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REGIONAL COUNCIL

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19 December 2024

Taylorville Resource Park Ltd
c/o Barker & Associates
KerstinG@barker.co.nz

Enquiries to: Michael Durand

Dear Ms Ghisel

RC-2024-0122 and RC-2021-0097-V10 – DISCHARGES OF CONTAMINANTS AT TAYLORVILLE RESOURCE PARK
Further information request under section 92(1) of the Resource Management Act 1991

Thank you for your application to discharge collected leachate and stormwater to land (RC-2024-0122) from the Taylorville Resource Park Ltd landfill and the application (RC2021.0097-V10) to change consent condition 11 of consent RC2021.0097 to authorise the discharges applied in application RC2024.0122. Also thank you for the response provided on s92(1) request related to application RC2024.0122 in a letter from Engeo addressed to Bruce Tinnelly of TRP dated 1 November 2024 and the accompanying AEE dated 19 October 2024.

We have engaged Carl Steffens of PDP to review AEE provided. Please see attached the review provided by PDP. As a result of these assessments further information is requested under section 92(1) of the RMA as listed below.

This information is requested so that WCRC can complete its assessment of the environmental effects of the proposed discharge and to determine notification or non-notification of the application. The additional information requested below will also enable us to assess potential adverse effects on the Grey District Council's water supply and potential ecological effects on surface water.

Information requested

1. Hydraulic conductivity estimates from onsite testing (pump testing and/or slug testing). If slug testing is used, then please provide testing data from at least 3 bore locations on the upper terrace surface.

2. Updated mounding and contaminant modelling simulations using the hydraulic conductivity estimates derived from the requested testing. Based on the testing results, please take into account that the results from testing (particularly slug testing) may provide local values for hydraulic conductivity but not necessarily be representative of the average hydraulic conductivity over the area of the landfill. Therefore, please provide multiple modelling simulations informed by the testing results using a realistic range of potential hydraulic conductivity values for the strata beneath the upper terrace surface (i.e. a sensitivity assessment based on varying the hydraulic conductivity that is informed by the testing results).

3. Updated contaminant modelling simulations using input parameters more consistent with high parameter concentrations that have been measured in leachate and wastewater.

4. An ecological survey of the surface water features and aquatic habitat surrounding the site, including Noname Creek, the drain along Taylorville Road, including that part of the drain that begins at spring seep TCD1 and the streams on the southern side of Taylorville Road (excluding the Grey River) and an impact assessment on surface water quality and ecological values resulting from the proposed discharge.

5. A water quality comparison between water samples collected from the GDC water supply, the Grey River, groundwater upgradient of the landfill north of Taylorville Road and surface water samples collected at TRD2 and TRD4. The samples should include analysis for anions and cations and nitrogen species, in addition to other parameters sampled to date by TRPL. The purpose of the sampling is to inform whether the GDC water supply source is dominantly Grey River water and that there is minimal input to the supply bores from upgradient groundwater and surface drainage.

6. Yield versus drawdown data from the GDC supply bores to confirm the gravel deposits immediately adjacent to the Grey River are of high permeability with a high hydraulic connection to the Grey River.

7. XRD sample analysis from the Kaiata mudstone underlying the landfill to confirm clay mineralogy in the mudstone and confirm ENGEO comments that swelling within any fractures that may be present in the mudstone will block the transmission of groundwater via a fracture network.

Next steps

The steps set out in section 92A(1) apply to this request. TRPL must take one of the options in section 92(1) by 3 February 2025, which is 15 working days from the date of this request.

Decisions under sections 95A and 95B of the RMA are postponed until receipt of this information, unless section 95C applies.

If you have any queries regarding this matter, please contact Michael Durand on 021 035 2593 or e-mail on michael@planzconsultants.co.nz.

Yours faithfully,

Michael Durand
Consultant Planning Officer
West Coast Regional Council

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memorandum

TO	Michael Durand	FROM	Carl Steffens
	Planz Consultants	DATE	18 December 2024
RE	Technical Review – TRPL short-term consent application to discharge contaminants to ground.		

Pattle Delamore Partners Limited (PDP) has been engaged by West Coast Regional Council (WCRC) to provide a technical review of a resource consent application by Taylorville Resource Park Limited. The application has been prepared by Barker and Associates Limited (B&A) with technical assessment provided by ENGEO Limited (ENGEO). The application seeks a temporary discharge (for up to six months) from the existing onsite retention pond to land via a soakage area. The maximum daily discharge is up to 800 m^3, which represents a continuous discharge of approximately 9.3 L/s). A change to condition 11 of existing resource consent RC-2021-0097-03 is also sought to allow for potential contamination of groundwater or surface water outside of the site.

PDP has recently prepared a report which commented on the potential impacts of TRPL landfill on the nearby Grey District Council (GDC) water supply intake (supply to Greymouth). That report is titled Impacts of Taylorville Resource Park Limtied Landfill on Grey District Council Coal Creek Water Supply Intake and is dated 11 October 2024. Based on limited available information, the report concluded that the risk of contamination to the water supply was likely to be low. However, the report also highlighted that there are considerable uncertainties regarding the risk posed by leachate migration and given the proximity of the GDC supply to the landfill, a very high level of assessment should be provided by the consent holder. To date, that information has not been provided.

While there is still considerable additional information required to assess the ongoing effects of the landfill on the environment, we note that an ENGEO memorandum dated 6 November 2024 reports that TRPL has recently installed eight additional monitoring bores (MB13-MB19s/d). ENGEO note that they have updated their groundwater flow contours based on groundwater elevation measurements in all existing and new bores at the site. They report that this updated information shows that groundwater flow is to the west-southwest and their memo presents a preliminary figure showing the updated contours that have been constructed by ENGEO. This is useful additional information, however we have not been able to review the data used to construct the contours and we also consider the presence of groundwater seeps along the Taylorville Road cutting indicate there is also a southerly component to groundwater flow that is not evident from the ENGEO contours. It is possible there could be groundwater divides at the site and more complex groundwater flow than indicated by the ENGEO contours.

Further to the existing risks to the environment (and human health based on the presