	-	-	-	-	70	-
RS10	11 Feb 2026	10:45:00	8	119	10.6	10.6	-	-	15.5	-	-	-	-	-	-	-	130	-
RS10	19 Feb 2026	10:30:00	7.9	109	10.6	10.6	-	-	14.5	-	-	-	-	-	-	-	27	-
RS10	25 Feb 2026	9:45:00	7.9	95	10.5	10.5	-	-	15.7	-	-	-	-	-	-	-	26	-
RS10	05 Mar 2026	10:15:00	8	116	10.7	10.7	-	-	14.2	-	-	-	-	-	-	-	23	-
RS10	10 Mar 2026	16:40:00	7.79	132.5	-	-	9.92	89.1	-	-	-	-	-	-	-	112.6	16.1	-
RS10	18 Mar 2026	10:30:00	7.3	101	10.3	10.3	-	-	15.8	-	-	-	-	-	-	-	78	-
RS10	24 Mar 2026	10:00:00	7.8	100	10.8	10.8	-	-	13.8	-	-	-	-	-	-	-	26	-
RS10	01 Apr 2026	10:44:00	7.9	117	11.2	11.2	-	-	11.1	-	-	-	-	-	-	-	16	-
RS10	07 Apr 2026	10:35:00	8	91	10.7	10.7	-	-	13.5	-	-	-	-	-	-	-	16	-
RS10	13 Apr 2026	10:15:00	7.8	107	10.6	10.6	-	-	11.2	-	-	-	-	-	-	-	8	-
RS10	22 Apr 2026	14:20:00	7.82	114.6	11.48	11.48	99.1	25.4	8	15.88	-	39	-	-	-	-	9	-
RS10	29 Apr 2026	10:45:00	8	122	-	11.5	-	-	10.7	-	-	-	-	-	-	-	<1	-
RS11	11 Mar 2025	11:30:00	7.51	112.4	8.55	8.55	-	-	16.5	-	-	-	-	-	-	>217.8	>17.3	-
RS11	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.5	106	-	-	-	37.8
RS11	03 Apr 2025	9:45:00	7.41	71.4	-	-	101.1	122.1	15.1	-	-	-	-	-	-	1,299.7	36.4	-
RS11	03 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS11	07 Apr 2025	12:00:00	7.65	74.1	-	-	111.5	149.1	15.4	-	-	120	-	-	-	547.5	50.4	-
RS11	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.4	73.6	-	-	-	25.9
RS11	10 Apr 2025	9:45:00	7.67	78.1	-	-	101.6	100.1	14.2	1.61	-	120	-	-	-	275.5	57.3	-
RS11	16 Apr 2025	12:20:00	7.74	57.4	10.12	10.12	-	143.9	15	-	-	120	-	-	-	-	19	-
RS11	23 Apr 2025	13:15:00	7.8	54	10.3	10.3	-	-	14.4	-	-	-	-	-	-	-	9	-
RS11	30 Apr 2025	11:50:00	7.8	65	10.1	10.1	-	-	13.4	-	-	-	-	-	-	-	22	-
RS11	06 May 2025	11:36:00	7.47	86.1	-	-	97.5	119.3	12.9	-	-	>120	-	-	-	52.8	28.1	-
RS11	14 May 2025	13:57:00	7.8	52	10.6	10.6	-	-	7.8	-	-	-	-	-	-	-	6	-
RS11	21 May 2025	12:07:00	7.6	53	10.7	10.7	-	-	12.7	-	-	-	-	-	-	-	2	-
RS11	28 May 2025	11:55:00	7.8	55	11.1	11.1	-	-	11.8	-	-	-	-	-	-	-	2	-
RS11	03 Jun 2025	10:34:00	7.45	67.4	-	-	94.3	81	11.4	-0.12	-	>120	-	-	-	-	5	-
RS11	12 Jun 2025	10:47:00	8	58	11.1	11.1	-	-	10.3	-	-	-	-	-	-	-	9	-
RS11	18 Jun 2025	12:16:00	8.2	48	13.6	13.6	-	-	4.5	-	-	-	-	-	-	-	6	-
RS11	01 Jul 2025	11:25:00	7.46	68.7	-	-	80.3	10.74	9.9	-	-	>120	-	-	-	59.1	9.9	-
RS11	09 Jul 2025	13:11:00	8	49	11.4	11.4	-	-	9.3	-	-	-	-	-	-	-	1	-
RS11	10 Jul 2025	10:53:00	8	84	11.5	11.5	-	-	9.6	-	-	-	-	-	-	-	2	-
RS11	24 Jul 2025	12:17:00	7.9	56	11.9	11.9	-	-	9.3	-	-	-	-	-	-	-	1	-
RS11	31 Jul 2025	13:18:00	8	50	11.5	11.5	-	-	9.7	-	-	-	-	-	-	-	<1	-
RS11	06 Aug 2025	12:13:00	7.52	62	10.27	10.27	90.5	40.8	8.8	-	-	-	-	-	-	19.2	3.1	-
RS11	13 Aug 2025	11:54:00	8	50	11.4	11.4	-	-	9.3	-	-	-	-	-	-	-	<1	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Collert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS11	19 Aug 2025	12:55:00	8.1	48	11.4	11.4	-	-	9.3	-	-	-	-	-	-	-	1	-
RS11	27 Aug 2025	11:50:00	7.8	64	11.6	11.6	-	-	8.8	-	-	-	-	-	-	-	2	-
RS11	04 Sep 2025	10:57:00	7.9	60	10.8	10.8	-	-	9.8	-	-	-	-	-	-	-	<1	-
RS11	11 Sep 2025	12:30:00	7.8	53	11.7	11.7	-	-	10.5	-	-	-	-	-	-	-	2	-
RS11	19 Sep 2025	9:12:00	-	-	-	-	-	-	-	-	-	-	7.6	63	-	-	5	-
RS11	30 Sep 2025	13:29:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	-
RS11	15 Oct 2025	12:38:00	7.46	61	11.5	11.5	-	34.2	10.4	-	-	>120	-	-	-	-	<1	-
RS11	12 Nov 2025	11:20:00	7.8	48	11.2	11.2	-	-	13	-	-	-	-	-	-	-	<1	-
RS11	19 Nov 2025	11:06:00	8	50	10.9	10.9	-	-	13.7	-	-	-	-	-	-	-	1	-
RS11	26 Nov 2025	12:06:00	8	50	11.5	11.5	-	-	13.9	-	-	-	-	-	-	-	2	-
RS11	02 Dec 2025	12:32:00	7.66	63.8	10.42	10.42	-	44.9	13.2	3.34	-	106	-	-	-	-	7	-
RS11	02 Dec 2025	12:32:00	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-
RS11	10 Dec 2025	12:00:00	7.9	63	10.3	10.3	-	-	16.7	-	-	-	-	-	-	-	1	-
RS11	17 Dec 2025	11:19:00	8	65	10.7	10.7	-	-	15.1	-	-	-	-	-	-	-	3	-
RS11	22 Dec 2025	11:26:00	7.5	64	10.8	10.8	-	-	14.3	-	-	-	-	-	-	-	1	-
RS11	29 Dec 2025	11:15:00	7.7	64	10.7	10.7	-	-	14.6	-	-	-	-	-	-	-	<1	-
RS11	06 Jan 2026	10:30:00	7.8	69	10.6	10.6	-	-	16.1	-	-	-	-	-	-	-	<1	-
RS11	13 Jan 2026	12:11:00	7.7	53	10.4	10.4	-	-	16.2	-	-	-	-	-	-	-	120	-
RS11	22 Jan 2026	13:39:00	7.8	61	10.3	10.3	-	-	15.6	-	-	-	-	-	-	-	<1	-
RS11	28 Jan 2026	10:45:00	7.9	57	10.7	10.7	-	-	16.5	-	-	-	-	-	-	-	1	-
RS11	03 Feb 2026	11:00:00	7.7	65	10.5	10.5	-	-	14.2	-	-	-	-	-	-	-	1	-
RS11	11 Feb 2026	12:20:00	7.8	69	10.4	10.4	-	-	16.2	-	-	-	-	-	-	-	6	-
RS11	19 Feb 2026	11:30:00	7.7	63	10.6	10.6	-	-	16.5	-	-	-	-	-	-	-	2	-
RS11	25 Feb 2026	11:45:00	7.7	68	10.4	10.4	-	-	17.3	-	-	-	-	-	-	-	8	-
RS11	05 Mar 2026	11:10:00	7.7	65	10.2	10.2	-	-	15.6	-	-	-	-	-	-	-	6	-
RS11	10 Mar 2026	12:00:00	7.6	65.6	-	-	10.31	75.6	14.3	2.03	-	>120	-	-	-	-	4	-
RS11	18 Mar 2026	11:15:00	7.5	67	10.2	10.2	-	-	16	-	-	-	-	-	-	-	5	-
RS11	24 Mar 2026	11:30:00	7.5	70	10.1	10.1	-	-	15.7	-	-	-	-	-	-	-	59	-
RS11	01 Apr 2026	11:30:00	7.8	72	10.3	10.3	-	-	14.7	-	-	-	-	-	-	-	18	-
RS11	07 Apr 2026	11:15:00	7.8	74	10.2	10.2	-	-	14.4	-	-	-	-	-	-	-	20	-
RS11	13 Apr 2026	12:30:00	7.9	67	10.2	10.2	-	-	14.6	-	-	-	-	-	-	-	19	-
RS11	22 Apr 2026	10:40:00	7.6	69.4	10.06	10.06	97.2	20.7	12.8	1.38	-	>120	-	-	-	-	14	-
RS11	23 Apr 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS11	29 Apr 2026	11:15:00	7.8	68	-	10.7	-	-	12.9	-	-	-	-	-	-	-	6	-
RS12	11 Mar 2025	10:00:00	7.39	77.3	8.57	8.57	-	-	16.7	-	-	-	-	-	-	387.3	5	-
RS12	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.3	137	-	-	39.9	46.9
RS12	03 Apr 2025	10:10:00	7.6	64	-	-	103	113.6	15.1	-	-	-	-	-	-	272.3	-	-
RS12	03 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.2	-
RS12	07 Apr 2025	11:48:00	7.63	70.1	-	-	108.2	119.9	15.3	-	-	120	-	-	-	290.9	-	-
RS12	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.4	73.2	-	-	115.3	27.4
RS12	10 Apr 2025	9:15:00	7.62	65.3	-	-	101.1	99.1	14.5	1.31	-	120	-	-	-	261.3	-	-
RS12	06 May 2025	11:15:00	7.6	63.6	-	-	102.4	30.6	12.4	-	-	-	-	-	-	45	54.6	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS12	03 Jun 2025	10:26:00	7.54	62.8	-	-	95.1	74.4	11.4	-	-	>120	-	-	-	-	4	-
RS12	01 Jul 2025	11:10:00	7.6	66.2	-	-	72.1	10.8	9.3	-	-	>120	-	-	-	73.8	5.3	-
RS12	06 Aug 2025	12:02:00	7.58	65.4	10.2	10.2	89.9	38.6	8.7	-	-	-	-	-	-	30.6	3.1	-
RS12	15 Oct 2025	12:55:00	7.4	61.1	11.4	11.4	-	36.7	10.4	-	-	>120	-	-	-	-	<1	-
RS12	02 Dec 2025	12:15:00	7.72	60	10.36	10.36	-	22.1	12.5	0.83	-	-	-	-	-	-	<1	-
RS12	02 Dec 2025	12:15:00	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
RS12	03 Feb 2026	11:15:00	7.7	64	10.5	10.5	-	-	14.3	-	-	-	-	-	-	-	5	-
RS12	05 Mar 2026	11:00:00	8.2	62	10.3	10.3	-	-	15.3	-	-	-	-	-	-	-	9	-
RS12	10 Mar 2026	11:25:00	7.57	64.7	-	-	10.55	59.8	14.2	1.42	-	>120	-	-	-	-	19	-
RS12	01 Apr 2026	11:40:00	7.8	66	10.4	10.4	-	-	14.7	-	-	-	-	-	-	-	19	-
RS12	22 Apr 2026	10:25:00	7.5	68.9	10.01	10.01	96.6	22.1	12.8	0.48	-	>120	-	-	-	-	-	-
RS12	23 Apr 2026	12:57:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-
RS13	11 Mar 2025	8:30:00	7.22	210	5.18	5.18	-	-	13.4	-	-	-	-	-	-	313	82	-
RS13	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.6	230	-	-	-	103
RS13	03 Apr 2025	10:25:00	7.38	79.4	-	-	100	118.2	14.9	-	-	-	-	-	-	435.2	222.4	-
RS13	07 Apr 2025	11:25:00	7.49	184.5	-	-	150.3	155.9	16.3	-	-	120	-	-	-	488.4	107.6	-
RS13	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	184	-	-	-	71.8
RS13	10 Apr 2025	8:55:00	7.44	41.6	-	-	90.8	118	12.3	1.6	-	120	-	-	-	206.4	52	-
RS13	06 May 2025	11:19:00	7.28	142	-	-	88.9	126	12.6	-	-	>120	-	-	-	64.5	37.9	-
RS13	03 Jun 2025	10:12:00	7.29	162.1	-	-	87.7	98.8	10.7	-	-	>120	-	-	-	-	8	-
RS13	01 Jul 2025	10:50:00	7.42	157.9	-	-	87.2	10.44	8.3	-	-	113	-	-	-	>201	38.4	-
RS13	06 Aug 2025	11:55:00	7.2	228.5	7.7	7.7	67.3	59	8.6	-	-	-	-	-	-	69.7	13.7	-
RS13	15 Oct 2025	13:12:00	7.47	69.3	11.47	11.47	-	37.6	10.4	-	-	>120	-	-	-	-	<1	-
RS13	02 Dec 2025	13:10:00	7.65	58.7	10.5	10.5	-	69.7	12.2	1.35	-	108	-	-	-	-	<1	-
RS13	02 Dec 2025	13:10:00	-	-	-	-	-	-	-	-	-	-	-	-	<3	-	-	-
RS13	03 Feb 2026	11:25:00	7.5	74	10.3	10.3	-	-	14.4	-	-	-	-	-	-	-	<1	-
RS13	05 Mar 2026	11:15:00	7.7	61	10.1	10.1	-	-	15.7	-	-	-	-	-	-	-	5	-
RS13	10 Mar 2026	11:10:00	7.2	148.3	-	-	10.47	83.9	14.7	1.02	-	>120	-	-	-	-	7	-
RS13	01 Apr 2026	11:50:00	7.4	129	9.9	9.9	-	-	15.4	-	-	-	-	-	-	-	120	-
RS13	22 Apr 2026	10:15:00	7.1	240.8	8.8	8.8	83	52.4	11.8	1.55	-	>120	-	-	-	-	-	-
RS13	23 Apr 2026	12:55:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	-
RS14	11 Mar 2025	9:30:00	7.7	61.7	8.8	8.8	-	-	16.5	-	-	-	-	-	-	410.6	33.6	-
RS14	11 Mar 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.3	60.4	-	-	-	23.2
RS14	03 Apr 2025	10:50:00	7.55	54.2	-	-	102.8	105.9	15.1	-	-	-	-	-	-	240	117.8	-
RS14	07 Apr 2025	11:00:00	7.78	62	-	-	141.2	155.3	15.3	-	-	120	-	-	-	435.2	96	-
RS14	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.4	60.8	-	-	-	23.8
RS14	10 Apr 2025	8:30:00	7.72	60.3	-	-	107.8	91	14.2	1.64	-	120	-	-	-	190.4	52	-
RS14	06 May 2025	10:45:00	7.4	61.2	-	-	103.2	43	12.4	-	-	>120	-	-	-	125.9	45.7	-
RS14	03 Jun 2025	10:02:00	7.72	62.4	-	-	101.4	93.1	11.3	0.3	-	>120	-	-	-	-	7	-
RS14	01 Jul 2025	10:34:00	7.61	62.3	-	-	82.5	10.88	9.7	-	-	>120	-	-	-	101.3	27.1	-
RS14	06 Aug 2025	11:40:00	7.65	63.2	10.43	10.43	91.7	48.2	8.7	-	-	-	-	-	-	42.9	5.3	-
RS14	15 Oct 2025	13:31:00	7.41	59	11.29	11.29	-	44	10.3	-	-	>120	-	-	-	-	<1	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS14	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS14	02 Dec 2025	12:57:00	7.6	59	10.48	10.48	-	61.8	12.2	0.78	-	110	-	-	-	-	5	-
RS14	02 Dec 2025	12:57:00	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
RS14	03 Feb 2026	11:35:00	7.4	83	10.4	10.4	-	-	14.8	-	-	-	-	-	-	-	4	-
RS14	05 Mar 2026	11:30:00	7.8	60	10.3	10.3	-	-	15.8	-	-	-	-	-	-	-	5	-
RS14	10 Mar 2026	10:40:00	7.66	62.9	-	-	11	55.1	14.2	-	-	>120	-	-	-	-	42	-
RS14	01 Apr 2026	12:00:00	7.8	63	10.5	10.5	-	-	15.2	-	-	-	-	-	-	-	130	-
RS14	22 Apr 2026	10:05:00	7.37	60.8	10.58	10.58	101.6	20.8	12.6	0.48	-	>120	-	-	-	-	-	-
RS14	23 Apr 2026	12:50:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-
RS15	01 Apr 2025	10:45:00	7.16	358.4	-	-	182.1	182.1	20.1	-	-	-	-	-	-	>2,420	435.2	-
RS15	03 Apr 2025	14:00:00	7.38	420.1	-	-	98.9	195.9	19.2	-	-	-	-	-	-	>2,420	32.3	-
RS15	07 Apr 2025	14:30:00	8	127.1	-	-	98	127.1	12.8	12.11	-	74	-	-	-	>2,420	28.5	-
RS15	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	470	-	-	-	106
RS15	10 Apr 2025	11:30:00	7.34	324.5	-	-	35.2	172.8	17.5	134.6	-	27	-	-	-	>2,420	17.1	-
RS15	16 Apr 2025	11:15:00	7.45	374.6	9.32	9.32	-	143	17.2	-	-	46	-	-	-	-	18	-
RS15	23 Apr 2025	12:21:00	7.4	393	9	9	-	-	17.4	-	-	-	-	-	-	-	14	-
RS15	30 Apr 2025	10:50:00	7.4	378	9.3	9.3	-	-	16.6	-	-	-	-	-	-	-	170	-
RS15	06 May 2025	12:55:00	7.42	432.3	-	-	102.1	111.4	15.9	-	-	35	-	-	-	>2,420	57.6	-
RS15	14 May 2025	12:45:00	7.3	323	9.3	9.3	-	-	16.2	-	-	-	-	-	-	-	40	-
RS15	21 May 2025	13:09:00	7.6	365	10.8	10.8	-	-	14.4	-	-	-	-	-	-	-	25	-
RS15	28 May 2025	12:50:00	7.5	449	10.4	10.4	-	-	12.9	-	-	-	-	-	-	-	13	-
RS15	03 Jun 2025	11:43:00	7.43	474.8	-	-	94.8	167.9	13.4	-	-	35	-	-	-	-	28	-
RS15	12 Jun 2025	10:12:00	7.6	335	11	11	-	-	10.2	-	-	-	-	-	-	-	33	-
RS15	18 Jun 2025	11:33:00	7.2	306	10.4	10.4	-	-	13	-	-	-	-	-	-	-	16	-
RS15	26 Jun 2025	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-
RS15	01 Jul 2025	12:03:00	7.35	380	-	-	42.3	10.47	11.5	-	-	22	-	-	-	>201	65.9	-
RS15	09 Jul 2025	12:42:00	7.5	313	11.6	11.6	-	-	9.8	-	-	-	-	-	-	-	60	-
RS15	10 Jul 2025	10:31:00	7.4	322	10.6	10.6	-	-	11.4	-	-	-	-	-	-	-	190	-
RS15	24 Jul 2025	11:31:00	7.3	312	10	10	-	-	11.4	-	-	-	-	-	-	-	750	-
RS15	31 Jul 2025	12:41:00	7.4	324	10.1	10.1	-	-	10.4	-	-	-	-	-	-	-	70	-
RS15	06 Aug 2025	9:17:00	7.2	459.5	8.87	8.87	82	48.2	10.8	-	-	-	-	-	-	>201	109.1	-
RS15	13 Aug 2025	12:38:00	7.4	360	10	10	-	-	11.6	-	-	-	-	-	-	-	170	-
RS15	19 Aug 2025	13:15:00	7.4	348	10.6	10.6	-	-	10.9	-	-	-	-	-	-	-	20	-
RS15	26 Aug 2025	0:00:00	7	319	9.7	9.7	-	-	15	-	-	-	-	-	-	-	100	-
RS15	04 Sep 2025	12:10:00	7.1	299	10	10	-	-	14	-	-	-	-	-	-	-	210	-
RS15	11 Sep 2025	12:40:00	7.1	287	10.4	10.4	-	-	14.2	-	-	-	-	-	-	-	80	-
RS15	19 Sep 2025	9:35:00	-	-	-	-	-	-	-	-	-	-	7	348	-	-	320	-
RS15	25 Sep 2025	11:10:00	7	280	10.3	10.3	-	-	15.1	-	-	-	-	-	-	-	150	-
RS15	30 Sep 2025	13:36:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	250	-
RS15	10 Oct 2025	13:19:00	7.4	305	9.9	9.9	-	-	16.7	-	-	-	-	-	-	-	76	-
RS15	15 Oct 2025	10:25:00	6.92	354.3	9	9	-	80.6	15.6	-	-	41.6	-	-	-	-	620	-
RS15	22 Oct 2025	11:28:00	7.1	267	10.7	10.7	-	-	15.1	-	-	-	-	-	-	-	41	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Collert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS15	29 Oct 2025	12:55:00	7.1	318	10.1	10.1	-	-	15.6	-	-	-	-	-	-	-	5	-
RS15	05 Nov 2025	0:00:00	6.9	344	9.6	9.6	-	-	17.9	-	-	-	-	-	-	-	25	-
RS15	12 Nov 2025	11:45:00	7	325	9.3	9.3	-	-	13.6	-	-	-	-	-	-	-	55	-
RS15	19 Nov 2025	13:30:00	7	346	8.9	8.9	-	-	19.9	-	-	-	-	-	-	-	30	-
RS15	26 Nov 2025	12:30:00	7.1	385	9.1	9.1	-	-	20.2	-	-	-	-	-	-	-	260	-
RS15	02 Dec 2025	11:14:00	6.72	374.4	8.47	8.47	-	67.8	19.6	5.15	-	10	-	-	-	-	310	-
RS15	02 Dec 2025	10:48:00	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	-
RS15	10 Dec 2025	12:12:00	7.1	350	8.5	8.5	-	-	20.6	-	-	-	-	-	-	-	780	-
RS15	17 Dec 2025	12:15:00	7.2	374	8.5	8.5	-	-	21.8	-	-	-	-	-	-	-	260	-
RS15	22 Dec 2025	12:29:00	6.9	370	8.6	-	-	-	19.4	-	-	-	-	-	-	-	-	-
RS15	29 Dec 2025	12:15:00	7	390	8.7	8.7	-	-	20.7	-	-	-	-	-	-	-	150	-
RS15	06 Jan 2026	11:27:00	7	430	8.5	8.5	-	-	21.8	-	-	-	-	-	-	-	320	-
RS15	13 Jan 2026	11:32:00	7	367	9	9	-	-	21.4	-	-	-	-	-	-	-	62	-
RS15	22 Jan 2026	12:59:00	7.1	372	8.9	8.9	-	-	21.9	-	-	-	-	-	-	-	150	-
RS15	28 Jan 2026	12:15:00	7.1	371	8.8	8.8	-	-	20.5	-	-	-	-	-	-	-	70	-
RS15	03 Feb 2026	12:45:00	7	406	8.9	8.9	-	-	20.3	-	-	-	-	-	-	-	67	-
RS15	11 Feb 2026	14:10:00	7.1	413	8.8	8.8	-	-	22.7	-	-	-	-	-	-	-	290	-
RS15	19 Feb 2026	12:00:00	7.1	419	8.6	8.6	-	-	21.1	-	-	-	-	-	-	-	370	-
RS15	25 Feb 2026	13:00:00	7.1	398	9	9	-	-	21.6	-	-	-	-	-	-	-	70	-
RS15	05 Mar 2026	13:00:00	7.1	407	8.8	8.8	-	-	20.8	-	-	-	-	-	-	-	240	-
RS15	10 Mar 2026	13:30:00	7.17	326.1	-	-	9.33	151.9	19.8	4.74	-	50	-	-	-	-	560	-
RS15	18 Mar 2026	12:30:00	7	398	8.7	8.7	-	-	20.4	-	-	-	-	-	-	-	35	-
RS15	24 Mar 2026	12:25:00	7.1	397	8.8	8.8	-	-	19.8	-	-	-	-	-	-	-	46	-
RS15	01 Apr 2026	13:00:00	7.1	387	9	9	-	-	19.3	-	-	-	-	-	-	-	43	-
RS15	07 Apr 2026	12:15:00	7.1	397	8.9	8.9	-	-	19.1	-	-	-	-	-	-	-	32	-
RS15	13 Apr 2026	13:45:00	7.1	392	8.6	8.6	-	-	18.4	-	-	-	-	-	-	-	16	-
RS15	22 Apr 2026	11:45:00	7.12	319.4	9.03	9.03	93	76.7	15.7	3.03	-	120	-	-	-	-	-	-
RS15	23 Apr 2026	13:10:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-
RS15	29 Apr 2026	13:10:00	7.2	390	-	9.4	-	-	17.5	-	-	-	-	-	-	-	25	-
RS16	01 Apr 2025	10:15:00	7.52	202.3	-	-	158.7	158.7	14.5	-	-	-	-	-	-	>2,420	648.8	-
RS16	03 Apr 2025	14:10:00	7.66	206	-	-	97.2	163.8	15.2	-	-	-	-	-	-	>2,420	120.1	-
RS16	07 Apr 2025	14:45:00	7.28	458.9	-	-	86.7	197	19.1	8.1	-	45	-	-	-	488.4	45.7	-
RS16	07 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	7.8	129	-	-	-	52.6
RS16	10 Apr 2025	10:58:00	7.67	170.1	-	-	103.2	145.6	10.2	23.72	-	27	-	-	-	1,046.2	16	-
RS16	16 Apr 2025	10:54:00	7.79	91.2	11.42	11.42	-	150.5	10.8	-	-	66	-	-	-	-	17	-
RS16	23 Apr 2025	12:09:00	8	102	11.3	11.3	-	-	11.9	-	-	-	-	-	-	-	6	-
RS16	30 Apr 2025	10:30:00	7.5	223	10.3	10.3	-	-	13.1	-	-	-	-	-	-	-	54	-
RS16	06 May 2025	13:22:00	7.54	296.1	-	-	103.8	102.4	11.9	-	-	85	-	-	-	2,419.6	86.5	-
RS16	21 May 2025	12:58:00	7.9	113	12.9	12.9	-	-	7.8	-	-	-	-	-	-	-	7	-
RS16	28 May 2025	12:45:00	7.7	214	12	12	-	-	8.8	-	-	-	-	-	-	-	25	-
RS16	03 Jun 2025	11:45:00	7.5	361.8	-	-	101.3	167.7	11.4	9.37	-	33	-	-	-	-	3	-
RS16	12 Jun 2025	10:06:00	7.8	145	12.4	12.4	-	-	6.2	-	-	-	-	-	-	-	190	-

Surface water results

			Field Parameters													Biological		Acidity & Alkalinity
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	TDS (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids	Total Coliforms (Colilert)	E.coli	Total Alkalinity (CaCO3)
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	mg/L	cm	pH units	µS/cm	mg/L	orgs/100mL	orgs/100mL	g CaCO3/m3
EQL													1	0.2	2.5		1	1
Location	**Date**	**Time**																
RS16	18 Jun 2025	11:46:00	7.6	306	12.8	12.8	-	-	7.1	-	-	-	-	-	-	-	40	-
RS16	01 Jul 2025	13:17:00	7.78	98.6	-	-	133	13.04	3.4	-	-	-	-	-	-	-	-	-
RS16	06 Aug 2025	9:36:00	7.45	200.8	11.8	11.8	93.2	54	4.5	-	-	-	-	-	-	>201	15	-
RS16	13 Aug 2025	12:25:00	7.8	139	12.2	12.2	-	-	7.7	-	-	-	-	-	-	-	47	-
RS16	19 Aug 2025	13:35:00	7.6	162	12.1	12.1	-	-	7.6	-	-	-	-	-	-	-	15	-
RS16	26 Aug 2025	0:00:00	7.6	134	12.3	12.3	-	-	9.1	-	-	-	-	-	-	-	31	-
RS16	04 Sep 2025	11:25:00	7.8	102	12.2	12.2	-	-	7.7	-	-	-	-	-	-	-	58	-
RS16	11 Sep 2025	13:42:00	7.6	109	12.7	12.7	-	-	8.4	-	-	-	-	-	-	-	24	-
RS16	15 Oct 2025	11:15:00	7.12	153.6	11.82	11.82	-	74	8.9	-	-	17	-	-	-	-	78	-
RS16	02 Dec 2025	10:48:00	7.31	137	10.6	10.6	-	37.2	11.2	63.9	-	8	-	-	-	-	360	-
RS16	02 Dec 2025	10:34:00	-	-	-	-	-	-	-	-	-	-	-	-	202	-	-	-
RS16	10 Mar 2026	13:40:00	7.19	341.2	-	-	9.54	149.6	18	6.78	-	60	-	-	-	-	2,100	-
RS16	22 Apr 2026	12:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RS16	22 Apr 2026	12:00:00	7.17	340	9.73	9.73	99	76.6	14.6	5.9	-	45	-	-	-	-	65	-

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Surface water results

			Hardness			Major Ions									Nutrients
			Total Hardness	Magnesium Hardness	Calcium Hardness	Calcium (filtered)	Magnesium (filtered)	Potassium (filtered)	Sodium (filtered)	Chloride (filtered)	Sulfate (filtered)	Cations Total	Anions Total	Dissolved Non-Purgeable Organic Carbon (DNPOC) (filtered)
			g eqv. CaCO3/m3	g eqv. CaCO3/m3	g eqv. CaCO3/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	g/m3
EQL			0.05	0.05	0.05	0.05	0.01	0.05	0.01	0.5	0.15	0.01	0.01	
Location Code	**Date**	**Time**												
RS01	10 Mar 2025	0:00:00	-	-	-	24.6	1.49	0.83	1.58	<0.50	7.13	1.44	1.31	-
RS02	10 Mar 2025	0:00:00	-	-	-	24.2	1.46	0.85	1.55	<0.50	7.25	1.42	1.29	-
RS04 B	07 Apr 2025	0:00:00	-	-	-	21.5	1.24	0.73	1.30	<0.50	7.46	1.25	1.19	-
RS04 B	22 Apr 2026	12:13:00	50.9	5.46	45.5	-	-	-	-	-	-	-	-	-
RS04 B	22 Apr 2026	12:13:00	-	-	-	-	-	-	-	-	-	-	-	0.4
RS06 B	11 Mar 2025	0:00:00	-	-	-	24.1	1.55	0.89	1.88	0.53	7.09	1.44	1.33	-
RS06 B	07 Apr 2025	0:00:00	-	-	-	21.8	1.33	1.4	2.92	1.64	8.22	1.38	1.31	-
RS06 B	22 Apr 2026	12:48:00	53.1	6.06	47.1	-	-	-	-	-	-	-	-	-
RS06 B	22 Apr 2026	12:48:00	-	-	-	-	-	-	-	-	-	-	-	0.9
RS09	11 Mar 2025	0:00:00	-	-	-	24.1	1.49	0.89	1.76	0.55	7.35	1.43	1.31	-
RS09	22 Apr 2026	13:00:00	56.5	8.66	47.9	-	-	-	-	-	-	-	-	-
RS09	22 Apr 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	0.9
RS10	11 Mar 2025	0:00:00	-	-	-	28.3	1.76	0.91	1.99	0.59	7.98	1.67	1.49	-
RS10	22 Apr 2026	14:20:00	58.8	6.62	52.2	-	-	-	-	-	-	-	-	-
RS10	22 Apr 2026	14:20:00	-	-	-	-	-	-	-	-	-	-	-	0.6
RS11	11 Mar 2025	0:00:00	-	-	-	14.6	0.96	1.7	4.61	2.91	4.13	1.10	0.95	-
RS11	07 Apr 2025	0:00:00	-	-	-	11.4	0.67	0.67	1.80	1.12	4.28	0.72	0.64	-
RS11	22 Apr 2026	10:45:00	28.3	2.76	25.5	-	-	-	-	-	-	-	-	-
RS11	22 Apr 2026	10:45:00	-	-	-	-	-	-	-	-	-	-	-	0.4
RS12	11 Mar 2025	0:00:00	-	-	-	15.4	1.25	3.5	10.3	6.59	4.69	1.51	1.24	-
RS12	07 Apr 2025	0:00:00	-	-	-	11.5	0.73	0.97	2.89	1.28	4.40	0.79	0.68	-
RS13	11 Mar 2025	0:00:00	-	-	-	34.3	1.77	1.3	3.30	2.01	5.49	2.07	2.26	-
RS13	07 Apr 2025	0:00:00	-	-	-	28.7	1.58	3.2	7.90	5.72	4.02	2.04	1.72	-
RS14	11 Mar 2025	0:00:00	-	-	-	9.93	0.61	0.42	1.25	<0.50	3.69	0.61	0.54	-
RS14	07 Apr 2025	0:00:00	-	-	-	9.55	0.58	0.43	1.19	0.55	4.17	0.59	0.58	-
RS15	07 Apr 2025	0:00:00	-	-	-	25.1	3.46	16.6	43.8	38.4	32.2	4.37	4.20	-
RS15	22 Apr 2026	11:50:00	72.4	10.5	61.8	-	-	-	-	-	-	-	-	-
RS15	22 Apr 2026	11:50:00	-	-	-	-	-	-	-	-	-	-	-	5.2
RS16	07 Apr 2025	0:00:00	-	-	-	21.7	1.24	0.88	1.67	0.80	7.71	1.28	1.25	-
RS16	22 Apr 2026	12:00:00	67.8	9.74	58.1	-	-	-	-	-	-	-	-	-
RS16	22 Apr 2026	12:00:00	-	-	-	-	-	-	-	-	-	-	-	2.8

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS01	10 Mar 2025	0:00:00	<0.002	0.0146	-	0.12	0.10	<0.0010	<0.005	<0.0050	-	-	-	-	-	-	-
RS01	08 Apr 2025	0:00:00	<0.002	0.0184	-	0.17	0.15	<0.0010	<0.005	0.13	<1.00	-	-	-	-	-	-
RS01	06 May 2025	0:00:00	<0.002	0.0149	-	<0.12	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS01	03 Jun 2025	12:35:00	<0.002	0.024	-	<0.1	<0.1	<0.001	<0.005	0.134	<1	-	-	-	-	-	-
RS01	01 Jul 2025	14:37:00	0.040	0.052	0.056	<0.1	<0.1	0.004	<0.005	0.023	-	<1	-	-	-	-	-
RS01	06 Aug 2025	0:00:00	<0.002	0.0352	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS01	15 Oct 2025	0:00:00	<0.002	0.0224	-	<0.10	<0.10	<0.0010	<0.005	0.076	<1.00	-	-	-	-	-	-
RS01	02 Dec 2025	13:34:00	0.002	0.019	-	0.1	0.1	<0.001	<0.005	0.122	<1	-	-	-	-	-	-
RS01	03 Feb 2026	10:45:00	0.006	0.01	0.01	3.81	3.8	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS01	05 Mar 2026	10:45:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS01	10 Mar 2026	16:10:00	<0.002	0.016	-	<0.1	<0.1	<0.001	<0.005	0.005	<1	-	-	-	-	-	-
RS01	01 Apr 2026	11:15:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS01	22 Apr 2026	14:00:00	<0.002	0.025	-	<0.1	<0.1	<0.001	<0.005	0.008	<1	-	-	-	-	-	-
RS02	10 Mar 2025	0:00:00	<0.002	0.0142	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	-	-	-	-	-	-	-
RS02	08 Apr 2025	0:00:00	<0.002	0.0161	-	<0.10	<0.10	<0.0010	<0.005	0.021	<1.00	-	-	-	-	-	-
RS02	06 May 2025	0:00:00	<0.002	0.0106	-	<0.11	<0.10	<0.0010	<0.005	0.0055	<1.00	-	-	-	-	-	-
RS02	03 Jun 2025	12:15:00	<0.002	0.022	-	<0.1	<0.1	<0.001	<0.005	0.009	<1	-	-	-	-	-	-
RS02	01 Jul 2025	14:02:00	<0.002	0.052	0.052	<0.1	<0.1	<0.001	<0.005	0.055	-	<1	-	-	-	-	-
RS02	06 Aug 2025	0:00:00	<0.002	0.0350	-	<0.10	<0.10	<0.0010	<0.005	0.018	<1.00	-	-	-	-	-	-
RS02	15 Oct 2025	0:00:00	<0.002	0.0169	-	<0.10	<0.10	<0.0010	<0.005	0.12	<1.00	-	-	-	-	-	-
RS02	02 Dec 2025	11:14:00	<0.002	0.02	-	0.2	0.1	<0.001	<0.005	0.123	<1	-	-	-	-	-	-
RS02	03 Feb 2026	11:25:00	0.006	0.01	<0.01	1.3	1.3	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS02	05 Mar 2026	12:55:00	0.014	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-
RS02	10 Mar 2026	14:20:00	<0.002	0.013	-	<0.1	<0.1	<0.001	<0.005	0.006	<1	-	-	-	-	-	-
RS02	01 Apr 2026	12:15:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS02	22 Apr 2026	13:25:00	<0.002	0.023	-	<0.1	<0.1	<0.001	<0.005	0.013	<1	-	-	-	-	-	-
RS04 B	07 Apr 2025	0:00:00	<0.002	0.0277	-	<0.10	<0.10	<0.0010	<0.005	0.018	<1.00	-	-	-	-	-	-
RS04 B	10 Apr 2025	0:00:00	<0.002	0.0159	-	<0.10	<0.10	<0.0010	0.008	0.015	<1.00	-	-	-	-	-	-
RS04 B	16 Apr 2025	10:35:00	0.004	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.03	<2	-	-	-	-	-	-
RS04 B	23 Apr 2025	11:54:00	0.003	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	30 Apr 2025	10:02:00	0.002	0.01	0.01	0.01	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	14 May 2025	12:30:00	<0.002	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	21 May 2025	12:43:00	0.002	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	28 May 2025	12:15:00	0.003	0.03	0.02	0.02	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	12 Jun 2025	9:58:00	0.04	0.04	0.04	0.04	<15	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	18 Jun 2025	11:39:00	0.005	0.03	0.03	0.03	<15	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	01 Jul 2025	14:14:00	<0.002	0.052	0.052	0.2	0.1	<0.001	<0.005	0.034	-	<1	-	-	-	-	-
RS04 B	09 Jul 2025	12:34:00	<0.002	0.04	0.04	0.84	0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-
RS04 B	16 Jul 2025	10:15:00	0.014	0.04	0.04	<0.8	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	24 Jul 2025	11:17:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS04 B	31 Jul 2025	12:28:00	0.002	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	06 Aug 2025	0:00:00	<0.002	0.0349	-	<0.10	<0.10	<0.0010	<0.005	0.013	<1.00	-	-	-	-	-	-
RS04 B	13 Aug 2025	12:15:00	0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	19 Aug 2025	13:21:00	0.005	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-
RS04 B	26 Aug 2025	0:00:00	0.003	0.03	0.03	<0.8	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	04 Sep 2025	12:00:00	0.003	0.03	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	11 Sep 2025	13:30:00	0.004	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS04 B	19 Sep 2025	9:27:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	25 Sep 2025	11:15:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.13	<2	-	-	-	-	-	-
RS04 B	30 Sep 2025	13:48:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.07	-	-	-	-	-	-	-
RS04 B	15 Oct 2025	0:00:00	<0.002	0.0210	-	<0.10	<0.10	<0.0010	<0.005	0.063	<1.00	-	-	-	-	-	-
RS04 B	22 Oct 2025	12:07:00	0.006	0.03	0.02	0.02	<0.8	<0.01	<0.01	0.3	<2	-	-	-	-	-	-
RS04 B	29 Oct 2025	12:45:00	0.005	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.32	<2	-	-	-	-	-	-
RS04 B	05 Nov 2025	0:00:00	0.004	0.02	0.02	<0.8	<0.8	<0.01	<0.01	0.23	<2	-	-	-	-	-	-
RS04 B	12 Nov 2025	11:32:00	0.003	<0.01	0.02	0.02	<0.8	<0.01	<0.01	0.26	<2	-	-	-	-	-	-
RS04 B	19 Nov 2025	13:40:00	0.005	0.01	0.01	0.01	<0.8	<0.01	<0.01	0.27	<2	-	-	-	-	-	-
RS04 B	26 Nov 2025	12:24:00	0.008	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.09	<2	-	-	-	-	-	-
RS04 B	02 Dec 2025	11:26:00	0.002	0.019	-	0.1	0.1	<0.001	<0.005	0.157	<1	-	-	-	-	-	-
RS04 B	10 Dec 2025	12:19:00	0.003	0.02	0.02	0.02	<0.8	<0.01	0.02	0.1	<2	-	-	-	-	-	-
RS04 B	17 Dec 2025	11:35:00	0.005	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.16	<2	-	-	-	-	-	-
RS04 B	22 Dec 2025	12:19:00	0.005	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.12	<2	-	-	-	-	-	-
RS04 B	29 Dec 2025	12:05:00	0.004	0.01	0.01	0.01	<0.8	<0.01	<0.01	0.1	<2	-	-	-	-	-	-
RS04 B	06 Jan 2026	11:18:00	0.003	0.01	0.01	0.01	<0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-
RS04 B	13 Jan 2026	11:36:00	0.006	0.02	0.02	1.02	1	<0.01	<0.01	0.13	<2	-	-	-	-	-	-
RS04 B	22 Jan 2026	12:50:00	0.004	0.01	0.01	0.91	0.9	<0.01	<0.01	0.06	<2	-	-	-	-	-	-
RS04 B	28 Jan 2026	12:00:00	0.016	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.03	<2	-	-	-	-	-	-
RS04 B	03 Feb 2026	12:35:00	0.007	0.01	0.01	1.11	1.1	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS04 B	11 Feb 2026	13:40:00	0.022	<0.01	<0.01	2.1	2.1	<0.01	<0.01	0.05	<2	-	-	-	-	-	-
RS04 B	19 Feb 2026	11:45:00	0.005	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	25 Feb 2026	12:00:00	0.004	<0.01	0.01	0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	05 Mar 2026	12:40:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-
RS04 B	10 Mar 2026	13:55:00	<0.002	0.016	-	<0.1	<0.1	<0.001	<0.005	0.007	<1	-	-	-	-	-	-
RS04 B	18 Mar 2026	12:15:00	<0.002	<0.01	<0.01	<0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	24 Mar 2026	12:40:00	0.023	0.01	0.01	0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	01 Apr 2026	12:50:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	07 Apr 2026	12:00:00	0.002	0.01	0.01	0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	13 Apr 2026	13:35:00	<0.002	0.01	0.01	0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS04 B	22 Apr 2026	12:13:00	<0.002	0.024	-	<0.1	<0.1	<0.001	<0.005	0.021	<1	-	0.561	0.025	0.0021	0.0015	<0.00002
RS04 B	29 Apr 2026	13:00:00	<0.002	0.01	0.01	0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS06 B	11 Mar 2025	0:00:00	<0.002	0.0212	-	<0.10	<0.10	<0.0010	0.03	<0.0050	-	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS06 B	01 Apr 2025	0:00:00	0.014	0.0747	-	<0.10	<0.10	<0.0010	0.04	0.032	<1.00	-	-	-	-	-	-
RS06 B	03 Apr 2025	0:00:00	0.059	0.160	-	0.56	0.40	0.0016	0.33	0.097	<1.00	-	-	-	-	-	-
RS06 B	07 Apr 2025	0:00:00	0.050	0.168	-	0.50	0.33	0.0018	0.23	0.075	<1.00	-	-	-	-	-	-
RS06 B	10 Apr 2025	0:00:00	0.098	0.148	-	0.94	0.79	0.0027	0.55	0.18	<1.00	-	-	-	-	-	-
RS06 B	16 Apr 2025	11:49:00	0.034	0.09	0.09	0.37 #2	0.28 #2	<0.01	0.21	0.06	<2	-	-	-	-	-	-
RS06 B	23 Apr 2025	12:48:00	0.141	0.26	0.27	1.27	1	<0.01	0.65	0.15	<2	-	-	-	-	-	-
RS06 B	30 Apr 2025	11:23:00	0.109	0.35	0.36	1.37 #2	1.01 #2	0.02	0.75	0.19	<2	-	-	-	-	-	-
RS06 B	06 May 2025	0:00:00	0.099	0.306	-	1.08	0.76	0.0108	0.58	0.12	<1.00	-	-	-	-	-	-
RS06 B	14 May 2025	13:20:00	0.004	0.16	0.16	0.16	<0.8	<0.01	0.01	0.01	<2	-	-	-	-	-	-
RS06 B	21 May 2025	13:26:00	0.077	0.18	0.18	0.81 #2	0.63 #2	<0.01	0.47	0.1	<2	-	-	-	-	-	-
RS06 B	28 May 2025	13:05:00	0.094	0.22	0.23	0.86 #2	0.63 #2	<0.01	0.47	0.13	<2	-	-	-	-	-	-
RS06 B	03 Jun 2025	11:16:00	0.089	0.254	-	1.1	0.8	0.008	0.560	0.135	2	-	-	-	-	-	-
RS06 B	12 Jun 2025	10:27:00	0.122	0.32	0.33	1.48 #2	1.15 #2	<0.01	0.86	0.17	97	-	-	-	-	-	-
RS06 B	18 Jun 2025	12:00:00	0.106	0.33	0.33	0.33	<15	<0.01	<0.01	0.12	<2	-	-	-	-	-	-
RS06 B	01 Jul 2025	12:44:00	0.136	0.247	0.252	1.3	1.0	0.006	0.747	0.191	-	2	-	-	-	-	-
RS06 B	09 Jul 2025	12:54:00	0.193	0.51	0.51	3.71	3.2	<0.01	1.28	0.49	2.63	-	-	-	-	-	-
RS06 B	16 Jul 2025	10:40:00	0.096	0.23	0.24	1.44	1.2	<0.01	0.74	0.17	<2	-	-	-	-	-	-
RS06 B	24 Jul 2025	11:55:00	0.072	0.44	0.46	2.36	1.9	0.02	0.85	0.38	6.11	-	-	-	-	-	-
RS06 B	31 Jul 2025	12:58:00	0.071	0.22	0.23	1.33	1.1	<0.01	0.63	0.14	2.18	-	-	-	-	-	-
RS06 B	06 Aug 2025	0:00:00	0.620	0.146	-	2.2	1.99	0.0204	1.72	0.73	2.53	-	-	-	-	-	-
RS06 B	13 Aug 2025	13:04:00	0.153	0.22	0.23	1.83	1.6	<0.01	1.33	0.23	3.19	-	-	-	-	-	-
RS06 B	19 Aug 2025	13:48:00	0.374	0.35	0.37	3.47	3.1	0.01	2.12	0.5	3.68	-	-	-	-	-	-
RS06 B	26 Aug 2025	0:00:00	0.016	0.47	0.47	<0.8	<0.8	<0.01	0.02	0.05	<2	-	-	-	-	-	-
RS06 B	04 Sep 2025	11:15:00	0.037	0.42	0.43	0.43	<0.8	<0.01	0.02	0.12	<2	-	-	-	-	-	-
RS06 B	11 Sep 2025	13:00:00	0.059	0.41	0.41	0.41	<0.8	<0.01	0.02	0.13	<2	-	-	-	-	-	-
RS06 B	19 Sep 2025	9:43:00	0.046	0.21	0.21	1.31	1.1	<0.01	<0.01	0.15	<2	-	-	-	-	-	-
RS06 B	25 Sep 2025	11:27:00	0.05	0.12	0.12	0.12	<0.8	<0.01	<0.01	0.17	<2	-	-	-	-	-	-
RS06 B	30 Sep 2025	14:00:00	0.053	0.16	0.16	1.16	1	<0.01	<0.01	0.16	-	-	-	-	-	-	-
RS06 B	10 Oct 2025	13:33:00	0.051	0.13	0.13	5.13	5	<0.01	<0.01	0.58	<2	-	-	-	-	-	-
RS06 B	15 Oct 2025	0:00:00	<0.020	0.0278	-	<0.10	<0.10	<0.0100	<0.05	0.20	<1.00	-	-	-	-	-	-
RS06 B	22 Oct 2025	12:24:00	0.026	0.07	0.07	0.07	<0.8	<0.01	0.05	0.27	<2	-	-	-	-	-	-
RS06 B	29 Oct 2025	12:20:00	0.05	0.08	0.08	0.08	<0.8	<0.01	0.08	0.28	<2	-	-	-	-	-	-
RS06 B	05 Nov 2025	0:00:00	0.025	0.07	0.07	1.1	1.1	<0.01	<0.01	0.31	<2	-	-	-	-	-	-
RS06 B	12 Nov 2025	11:58:00	0.049	0.09	0.09	0.09	<0.8	<0.01	0.02	0.26	<2	-	-	-	-	-	-
RS06 B	19 Nov 2025	14:00:00	0.012	0.08	0.08	0.08	<0.8	<0.01	<0.01	0.27	<2	-	-	-	-	-	-
RS06 B	26 Nov 2025	12:49:00	0.048	0.21	0.21	0.21	<0.8	<0.01	<0.01	0.16	<2	-	-	-	-	-	-
RS06 B	02 Dec 2025	10:03:00	0.098	0.151	-	0.3	0.2	<0.001	0.008	0.235	<1	-	-	-	-	-	-
RS06 B	10 Dec 2025	12:33:00	0.085	0.1	0.1	0.1	<0.8	<0.01	<0.01	0.16	<2	-	-	-	-	-	-
RS06 B	17 Dec 2025	11:50:00	0.095	0.21	0.21	0.21	<0.8	<0.01	0.14	0.21	<2	-	-	-	-	-	-
RS06 B	22 Dec 2025	11:46:00	0.182	0.26	0.26	0.26	<0.8	<0.01	0.01	0.33	<2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS06 B	29 Dec 2025	11:40:00	0.175	0.38	0.38	0.38	<0.8	<0.01	0.01	0.25	<2	-	-	-	-	-	-
RS06 B	06 Jan 2026	10:50:00	0.279	0.16	0.17	0.17	<0.8	<0.01	0.12	0.32	<2	-	-	-	-	-	-
RS06 B	13 Jan 2026	11:52:00	0.205	0.32	0.32	1.22	0.9	<0.01	<0.01	0.34	<2	-	-	-	-	-	-
RS06 B	22 Jan 2026	13:12:00	0.216	0.25	0.25	1.65	1.4	<0.01	<0.01	0.3	<2	-	-	-	-	-	-
RS06 B	28 Jan 2026	11:15:00	0.231	0.14	0.14	0.14	<0.8	<0.01	<0.01	0.27	<2	-	-	-	-	-	-
RS06 B	03 Feb 2026	12:10:00	0.147	0.48	0.49	1.49	1	<0.01	<0.01	0.22	<2	-	-	-	-	-	-
RS06 B	11 Feb 2026	13:00:00	0.09	0.17	0.17	3.97	3.8	<0.01	<0.01	0.12	<2	-	-	-	-	-	-
RS06 B	19 Feb 2026	11:50:00	0.269	0.61	0.63	1.63	1	0.02	0.36	0.4	<2	-	-	-	-	-	-
RS06 B	25 Feb 2026	12:40:00	0.196	0.5	0.5	0.5	<0.8	<0.01	0.01	0.28	<2	-	-	-	-	-	-
RS06 B	05 Mar 2026	12:55:00	0.034	0.07	0.07	0.07	<0.8	<0.01	<0.01	0.05	<2	-	-	-	-	-	-
RS06 B	10 Mar 2026	13:05:00	0.335	0.374	-	0.5	0.2	0.001	0.007	0.366	<1	-	-	-	-	-	-
RS06 B	18 Mar 2026	11:35:00	0.296	0.32	0.33	0.33	<0.8	<0.01	<0.01	0.4	<2	-	-	-	-	-	-
RS06 B	24 Mar 2026	11:45:00	0.18	0.39	0.4	0.4	<0.8	<0.01	<0.01	0.29	<2	-	-	-	-	-	-
RS06 B	01 Apr 2026	12:30:00	0.194	0.34	0.34	0.34	<0.8	<0.01	<0.01	0.25	<2	-	-	-	-	-	-
RS06 B	07 Apr 2026	11:35:00	0.121	0.25	0.25	0.25	<0.8	<0.01	<0.01	0.17	<2	-	-	-	-	-	-
RS06 B	13 Apr 2026	13:00:00	0.172	0.31	0.31	0.31	<0.8	<0.01	<0.01	0.33	<2	-	-	-	-	-	-
RS06 B	22 Apr 2026	12:48:00	0.117	0.288	-	0.3	<0.1	<0.001	<0.005	0.108	<1	-	0.478	0.039	0.0022	0.0017	<0.00002
RS06 B	29 Apr 2026	11:45:00	0.103	0.31	0.31	0.31	<0.8	<0.01	0.01	0.14	<2	-	-	-	-	-	-
RS09	11 Mar 2025	0:00:00	<0.002	0.0177	-	1.1	1.10	<0.0010	0.03	0.0051	-	-	-	-	-	-	-
RS09	01 Apr 2025	0:00:00	<0.002	0.0224	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS09	03 Apr 2025	0:00:00	<0.002	0.0071	-	<0.10	<0.10	<0.0010	0.005	0.0056	<1.00	-	-	-	-	-	-
RS09	08 Apr 2025	0:00:00	0.078	0.179	-	0.56	0.38	0.0018	0.35	0.11	<1.00	-	-	-	-	-	-
RS09	10 Apr 2025	0:00:00	0.073	0.144	-	0.69	0.54	0.0021	0.39	0.12	<1.00	-	-	-	-	-	-
RS09	16 Apr 2025	12:34:00	0.03	0.09	0.09	0.33 #2	0.241 #2	<0.01	0.18	0.06	2	-	-	-	-	-	-
RS09	23 Apr 2025	13:35:00	0.05	0.16	0.16	1.36	1.2	<0.01	0.29	0.07	<2	-	-	-	-	-	-
RS09	30 Apr 2025	12:01:00	0.05	0.23	0.24	0.58 #2	0.34 #2	<0.01	0.25	0.07	<2	-	-	-	-	-	-
RS09	06 May 2025	0:00:00	0.101	0.301	-	1.09	0.78	0.0107	0.58	0.13	<1.00	-	-	-	-	-	-
RS09	14 May 2025	14:10:00	0.004	0.12	0.12	0.12	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS09	21 May 2025	12:20:00	0.063	0.14	0.14	0.68 #2	0.54 #2	<0.01	0.4	0.08	<2	-	-	-	-	-	-
RS09	28 May 2025	12:07:00	0.046	0.09	0.09	0.41 #2	0.32 #2	<0.01	0.24	0.08	8.91	-	-	-	-	-	-
RS09	03 Jun 2025	11:15:00	0.062	0.189	-	0.8	0.6	0.006	0.394	0.099	<1	-	-	-	-	-	-
RS09	12 Jun 2025	10:56:00	0.067	0.21	0.21	0.87 #2	0.66 #2	<0.01	0.49	0.1	<2	-	-	-	-	-	-
RS09	18 Jun 2025	12:28:00	0.065	0.2	0.2	0.2	<15	<0.01	<0.01	0.07	<2	-	-	-	-	-	-
RS09	01 Jul 2025	12:30:00	0.124	0.242	0.247	1.3	1.0	0.005	0.696	0.185	-	2	-	-	-	-	-
RS09	09 Jul 2025	13:18:00	0.127	0.37	0.37	2.77	2.4	<0.01	0.85	0.19	<2	-	-	-	-	-	-
RS09	16 Jul 2025	11:11:00	0.07	0.15	0.15	1.45	1.3	<0.01	0.45	0.14	2.01	-	-	-	-	-	-
RS09	24 Jul 2025	12:36:00	0.056	0.32	0.35	1.75	1.4	0.03	0.64	0.32	4.35	-	-	-	-	-	-
RS09	31 Jul 2025	13:30:00	0.046	0.19	0.19	0.19	<0.8	<0.01	0.4	0.11	<2	-	-	-	-	-	-
RS09	06 Aug 2025	0:00:00	0.555	0.144	-	2.0	1.88	0.0183	1.59	0.66	2.30	-	-	-	-	-	-
RS09	13 Aug 2025	13:16:00	0.148	0.2	0.21	1.41	1.2	<0.01	1.29	0.24	3.05	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS09	19 Aug 2025	13:55:00	0.39	0.37	0.38	3.28	2.9	0.01	2.05	0.5	4.24	-	-	-	-	-	-
RS09	26 Aug 2025	0:00:00	0.013	0.4	0.41	<0.8	<0.8	<0.01	0.02	0.05	<2	-	-	-	-	-	-
RS09	04 Sep 2025	11:10:00	0.047	0.47	0.48	0.48	<0.8	<0.01	0.02	0.13	<2	-	-	-	-	-	-
RS09	11 Sep 2025	13:10:00	0.053	0.38	0.38	0.38	<0.8	<0.01	0.02	0.11	<2	-	-	-	-	-	-
RS09	19 Sep 2025	9:49:00	0.038	0.17	0.17	1.07	0.9	<0.01	<0.01	0.16	<2	-	-	-	-	-	-
RS09	25 Sep 2025	11:35:00	0.045	0.12	0.12	0.12	<0.8	<0.01	<0.01	0.18	<2	-	-	-	-	-	-
RS09	30 Sep 2025	14:05:00	0.045	0.14	0.14	0.14	<0.8	<0.01	<0.01	0.19	-	-	-	-	-	-	-
RS09	15 Oct 2025	0:00:00	0.025	0.0444	-	<0.10	<0.10	<0.0010	<0.005	0.089	<1.00	-	-	-	-	-	-
RS09	02 Dec 2025	9:45:00	0.073	0.125	-	0.3	0.2	<0.001	<0.005	0.199	<1	-	-	-	-	-	-
RS09	10 Dec 2025	12:38:00	0.073	0.07	0.07	2.17	2.1	<0.01	0.18	0.18	<2	-	-	-	-	-	-
RS09	22 Dec 2025	11:59:00	0.213	0.26	1.1	1.09	<0.8	0.8	0.06	0.26	<2	-	-	-	-	-	-
RS09	29 Dec 2025	11:55:00	0.159	0.35	0.35	0.35	<0.8	<0.01	<0.01	0.23	<2	-	-	-	-	-	-
RS09	06 Jan 2026	11:05:00	0.261	0.15	0.15	0.15	<0.8	<0.01	0.11	0.3	<2	-	-	-	-	-	-
RS09	22 Jan 2026	13:18:00	0.206	0.22	0.22	0.22	<0.8	<0.01	<0.01	0.37	<2	-	-	-	-	-	-
RS09	28 Jan 2026	11:40:00	0.193	0.21	0.2	0.2	<0.8	<0.01	<0.01	0.25	<2	-	-	-	-	-	-
RS09	03 Feb 2026	12:20:00	0.104	0.35	0.35	2.95	2.6	<0.01	<0.01	0.24	<2	-	-	-	-	-	-
RS09	11 Feb 2026	12:45:00	0.165	0.27	0.28	3.08	2.8	<0.01	<0.01	0.21	<2	-	-	-	-	-	-
RS09	19 Feb 2026	11:40:00	0.159	0.32	0.33	0.33	<0.8	0.01	0.2	0.22	<2	-	-	-	-	-	-
RS09	25 Feb 2026	12:20:00	0.099	0.17	0.17	0.17	<0.8	<0.01	<0.01	0.15	<2	-	-	-	-	-	-
RS09	05 Mar 2026	12:45:00	0.114	0.17	0.17	0.17	<0.8	<0.01	<0.01	0.17	<2	-	-	-	-	-	-
RS09	10 Mar 2026	12:55:00	0.245	0.291	-	0.4	0.1	<0.001	<0.005	0.248	<1	-	-	-	-	-	-
RS09	18 Mar 2026	11:45:00	0.224	0.13	0.13	0.13	<0.8	<0.01	<0.01	0.33	<2	-	-	-	-	-	-
RS09	24 Mar 2026	12:00:00	0.095	0.16	0.16	0.16	<0.8	<0.01	<0.01	0.13	<2	-	-	-	-	-	-
RS09	01 Apr 2026	12:40:00	0.121	0.24	0.24	0.24	<0.8	<0.01	<0.01	0.19	<2	-	-	-	-	-	-
RS09	07 Apr 2026	11:45:00	0.097	0.16	0.16	0.16	<0.8	<0.01	<0.01	0.12	<2	-	-	-	-	-	-
RS09	13 Apr 2026	13:15:00	0.13	0.2	0.2	0.2	<0.8	<0.01	<0.01	0.25	<2	-	-	-	-	-	-
RS09	22 Apr 2026	13:00:00	0.116	0.291	-	0.4	0.1	<0.001	<0.005	0.213	<1	-	1.65	0.027	0.0039	0.0017	<0.00002
RS09	29 Apr 2026	11:30:00	0.027	0.1	0.1	0.1	<0.8	<0.01	<0.01	0.06	<2	-	-	-	-	-	-
RS10	11 Mar 2025	0:00:00	<0.002	0.0571	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	-	-	-	-	-	-	-
RS10	08 Apr 2025	0:00:00	<0.002	0.0277	-	<0.10	<0.10	<0.0010	<0.005	0.074	<1.00	-	-	-	-	-	-
RS10	10 Apr 2025	0:00:00	<0.002	0.0347	-	<0.10	<0.10	<0.0010	0.02	0.011	<1.00	-	-	-	-	-	-
RS10	16 Apr 2025	13:45:00	0.007	0.01	0.01	0.01	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS10	23 Apr 2025	14:43:00	0.004	0.03	0.03	0.03	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS10	30 Apr 2025	12:50:00	0.006	0.03	0.03	0.084 #2	0.054 #2	<0.01	0.04	0.01	<2	-	-	-	-	-	-
RS10	06 May 2025	0:00:00	<0.002	0.0288	-	<0.13	<0.10	<0.0010	0.01	<0.0050	8.85	-	-	-	-	-	-
RS10	14 May 2025	14:44:00	<0.002	0.05	0.05	0.05	<0.8	<0.01	<0.01	0.01	<2	-	-	-	-	-	-
RS10	21 May 2025	13:56:00	0.005	0.05	0.04	0.04	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS10	28 May 2025	11:30:00	0.007	0.03	0.03	0.03	<0.8	<0.01	0.03	0.02	<2	-	-	-	-	-	-
RS10	03 Jun 2025	13:00:00	<0.002	0.038	-	<0.1	<0.1	<0.001	0.022	0.013	<1	-	-	-	-	-	-
RS10	12 Jun 2025	11:23:00	0.004	0.04	0.05	0.05	<15	<0.01	0.01	<0.01	<2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS10	18 Jun 2025	12:58:00	0.007	0.04	0.04	0.04	<15	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS10	26 Jun 2025	13:45:00	0.016	0.03	0.02	1.42	1.4	<0.01	<0.01	1.02	<2	-	-	-	-	-	-
RS10	01 Jul 2025	15:07:00	<0.002	0.070	0.070	<0.1	<0.1	<0.001	<0.005	0.014	-	1	-	-	-	-	-
RS10	09 Jul 2025	13:52:00	<0.002	0.07	0.06	1.56	1.5	<0.01	<0.01	0.03	<2	-	-	-	-	-	-
RS10	16 Jul 2025	11:31:00	0.003	0.03	0.03	<0.8	<0.8	<0.01	<0.01	0.11	<2	-	-	-	-	-	-
RS10	24 Jul 2025	13:17:00	0.004	0.07	0.07	0.07	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS10	31 Jul 2025	14:00:00	0.002	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS10	06 Aug 2025	0:00:00	0.024	0.0452	-	0.23	0.18	<0.0010	0.05	0.066	<1.00	-	-	-	-	-	-
RS10	13 Aug 2025	13:45:00	0.004	0.03	0.03	0.03	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS10	19 Aug 2025	10:52:00	0.008	0.04	0.04	0.04	<0.8	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS10	27 Aug 2025	12:25:00	0.003	0.03	0.03	<0.8	<0.8	<0.01	0.01	<0.01	<2	-	-	-	-	-	-
RS10	04 Sep 2025	13:56:00	0.004	0.03	0.03	0.03	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS10	11 Sep 2025	14:30:00	0.004	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.05	<2	-	-	-	-	-	-
RS10	19 Sep 2025	10:32:00	0.005	0.04	0.04	0.84	0.8	<0.01	0.03	0.17	<2	-	-	-	-	-	-
RS10	25 Sep 2025	12:18:00	0.002	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.09	<2	-	-	-	-	-	-
RS10	30 Sep 2025	14:31:00	0.003	0.05	0.05	0.05	<0.8	<0.01	<0.01	0.43	-	-	-	-	-	-	-
RS10	10 Oct 2025	14:02:00	0.009	0.03	0.03	4.73	4.7	<0.01	<0.01	0.33	<2	-	-	-	-	-	-
RS10	15 Oct 2025	0:00:00	<0.002	0.0332	-	<0.10	<0.10	<0.0010	<0.005	0.039	<1.00	-	-	-	-	-	-
RS10	22 Oct 2025	13:04:00	0.003	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.75	<2	-	-	-	-	-	-
RS10	29 Oct 2025	13:30:00	0.005	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.41	<2	-	-	-	-	-	-
RS10	05 Nov 2025	0:00:00	0.003	0.02	0.02	1	1	<0.01	<0.01	0.13	<2	-	-	-	-	-	-
RS10	12 Nov 2025	12:31:00	0.003	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.13	<2	-	-	-	-	-	-
RS10	19 Nov 2025	13:04:00	0.003	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.19	<2	-	-	-	-	-	-
RS10	26 Nov 2025	11:37:00	<0.002	0.1	0.1	0.1	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS10	02 Dec 2025	14:04:00	<0.002	0.034	-	<0.1	<0.1	<0.001	<0.005	0.036	<1	-	-	-	-	-	-
RS10	10 Dec 2025	13:17:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.09	<2	-	-	-	-	-	-
RS10	17 Dec 2025	10:45:00	0.004	0.08	0.08	0.08	<0.8	<0.01	0.01	0.22	<2	-	-	-	-	-	-
RS10	22 Dec 2025	10:50:00	0.005	0.04	0.04	4.74	4.7	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS10	29 Dec 2025	10:55:00	0.004	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.06	<2	-	-	-	-	-	-
RS10	06 Jan 2026	9:45:00	0.008	0.06	0.06	0.06	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS10	13 Jan 2026	12:40:00	0.005	0.05	0.05	1.05	1	<0.01	<0.01	0.13	<2	-	-	-	-	-	-
RS10	22 Jan 2026	14:06:00	0.024	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS10	28 Jan 2026	13:05:00	0.026	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS10	03 Feb 2026	10:15:00	0.008	0.03	0.03	1.03	1	<0.01	<0.01	0.06	<2	-	-	-	-	-	-
RS10	11 Feb 2026	10:45:00	0.048	0.02	0.02	2.02	2	<0.01	<0.01	0.07	<2	-	-	-	-	-	-
RS10	19 Feb 2026	10:30:00	0.012	0.03	0.03	0.03	<0.8	<0.01	0.02	0.02	<2	-	-	-	-	-	-
RS10	25 Feb 2026	9:45:00	0.007	0.02	0.02	0.02	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS10	05 Mar 2026	10:15:00	0.007	0.03	0.03	1.13	1.1	<0.01	<0.01	0.03	<2	-	-	-	-	-	-
RS10	10 Mar 2026	16:40:00	0.007	0.038	-	<0.1	<0.1	<0.001	<0.005	0.009	<1	-	-	-	-	-	-
RS10	18 Mar 2026	10:30:00	0.006	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS10	24 Mar 2026	10:00:00	0.007	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS10	01 Apr 2026	10:44:00	0.007	0.04	0.04	0.04	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS10	07 Apr 2026	10:35:00	0.005	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS10	13 Apr 2026	10:15:00	0.006	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS10	22 Apr 2026	14:20:00	<0.002	0.052	-	<0.1	<0.1	<0.001	<0.005	0.044	<1	-	0.564	0.023	0.0022	0.0016	<0.00002
RS10	29 Apr 2026	10:45:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS11	11 Mar 2025	0:00:00	<0.002	0.278	-	1.0	0.72	0.0046	0.63	<0.0050	-	-	-	-	-	-	-
RS11	03 Apr 2025	0:00:00	<0.002	0.349	-	0.58	0.33	0.00511	0.30	0.059	<1.00	-	-	-	-	-	-
RS11	07 Apr 2025	0:00:00	<0.002	0.0659	-	<0.10	<0.10	0.0013	0.08	<0.0050	<1.00	-	-	-	-	-	-
RS11	10 Apr 2025	0:00:00	<0.002	0.0677	-	0.46	0.39	0.0011	0.09	<0.0050	<1.00	-	-	-	-	-	-
RS11	16 Apr 2025	12:20:00	0.002	0.18	0.18	0.18	<0.8	<0.01	0.11	<0.01	<2	-	-	-	-	-	-
RS11	23 Apr 2025	13:15:00	0.003	0.04	0.04	0.04	<0.8	<0.01	0.06	<0.01	<2	-	-	-	-	-	-
RS11	30 Apr 2025	11:50:00	0.003	0.04	0.04	0.22 [#2]	0.18 [#2]	<0.01	0.13	0.01	<2	-	-	-	-	-	-
RS11	06 May 2025	0:00:00	<0.002	0.105	-	0.25	0.14	0.0017	0.15	<0.0050	<1.00	-	-	-	-	-	-
RS11	14 May 2025	13:57:00	<0.002	0.03	0.03	0.11 [#2]	0.08 [#2]	<0.01	0.06	<0.01	<2	-	-	-	-	-	-
RS11	21 May 2025	12:07:00	<0.002	0.04	0.04	0.11 [#2]	0.07 [#2]	<0.01	0.05	<0.01	<2	-	-	-	-	-	-
RS11	28 May 2025	11:55:00	0.005	0.02	0.02	0.06 [#2]	0.04 [#2]	<0.01	0.03	0.01	<2	-	-	-	-	-	-
RS11	03 Jun 2025	10:34:00	<0.002	0.075	-	0.3	0.2	0.002	0.139	<0.005	<1	-	-	-	-	-	-
RS11	12 Jun 2025	10:47:00	0.014	0.07	0.07	0.28 [#2]	0.21 [#2]	<0.01	0.16	<0.01	<2	-	-	-	-	-	-
RS11	18 Jun 2025	12:16:00	0.004	0.04	0.04	0.16 [#2]	0.12 [#2]	<0.01	0.09	<0.01	<2	-	-	-	-	-	-
RS11	01 Jul 2025	11:25:00	<0.002	0.061	0.061	<0.1	<0.1	<0.001	0.051	<0.005	-	1	-	-	-	-	-
RS11	09 Jul 2025	13:11:00	<0.002	0.07	0.06	2.46	2.4	<0.01	0.07	<0.01	<2	-	-	-	-	-	-
RS11	10 Jul 2025	10:53:00	0.003	0.07	0.07	<0.95 [#2]	0.15 [#2]	<0.01	0.11	<0.01	<2	-	-	-	-	-	-
RS11	10 Jul 2025	10:53:00	-	-	-	-	<0.8	-	-	-	-	-	-	-	-	-	-
RS11	24 Jul 2025	12:17:00	0.003	0.12	0.12	0.25 [#2]	0.13 [#2]	<0.01	0.18	<0.01	<2	-	-	-	-	-	-
RS11	31 Jul 2025	13:18:00	0.003	0.05	0.05	0.05	<0.8	<0.01	0.05	<0.01	<2	-	-	-	-	-	-
RS11	06 Aug 2025	0:00:00	<0.002	0.0675	-	0.20	0.14	<0.0010	0.06	<0.0050	<1.00	-	-	-	-	-	-
RS11	13 Aug 2025	11:54:00	0.003	0.04	0.04	0.04	<0.8	<0.01	0.06	<0.01	<2	-	-	-	-	-	-
RS11	19 Aug 2025	12:55:00	0.002	0.08	0.08	0.08	<0.8	<0.01	0.1	0.01	<2	-	-	-	-	-	-
RS11	27 Aug 2025	11:50:00	0.003	0.11	0.11	<0.8	<0.8	<0.01	0.08	<0.01	<2	-	-	-	-	-	-
RS11	04 Sep 2025	10:57:00	0.003	0.16	0.16	0.16	<0.8	<0.01	0.11	<0.01	<2	-	-	-	-	-	-
RS11	11 Sep 2025	12:30:00	0.003	0.05	0.05	0.05	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS11	19 Sep 2025	9:12:00	<0.002	0.05	0.05	0.05	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS11	30 Sep 2025	13:29:00	0.002	0.04	0.04	0.04	<0.8	<0.01	<0.01	<0.01	-	-	-	-	-	-	-
RS11	15 Oct 2025	0:00:00	<0.002	0.0354	-	<0.10	<0.10	<0.0010	0.006	<0.0050	<1.00	-	-	-	-	-	-
RS11	12 Nov 2025	11:20:00	0.029	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.02	<2	-	-	-	-	-	-
RS11	19 Nov 2025	11:06:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	0.04	<2	-	-	-	-	-	-
RS11	26 Nov 2025	12:06:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS11	02 Dec 2025	12:32:00	<0.002	0.032	-	<0.1	<0.1	<0.001	0.017	0.007	<1	-	-	-	-	-	-
RS11	10 Dec 2025	12:00:00	0.003	0.03	0.03	0.03	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS11	17 Dec 2025	11:19:00	0.003	0.04	0.04	0.04	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS11	22 Dec 2025	11:26:00	0.01	0.02	0.03	0.03	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS11	29 Dec 2025	11:15:00	0.003	0.02	0.03	0.03	<0.8	<0.01	0.01	0.01	<2	-	-	-	-	-	-
RS11	06 Jan 2026	10:30:00	0.002	0.03	0.03	0.03	<0.8	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS11	13 Jan 2026	12:11:00	0.017	0.04	0.04	1.24	1.2	<0.01	0.02	0.02	<2	-	-	-	-	-	-
RS11	22 Jan 2026	13:39:00	0.003	0.02	0.02	0.02	<0.8	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS11	28 Jan 2026	10:45:00	0.003	0.02	0.02	0.02	<0.8	<0.01	0.02	0.01	<2	-	-	-	-	-	-
RS11	03 Feb 2026	11:00:00	0.006	0.02	0.02	1.22	1.2	<0.01	0.01	<0.01	<2	-	-	-	-	-	-
RS11	11 Feb 2026	12:20:00	0.007	0.03	0.03	2.63	2.6	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS11	19 Feb 2026	11:30:00	0.003	0.02	0.02	0.02	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS11	25 Feb 2026	11:45:00	0.005	0.02	0.02	0.02	<0.8	<0.01	0.04	<0.01	<2	-	-	-	-	-	-
RS11	05 Mar 2026	11:10:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS11	10 Mar 2026	12:00:00	<0.002	0.028	-	0.1	0.1	<0.001	0.030	<0.005	<1	-	-	-	-	-	-
RS11	18 Mar 2026	11:15:00	<0.002	0.01	0.01	0.81	0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS11	24 Mar 2026	11:30:00	0.008	0.02	0.02	0.02	<0.8	<0.01	0.04	<0.01	<2	-	-	-	-	-	-
RS11	01 Apr 2026	11:30:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS11	07 Apr 2026	11:15:00	<0.002	0.04	0.04	0.04	<0.8	<0.01	0.06	<0.01	<2	-	-	-	-	-	-
RS11	13 Apr 2026	12:30:00	0.009	0.03	0.03	0.03	<0.8	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS11	22 Apr 2026	10:45:00	<0.002	0.036	-	<0.1	<0.1	<0.001	0.026	<0.005	<1	-	.014599243	0.007	0.0013	0.0012	<0.00002
RS11	29 Apr 2026	11:15:00	0.018	0.03	0.03	0.03	<0.8	<0.01	0.03	0.02	<2	-	-	-	-	-	-
RS12	11 Mar 2025	0:00:00	0.063	0.258	-	3.0	2.78	0.0027	1.06	0.064	-	-	-	-	-	-	-
RS12	03 Apr 2025	0:00:00	0.048	0.179	-	0.74	0.56	0.00711	0.59	0.056	<1.00	-	-	-	-	-	-
RS12	07 Apr 2025	0:00:00	0.005	0.0655	-	<0.10	<0.10	<0.0010	0.12	0.0093	<1.00	-	-	-	-	-	-
RS12	10 Apr 2025	0:00:00	0.007	0.112	-	0.28	0.17	0.0011	0.16	0.0088	<1.00	-	-	-	-	-	-
RS12	06 May 2025	0:00:00	<0.002	0.0120	-	<0.11	<0.10	<0.0010	0.04	<0.0050	<1.00	-	-	-	-	-	-
RS12	03 Jun 2025	10:26:00	<0.002	0.031	-	0.1	0.1	<0.001	0.057	<0.005	<1	-	-	-	-	-	-
RS12	01 Jul 2025	11:10:00	<0.002	0.034	0.034	<0.1	<0.1	<0.001	0.023	<0.005	-	<1	-	-	-	-	-
RS12	06 Aug 2025	0:00:00	<0.002	0.0337	-	<0.10	<0.10	<0.0010	0.02	<0.0050	<1.00	-	-	-	-	-	-
RS12	15 Oct 2025	0:00:00	<0.002	0.0339	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS12	02 Dec 2025	12:15:00	<0.002	0.03	-	<0.1	<0.1	<0.001	<0.005	<0.005	<1	-	-	-	-	-	-
RS12	03 Feb 2026	11:15:00	0.028	0.02	0.02	1.62	1.6	<0.01	0.02	0.03	<2	-	-	-	-	-	-
RS12	05 Mar 2026	11:00:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS12	10 Mar 2026	11:25:00	0.003	0.052	-	0.2	0.1	<0.001	0.071	0.005	<1	-	-	-	-	-	-
RS12	01 Apr 2026	11:40:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	0.02	<0.01	<2	-	-	-	-	-	-
RS12	22 Apr 2026	10:30:00	<0.002	0.049	-	<0.1	<0.1	<0.001	0.040	<0.005	<1	-	-	-	-	-	-
RS13	11 Mar 2025	0:00:00	<0.002	0.113	-	0.52	0.40	0.0033	0.44	<0.0050	-	-	-	-	-	-	-
RS13	03 Apr 2025	0:00:00	<0.002	0.166	-	0.28	0.26	0.0041	0.20	<0.0050	<1.00	-	-	-	-	-	-
RS13	07 Apr 2025	0:00:00	<0.002	0.422	-	1.1	0.71	0.0047	0.74	<0.0050	<1.00	-	-	-	-	-	-
RS13	10 Apr 2025	0:00:00	<0.002	0.183	-	0.63	0.44	0.0023	0.42	<0.0050	<1.00	-	-	-	-	-	-
RS13	06 May 2025	0:00:00	<0.002	0.391	-	0.72	0.33	0.0032	0.24	<0.0050	<1.00	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS13	03 Jun 2025	10:12:00	<0.002	0.153	-	0.5	0.3	0.003	0.295	<0.005	<1	-	-	-	-	-	-
RS13	01 Jul 2025	10:50:00	<0.002	0.241	0.242	0.4	0.2	0.001	0.015	0.036	-	<1	-	-	-	-	-
RS13	06 Aug 2025	0:00:00	<0.002	0.194	-	0.32	0.13	0.0020	0.03	0.026	<1.00	-	-	-	-	-	-
RS13	15 Oct 2025	0:00:00	<0.002	0.0313	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS13	02 Dec 2025	13:10:00	<0.002	0.03	-	<0.1	<0.1	<0.001	<0.005	<0.005	<1	-	-	-	-	-	-
RS13	03 Feb 2026	11:25:00	0.008	0.02	0.02	1.82	1.8	<0.01	0.02	0.02	<2	-	-	-	-	-	-
RS13	05 Mar 2026	11:15:00	<0.002	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS13	10 Mar 2026	11:10:00	<0.002	0.239	-	0.6	0.3	0.002	0.236	<0.005	<1	-	-	-	-	-	-
RS13	01 Apr 2026	11:50:00	<0.002	0.14	0.14	0.14	<0.8	<0.01	0.03	<0.01	<2	-	-	-	-	-	-
RS13	22 Apr 2026	10:20:00	<0.002	0.440	-	0.4	<0.1	0.002	0.088	0.019	<1	-	-	-	-	-	-
RS14	11 Mar 2025	0:00:00	<0.002	0.0064	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	-	-	-	-	-	-	-
RS14	03 Apr 2025	0:00:00	<0.002	0.0282	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS14	07 Apr 2025	0:00:00	<0.002	0.0176	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS14	10 Apr 2025	0:00:00	<0.002	0.0333	-	<0.10	<0.10	<0.0010	0.005	<0.0050	<1.00	-	-	-	-	-	-
RS14	06 May 2025	0:00:00	<0.002	0.0398	-	<0.14	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS14	03 Jun 2025	10:02:00	<0.002	0.110	-	0.1	<0.1	<0.001	<0.005	<0.005	<1	-	-	-	-	-	-
RS14	01 Jul 2025	10:34:00	<0.002	0.028	0.028	<0.1	<0.1	<0.001	<0.005	<0.005	-	1	-	-	-	-	-
RS14	06 Aug 2025	0:00:00	<0.002	0.0311	-	0.27	0.24	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS14	15 Oct 2025	0:00:00	<0.002	0.0290	-	<0.10	<0.10	<0.0010	<0.005	<0.0050	<1.00	-	-	-	-	-	-
RS14	02 Dec 2025	12:57:00	<0.002	0.031	-	<0.1	<0.1	<0.001	<0.005	<0.005	<1	-	-	-	-	-	-
RS14	03 Feb 2026	11:35:00	0.006	0.04	0.04	0.94	0.9	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS14	05 Mar 2026	11:30:00	<0.002	0.01	0.01	0.01	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS14	10 Mar 2026	10:40:00	<0.002	0.065	-	<0.1	<0.1	<0.001	<0.005	<0.005	<1	-	-	-	-	-	-
RS14	01 Apr 2026	12:00:00	0.003	0.02	0.02	0.02	<0.8	<0.01	<0.01	<0.01	<2	-	-	-	-	-	-
RS14	22 Apr 2026	10:05:00	<0.002	0.018	-	<0.1	<0.1	<0.001	<0.005	<0.005	<1	-	-	-	-	-	-
RS15	01 Apr 2025	0:00:00	1.867	6.85	-	8.3	1.43	0.0195	0.15	3.59	2.19	-	-	-	-	-	-
RS15	03 Apr 2025	0:00:00	1.774	4.56	-	16	11.2	0.0301	8.62	2.41	12.3	-	-	-	-	-	-
RS15	07 Apr 2025	0:00:00	1.707	3.95	-	13	9.34	0.0342	6.95	2.27	6.17	-	-	-	-	-	-
RS15	10 Apr 2025	0:00:00	1.415	2.03	-	14	11.5	0.0396	8.13	1.86	16.5	-	-	-	-	-	-
RS15	16 Apr 2025	11:15:00	1.01	2.52	2.6	11.5	8.9	0.07	6.23	1.56	9.09	-	-	-	-	-	-
RS15	23 Apr 2025	12:21:00	1.23	2.87	3	13.4	10.4	0.1	6.32	1.56	9.63	-	-	-	-	-	-
RS15	30 Apr 2025	10:50:00	1.01	3.43	3.6	13.7	10.1	0.13	7.8	1.52	9.27	-	-	-	-	-	-
RS15	06 May 2025	0:00:00	0.954	3.36	-	11.1	7.58	0.115	5.83	2.20	<1.00	-	-	-	-	-	-
RS15	14 May 2025	12:45:00	0.038	3.08	3.1	5.29	2.2	<0.01	0.08	0.2	2.9	-	-	-	-	-	-
RS15	21 May 2025	13:09:00	1.24	1.55	1.6	12.6	11	0.03	7.33	1.84	14.5	-	-	-	-	-	-
RS15	28 May 2025	12:50:00	1.62	1.62	15	15	13.3	0.06	8.82	2.77	18.3	-	-	-	-	-	-
RS15	03 Jun 2025	11:43:00	1.20	2.87	-	14.3	11.3	0.097	8.10	1.80	12	-	-	-	-	-	-
RS15	12 Jun 2025	10:12:00	1.58	1.7	1.8	18.3	16.5	0.06	11.5	2.25	15.4	-	-	-	-	-	-
RS15	18 Jun 2025	11:33:00	2.05	6.36	6.4	6.4	<15	<0.01	0.07	3.09	2.17	-	-	-	-	-	-
RS15	26 Jun 2025	13:00:00	1.47	1.02	1.1	18.1	17	0.04	12	2.16	21.2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS15	01 Jul 2025	12:03:00	1.63	2.57	2.62	15.8	13.2	0.047	9.13	2.48	-	18	-	-	-	-	-
RS15	09 Jul 2025	12:42:00	1.59	1.76	1.8	18.6	16.8	0.04	10.9	2.39	18.2	-	-	-	-	-	-
RS15	10 Jul 2025	10:31:00	0.955	1.44	1.5	16.4	14.9	0.04	7.23	2.23	17	-	-	-	-	-	-
RS15	24 Jul 2025	11:31:00	0.266	2.91	3	26.6	23.6	0.05	5.57	4.47	20.4	-	-	-	-	-	-
RS15	31 Jul 2025	12:41:00	0.694	1.27	1.3	11.8	10.5	0.04	6.53	1.26	15.4	-	-	-	-	-	-
RS15	06 Aug 2025	0:00:00	4.567	1.12	-	18	16.4	0.136	13.8	4.91	17.4	-	-	-	-	-	-
RS15	13 Aug 2025	12:38:00	1.52	0.35	0.42	20.1	19.7	0.07	14.5	2.34	22.6	-	-	-	-	-	-
RS15	19 Aug 2025	13:15:00	2.42	0.57	0.62	19.8	19.2	0.05	14.6	3.3	18	-	-	-	-	-	-
RS15	26 Aug 2025	0:00:00	0.075	2.96	3	4.87	1.9	0.01	0.08	0.3	<3	-	-	-	-	-	-
RS15	04 Sep 2025	12:10:00	0.258	2.55	2.6	4.46	1.9	0.01	0.1	0.78	5.01	-	-	-	-	-	-
RS15	11 Sep 2025	12:40:00	0.397	2.77	2.8	4.99	2.2	0.01	0.1	0.86	<6	-	-	-	-	-	-
RS15	19 Sep 2025	9:35:00	0.689	2.68	2.7	8.09	5.4	<0.01	0.07	1.31	<6	-	-	-	-	-	-
RS15	25 Sep 2025	11:10:00	1.33	2.85	2.9	5.46	2.6	<0.01	0.08	1.76	4.05	-	-	-	-	-	-
RS15	30 Sep 2025	13:36:00	0.981	2.7	2.7	4.92	2.2	0.01	0.09	1.54	-	-	-	-	-	-	-
RS15	10 Oct 2025	13:19:00	1.5	3.05	3.1	9.76	6.7	<0.01	0.11	1.88	3.09	-	-	-	-	-	-
RS15	15 Oct 2025	0:00:00	2.767	2.37	-	4.3	1.94	<0.0100	0.12	3.32	3.76	-	-	-	-	-	-
RS15	22 Oct 2025	11:28:00	1.02	2.1	2.1	7.4	5.3	0.02	1.85	1.5	5.93	-	-	-	-	-	-
RS15	29 Oct 2025	12:55:00	2.01	2.19	2.2	7.41	5.2	0.02	2.65	2.23	5.37	-	-	-	-	-	-
RS15	05 Nov 2025	0:00:00	1.22	1.85	1.9	1.8	1.8	<0.01	0.08	1.49	2.33	-	-	-	-	-	-
RS15	12 Nov 2025	11:45:00	1.85	3.19	3.2	4.4	1.2	<0.01	0.08	2.18	<2	-	-	-	-	-	-
RS15	19 Nov 2025	13:30:00	0.931	4.56	4.6	5.87	1.3	<0.01	0.09	1.76	<2	-	-	-	-	-	-
RS15	26 Nov 2025	12:30:00	2.19	3.31	3.3	4.72	1.4	<0.01	0.13	2.53	<2	-	-	-	-	-	-
RS15	02 Dec 2025	10:48:00	2.85	3.54	-	5.5	2	<0.01 #1	0.12	3.17	3	-	-	-	-	-	-
RS15	10 Dec 2025	12:12:00	3.73	2.32	2.3	4.63	2.3	0.01	0.22	2.53	<3.04	-	-	-	-	-	-
RS15	17 Dec 2025	12:15:00	1.44	3.26	3.3	5.77	2.5	<0.01	0.21	1.75	2.52	-	-	-	-	-	-
RS15	22 Dec 2025	12:29:00	2.5	3.12	3.1	4.54	1.4	0.01	0.19	2.59	2.22	-	-	-	-	-	-
RS15	29 Dec 2025	12:15:00	1.41	3.38	3.4	4.38	1	<0.01	0.09	1.65	<2	-	-	-	-	-	-
RS15	06 Jan 2026	11:27:00	3.94	2.69	2.7	6.92	4.2	0.03	1.99	4.78	3.28	-	-	-	-	-	-
RS15	13 Jan 2026	11:32:00	2.64	3.82	3.8	5.83	2	<0.01	0.08	2.48	<2	-	-	-	-	-	-
RS15	22 Jan 2026	12:59:00	3.31	3.91	3.9	6.11	2.2	<0.01	0.07	3.64	<2	-	-	-	-	-	-
RS15	28 Jan 2026	12:15:00	3.08	2.87	2.9	4.78	1.9	<0.01	0.07	3.52	<2	-	-	-	-	-	-
RS15	03 Feb 2026	12:45:00	2.85	5.98	6	12.9	6.9	<0.01	0.08	3.62	<2	-	-	-	-	-	-
RS15	11 Feb 2026	14:10:00	1.61	4.24	4.2	7.95	3.7	<0.01	0.07	2.17	<2	-	-	-	-	-	-
RS15	19 Feb 2026	12:00:00	2.26	4.52	4.6	8.5	3.9	0.12	2.29	2.88	<2	-	-	-	-	-	-
RS15	25 Feb 2026	13:00:00	1.44	3.94	4	5.45	1.5	<0.01	0.07	2.13	<2	-	-	-	-	-	-
RS15	05 Mar 2026	13:00:00	2.48	3.78	3.8	5.89	2.1	<0.01	0.06	3.64	<2	-	-	-	-	-	-
RS15	10 Mar 2026	13:30:00	2.47	2.90	-	4.3	1.4	<0.010 #1	0.103	2.97	<1	-	-	-	-	-	-
RS15	18 Mar 2026	12:30:00	3.02	3.34	3.3	41	37.7	<0.01	0.07	3.56	<2	-	-	-	-	-	-
RS15	24 Mar 2026	12:25:00	1.77	3.23	3.2	4.7	1.5	<0.01	0.06	2.38	<2	-	-	-	-	-	-
RS15	01 Apr 2026	13:00:00	2.43	3.74	3.7	3.74	<0.8	<0.01	0.06	2.79	<2	-	-	-	-	-	-

Surface water results

			Nutrients								Organic Indicators		Metals				
			Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD	Aluminium	Aluminium (filtered)	Arsenic	Arsenic (filtered)	Cadmium
			g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2	0.003	0.003	0.0005	0.0005	0.00002
Location Code	**Date**	**Time**															
RS15	07 Apr 2026	12:15:00	1.37	3.28	3.3	4.58	1.3	<0.01	0.05	2.24	<2	-	-	-	-	-	-
RS15	13 Apr 2026	13:45:00	1.93	3.29	3.3	4.89	1.6	<0.01	0.06	2.7	<2	-	-	-	-	-	-
RS15	22 Apr 2026	11:50:00	1.15	2.63	-	3.7	1.1	<0.010 #1	0.054	1.46	<1	-	0.082	<0.030 #1	<0.0050 #1	<0.0050 #1	<0.00020 #1
RS15	29 Apr 2026	13:10:00	1.04	3.37	3.4	5.07	1.7	<0.01	0.06	1.49	<2	-	-	-	-	-	-
RS16	01 Apr 2025	0:00:00	1.473	5.60	-	7.1	1.43	0.0203	0.14	1.74	<1.00	-	-	-	-	-	-
RS16	03 Apr 2025	0:00:00	0.184	0.526	-	1.9	1.32	0.0040	0.84	0.28	1.99	-	-	-	-	-	-
RS16	07 Apr 2025	0:00:00	0.015	0.0685	-	0.17	0.11	<0.0010	0.07	0.031	<1.00	-	-	-	-	-	-
RS16	10 Apr 2025	0:00:00	0.354	0.477	-	2.5	2.02	<0.0100	2.32	0.57	3.06	-	-	-	-	-	-
RS16	16 Apr 2025	10:54:00	0.113	0.24	0.24	3.74	3.5	<0.01	0.71	0.18	3.93	-	-	-	-	-	-
RS16	23 Apr 2025	12:09:00	0.078	0.19	0.19	0.86 #2	0.67 #2	<0.01	0.5	0.12	2.38	-	-	-	-	-	-
RS16	30 Apr 2025	10:30:00	0.62	1.55	1.6	7.02	5.4	0.07	2.7	0.85	7.06	-	-	-	-	-	-
RS16	06 May 2025	0:00:00	0.433	1.66	-	5.69	3.97	0.0592	2.74	0.59	5.93	-	-	-	-	-	-
RS16	21 May 2025	12:58:00	0.037	0.1	0.09	0.41 #2	0.32 #2	<0.01	0.24	0.07	<2	-	-	-	-	-	-
RS16	28 May 2025	12:45:00	0.706	1.31	5.9	5.9	4.6	0.03	3.49	1.04	8.83	-	-	-	-	-	-
RS16	03 Jun 2025	11:45:00	<0.020 #1	0.038	-	0.4	0.4	<0.010 #1	<0.050 #1	0.007	<1	-	-	-	-	-	-
RS16	12 Jun 2025	10:06:00	0.365	0.44	0.45	2.01 #2	1.56 #2	0.01	1.16	0.23	2.7	-	-	-	-	-	-
RS16	18 Jun 2025	11:46:00	1.93	6.22	6.2	6.2	<15	<0.01	0.08	2.01	2.33	-	-	-	-	-	-
RS16	06 Aug 2025	0:00:00	1.257	0.325	-	4.8	4.43	0.0415	3.85	1.53	4.98	-	-	-	-	-	-
RS16	13 Aug 2025	12:25:00	0.237	0.49	0.52	3.52	3	0.02	2.64	0.49	5.51	-	-	-	-	-	-
RS16	19 Aug 2025	13:35:00	0.765	0.67	0.69	6.29	5.6	0.02	4.1	0.97	8.02	-	-	-	-	-	-
RS16	26 Aug 2025	0:00:00	0.015	0.5	0.5	<0.8	<0.8	<0.01	0.02	0.05	<2	-	-	-	-	-	-
RS16	04 Sep 2025	11:25:00	0.07	0.69	0.69	0.69	<0.8	<0.01	0.03	0.18	<2	-	-	-	-	-	-
RS16	11 Sep 2025	13:42:00	0.102	0.73	0.74	0.74	<0.8	<0.01	0.03	0.22	<2	-	-	-	-	-	-
RS16	15 Oct 2025	0:00:00	0.752	0.600	-	1.3	0.66	0.0022	0.03	1.09	<1.00	-	-	-	-	-	-
RS16	02 Dec 2025	10:34:00	1.35	1.8	-	3.3	1.5	<0.01 #1	0.059	1.59	<1	-	-	-	-	-	-
RS16	10 Mar 2026	13:40:00	2.22	2.67	-	3.8	1.1	<0.010 #1	0.093	2.60	<1	-	-	-	-	-	-
RS16	22 Apr 2026	12:00:00	0.826	1.93	-	2.7	0.7	<0.010 #1	<0.050 #1	1.08	<1	-	0.757	<0.030 #1	<0.0050 #1	<0.0050 #1	<0.00020 #1

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

#2 Estimated result. TKN calculated using percentage of ammonia (assuming percentage remains similar between samples at 74.5%). TN updated to reflect estimated TKN result. Updated due to original lab value for TN appearing higher than Amm-N due to high LOQ for TKN

Surface water results

			Metals														
			Cadmium (filtered)	Chromium (III+VI)	Chromium (III+VI) (filtered)	Copper	Copper (filtered)	Iron (filtered)	Lead	Lead (filtered)	Manganese (filtered)	Mercury	Mercury (filtered)	Nickel	Nickel (filtered)	Zinc	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL			0.00002	0.0002	0.0002	0.0002	0.0002	0.005	0.00005	0.00005	0.0005	0.00008	0.00008	0.0002	0.0002	0.001	0.001
Location Code	**Date**	**Time**															
RS01	10 Mar 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.00087	-	-	-	-	-	<0.0010
RS02	10 Mar 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.0010	-	-	-	-	-	<0.0010
RS04 B	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.0021	-	-	-	-	-	<0.0010
RS04 B	22 Apr 2026	12:13:00	<0.00002	0.0007	<0.0002	0.0015	0.0006	-	0.00074	<0.00005	-	<0.0001	<0.00008	0.0009	<0.0002	0.006	<0.001
RS04 B	22 Apr 2026	12:13:00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00140	<0.0005
RS06 B	11 Mar 2025	0:00:00	-	-	-	-	-	0.011	-	-	0.0068	-	-	-	-	-	<0.0010
RS06 B	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.0094	-	-	-	-	-	0.0021
RS06 B	22 Apr 2026	12:48:00	<0.00002	0.0008	<0.0002	0.0017	0.0008	-	0.00078	0.00011	-	<0.0001	<0.00008	0.0009	0.0002	0.015	0.010
RS06 B	22 Apr 2026	12:48:00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0079	0.0100
RS09	11 Mar 2025	0:00:00	-	-	-	-	-	0.052	-	-	0.010	-	-	-	-	-	0.0013
RS09	22 Apr 2026	13:00:00	<0.00002	0.0020	<0.0002	0.0048	0.0010	-	0.00311	0.00014	-	<0.0001	<0.00008	0.0027	0.0003	0.017	0.020
RS09	22 Apr 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0111	0.0090
RS10	11 Mar 2025	0:00:00	-	-	-	-	-	0.0085	-	-	0.0096	-	-	-	-	-	<0.0010
RS10	22 Apr 2026	14:20:00	<0.00002	0.0007	<0.0002	0.0017	0.0005	-	0.00080	<0.00005	-	<0.0001	<0.00008	0.0009	0.0002	0.005	0.013
RS10	22 Apr 2026	14:20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00095	0.0061
RS11	11 Mar 2025	0:00:00	-	-	-	-	-	0.029	-	-	0.136	-	-	-	-	-	0.0012
RS11	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.018	-	-	-	-	-	<0.0010
RS11	22 Apr 2026	10:45:00	<0.00002	0.0003	<0.0002	0.0007	0.0007	-	0.00007	0.00007	-	<0.0001	<0.00008	0.0004	0.0004	0.005	0.057
RS11	22 Apr 2026	10:45:00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00057	<0.0005
RS12	11 Mar 2025	0:00:00	-	-	-	-	-	0.016	-	-	0.582	-	-	-	-	-	<0.0010
RS12	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.029	-	-	-	-	-	0.0011
RS13	11 Mar 2025	0:00:00	-	-	-	-	-	0.0070	-	-	0.031	-	-	-	-	-	0.0014
RS13	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.050	-	-	-	-	-	0.0018
RS14	11 Mar 2025	0:00:00	-	-	-	-	-	0.0098	-	-	0.0024	-	-	-	-	-	<0.0010
RS14	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	<0.00050	-	-	-	-	-	0.0020
RS15	07 Apr 2025	0:00:00	-	-	-	-	-	0.11	-	-	0.0521	-	-	-	-	-	0.061
RS15	22 Apr 2026	11:50:00	<0.00020 [#1]	<0.0020 [#1]	<0.0020 [#1]	0.0095	0.0039	-	0.00072	0.00058	-	<0.0010 [#1]	<0.00080 [#1]	<0.0020 [#1]	<0.0020 [#1]	0.101	0.095
RS16	07 Apr 2025	0:00:00	-	-	-	-	-	<0.0050	-	-	0.0090	-	-	-	-	-	<0.0010
RS16	22 Apr 2026	12:00:00	<0.00020 [#1]	0.0029	<0.0020 [#1]	0.0045	0.0021	-	0.00125	<0.00050 [#1]	-	<0.0010 [#1]	<0.00080 [#1]	<0.0020 [#1]	<0.0020 [#1]	0.129	0.057
RS16	22 Apr 2026	12:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.056	0.046

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Effluent results

			Field Parameters									Laboratory		
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	cm	pH units	µS/cm	mg/L
EQL												1	0.2	2.5
Location Code	**Date**	**Time**												
EFF	03 Apr 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	16 Apr 2025	10:03:00	6.94	380.7	6.7	6.7	-	134.9	17.4	-	-	-	-	-
EFF	23 Apr 2025	11:30:00	7.3	402	7.3	7.3	-	-	17.8	-	-	-	-	-
EFF	30 Apr 2025	9:49:00	6.9	414	5.7	5.7	-	-	16.4	-	-	-	-	-
EFF	06 May 2025	14:10:00	7.16	429.6	-	-	95.5	180.5	15.6	-	>120	-	-	-
EFF	06 May 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	07 May 2025	14:30:00	-	-	-	-	-	-	-	-	-	-	-	22.8
EFF	14 May 2025	12:05:00	7.5	340	7.5	7.5	-	-	18	-	-	-	-	-
EFF	21 May 2025	11:53:00	7.1	427	9.9	9.9	-	-	15.3	-	-	-	-	-
EFF	28 May 2025	14:05:00	7.4	443	9.5	9.5	-	-	13	-	-	-	-	-
EFF	03 Jun 2025	10:49:00	7.32	462.1	-	-	89.9	163.7	13.9	10.82	-	-	-	-
EFF	03 Jun 2025	10:49:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Jun 2025	13:05:00	-	-	-	-	-	-	-	-	-	-	-	19
EFF	12 Jun 2025	9:46:00	7.6	341	10.4	10.4	-	-	10.3	-	-	-	-	-
EFF	18 Jun 2025	11:19:00	7.2	406	9	9	-	-	11.8	-	-	-	-	-
EFF	26 Jun 2025	13:20:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	01 Jul 2025	11:38:00	7.29	458.8	-	-	160.4	9.24	10.4	-	-	-	-	-
EFF	01 Jul 2025	11:38:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	07 Jul 2025	13:35:00	-	-	-	-	-	-	-	-	-	-	-	49.5
EFF	09 Jul 2025	12:18:00	7.2	328	10	10	-	-	10.9	-	-	-	-	-
EFF	10 Jul 2025	9:54:00	7.3	331	7.8	7.8	-	-	12.6	-	-	-	-	-
EFF	14 Jul 2025	8:55:00	-	-	-	-	-	-	-	-	-	-	-	33.1
EFF	24 Jul 2025	10:53:00	7.2	356	8.8	8.8	-	-	11.5	-	-	-	-	-
EFF	31 Jul 2025	12:02:00	7.3	335	7.9	7.9	-	-	13.1	-	-	-	-	-
EFF	06 Aug 2025	11:20:00	7.01	461.7	4.44	4.44	40.2	129.1	9.7	-	-	-	-	-
EFF	06 Aug 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	07 Aug 2025	11:45:00	-	-	-	-	-	-	-	-	-	-	-	52.7
EFF	13 Aug 2025	11:37:00	7.2	342	7.2	7.2	-	-	11.5	-	-	-	-	-
EFF	19 Aug 2025	10:10:00	7.3	337	8.6	8.6	-	-	10.6	-	-	-	-	-
EFF	26 Aug 2025	0:00:00	7.1	325	8.2	8.2	-	-	14.9	-	-	-	-	-

Effluent results

			Field Parameters									Laboratory		
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	cm	pH units	µS/cm	mg/L
EQL												1	0.2	2.5
Location Code	**Date**	**Time**												
EFF	04 Sep 2025	10:20:00	6.9	383	7.8	7.8	-	-	14.4	-	-	-	-	-
EFF	04 Sep 2025	10:20:00	-	-	-	-	-	-	-	-	-	-	-	12.2
EFF	11 Sep 2025	11:45:00	7.2	299	8.1	8.1	-	-	14.4	-	-	-	-	-
EFF	19 Sep 2025	9:00:00	-	-	-	-	-	-	-	-	-	6.9	347	-
EFF	25 Sep 2025	11:00:00	6.8	315	7.9	7.9	-	-	15.6	-	-	-	-	-
EFF	30 Sep 2025	13:13:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	30 Sep 2025	7:55:00	-	-	-	-	-	-	-	-	-	-	-	11.1
EFF	07 Oct 2025	12:30:00	-	-	-	-	-	-	-	-	-	-	-	7.1
EFF	10 Oct 2025	12:54:00	7.3	317	8.2	8.2	-	-	18.4	-	-	-	-	-
EFF	15 Oct 2025	9:05:00	6.74	356.2	6.29	6.29	-	86	10.6	-	-	-	-	-
EFF	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	15 Oct 2025	9:05:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	22 Oct 2025	11:10:00	7.2	285	9.4	9.4	-	-	15.7	-	-	-	-	-
EFF	29 Oct 2025	11:54:00	7.1	314	9.5	9.5	-	-	15.6	-	-	-	-	-
EFF	04 Nov 2025	11:35:00	-	-	-	-	-	-	-	-	-	-	-	8.2
EFF	05 Nov 2025	11:08:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Nov 2025	0:00:00	6.6	367	7.6	7.6	-	-	18.4	-	-	-	-	-
EFF	12 Nov 2025	11:02:00	6.9	372	7.7	7.7	-	-	18.9	-	-	-	-	-
EFF	19 Nov 2025	11:31:00	6.8	343	6	6	-	-	19.3	-	-	-	-	-
EFF	26 Nov 2025	13:15:00	6.4	390	7.2	7.2	-	-	22	-	-	-	-	-
EFF	02 Dec 2025	11:41:00	6.79	374.2	6.78	6.78	-	107.7	19.3	71.8	106	-	-	-
EFF	02 Dec 2025	11:41:00	-	-	-	-	-	-	-	-	-	-	-	24
EFF	04 Dec 2025	11:00:00	-	-	-	-	-	-	-	-	-	-	-	4
EFF	10 Dec 2025	11:43:00	7.1	365	6.7	6.7	-	-	22.3	-	-	-	-	-
EFF	17 Dec 2025	12:45:00	6.9	376	6.1	6.1	-	-	21	-	-	-	-	-
EFF	22 Dec 2025	12:45:00	6.7	374	6.6	6.6	-	-	20	-	-	-	-	-
EFF	29 Dec 2025	12:45:00	6.8	390	6.6	6.6	-	-	20.8	-	-	-	-	3.6
EFF	06 Jan 2026	12:30:00	6.8	436	6.3	6.3	-	-	22.9	-	-	-	-	8.9

Effluent results

			Field Parameters									Laboratory		
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	cm	pH units	µS/cm	mg/L
EQL												1	0.2	2.5
Location Code	**Date**	**Time**												
EFF	06 Jan 2026	12:35:00	-	-	-	-	-	-	-	-	-	-	-	18.2
EFF	13 Jan 2026	11:17:00	6.9	360	7.3	7.3	-	-	20.8	-	-	-	-	4.8
EFF	19 Jan 2026	9:15:00	-	-	-	-	-	-	-	-	-	-	-	<2.6
EFF	22 Jan 2026	12:39:00	7	376	7	7	-	-	22.6	-	-	-	-	2.6
EFF	27 Jan 2026	8:20:00	-	-	-	-	-	-	-	-	-	-	-	4.3
EFF	28 Jan 2026	12:25:00	6.9	405	7.2	7.2	-	-	21	-	-	-	-	3.6
EFF	28 Jan 2026	13:05:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	03 Feb 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	03 Feb 2026	13:00:00	6.9	406	7.3	7.3	-	-	20.9	-	-	-	-	-
EFF	03 Feb 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	10
EFF	11 Feb 2026	14:25:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	11 Feb 2026	14:25:00	7.1	417	7.1	7.1	-	-	23.9	-	-	-	-	2.7
EFF	19 Feb 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	19 Feb 2026	13:00:00	6.9	423	6.2	6.2	-	-	21.3	-	-	-	-	6.8
EFF	25 Feb 2026	13:15:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	25 Feb 2026	13:15:00	6.9	401	6.5	6.5	-	-	22.5	-	-	-	-	6.2
EFF	05 Mar 2026	14:33:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Mar 2026	13:20:00	6.9	409	6.7	6.7	-	-	20.6	-	-	-	-	-
EFF	05 Mar 2026	13:20:00	-	-	-	-	-	-	-	-	-	-	-	5.7
EFF	10 Mar 2026	14:35:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	10 Mar 2026	14:35:00	6.95	402.6	-	-	8.25	155.3	21.2	201.65	-	-	-	-
EFF	12 Mar 2026	11:40:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	18 Mar 2026	12:45:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	18 Mar 2026	12:45:00	6.8	404	6.9	6.9	-	-	21.7	-	-	-	-	5.8
EFF	24 Mar 2026	11:20:00	6.9	398	7	7	-	-	21.1	-	-	-	-	8
EFF	01 Apr 2026	13:20:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	01 Apr 2026	14:00:00	-	-	-	-	-	-	-	-	-	-	-	<5
EFF	01 Apr 2026	13:20:00	6.8	394	6.9	6.9	-	-	20.1	-	-	-	-	-
EFF	07 Apr 2026	12:35:00	6.9	396	7.4	7.4	-	-	19.8	-	-	-	-	<5
EFF	13 Apr 2026	14:00:00	6.9	349	6.9	6.9	-	-	18.8	-	4	-	-	4.1

Effluent results

			Field Parameters									Laboratory		
			pH (Field)	Electrical conductivity (field)	Dissolved Oxygen (Field)	Dissolved Oxygen (Field) (filtered)	DO (%S) (Field)	Redox (Field)	Temperature (Field)	Turbidity (Field)	Clarity	pH (Lab)	Electrical conductivity (lab)	Total Suspended Solids
			pH units	µS/cm	mg/L	mg/L	%S	mV	°C	NTU	cm	pH units	µS/cm	mg/L
EQL												1	0.2	2.5
Location Code	**Date**	**Time**												
EFF	22 Apr 2026	11:06:00	6.93	380.6	7.98	7.98	83.3	89.7	16.4	43.55	-	-	-	-
EFF	22 Apr 2026	11:06:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	22 Apr 2026	11:06:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	23 Apr 2026	13:25:00	-	-	-	-	-	-	-	-	-	-	-	-
EFF	29 Apr 2026	13:30:00	6.9	394	-	7.7	-	-	18.9	-	-	-	-	5.6

Effluent results

			Hardness			Biological		Nutrients									Organic Indicators	
			Calcium Hardness	Magnesium Hardness	Total Hardness	Total Coliforms (Colilert)	E.coli	Dissolved Non-Purgeable Organic Carbon (DNPOC) (filtered)	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD
			g eqv. CaCO3/m3	g eqv. CaCO3/m3	g eqv. CaCO3/m3	orgs/100mL	orgs/100mL	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3
EQL			0.05	0.05	0.05		1		0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2
Location Code	**Date**	**Time**																
EFF	03 Apr 2025	0:00:00	-	-	-	-	<10	-	-	-	-	-	-	-	-	-	-	-
EFF	16 Apr 2025	10:03:00	-	-	-	-	5	-	0.85	2.82	2.8	11.1	8.3	0.02	5.11	1.38	9.96	-
EFF	23 Apr 2025	11:30:00	-	-	-	-	12	-	1.13	2.95	3	13	10	0.04	6.39	1.54	12.9	-
EFF	30 Apr 2025	9:49:00	-	-	-	-	14	-	0.838	3.6	3.7	14.4	10.7	0.06	6.73	1.44	9.27	-
EFF	06 May 2025	14:10:00	-	-	-	1,046.2	4.1	-	-	-	-	-	-	-	-	-	-	-
EFF	06 May 2025	0:00:00	-	-	-	-	-	-	0.939	3.68	-	11.88	8.17	0.0342	5.70	1.04	8.29	-
EFF	07 May 2025	14:30:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	14 May 2025	12:05:00	-	-	-	-	8	-	0.046	2.79	2.8	4.99	2.2	<0.01	0.1	0.26	3.65	-
EFF	21 May 2025	11:53:00	-	-	-	-	14	-	1.75	0.91	0.93	14.8	13.9	0.02	9.55	2.38	19.4	-
EFF	28 May 2025	14:05:00	-	-	-	-	3	-	1.77	1.55	15	15	13.4	0.03	8.36	2.7	19.6	-
EFF	03 Jun 2025	10:49:00	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-
EFF	03 Jun 2025	10:49:00	-	-	-	-	-	-	1.01	3.04	-	14.0	10.9	0.023	6.71	1.57	8	-
EFF	05 Jun 2025	13:05:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	12 Jun 2025	9:46:00	-	-	-	-	2	-	1.56	4.22	4.2	20.5	16.3	0.01	11.4	2.37	13.5	-
EFF	18 Jun 2025	11:19:00	-	-	-	-	10	-	2.03	6.43	6.4	6.4	<15	<0.01	0.06	2.17	2.11	-
EFF	26 Jun 2025	13:20:00	-	-	-	-	2	-	1.43	1.74	1.8	19.8	18	0.02	12.3	2.25	16.4	-
EFF	01 Jul 2025	11:38:00	-	-	-	>201	15	-	-	-	-	-	-	-	-	-	-	-
EFF	01 Jul 2025	11:38:00	-	-	-	-	-	-	1.74	2.50	2.54	16.1	13.6	0.036	9.63	2.28	-	21
EFF	07 Jul 2025	13:35:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	09 Jul 2025	12:18:00	-	-	-	-	29	-	1.59	1.86	1.9	18.2	16.3	0.04	11.1	2.43	16.7	-
EFF	10 Jul 2025	9:54:00	-	-	-	-	160	-	0.963	1.74	1.8	16	14.2	0.05	8.51	2.24	17.7	-
EFF	14 Jul 2025	8:55:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	24 Jul 2025	10:53:00	-	-	-	-	900	-	0.98	0.36	0.38	18.6	18.2	0.02	8.45	4.57	46.8	-
EFF	31 Jul 2025	12:02:00	-	-	-	-	70	-	0.67	1.37	1.4	12.5	11.1	0.06	6.35	1.48	19.7	-
EFF	06 Aug 2025	11:20:00	-	-	-	-	310	-	-	-	-	-	-	-	-	-	-	-
EFF	06 Aug 2025	0:00:00	-	-	-	-	-	-	8.089	0.381	-	21	20.3	0.203	17.3	9.99	23.2	-
EFF	07 Aug 2025	11:45:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	13 Aug 2025	11:37:00	-	-	-	-	50	-	0.894	0.45	0.48	16.4	15.9	0.04	12.7	2.29	22.4	-
EFF	19 Aug 2025	10:10:00	-	-	-	-	48	-	2.22	0.61	0.66	18.9	18.2	0.05	13.2	3.17	19.7	-
EFF	26 Aug 2025	0:00:00	-	-	-	-	63	-	0.075	2.98	3	4.99	2	0.01	0.09	0.32	<6	-

Effluent results

			Hardness			Biological		Nutrients									Organic Indicators	
			Calcium Hardness	Magnesium Hardness	Total Hardness	Total Coliforms (Colilert)	E.coli	Dissolved Non-Purgeable Organic Carbon (DNPOC) (filtered)	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD
			g eqv. CaCO3/m3	g eqv. CaCO3/m3	g eqv. CaCO3/m3	orgs/100mL	orgs/100mL	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3
EQL			0.05	0.05	0.05		1		0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2
Location Code	**Date**	**Time**																
EFF	04 Sep 2025	10:20:00	-	-	-	-	45	-	0.194	2.75	2.8	5.76	3	0.01	0.1	0.74	<6	-
EFF	04 Sep 2025	10:20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	11 Sep 2025	11:45:00	-	-	-	-	42	-	0.437	2.81	2.8	5.32	2.5	<0.01	0.09	0.86	<6	-
EFF	19 Sep 2025	9:00:00	-	-	-	-	220	-	0.642	2.41	2.4	4.92	2.5	<0.01	0.08	1.31	<6	-
EFF	25 Sep 2025	11:00:00	-	-	-	-	170	-	1.43	2.89	2.9	5.3	2.4	<0.01	0.07	1.78	3.9	-
EFF	30 Sep 2025	13:13:00	-	-	-	-	260	-	0.958	2.67	2.7	4.78	2.1	<0.01	0.08	1.48	-	-
EFF	30 Sep 2025	7:55:00	-	-	-	-	330[#2]	-	-	-	-	5.14[#2]	-	-	0.11[#2]	1.66[#2]	<6[#2]	-
EFF	07 Oct 2025	12:30:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	10 Oct 2025	12:54:00	-	-	-	-	38	-	1.44	2.95	3	8.95	6	<0.01	0.09	1.94	3.81	-
EFF	15 Oct 2025	9:05:00	-	-	-	-	49	-	-	-	-	-	-	-	-	-	-	-
EFF	15 Oct 2025	0:00:00	-	-	-	-	-	-	2.740	2.50	-	4.1	1.56	<0.0100	0.10	3.15	2.99	-
EFF	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	15 Oct 2025	0:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	15 Oct 2025	9:05:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	22 Oct 2025	11:10:00	-	-	-	-	38	-	0.905	2.07	2.1	7.3	5.2	0.01	1.7	1.52	5.96	-
EFF	29 Oct 2025	11:54:00	-	-	-	-	4	-	1.81	2.15	2.2	7.76	5.6	<0.01	2.49	2.31	4.85	-
EFF	04 Nov 2025	11:35:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Nov 2025	11:08:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Nov 2025	0:00:00	-	-	-	-	3	-	1.22	2.3	2.3	1.9	1.9	<0.01	0.07	1.5	2.23	-
EFF	12 Nov 2025	11:02:00	-	-	-	-	24	-	1.79	3.21	3.2	4.72	1.5	<0.01	0.09	2.18	<2	-
EFF	19 Nov 2025	11:31:00	-	-	-	-	13	-	1.11	3.91	3.9	5.11	1.2	<0.01	0.09	1.78	<2	-
EFF	26 Nov 2025	13:15:00	-	-	-	-	47	-	1.62	2.9	2.9	4.6	1.7	<0.01	0.12	2.5	<2	-
EFF	02 Dec 2025	11:41:00	-	-	-	-	69	-	-	-	-	-	-	-	-	-	-	-
EFF	02 Dec 2025	11:41:00	-	-	-	-	-	-	2.76	3.48	-	5.6	2.1	<0.01[#1]	0.127	2.96	6	-
EFF	04 Dec 2025	11:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	10 Dec 2025	11:43:00	-	-	-	-	130	-	2.06	3.07	3.1	5.18	2.1	<0.01	0.19	2.56	<2.73	-
EFF	17 Dec 2025	12:45:00	-	-	-	-	16	-	1.59	3.33	3.3	5.24	1.9	<0.01	0.18	1.87	<2	-
EFF	22 Dec 2025	12:45:00	-	-	-	-	8	-	2.51	2.59	2.6	4.71	2.1	0.01	0.22	2.8	2.28	-
EFF	29 Dec 2025	12:45:00	-	-	-	-	26	-	1.42	3.4	3.4	4.9	1.5	<0.01	0.11	1.59	<2	-

Effluent results

			Hardness			Biological		Nutrients									Organic Indicators	
			Calcium Hardness	Magnesium Hardness	Total Hardness	Total Coliforms (Colilert)	E.coli	Dissolved Non-Purgeable Organic Carbon (DNPOC) (filtered)	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD
			g eqv. CaCO3/m3	g eqv. CaCO3/m3	g eqv. CaCO3/m3	orgs/100mL	orgs/100mL	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3
EQL			0.05	0.05	0.05		1		0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2
Location Code	**Date**	**Time**																
EFF	06 Jan 2026	12:30:00	-	-	-	-	40	-	3.78	2.63	2.7	6.56	3.9	0.03	1.89	4.31	2.98	-
EFF	06 Jan 2026	12:35:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	13 Jan 2026	11:17:00	-	-	-	-	16	-	2.26	3.88	3.9	6.79	2.9	<0.01	0.08	2.36	<2	-
EFF	19 Jan 2026	9:15:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	22 Jan 2026	12:39:00	-	-	-	-	<1	-	3.39	4.77	4.8	7.08	2.3	<0.01	0.06	3.72	<2	-
EFF	27 Jan 2026	8:20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	28 Jan 2026	12:25:00	-	-	-	-	2	-	2.99	2.8	2.8	5	2.2	<0.01	0.08	3.58	<2	-
EFF	28 Jan 2026	13:05:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	03 Feb 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	03 Feb 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	03 Feb 2026	13:00:00	-	-	-	-	10	-	-	5	-	5.97	-	-	0.11	2.43	2.82	3
EFF	11 Feb 2026	14:25:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	11 Feb 2026	14:25:00	-	-	-	-	16	-	1.77	4.25	4.3	9.16	4.9	<0.01	0.07	2.15	<2	-
EFF	19 Feb 2026	13:00:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	19 Feb 2026	13:00:00	-	-	-	-	13	-	2.01	3.73	3.8	8.2	4.4	0.08	2.17	2.72	2.42	-
EFF	25 Feb 2026	13:15:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	25 Feb 2026	13:15:00	-	-	-	-	12	-	1.78	3.29	3.3	5.29	2	<0.01	0.07	2.28	<3	-
EFF	05 Mar 2026	14:33:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Mar 2026	13:20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	05 Mar 2026	13:20:00	-	-	-	-	6	-	-	4.65	-	5.72	-	-	0.09	3.69	<3	<3
EFF	10 Mar 2026	14:35:00	-	-	-	-	-	-	2.97	3.40	-	5.3	1.9	<0.010 [#1]	0.183	3.54	3	-
EFF	10 Mar 2026	14:35:00	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-
EFF	12 Mar 2026	11:40:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	18 Mar 2026	12:45:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	18 Mar 2026	12:45:00	-	-	-	-	3	-	2.54	3.33	3.3	5.14	1.8	<0.01	0.08	3.56	<3	-
EFF	24 Mar 2026	11:20:00	-	-	-	-	6	-	1.65	3.32	3.3	4.8	1.5	<0.01	0.06	2.45	<3	-
EFF	01 Apr 2026	13:20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	01 Apr 2026	14:00:00	-	-	-	-	1	-	-	4.24	-	1.8	-	-	0.08	2.86	<3	<3
EFF	01 Apr 2026	13:20:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	07 Apr 2026	12:35:00	-	-	-	-	35	-	1.86	3.53	3.5	4.63	1.1	<0.01	0.05	2.28	<2	-

Effluent results

			Hardness			Biological		Nutrients									Organic Indicators	
			Calcium Hardness	Magnesium Hardness	Total Hardness	Total Coliforms (Colilert)	E.coli	Dissolved Non-Purgeable Organic Carbon (DNPOC) (filtered)	Dissolved Reactive Phosphorus (FIA) (DRP)	Nitrate (as N)	Nitrogen (Total Oxidised) (as N)	Nitrogen (Total)	Kjeldahl Nitrogen Total	Nitrite (as NO2-)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)	TBOD
			g eqv. CaCO3/m3	g eqv. CaCO3/m3	g eqv. CaCO3/m3	orgs/100mL	orgs/100mL	g/m3	g/m3	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	g/m3	g/m3
EQL			0.05	0.05	0.05		1		0.002	0.002	0.002	0.1	0.1	0.001	0.005	0.005	1	1 - 2
Location Code	**Date**	**Time**																
EFF	13 Apr 2026	14:00:00	-	-	-	-	4	-	2.07	4.58	4.6	6.28	1.7	<0.01	0.06	2.7	<2	-
EFF	22 Apr 2026	11:06:00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EFF	22 Apr 2026	11:06:00	-	-	-	-	-	5.8	-	-	-	-	-	-	-	-	-	-
EFF	22 Apr 2026	11:06:00	63.8	10.5	74.3	-	-	-	1.35	3.01	-	4.3	1.3	<0.010 #1	0.064	1.59	2	-
EFF	23 Apr 2026	13:25:00	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
EFF	29 Apr 2026	13:30:00	-	-	-	-	1	-	1.02	3.42	3.4	7.92	4.5	<0.01	0.06	1.49	<2	-

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

#2 Estimated result. TKN calculated using percentage of ammonia (assuming percentage remains similar between samples at 74.5%). TN updated to reflect estimated TKN result. Updated due to original lab value for TN appearing higher than Amm-N due to high LOQ for TKN

Effluent metal results

Location Code	Date	Time	Aluminium mg/L	Aluminium (filtered) mg/L	Arsenic mg/L	Arsenic (filtered) mg/L	Cadmium mg/L	Cadmium (filtered) mg/L	Chromium (III+VI) mg/L	Chromium (III+VI) (filtered) mg/L	Copper mg/L
EFF	15 Oct 2025	0:00:00	-	-	<0.0050	-	<0.00020	-	<0.0020	-	0.0037
EFF	05 Nov 2025	11:08:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.003
EFF	28 Jan 2026	13:05:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.006
EFF	03 Feb 2026	13:00:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.005
EFF	11 Feb 2026	14:25:00	-	-	<0.002	-	<0.001	-	0.002	-	0.005
EFF	19 Feb 2026	13:00:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.004
EFF	25 Feb 2026	13:15:00	-	-	<0.002	-	<0.001	-	0.001	-	0.006
EFF	05 Mar 2026	14:33:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.008
EFF	12 Mar 2026	11:40:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.006
EFF	18 Mar 2026	12:45:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.008
EFF	01 Apr 2026	13:20:00	-	-	<0.002	-	<0.001	-	<0.001	-	0.006
EFF	22 Apr 2026	11:06:00	0.183	<0.030 #1	<0.0050 #1	<0.0050 #1	<0.00020 #1	<0.00020 #1	<0.0020 #1	<0.0020 #1	0.0053

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Effluent metal results

Location Code	Date	Time	Copper (filtered)	Lead	Lead (filtered)	Mercury	Mercury (filtered)	Nickel	Nickel (filtered)	Zinc	Zinc (filtered)
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EFF	15 Oct 2025	0:00:00	-	0.0023	-	<0.0010	-	<0.0020	-	0.475	-
EFF	05 Nov 2025	11:08:00	-	<0.001	-	<0.001	-	<0.001	-	0.066	-
EFF	28 Jan 2026	13:05:00	-	<0.001	-	<0.001	-	<0.001	-	0.085	-
EFF	03 Feb 2026	13:00:00	-	<0.001	-	<0.001	-	<0.001	-	0.079	-
EFF	11 Feb 2026	14:25:00	-	<0.001	-	<0.001	-	0.001	-	0.093	-
EFF	19 Feb 2026	13:00:00	-	<0.001	-	<0.001	-	<0.001	-	0.079	-
EFF	25 Feb 2026	13:15:00	-	<0.001	-	<0.001	-	<0.001	-	0.11	-
EFF	05 Mar 2026	14:33:00	-	<0.001	-	<0.001	-	0.001	-	0.121	-
EFF	12 Mar 2026	11:40:00	-	<0.001	-	<0.001	-	<0.001	-	0.097	-
EFF	18 Mar 2026	12:45:00	-	0.001	-	<0.001	-	0.005	-	0.106	-
EFF	01 Apr 2026	13:20:00	-	<0.001	-	<0.001	-	<0.001	-	0.104	-
EFF	22 Apr 2026	11:06:00	0.0037	0.00083	0.00057	<0.0010[#1]	<0.00080[#1]	<0.0020[#1]	<0.0020[#1]	0.109	0.095

Comments

#1 Reported Analyte LOR is higher than Requested Analyte LOR

Effluent microplastics & PFAS results (15 Oct 2025)

Parameter	Unit	EFF result	Parameter	Unit	EFF result
Polyamide	MPs/L	44	Perfluorooctanoic acid (PFOA)	µg/L	0.0043
Polycarbonate	MPs/L	9	Perfluorononanoic acid (PFNA)	µg/L	0.00022
Polyethylene	MPs/L	<4	Perfluorodecanoic acid (PFDA)	µg/L	0.00045
Polyethylene Terephthalate	MPs/L	6	Perfluoroundecanoic acid (PFUnDA)	µg/L	<0.0010
Polymethylmethacrylate	MPs/L	<4	Perfluorododecanoic acid (PFDoDA)	µg/L	<0.0010
Polypropylene	MPs/L	14	Perfluorotridecanoic acid (PFTrDA)	µg/L	<0.0010
Polystyrene	MPs/L	<4	Perfluorotetradecanoic acid (PFTeDA)	µg/L	<0.0010
Polyurethane	MPs/L	17	Perfluorooctane sulfonamide (PFOSA)	µg/L	<0.00020
Polyvinyl Chloride	MPs/L	<3	N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	<0.0010
Perfluoropropanesulfonic acid (PFPrS)	µg/L	<0.00020	N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	<0.0010
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.0017	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	<0.0010
Perfluoropentane sulfonic acid (PFPeS)	µg/L	<0.00020	N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	<0.0010
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.00032	N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	<0.0010
PFHxS (mono-branched)	µg/L	<0.00010	N-Methyl perfluorooctane sulfonamidoethanol (MEFOSE)	µg/L	<0.0010
PFHxS (di-branched)	µg/L	<0.00010	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	<0.0010
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	<0.00020	6:2 Fluorotelomer Sulfonate (6:2 FTS)	µg/L	<0.0050
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.00066	8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	<0.0010
PFOS (di-branched)	µg/L	<0.00010	Tetrafluoro-2-(heptafluoropropoxy) propanoic acid (HFPO-DA / GenX)	µg/L	<0.0010
PFOS (mono-branched)	µg/L	0.00038	PFHxS (linear)	µg/L	0.00032
Perfluorononane sulfonate (PFNS)	µg/L	<0.0010	PFOS (linear)	µg/L	0.00027
Perfluorodecanesulfonic acid (PFDS)	µg/L	<0.0010	Sum (PFHxS (Total) + PFOS (Total) + PFOA)*	µg/L	0.0053
Perfluorobutanoic acid (PFBA)	µg/L	0.0020	Sum (PFHxS (Total) + PFOS (Total))*	µg/L	0.00098
Perfluoropentanoic acid (PFPeA)	µg/L	0.016	Sum (PFOS (Total) + PFOA (Total))*	µg/L	0.0050
Perfluorohexanoic acid (PFHxA)	µg/L	0.0059	Sum of PFAS (n=10)*	µg/L	0.031
Perfluoroheptanoic acid (PFHpA)	µg/L	0.00064	Sum of PFAS (n=31)*	µg/L	0.032

Effluent Operational sampling

			Total Suspended Solids	E.coli	Nitrate (as N)	Nitrogen (Total)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			mg/L	orgs/100mL	mg/L	mg/L	mg/L	mg/L	g/m3
EQL			2.5	1	0.002	0.1	0.005	0.005	1
Location Code	**Date**	**Time**							
EFF	16 Apr 2025	8:40:00	8.7	10	-	15.4	7.48	1.61	7.52
EFF	23 Apr 2025	8:10:00	7.7	<10	-	13.2	8.29	1.64	8.19
EFF	02 May 2025	8:56:00	6	<10	-	16.3	9.26	1.69	7.46
EFF	07 May 2025	9:10:00	12.5	70	-	13.7	5.43	1.58	19.7
EFF	12 May 2025	8:42:00	<2.5	10	-	5.49	0.1	0.13	<6
EFF	20 May 2025	8:45:00	12.6	10	-	16.6	10.2	2.09	11.7
EFF	28 May 2025	9:04:00	20.8	40	-	17.9	11.4	3.18	18.6
EFF	06 Jun 2025	8:47:00	26	10	-	13.9	6.13	1.42	9.06
EFF	09 Jun 2025	8:30:00	24.8	<10	-	14.6	8.34	1.59	12
EFF	17 Jun 2025	8:52:00	2.9	10	-	7.23	0.1	2.11	3.25
EFF	25 Jun 2025	8:56:00	27.3	1	-	17.9	7.92	3.01	20.1
EFF	04 Jul 2025	11:25:00	37.3	80	-	13.5	5.96	2.26	13.4
EFF	11 Jul 2025	8:35:00	40.7	30	-	16.4	6.89	3.03	19.9
EFF	14 Jul 2025	8:55:00	31.8	10	-	14	7.6	4.78	17.2
EFF	22 Jul 2025	9:00:00	25.3	70	-	16.3	10.6	1.97	18.7
EFF	30 Jul 2025	10:55:00	23.4	60	-	19.4	11.1	1.95	19.7
EFF	07 Aug 2025	8:40:00	41.5	900	-	28	19.1	6.85	30
EFF	15 Aug 2025	8:15:00	24.3	30	-	23.4	13.1	2.37	20
EFF	18 Aug 2025	8:25:00	39.3	60	-	21.9	11.8	3.12	21.8
EFF	26 Aug 2025	8:00:00	6.1	50	-	5.18	0.12	0.33	<3
EFF	03 Sep 2025	7:00:00	4.1	<10	-	5.71	0.18	0.56	6.2
EFF	11 Sep 2025	8:15:00	10.9	200	-	5.28	0.11	0.98	6.76
EFF	19 Sep 2025	9:20:00	24.4	4000	-	4.66	0.09	1.32	<6
EFF	22 Sep 2025	8:20:00	8.2	350	-	4.54	0.12	1.37	8
EFF	08 Oct 2025	8:30:00	5.1	-	-	4.89	0.11	1.46	2.81
EFF	16 Oct 2025	9:15:00	16	1400	-	4.62	0.21	3.87	6.69
EFF	24 Oct 2025	8:00:00	14.8	330	-	6.27	1.79	1.54	7.77
EFF	28 Oct 2025	9:15:00	2.8	10	-	3.95	0.06	1.46	2.25
EFF	04 Nov 2025	8:25:00	6.8	10	-	4.27	0.14	1.85	3.78
EFF	12 Nov 2025	9:40:00	3.2	10	-	4.78	0.1	2.05	2.51
EFF	20 Nov 2025	8:15:00	2.9	10	-	4.88	0.18	3.12	<3
EFF	28 Nov 2025	9:15:00	3.6	130	-	5.43	0.18	2.78	2.18
EFF	01 Dec 2025	9:30:00	7.8	60	-	6.16	0.16	2.82	3.52
EFF	09 Dec 2025	9:20:00	5	170	-	5.06	0.24	2.26	3.56
EFF	17 Dec 2025	8:20:00	13	55	-	4.75	0.25	1.68	2.9
EFF	22 Dec 2025	9:15:00	3.4	22	-	5.33	0.21	2.37	2.18
EFF	30 Dec 2025	9:10:00	<2.5	5	-	5.41	0.28	1.97	<2
EFF	08 Jan 2026	9:20:00	<5	58	-	6.16	0.23	1.51	2.71
EFF	16 Jan 2026	8:20:00	<2.6	-	-	5.33	0.1	2.78	<2
EFF	04 Feb 2026	9:15:00	<5	21	-	6.55	0.11	3.11	2.13
EFF	12 Feb 2026	9:20:00	3.5	14	-	5.98	0.24	2.76	<2
EFF	20 Feb 2026	9:15:00	3.8	610	-	6.18	0.94	2.3	2.12
EFF	23 Feb 2026	9:20:00	4.4	5	-	5.05	0.09	2.03	<3

Effluent Operational sampling

			Total Suspended Solids	E.coli	Nitrate (as N)	Nitrogen (Total)	Ammonia	Phosphorus (Total)	Carbonaceous Biochemical Oxygen Demand (cBOD5)
			mg/L	orgs/100mL	mg/L	mg/L	mg/L	mg/L	g/m3
EQL			2.5	1	0.002	0.1	0.005	0.005	1
Location Code	**Date**	**Time**							
EFF	16 Apr 2025	8:40:00	8.7	10	-	15.4	7.48	1.61	7.52
EFF	05 Mar 2026	8:45:00	<5	6	-	5.85	0.07	3.71	<3
EFF	11 Mar 2026	11:00:00	6.8	24	-	6.18	0.1	3.24	<3
EFF	19 Mar 2026	9:20:00	<5	<1	-	5.4	0.08	3.52	<3
EFF	27 Mar 2026	11:24:00	4.9	1	4.46	5.17	0.07	2.57	2.23
EFF	30 Mar 2026	9:10:00	<5	3	3.84	4.59	0.07	3.3	<2
EFF	08 Apr 2026	8:15:00	<5	<1 #1	4.81	5.46	0.07	2.8	<2
EFF	16 Apr 2026	9:10:00	<5	1 #1	4.89	5.45	0.06	2.94	<2
EFF	24 Apr 2026	9:25:00	<5	-	3.99	4.87	0.05	1.56	<2
EFF	24 Apr 2026	11:32:00	-	6	-	-	-	-	-
EFF	28 Apr 2026	9:10:00	<2.5	-	4.59	4.97	0.06	1.62	<2
EFF	28 Apr 2026	11:55:00	-	<1	-	-	-	-	-

Comments

#1 Not accredited as outside of 24 hour period

Appendix C

Kawarau River Bathymetry Survey

Kawarau River bathymetry survey

March 2026

Prepared for GHD
Anthony Kirk

March 2026

Prepared by:
Marty Flanagan

For any information regarding this report please contact:

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Client Report No: 2026064EI
Report date: March 2026
Project No: SCJ269PRO / GHD

Revision	Description	Date
Version 1.0	Final version sent to client	31 March 2026

Quality Assurance Statement		
[redacted]	Reviewed by:	Andrew Willsman
[redacted]	Formatting checked by:	Nic McNeil
[redacted]	Approved for release by:	Charles Pearson

Contents

Tables

Figures

Executive summary

This report presents a summary of the work undertaken by Earth Sciences NZ (ESNZ) in response to a request from GHD to obtain bathymetry data from a reach of the Kawarau River, near the Shotover River confluence.

GHD provided the approximate co-ordinate locations where cross-section data collection was required.

ESNZ Technical field staff were at location on 11 March 2026 to conduct the field survey data collection during a period of low river flow.

Data processing and summary information are presented in this report, along with an Excel spreadsheet summary of the processed survey data provided to the client. No detailed data analysis or specific product output was requested from GHD.

1 Data collection

ESNZ Field Staff scheduled the data collection activities to coincide with GHD sampling operations, with survey data being obtained on Wednesday 11 March 2026. Weather conditions were fine and Kawarau River flow was low (approximately 105 – 110 m^3/s), which was slightly higher than normal summer low flow for this time of year.

Boating operations were co-ordinated with an ESNZ Boat Safety Plan and notification of vessel operation were provided to the QLDC Harbour Master and commercial tourism operator (K-Jet) with radio communications maintained throughout the day. The jetboat was launched and retrieved from the vehicle access point, upstream of the Shotover delta confluence area.

Two technical field staff accessed the river locations and completed survey transects using an ESNZ jetboat, Riverpro ADCP profiler and Emlid RTK-GNSS survey equipment.

A total of five (5) cross-section transect profiles were collected (Figure 1-1), including shallow water levels and the above water-line bank elevations being obtained by manual wading with the RTK-Rover unit. One (1) longitudinal profile along a section of the river thalweg was also obtained. These transects were close approximations to the coordinate information provided by GHD.

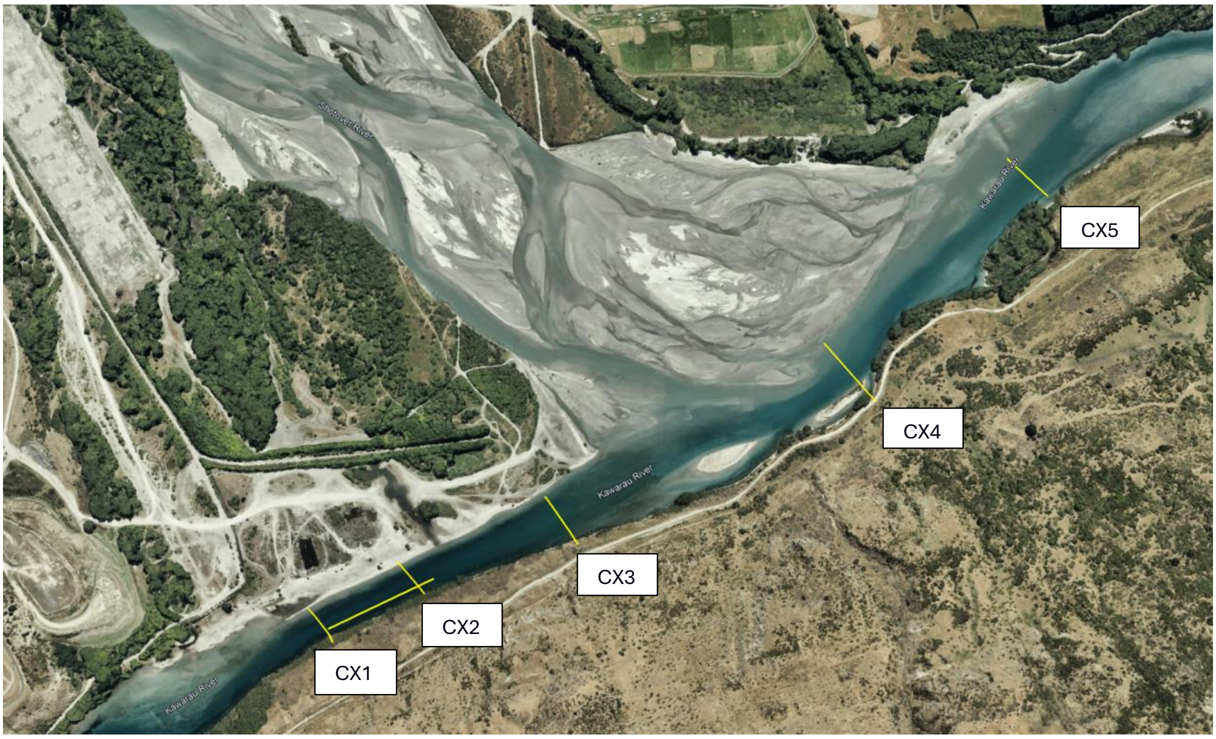


Figure 1-1: Kawarau River surveyed transect locations, as indicated by yellow lines with cross-sections numbered. Longitudinal profile indicated between cross-sections CX1 and CX2.

1.1 Data collection methodology

Survey data were collected using the Emlid RTK-GNSS equipment, with a base station setup bankside and referenced to a benchmark provided by GHD (referred to as BH16), which we understand is in terms of datum DVD58.

The wetted area cross-section of each transect was measured using a Teledyne RDI RiverPro acoustic Doppler current profiler (ADCP 1200kHz), tethered in a Riverpro hull deployed from the side of the jetboat (Figure 1-2).

Shallow side edges of the channel area (<0.5 m depth) and the unwetted banks of each cross-section were surveyed using the Emlid Rover RTK-GNSS receiver, deployed on a 2 m staff by manual survey by wading or walking and collecting points along that transect line.

Figure 1-2: Jetboat with ADCP Riverpro profiler attached on sidearm, RTK-rover positioned at survey transect on bank.

2 Data processing

All resultant survey data are supplied in New Zealand Transverse Mercator 2000 (NZTM2000) projection and heights relative to New Zealand Vertical Datum 2016 (NZVD2016) and processed relative to the local height datum DVD58, as referenced from the top of the pvc pipe inside the groundwater bore casing. This produced a datum offset of 0.267 m, which is consistent with other NZVD2016 / DVD58 conversions identified for nearby benchmarks. This offset was then applied to all surveyed points to generate levels in DVD58

All RTK survey data were collected to a data accuracy of +/- 0.030 m).

The cross-section data summarised in the supplied spreadsheet are provided both as raw ship-track (Figure 2-1) and straightened transect co-ordinates. The ADCP data have been post processed to combine the measured mean velocity data of ensembles, correlated with the cross-section profile across each transect.

Figure 2-1: ArcGIS displaying ship-track transects of each cross-section.

3 Data summary

Velocity profile plots are provided for each cross-section in Section 3.1, displayed with reference to bottom track width to present a better graphical interpretation of the velocity magnitude.

Each cross-section profile was measured starting from 0 m relative to the true left bank.

The wetted area detail of ADCP bottom-track profile data is summarised for each transect in Table 3-1. This includes the estimated area (unmeasured by ADCP) of each channel to the water's edge, hence reported widths in Table 3-1 are slightly greater than the ADCP profile plots.

Table 3-1: Summarised ADCP profile data.

Transect	Start time (NZST)	Total flow (m^3/s)	Width (m)	Area (m^2)	Mean channel velocity (m/s)	Max channel depth (m)
CX1	12:54	106.6	45.3	154.2	0.587	5.25
CX2	13:10	106.3	48.6	159.4	0.581	4.77
CX3	13:32	110.9	82.9	128.6	0.809	2.19
CX4	14:02	124.6	56.8	18.7	0.810	3.33
CX5	14:22	123.9	104.4	107.6	1.120	1.83
Thalweg	14:36	N/A	N/A	N/A	0.984	5.25

3.1 ADCP profiles

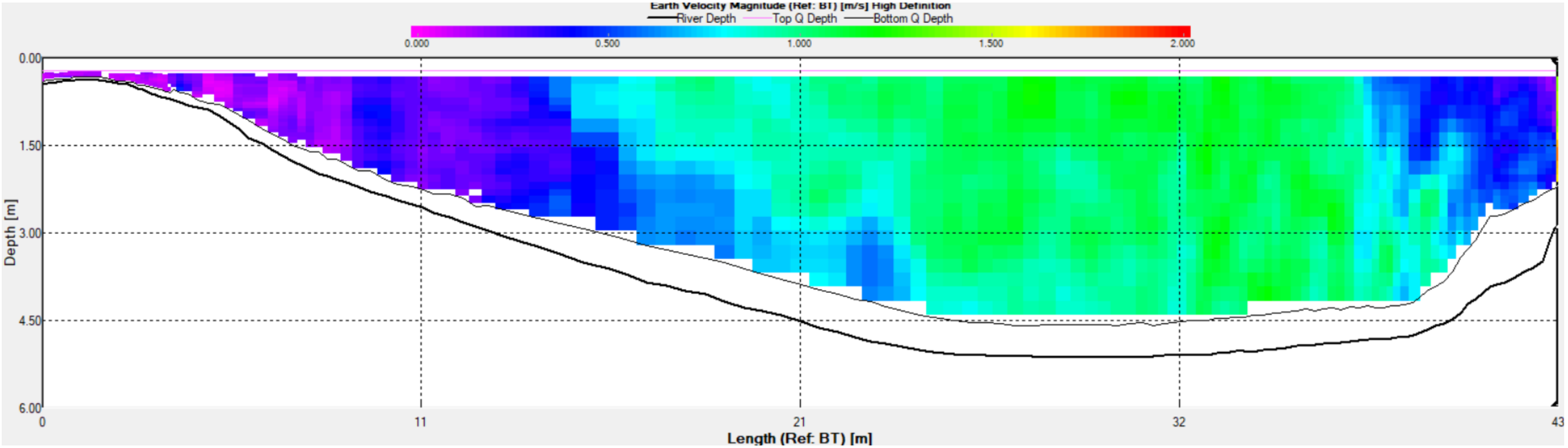


Figure 3-1: CX1 profile.

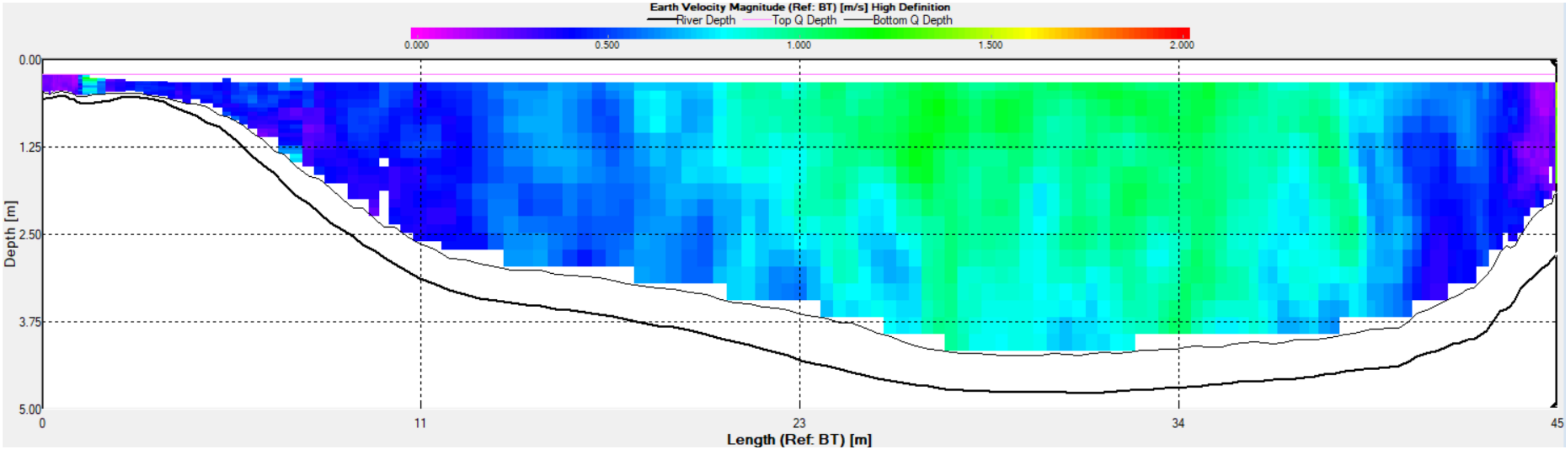


Figure 3-2: CX2 profile.

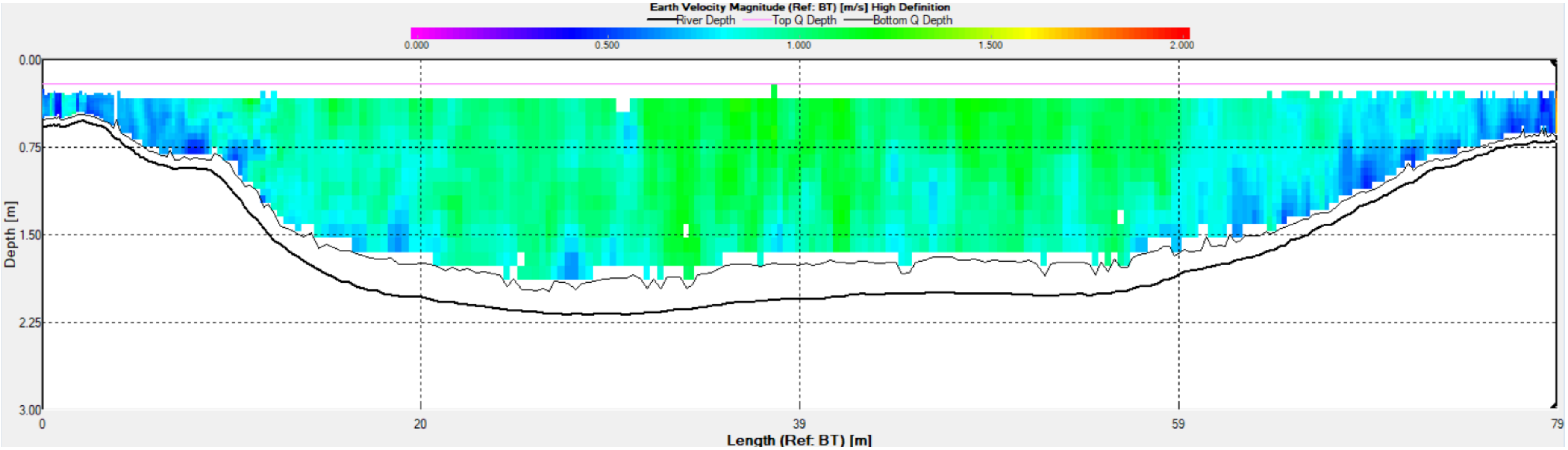


Figure 3-3: CX3 profile.

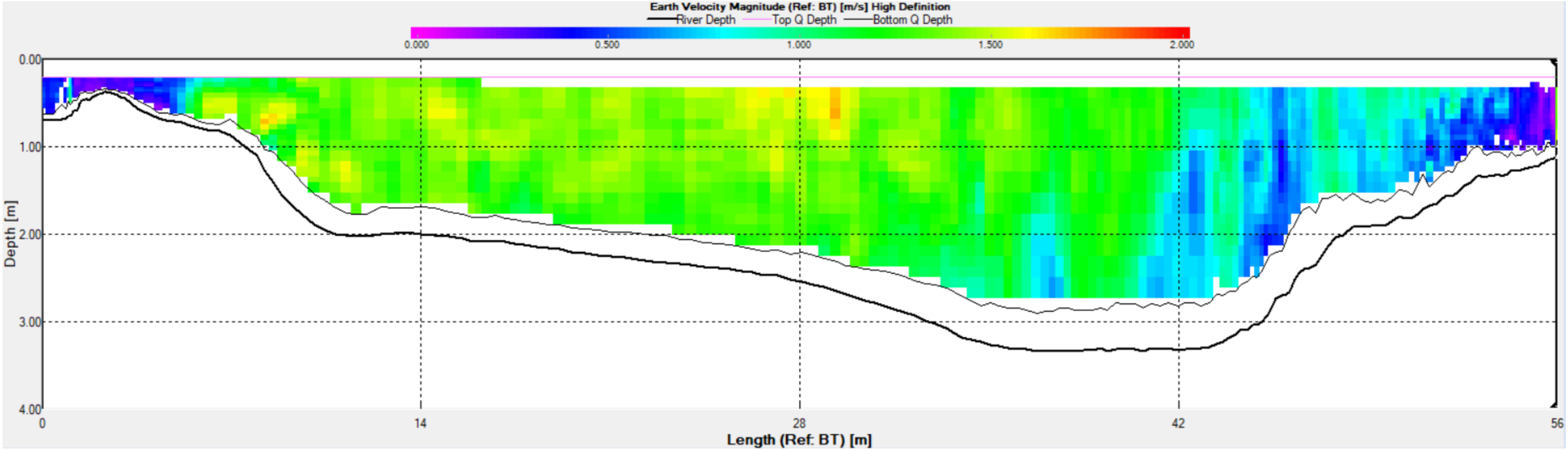


Figure 3-4: CX4 profile.

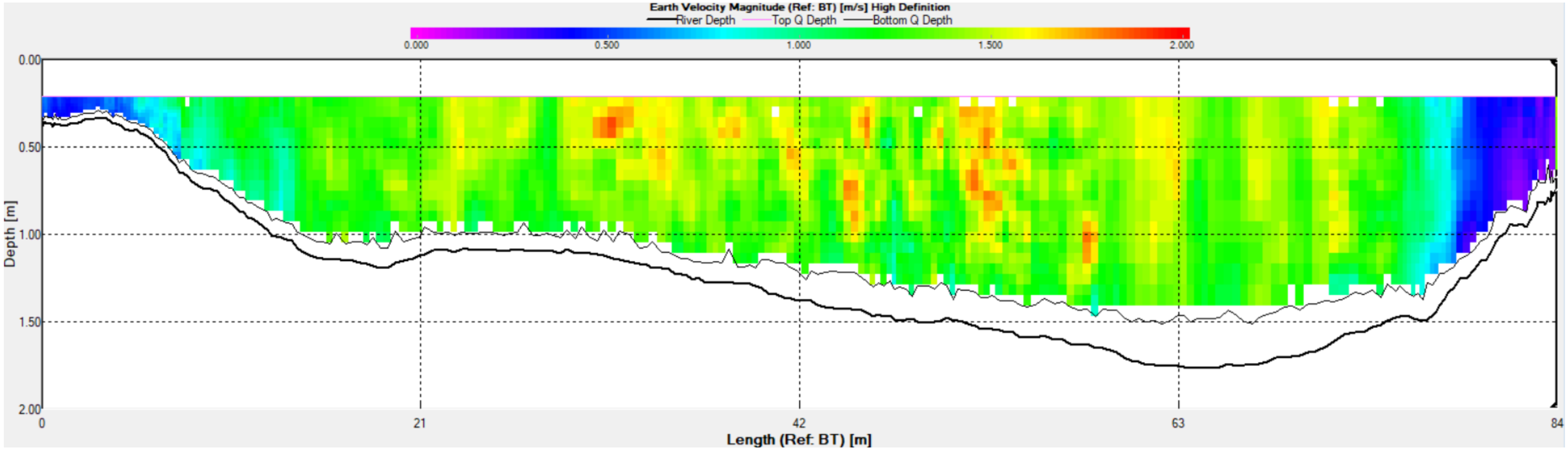


Figure 3-5: CX5 profile.

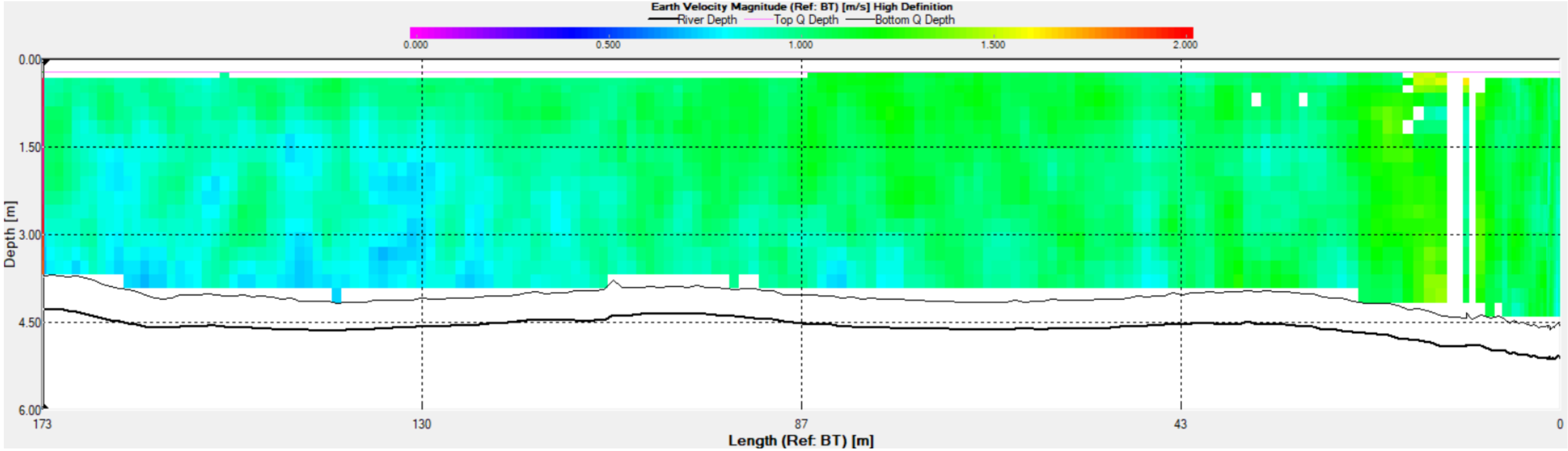


Figure 3-6: Thalweg longitudinal profile.

4 Acknowledgements

Thanks to ESNZ staff Andrew Willsman (Dunedin Field Team Leader & Jetboat Skipper) and Darren May (Central Otago Field Team Leader) for providing the field data collection activities and on-site logistics. Survey data were collated and post-processed by Hamish Sutton.

Appendix D

Water Balance Model

Introduction

GoldSim 15 was used to develop a water balance model for the predicted downstream water quality in the Kawarau River following complete mixing of treated wastewater with the Kawarau River, with this occurring approximately 4 km downstream of the discharge location.

Data Sources

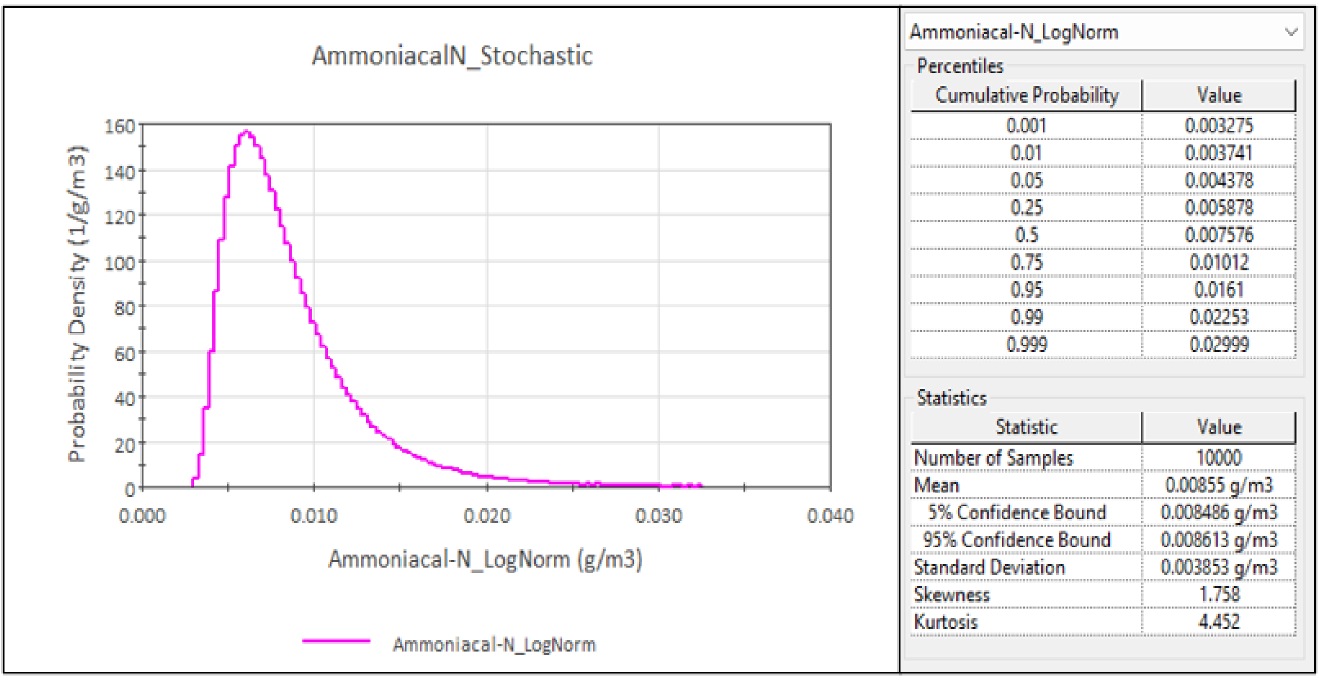
- **River Flow**: River flow conditions were derived from the available daily flow record from Site 75262 Kawarau at Chards Rd spanning November 1962 to March 2026. A rolling 7-day mean annual low flow (7day-MALF) of 88.6 m^3/s was calculated from the daily flow data. The 7day-MALF values were assigned and averaged per hydrological year, then averaged across all years of record to derive a long-term average low-flow condition, which was adopted for the assessment of downstream water quality effect.
- **Discharge Flow**: The wastewater discharge volume was represented using the peak dry weather flow (PDWF) estimated as 0.36 m^3/s for the projected year 2060.
- **River Background Contaminant Concentrations**: A single value (median) for upstream concentrations was derived from the water quality monitoring data for location RS14, from March 2025 to March 2026 and adopted for assessment.

Adopted wastewater quality

The proposed long term discharge limits for effluent quality provided metrics for predicting median and 95%ile concentrations. A probabilistic (stochastic) water quality model was developed in GoldSim for fitting the specified median and 95%ile values to statistical distributions. The fitted stochastic distributions were truncated to prevent extrapolation beyond realistic concentration ranges. The fitted distributions for each parameter considered are presented in Figure D.1 to Figure D.6 below.

A Monte Carlo simulation of 10,000 realisations was modelled, sampling from the fitted distributions to generate concentration distributions for downstream water quality for each modelled parameter. The predicted median, 80th percentile and 95th percentile mixed concentrations were compared to the relevant water quality criteria.

The use of stochastic modelling within GoldSim was deliberately limited to parameters that were not explicitly defined in the proposed discharge consent limits. Probabilistic (Monte Carlo) analysis was used solely to derive intermediate statistics, including 80%ile concentrations, which were required for assessment against applicable water quality criteria but were not provided directly in the consent limits. All effluent concentration values that are explicitly specified in the proposed discharge limits (median and 95%ile) were represented in the model as fixed, single-value inputs.



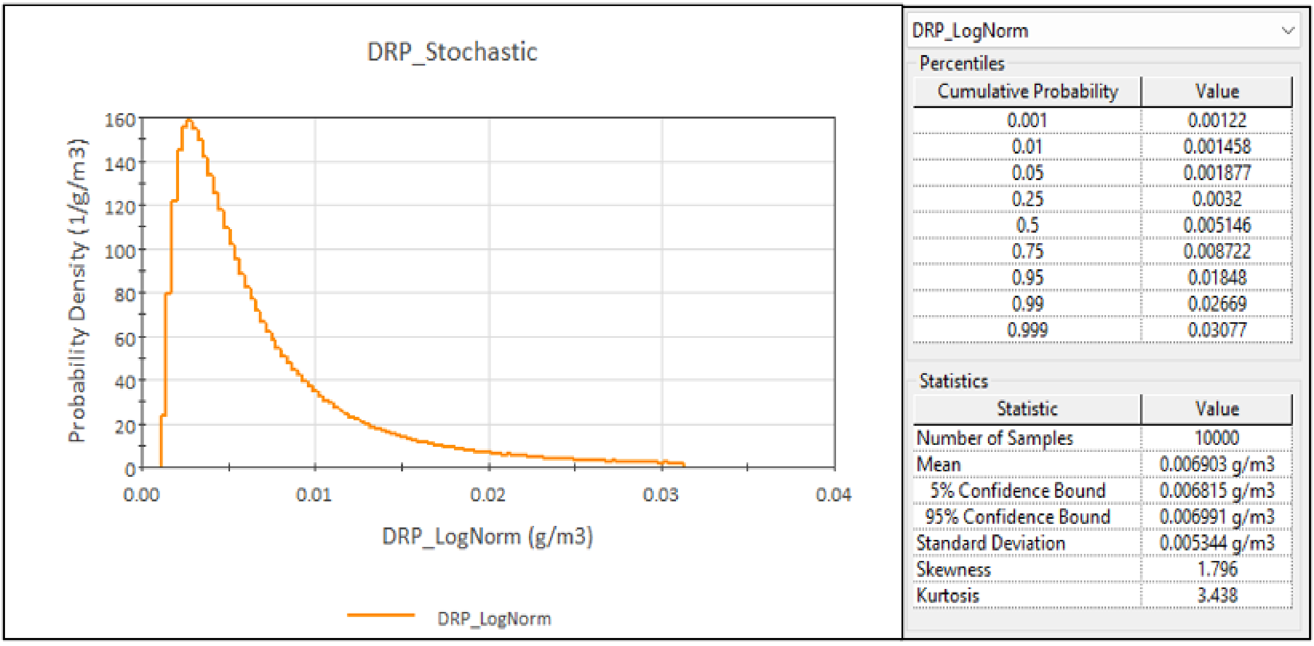
Percentiles

Cumulative Probability	Value
0.001	0.003275
0.01	0.003741
0.05	0.004378
0.25	0.005878
0.5	0.007576
0.75	0.01012
0.95	0.0161
0.99	0.02253
0.999	0.02999

Statistics

Statistic	Value
Number of Samples	10000
Mean	0.00855 g/m3
5% Confidence Bound	0.008486 g/m3
95% Confidence Bound	0.008613 g/m3
Standard Deviation	0.003853 g/m3
Skewness	1.758
Kurtosis	4.452

Figure D.1 ***Downstream water quality – probabilistic (lognormal) distribution of modelled concentrations of Ammoniacal-N derived from Monte Carlo simulation***



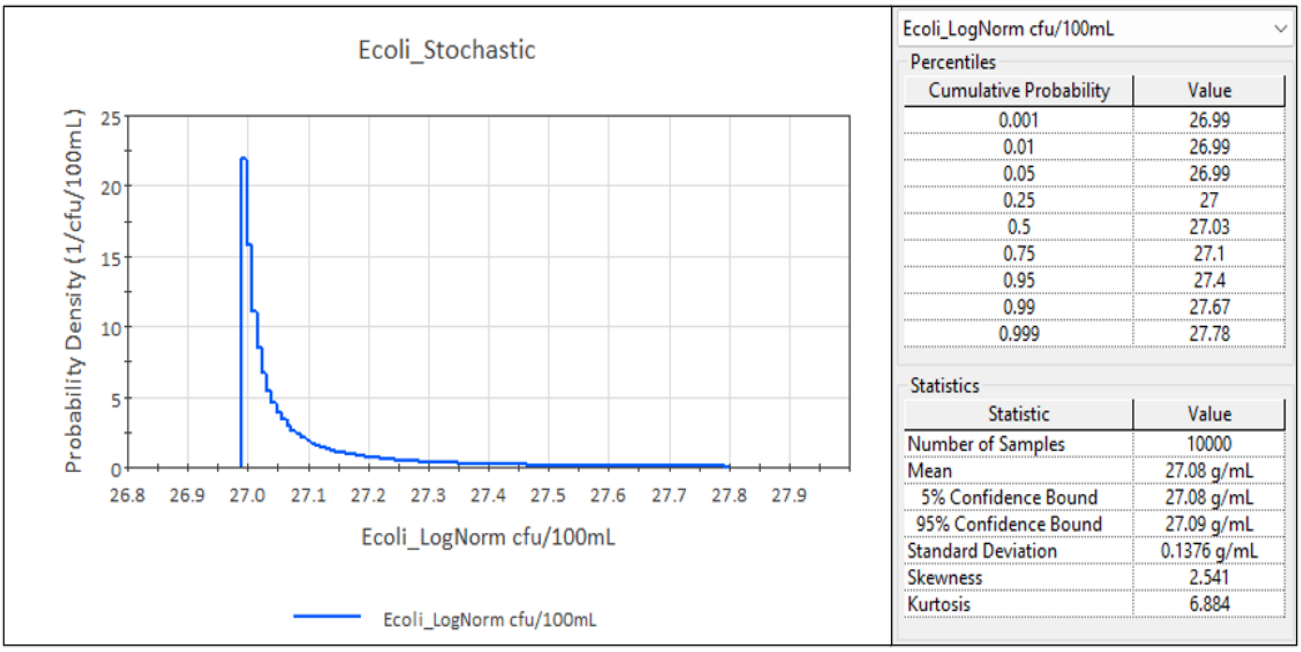
Percentiles

Cumulative Probability	Value
0.001	0.00122
0.01	0.001458
0.05	0.001877
0.25	0.0032
0.5	0.005146
0.75	0.008722
0.95	0.01848
0.99	0.02669
0.999	0.03077

Statistics

Statistic	Value
Number of Samples	10000
Mean	0.006903 g/m3
5% Confidence Bound	0.006815 g/m3
95% Confidence Bound	0.006991 g/m3
Standard Deviation	0.005344 g/m3
Skewness	1.796
Kurtosis	3.438

Figure D.2 ***Downstream water quality – probabilistic (lognormal) distribution of modelled concentration of Dissolved Reactive Phosphorus (DRP) derived from Monte Carlo simulation***



Ecoli_LogNorm cfu/100mL

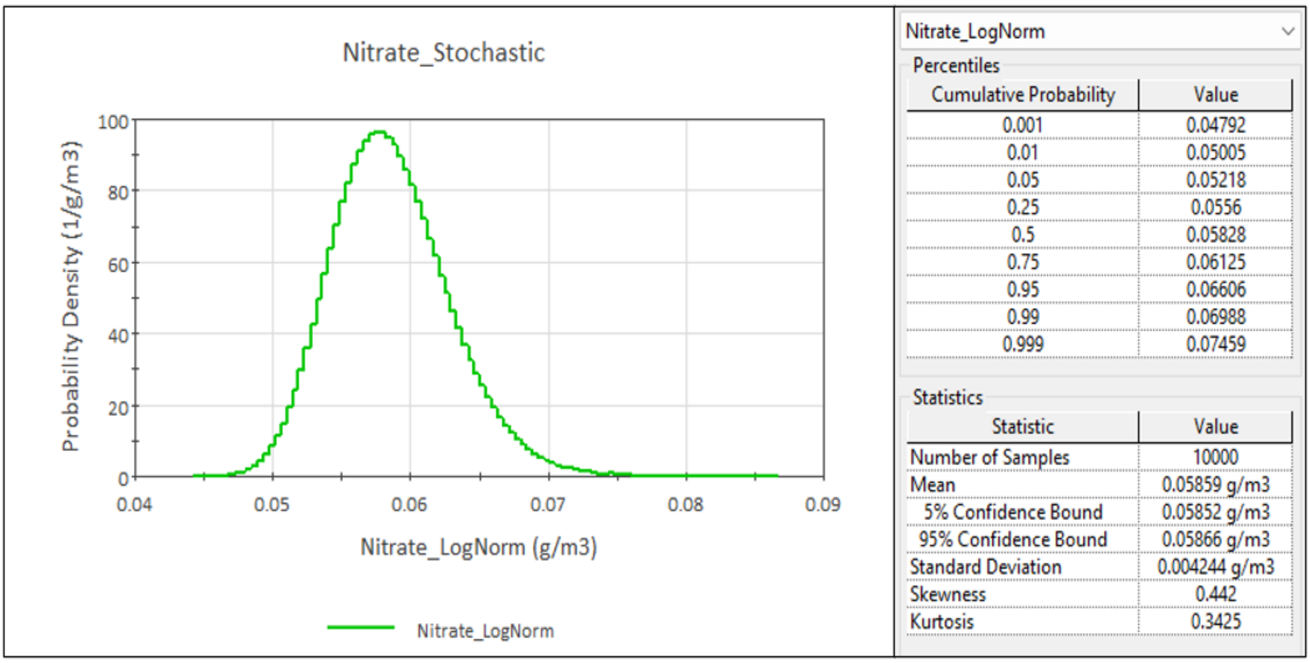
Percentiles

Cumulative Probability	Value
0.001	26.99
0.01	26.99
0.05	26.99
0.25	27
0.5	27.03
0.75	27.1
0.95	27.4
0.99	27.67
0.999	27.78

Statistics

Statistic	Value
Number of Samples	10000
Mean	27.08 g/mL
5% Confidence Bound	27.08 g/mL
95% Confidence Bound	27.09 g/mL
Standard Deviation	0.1376 g/mL
Skewness	2.541
Kurtosis	6.884

Figure D.3 ***Downstream water quality – probabilistic (lognormal) distribution of modelled concentrations of E. coli derived from Monte Carlo simulation***



Nitrate_LogNorm

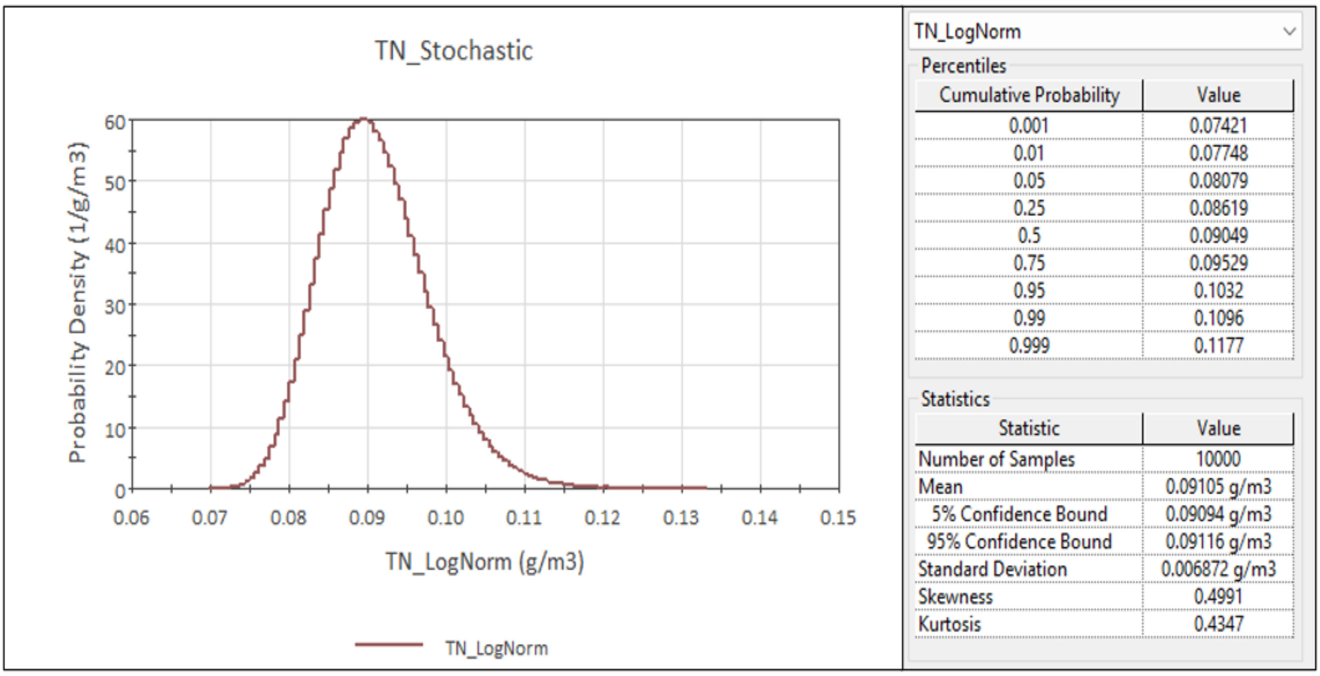
Percentiles

Cumulative Probability	Value
0.001	0.04792
0.01	0.05005
0.05	0.05218
0.25	0.0556
0.5	0.05828
0.75	0.06125
0.95	0.06606
0.99	0.06988
0.999	0.07459

Statistics

Statistic	Value
Number of Samples	10000
Mean	0.05859 g/m3
5% Confidence Bound	0.05852 g/m3
95% Confidence Bound	0.05866 g/m3
Standard Deviation	0.004244 g/m3
Skewness	0.442
Kurtosis	0.3425

Figure D.4 ***Downstream water quality – probabilistic (lognormal) distribution of modelled concentrations of Nitrate NO3-N derived from Monte Carlo simulation***



TN_LogNorm

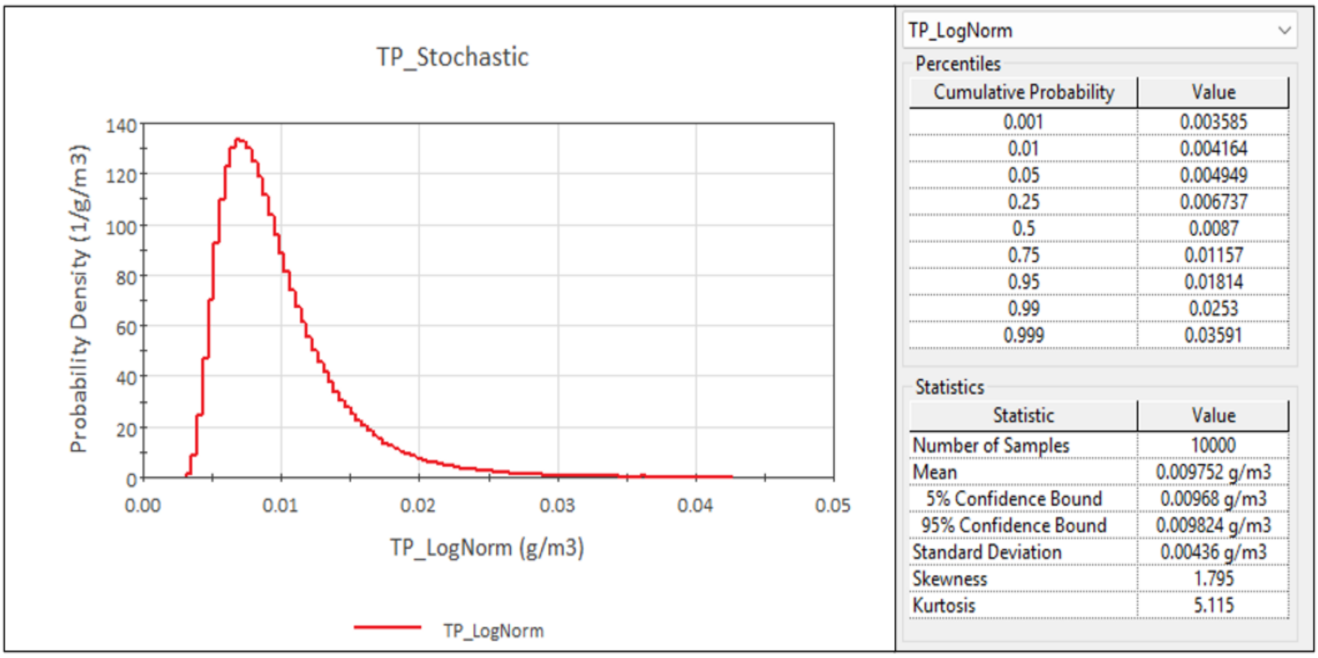
Percentiles

Cumulative Probability	Value
0.001	0.07421
0.01	0.07748
0.05	0.08079
0.25	0.08619
0.5	0.09049
0.75	0.09529
0.95	0.1032
0.99	0.1096
0.999	0.1177

Statistics

Statistic	Value
Number of Samples	10000
Mean	0.09105 g/m3
5% Confidence Bound	0.09094 g/m3
95% Confidence Bound	0.09116 g/m3
Standard Deviation	0.006872 g/m3
Skewness	0.4991
Kurtosis	0.4347

Figure D.5 ***Downstream water quality – probabilistic (lognormal) distribution of modelled concentrations of Total Nitrogen (TN) derived from Monte Carlo simulation***



TP_LogNorm

Percentiles

Cumulative Probability	Value
0.001	0.003585
0.01	0.004164
0.05	0.004949
0.25	0.006737
0.5	0.0087
0.75	0.01157
0.95	0.01814
0.99	0.0253
0.999	0.03591

Statistics

Statistic	Value
Number of Samples	10000
Mean	0.009752 g/m3
5% Confidence Bound	0.00968 g/m3
95% Confidence Bound	0.009824 g/m3
Standard Deviation	0.00436 g/m3
Skewness	1.795
Kurtosis	5.115

Figure D.6 ***Downstream water quality – probabilistic (lognormal) distribution of modelled concentrations of Total Phosphorus (TP) derived from Monte Carlo simulation***

Model Components

The GoldSim model has several components which are detailed below. An overview of the model showing the component connections is shown in Figure D7 below:

- **V1_River_Mean**: Input for the River flow without discharge (88.6 m^3/s)
- **V2_Discharge_Volume_PDWF**: Input for the predicted PDWF discharge volume (31,085 m^3/day (0.36 m^3/s) in 2060)
- **V3_Downstream_volume_PDWF**: The sum of **V1_River_Mean** and **V2_Discharge_Volume_PDWF**, representing the combined river and discharge flow downstream of the outfall.
- **Containers**: Parameter-specific containers were used to house the internal calculations for each assessed parameter, ensuring calculations were organised. Each container has the relevant name of each parameter assessed.

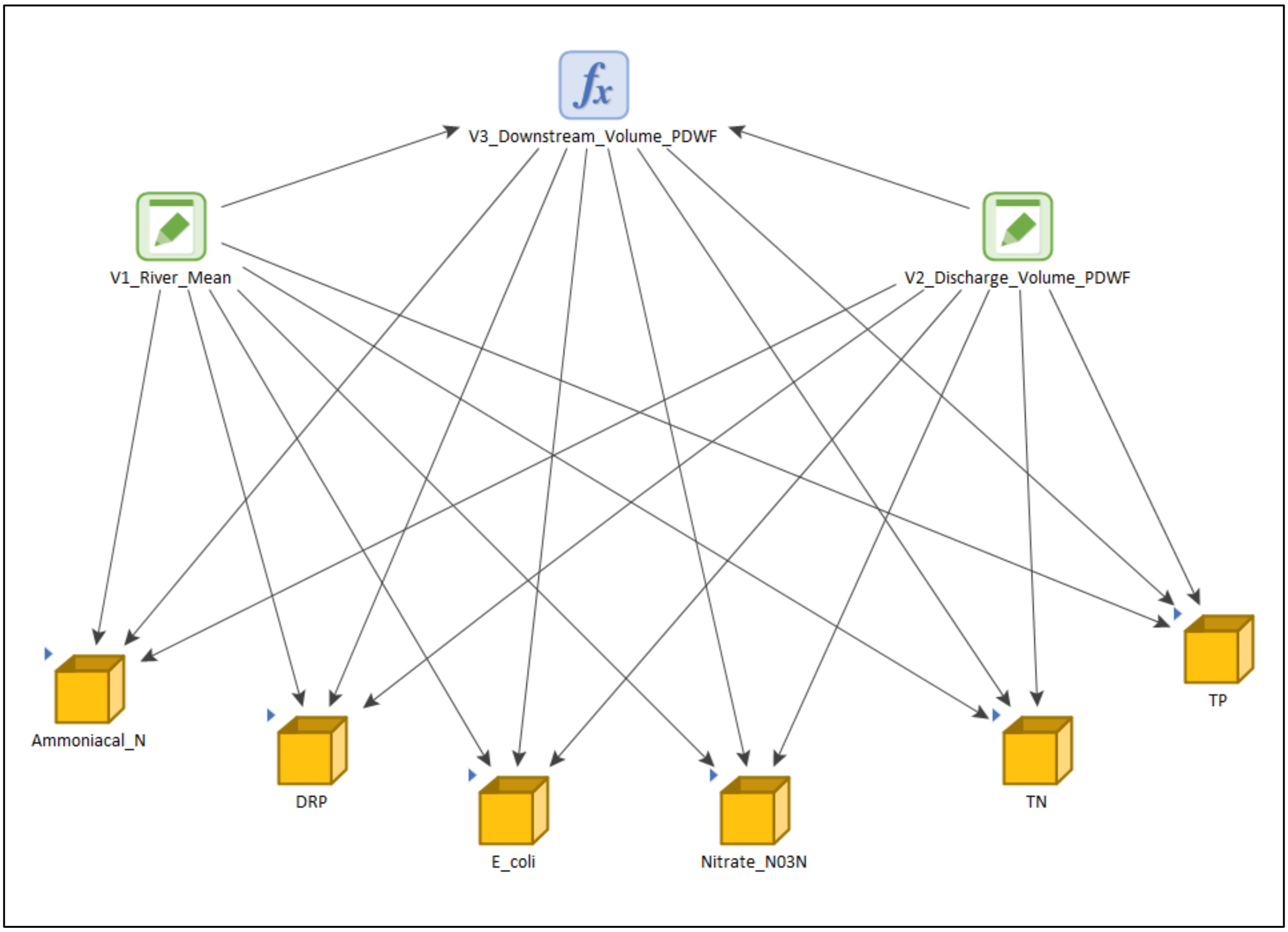


Figure D.7 ***GoldSim model overview***

Appendix E

Dispersion Model

Introduction

Dispersion modelling of the proposed discharge of treated wastewater into the Kawarau River was undertaken using three-dimensional computational fluid dynamics (CFD) modelling implemented in OpenFOAM (version 13).

Two discrete modelling frameworks were developed to represent different spatial and hydraulic scales:

1. **Near-field mixing area discharge modelling**, focusing on mixing processes immediately downstream of the discharge structure and quantification of initial dilution; and
2. **Reasonable mixing zone modelling**, simulating the downstream transport and dispersion of the treated wastewater plume through the Kawarau River and across the confluence with the Kimiākau/Shotover River.

Comparative assessment of the near-field dilution was also undertaken using the USEPA CORMIX mixing zone model to provide an independent check of jet-driven mixing behaviour.

The description of the model builds and adopted properties are detailed below

Modelling Approach

The CFD modelling approach solves:

- The incompressible Navier–Stokes equations for turbulent flow; and
- A passive scalar transport equation representing treated wastewater concentration.

The OpenFOAM solver configuration comprised:

- Transient solution using a PIMPLE algorithm (combined PISO–SIMPLE approach)
- Turbulence represented using a Reynolds-Averaged Navier–Stokes (RANS) framework with a *k–ε turbulence model*
- Scalar transport implemented via a dedicated scalarTransport function object

  Adaptive time-stepping to maintain numerical stability, with a target Courant number (Co) ≤ 0.8.

The model assumes:

- Incompressible flow conditions.
- Fully turbulent river flow.
- Conservative passive tracer behaviour (i.e., no decay or reaction processes applied).

Numerical solver settings and Physical Assumptions

The following numerical solver were adopted:

- Transient PIMPLE algorithm (nOuterCorrectors = 1, pure PISO emulation)
- Scalar transport solved simultaneously with flow (no separate concentration run)
- Adaptive time stepping (deltaT = 0.05 s, maxCo = 0.8, maxDeltaT = 0.1 s)
- Pressure: GAMG, GaussSeidel smoother (tolerance 1e-6)
- Velocity/k/ε: smoothSolver, symGaussSeidel (tolerance 1e-5)
- Concentration (C): smoothSolver, symGaussSeidel (tolerance 1e-8)

The following Discretisation approaches were adopted:

- Time: Euler (first-order)
- Gradient: Gauss linear
- Divergence: 2nd-order upwind for momentum and concentration (bounded Gauss linearUpwind grad(C))
- Laplacian: Gauss linear corrected

Physical assumptions:

- Turbulence: RANS k-epsilon, wall roughness Ks = 0.1 m (medium gravel)
- Scalar transport: turbulent Schmidt number Sct = 0.7
- Rigid-lid free surface
- Concentration C is passive scalar (no settling, decay, or reaction)

Dispersion Modelling – Discharge Structure

Model Domain and Geometry

The model domain represented with the discharge structure model represents the river reach surrounding the proposed discharge structure and extends sufficiently downstream to capture the initial near-field mixing area and flow downstream of the discharge structure prior to the confluence with Kimiākau/Shotover River channel/s.

The model uses the CX3 river transect bathymetry from the March 2026 ESNZ river survey, extruded 300 m downstream to represent the reach. The channel is wide (80.5 m) and relatively shallow (mean depth 2.18 m). The discharge structure is represented by a 10 m intrusion of the riverbank into the river, with 10m wide face that grades from and back to the riverbank 40m upstream and 40 m downstream of the structure face.

The discharge is represented as a wall-mounted lateral inflow boundary consistent with the concept design of the structure, where treated wastewater flows through the end of the rock structure.

Mesh Design and Resolution

Mesh developed for the discharge structure model used a structured mesh of hexahedral cells generated with OpenFOAM’s blockMesh. The mesh was refined in high-gradient regions to provide greater resolution and numerical stability.

Key mesh characteristics include:

- Base cell size: 0.5 m (horizontal), 0.2 m (vertical)
- Level 1 refinement: 0.25 m × 0.25 m × 0.1 m (True left of river upstream and downstream of discharge structure)
- Level 2 refinement: 0.125 m × 0.125 m × 0.05 m (discharge point + 20 m downstream)
- Total triangles in STL: 389,444 (bed, free surface, inlet, outlet, left bank, right bank)

Boundary Conditions

The flow conditions represented in the model are applied as the flow field measured at transect CX3 in the March 2026 ESNZ survey, representing a low-flow condition at CX3 of approximately 110 m^3/s. Discharge to the river was assumed to be equivalent to the predicted peak 2060 dry-weather flow (0.36 m^3/s), and so represent a likely upper bound for potential effects to river water quality.

Boundary conditions for the discharge structure model were defined as follows:

Upstream inlet

- Velocity: Mapped fixed value velocities were interpolated to cell values from March 2026 ESNZ river survey data.
- Concentration: Fixed value 0 g/m^3 (clean river)
- Turbulence: Kinetic energy and dissipation rate at the tributary inlet were estimated using TI = 8% and a mixing length $\ell=0.07Dh$.

Downstream outlet

- Velocity: zeroGradient
- Pressure: Fixed value 0
- Concentration: inletOutlet

Riverbed and banks

- Velocity: noSlip, providing for turbulence
- Turbulence: standard wall functions (nutkRoughWallFunction, Ks = 0.1 m, Cs = 0.5)
- Concentration: zeroGradient

Free surface

- Velocity: slip (rigid-lid assumption)
- Concentration: zeroGradient

Discharge outlet

- The discharge is a rectangular opening (4 m wide × 0.4 m tall, area 1.6 m^2) at x = 62–66 m, z = -1.0 to -0.6 m below the free surface.
- Flow rate: 0.36 m^3/s (mean velocity 0.2125 m/s, at 90 degrees to Kawarau River flow)
- Concentration: Fixed value 100.0 #/m^3 (adopted concentration representative of 100% wastewater contaminant concentrations). Equivalent of 36 #/s discharge.
- Turbulence: Kinetic energy and dissipation rate at the tributary inlet were estimated using TI = 8% and a mixing length $\ell=0.07Dh$.

Dispersion modelling – mixing zone model

The mixing zone model represents the downstream transport and mixing of the treated wastewater plume through the Kawarau River, including the confluence with the Kimiākau/Shotover River. The domain covers approximately 850m river reach, from transect CX3 to CX5, incorporating both the mainstem and the left bank Kimiākau/Shotover River inflow.

The Kimiākau/Shotover River is represented as a shallow inflow channel, with flow entering the Kawarau at approximately 45 degrees to the main channel flow. River flows represent the flow conditions measured during the March 2026 river survey. The inflow rate of 14 m^3/s for the Shotover River was determined as the difference in total measured flow between CX3 (110 m^3/s) and CX5 (124 m^3/s) transects. These are considered to represent low flow conditions of both Kawarau and Kimiākau/Shotover River conditions.

The initial treated wastewater mixing resulting at the point of discharge and as a result of the discharge structure is considered through adoption of the outlet concentrations and flow of the discharge structure model, as the inlet conditions for this near-field mixing area model. Progressive dilution of the plume following discharge and through the river confluence, to the end of the reasonable mixing zone in the vicinity of CX5 (and monitoring location RS10), is therefore represented by the results of this mixing zone model.

Mesh Design and Resolution

Mesh generation for the mixing zone model adopted a fully unstructured mesh approach, generated directly from STL geometry, making use of snappyHexMesh and polyMesh to allow simulation of the change in bathymetry and river geometry. Targeted mesh refinement was carried out in regions of complex mixing and high-gradient flow/concentrations, such as at the confluence of the Kawarau and Kimiākau/Shotover Rivers.

Key mesh characteristics include:

- **Base cell size:** 1.0 m (horizontal), 0.2 m (vertical) in the far field, providing efficient coverage of the main channel.
- **Level 1 refinement:** 0.5 m × 0.5 m × 0.1 m applied to the mainstem and confluence region, ensuring adequate resolution of the primary mixing zone and shear layers.
- **Level 2 refinement:** 0.25 m × 0.25 m × 0.05 m applied within two focused lateral-streamwise windows (full depth) at the tributary mixing interface and adjacent right-bank shear layer, capturing steep velocity and concentration gradients and reducing numerical artefacts.
- **Vertical discretization:** 14 layers throughout the domain, providing enhanced resolution of near-surface gradients and vertical mixing processes.
- **Total mesh size:** Approximately 2.3 million cells, balancing high local resolution with computational efficiency.

Boundary Conditions

Boundary conditions for the mixing zone model were defined as follows:

Upstream inlet

Mapped fixed value velocities were interpolated to cell values from March 2026 ESNZ river survey data.

- Velocity: Mapped fixed value flow field from Discharge Structure model outlet boundary conditions.
- Concentration: Mapped concentration from Discharge Structure model outlet boundary conditions (where outlet approximates steady state conditions with mass continuity from discharge to outlet (~34 g/s).
- Turbulence: $k = 2.782e\text{-}3\ m^2/s^2$, $\varepsilon = 1.873e\text{-}4\ m^2/s^3$

Downstream outlet

- Velocity: zeroGradient
- Pressure: fixedValue 0
- Concentration: inletOutlet

Riverbed and banks

- Velocity: noSlip, providing for turbulence
- Turbulence: standard wall functions (nutkRoughWallFunction, Ks = 0.1 m, Cs = 0.5)
- Concentration: zeroGradient

Free surface

- Velocity: slip (rigid-lid assumption)
- Concentration: zeroGradient

Side Channel (Kimiākau/Shotover River inflow)

The Kimiākau/Shotover River inflow was assigned as a carved section on the true left riverbank as follows:

- Shape: 22.7 m long × approximately 0.42 m deep, with an area of 9.6 m^2 and effective area (accounting for flow direction) of 6.9 m^2.
- Velocity: Fixed value of 2.04 m/s, delivery 14 m^3/s at 45 degrees into Kawarau River flow. Reflecting the difference in flow measured between transects CX3 and CX5 during the March 2026 ESNZ river survey.
- Concentration: uniform 0.01 (small non-zero to improve numerical stability in initial mixing zone)
- Turbulence: Kinetic energy and dissipation rate at the tributary inlet were estimated using TI = 8% and a mixing length $\ell = 0.07Dh$.

Model Validation

The following tests and model quality checks were performed:

- Mesh checks were completed by OpenFOAM checkMesh tool, to confirm likelihood of achieving numerical stability.
- Pre-run Courant number estimates (Co max ≈ 0.70) were well below the configured limit (Co = 0.8), confirming stable time-stepping.
- Post-run acceptance checks confirmed no spurious oscillations or artificial diffusion in the concentration field.
- The model's rigid-lid free surface assumption was validated by the low Froude number (Fr ≈ 0.13).
- The simulated discharge Reynolds number ($Re >> 10^4$) confirmed fully turbulent flow, consistent with field conditions.
- Mass balance inlet and outlet checks to confirm mass continuity in the model and to indicate plume development has reached steady-state.

Model Results

Table E.1 outlines the predicted model concentrations.

Table E.1 *Dispersion model results*

Dispersion Model	Discharge residual treated wastewater %	Approximate distance from discharge (m)	Predicted residual treated wastewater %	Adopted treated wastewater % for water quality prediction
Discharge structure	100	100	17.9	20
Mixing zone	17.9	800	1.5 (1.6)[1]	2
Note: 1 – extrapolated steady state value				

Model results for the mixing zone model indicated that for simulated time up to 2000 seconds the model was approaching, but had not achieved steady state conditions. Due to the high computational load of this model and long model run times, longer run times were not carried out. Instead, the model results were extrapolated forward to an approximated steady state concentration. Figure E.1 provides the model results for timesteps up to 2000 seconds simulated time, demonstrating the near steady state conditions achieved. To accommodate uncertainty of the predicted steady state conditions, a conservatively high % residual concentration (2%) was adopted for predictions of water quality.

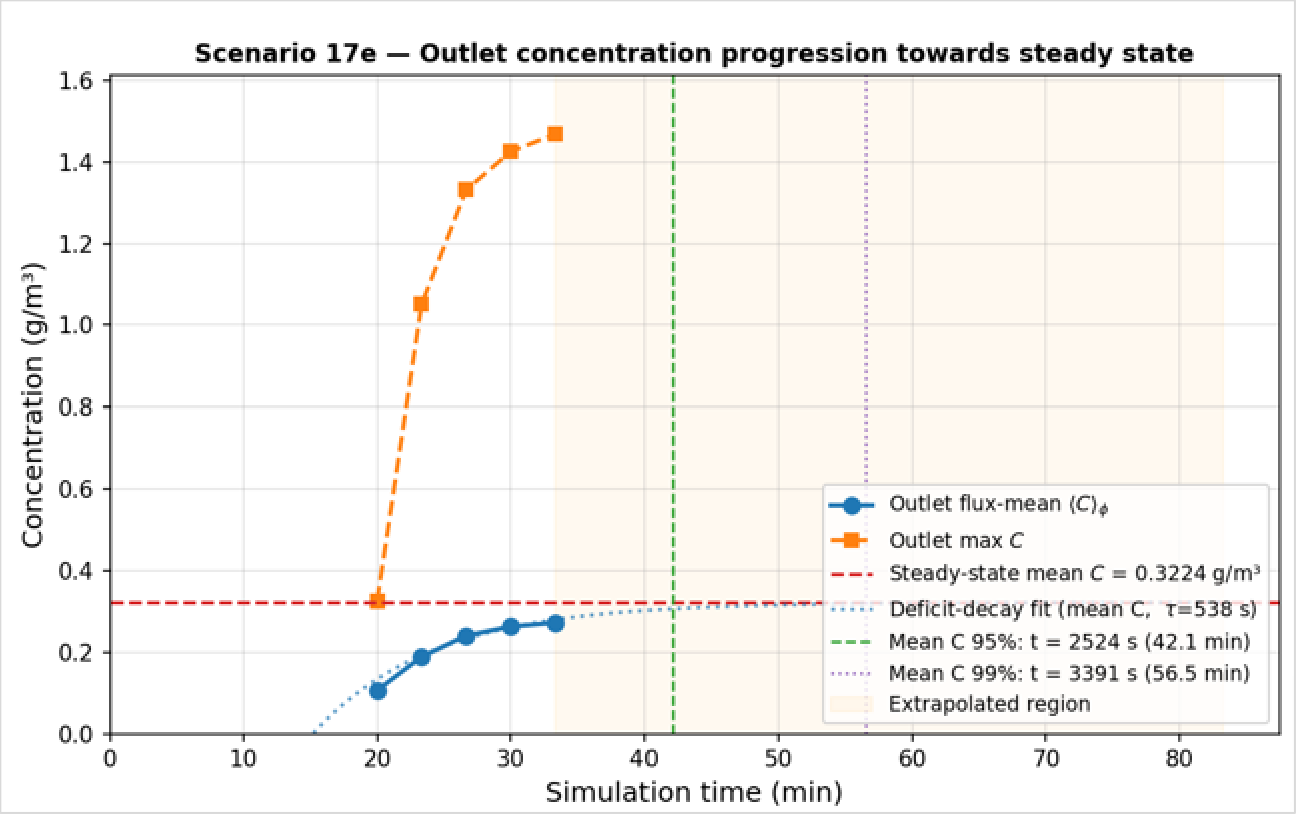


Figure E.1 ***Mixing zone model results and steady state approximation***

Figure E.2 and Figure E.3 illustrate the water velocity and the concentration results at surface respectively for the discharge structure model.

Figure E.4 and Figure E.5 illustrate water velocity and the concentration results at surface respectively for the mixing zone model.

Note that colour scales differ between the illustrated results for the discharge structure and mixing zone models.

Figure E.2 Discharge structure model – Predicted water velocity at surface

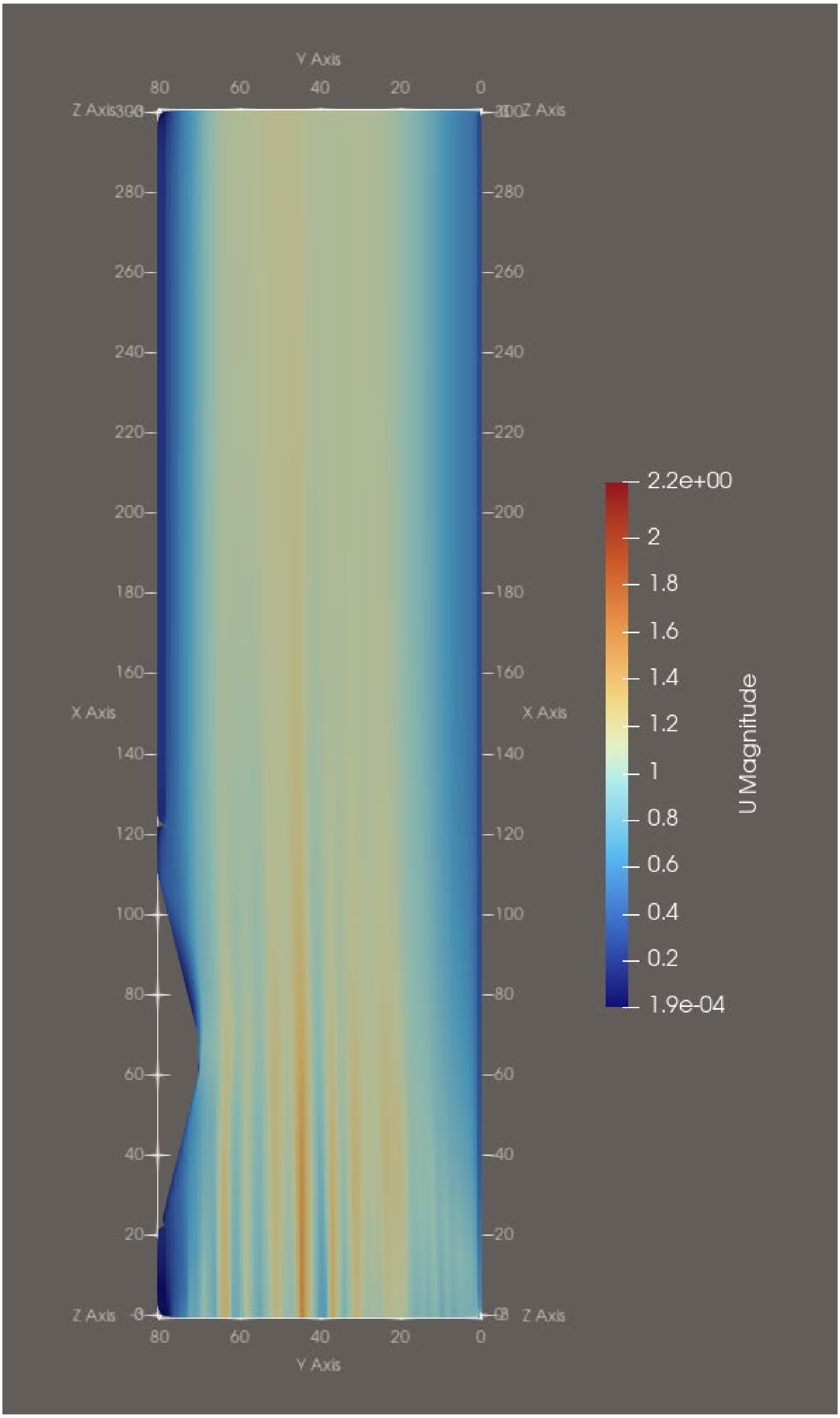


Figure E.3 Discharge structure model – Predicted concentration at surface

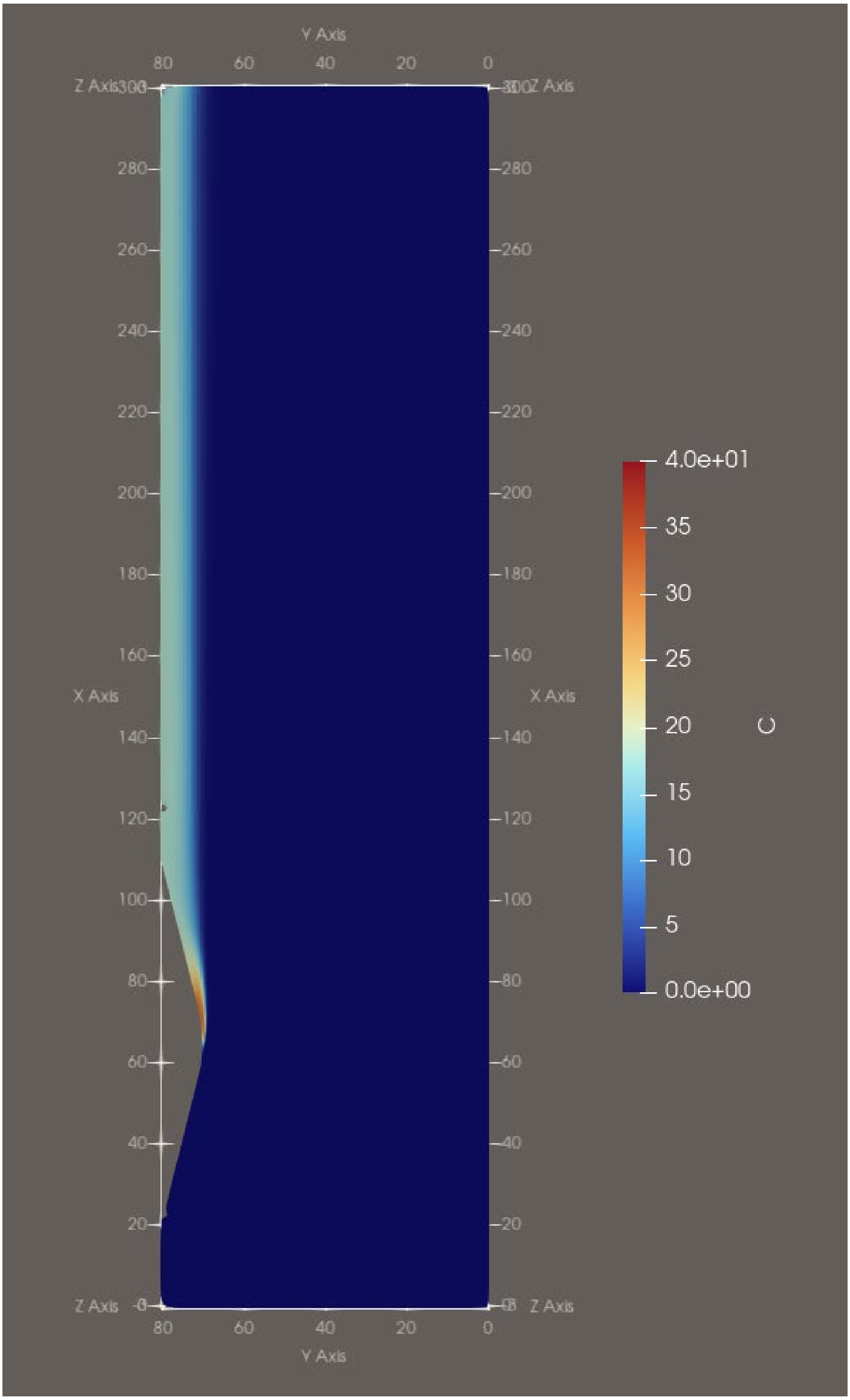


Figure E.4 Mixing zone model results – Predicted water velocity at surface

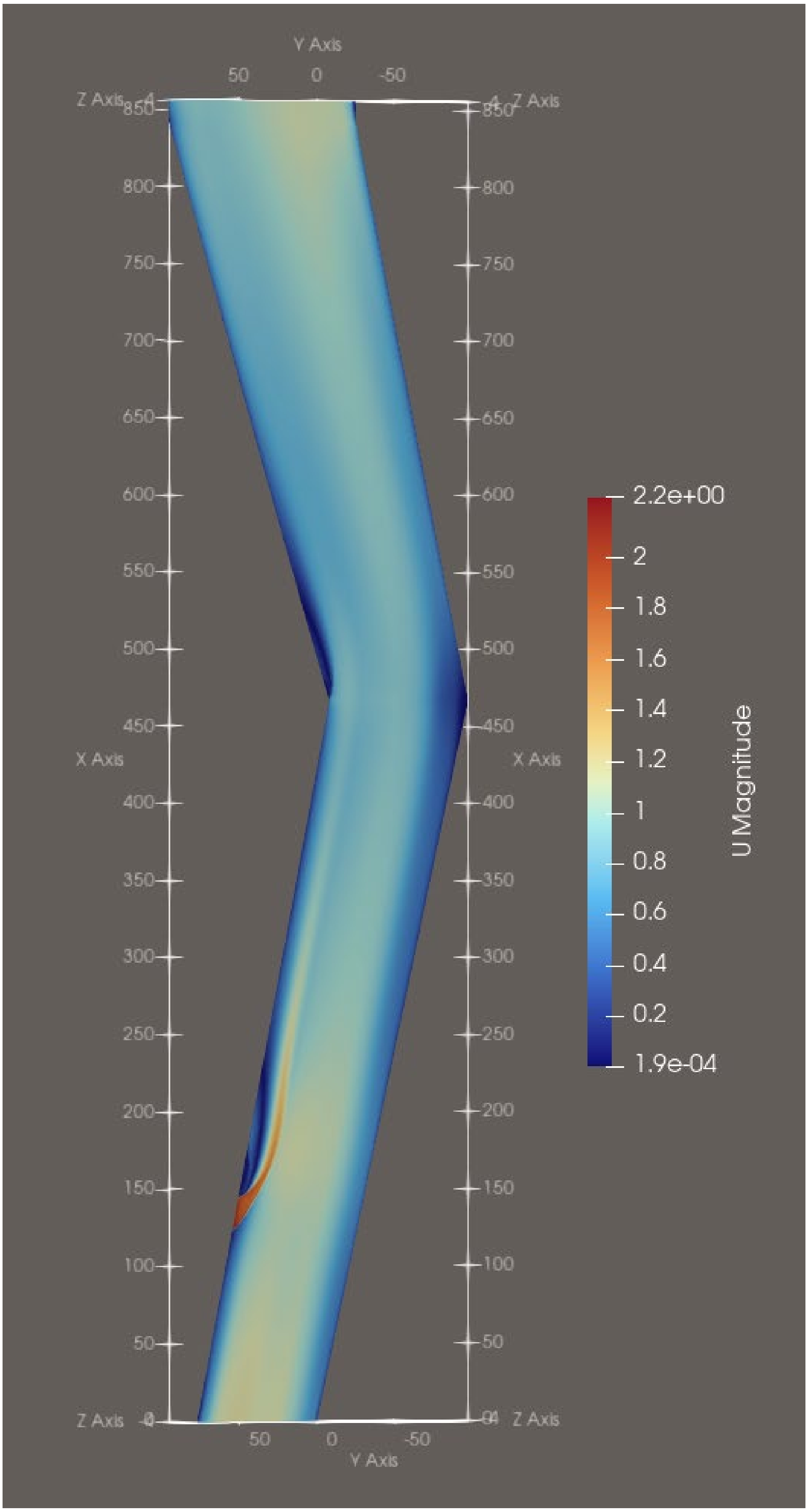
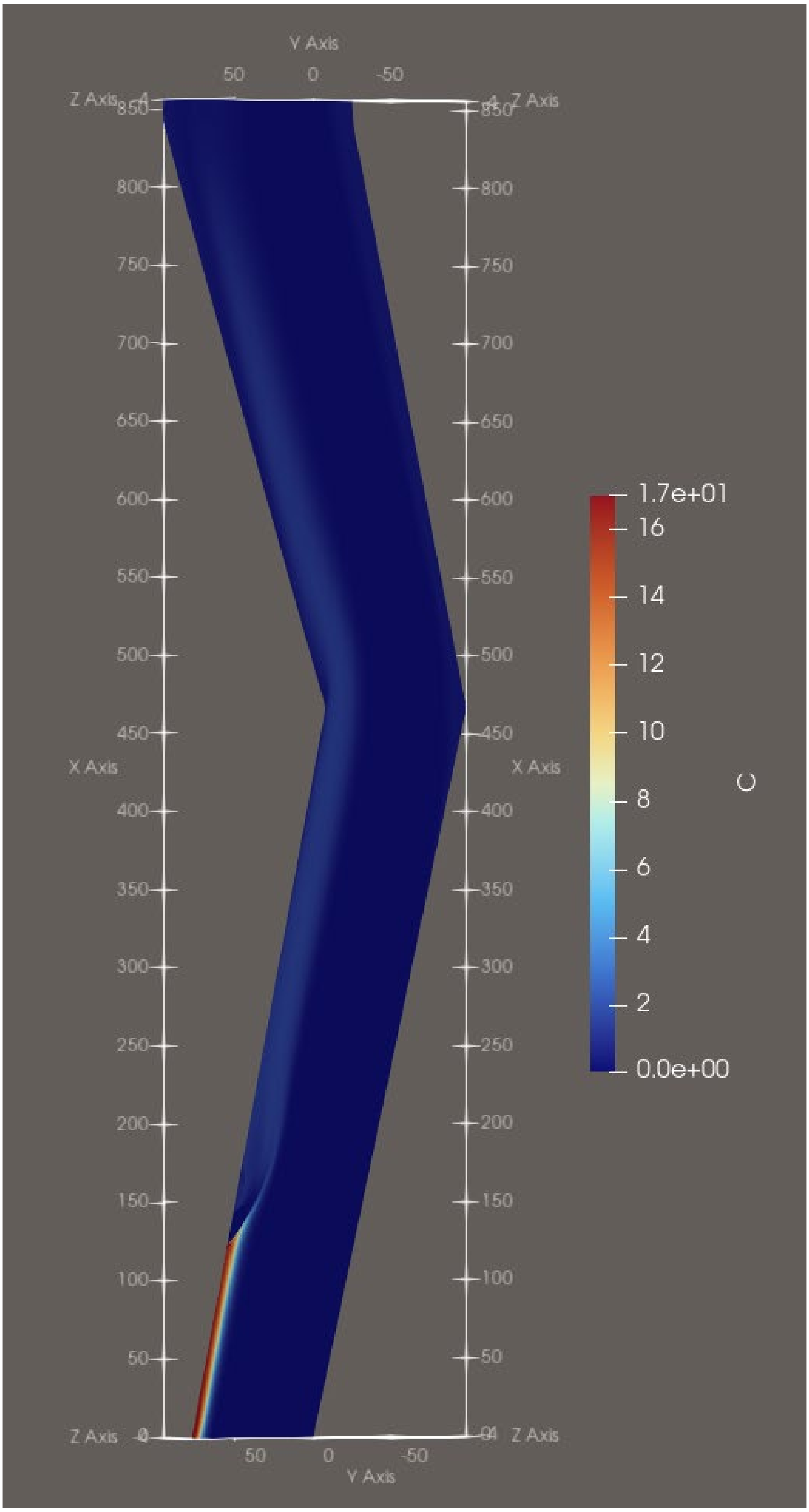


Figure E.5 Mixing Zone model results – Predicted concentration at surface



CORMIX model comparison

The CORMIX modelling system (Version 5.0 or higher) is a software system for the analysis, prediction, and design of aqueous toxic or conventional pollutant discharges into diverse water bodies. The major emphasis of the system is on the geometry and dilution characteristics of the initial near-field mixing area. The CORMIX system represents a robust and versatile CAD methodology for predicting qualitative features (e.g. flow classification) and quantitative aspects (e.g. dilution ratio, plume trajectory) of the hydrodynamic mixing processes resulting from different discharge configurations (Jirka & Doneker, 2007)

Discharge Configuration

The discharge was represented in CORMIX as an above-surface, single-port jet discharge, consistent with the conceptualisation of flow exiting the rock-lined channel.

- Discharge type: Above Surface jet-like (CORMIX-1 Single Port module).
- Configuration: Single-port, jet-like discharge located 10 m from the left (nearest) bank.
- Port area: 0.8 m², adopted to best represent the effective discharge area associated with flow through the porous rock channel, within the limitations of the CORMIX requirements for port area/channel depth.
- Horizontal angle SIGMA: 270 – Indicative of a perpendicular discharge to river flow direction.
- Vertical Angle THETA: 0 – The port is not angled upwards/downwards.

The adopted port area is smaller than the proposed discharge area and is intended to approximate the distributed nature of flow through the rock media. This simplification was required to satisfy CORMIX model constraints related to port geometry, ambient depth, and receiving water velocity. As a result, the modelled discharge is released through a more concentrated outlet than would occur in the designed outlet, leading to enhanced entrainment at the point of discharge in the model. Due to this, the model simulates higher initial dilution relative to a more distributed discharge. Accordingly, the predicted dilution is considered less conservative than would be expected under actual field conditions. Discharge to the river was assumed to be equivalent to the predicted peak 2060 dry-weather flow (0.34 m³/s), representing a likely upper bound for potential effects on river water quality.

Ambient Conditions - Receiving Environment

The receiving environment was parameterised using representative bulk hydraulic properties for ESNZ cross-section CX3 (ESNZ, 2026):

- Channel width: 80 m
- Average representative water depth: 1.1 m
- Discharge elevation: 1.0 m above the bed (i.e. near-surface release)
- Ambient Velocity: 0.79 m/s
- Manning's n: 0.03
- Freshwater temperature: 20 °C

The flow conditions represented in the model were based on the flow field measured at transect CX3 during the March 2026 ESNZ survey, representing a low-flow condition with a velocity of approximately 0.78 m/s.

The receiving environment was represented in CORMIX as a steady, bounded, uniform open channel, consistent with the model's idealised near-field framework. Channel geometry was defined using representative bulk properties, with a constant depth and width applied across the model domain.

A Manning's roughness coefficient of 0.03 was adopted to represent a natural gravel–cobble riverbed. Ambient conditions assume steady-state hydraulics, with no temporal variability in flow or water level. The ambient water temperature was specified as 20 °C, no wind speed was applied, and the channel depth at the discharge location was set at 1.0 m.

Key Assumptions & Limitations

- The channel is assumed to have uniform depth and width, with no lateral or vertical variability in flow conditions
- Localised features (e.g. bedforms, secondary currents, bank effects) are not represented
- The discharge is treated as a single coherent jet, despite representing flow through a porous rock structure
- The equivalent port area (0.8 m²) assumes uniform distribution of flow across the outlet zone
- The discharge is assumed to be neutrally buoyant, with no significant density difference between effluent and receiving water
- Both discharge and ambient hydraulic conditions are assumed constant over time. Temporal variability is not captured
- Contaminants are modelled as conservative. No settling, decay, or transformation processes. Predicted concentration reduction is controlled solely by dilution

Interpretation

The adopted model configuration has several implications for interpretation of results:

- The large equivalent port area (0.8 m²) and jet representation enhance entrainment and produce higher initial dilution than may occur from a discrete or more constrained outlet, resulting in a less conservative estimate of near-field mixing
- The assumption of uniform channel geometry and hydraulics simplifies the receiving environment and may not capture localised mixing constraints or preferential flow paths

As the model is restricted to near-field processes, results should be interpreted as:

- Robust for initial dilution estimates (noting less conservative than OpenFOAM model
- Not representative of full plume extent or far-field transport

The CORMIX model predicts rapid initial dilution of the discharge within the near-field region immediately downstream of the outfall. Model outputs indicate that dilution increases progressively over a short distance, with achieved dilution on the order of approximately 6–8-fold by the end of the near-field region (~4 m downstream). The dilution graph and modelled plume are shown below.

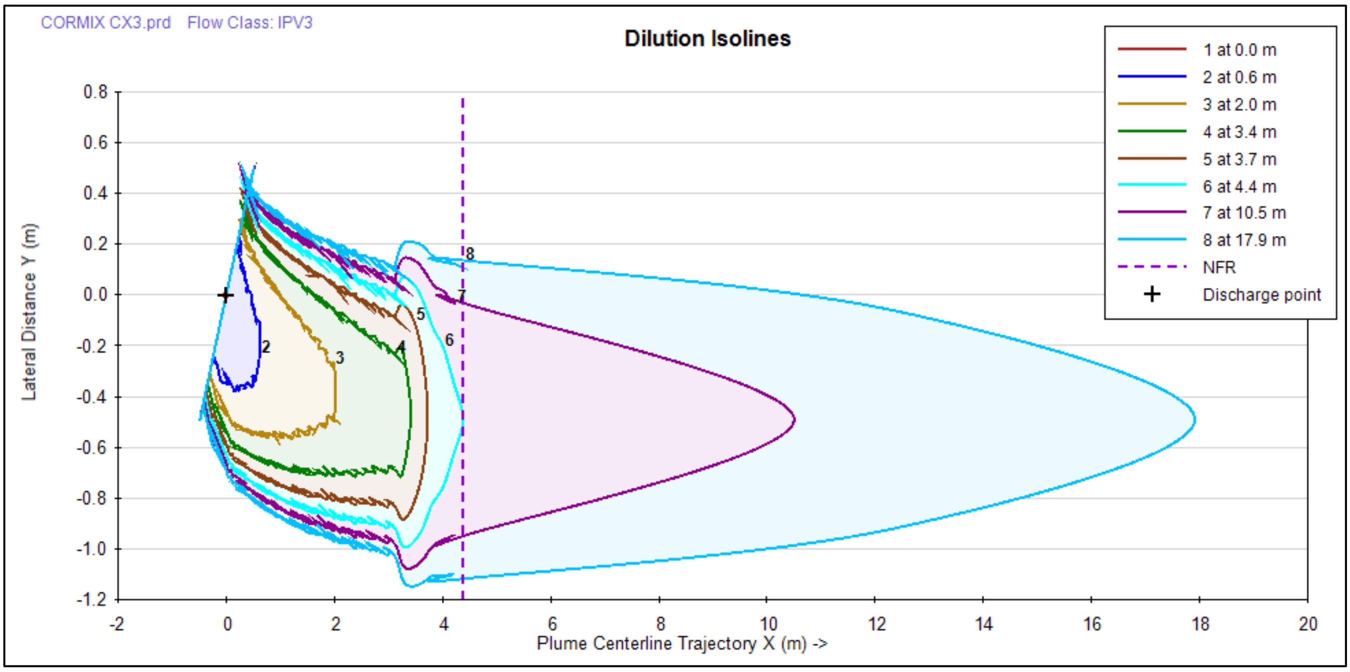


Figure E.6 *CORMIX model- Dilution vs Distance with dilution islolines*

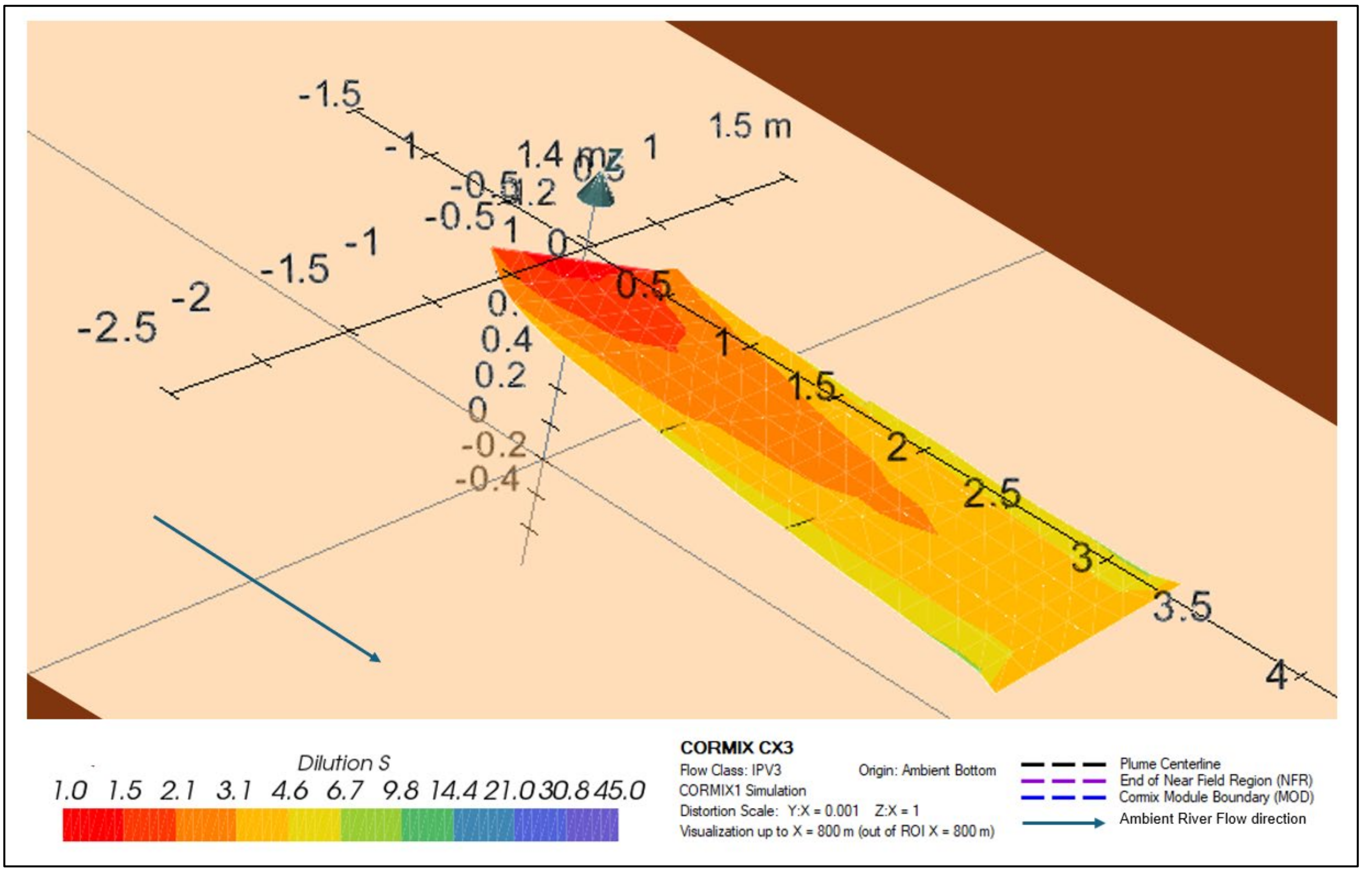


Figure E.7 CORMIX CorVue - Plume Visualisation of the simulated discharge plume

Appendix F

Statistical Analysis

Wilcoxon Signed Rank Test

The Wilcoxon signed-rank test is a nonparametric statistical test used to compare two related samples or paired measurements to assess whether their population median difference is zero. The critical value for the Wilcoxon signed-rank test is obtained from an exact critical values table using the effective sample size n, the selected significance level α, and whether the test is one-sided or two-sided.

For this analysis, the adopted significance level was 0.05, meaning there is a 5% risk of incorrectly rejecting the null hypothesis when it is actually true.

The two hypotheses' are as follows:

Null hypothesis: H_0: median $(d_i) = 0$
Alternate hypothesis: H_1: median $(d_i) \neq 0$

To obtain a meaningful inference, at least 5 non zero pairs are required[9].Both Dissolved Reactive Phosphorus (DRP) and Ammoniacal Nitrogen only had 4 non-zero pairs, therefore there is insufficient evidence to reject the null hypothesis. The observation can still be made that on 7 occasions; there was 0 difference between the samples.

Required equations

$d_i =$ RS14$_i$ - RS10$_i$

$W^+ = \Sigma$Ranks $d_i > 0$

$W^- = \Sigma$Ranks $d_i < 0$

T $= \min(W^+, W^-)$

The results for three analytes – Nitrate as N, DRP and Ammoniacal Nitrogen are displayed in Tables F.1 – F.3 below.

Table F.1 - Wilcoxon Signed Rank Test (Nitrate (as N))

Date	RS10 Nitrate (as N)	RS14 Nitrate (as N)	d_i	$\|d_i\|$	Rank	W^+	W^-
11 Mar 2025	0.0571	0.0064	-0.0507	0.0507	10		10
10 Apr 2025	0.0347	0.0333	-0.0014	0.0014	1		1
06 May 2025	0.0288	0.0398	0.011	0.011	5	5	
03 Jun 2025	0.038	0.11	0.072	0.072	11	11	
01 Jul 2025	0.07	0.028	-0.042	0.042	9		9
06 Aug 2025	0.0452	0.0311	-0.0141	0.0141	6		6
15 Oct 2025	0.0332	0.029	-0.0042	0.0042	3		3
02 Dec 2025	0.034	0.031	-0.003	0.003	2		2
03 Feb 2026	0.03	0.04	0.01	0.01	4	4	
05 Mar 2026	0.03	0.01	-0.02	0.02	7		7
10 Mar 2026	0.038	0.065	0.027	0.027	8	8	
						T	28
						n	11

Based on a sample size of 11, the critical value that corresponds to α = 0.05 is 10.

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[9] Welsch, D., Neuhäuser, M. (2025). Wilcoxon-Signed-Rank Test. In: Lovric, M. (eds) International Encyclopedia of Statistical Science

As the test statistic (T) exceeds the critical value, the null hypothesis is not rejected at the 0.05 significance level. Therefore we can conclude there is no significant difference between Nitrate as N values at RS10 and RS14, upstream and downstream of the Shotover WWTP.

Table F.2 Wilcoxon signed rank test (Dissolved Reactive Phosphorus (DRP))

Date	RS10 DRP	RS14 DRP	Difference (RS14 - RS10)	Abs. Difference	Rank	Positive Rank	Negative Rank
11 Mar 2025	0.001	0.001	0	0			
10 Apr 2025	0.001	0.001	0	0			
06 May 2025	0.001	0.001	0	0			
03 Jun 2025	0.001	0.001	0	0			
01 Jul 2025	0.001	0.001	0	0			
06 Aug 2025	0.024	0.001	-0.023	0.023	11		11
15 Oct 2025	0.001	0.001	0	0			
02 Dec 2025	0.001	0.001	0	0			
03 Feb 2026	0.008	0.006	-0.002	0.002	8		8
05 Mar 2026	0.007	0.001	-0.006	0.006	9.5		9.5
10 Mar 2026	0.007	0.001	-0.006	0.006	9.5		9.5
						Test statistic	0
						Sample Size	4

Table F.3 Wilcoxon signed rank test (Ammoniacal Nitrogen)

Date	RS10 Ammoniacal Nitrogen	RS14 Ammoniacal Nitrogen	Difference (RS14 - RS10)	Abs. Difference	Rank	Positive Rank	Negative Rank
11 Mar 2025	0.0025	0.0025	0	0			
10 Apr 2025	0.02	0.005	-0.015	0.015	9		9
06 May 2025	0.01	0.0025	-0.0075	0.0075	8		8
03 Jun 2025	0.022	0.0025	-0.0195	0.0195	10		10
01 Jul 2025	0.0025	0.0025	0	0			
06 Aug 2025	0.05	0.0025	-0.0475	0.0475	11		11
15 Oct 2025	0.0025	0.0025	0	0			
02 Dec 2025	0.0025	0.0025	0	0			
03 Feb 2026	0.005	0.005	0	0			
05 Mar 2026	0.005	0.005	0	0			
10 Mar 2026	0.0025	0.0025	0	0			

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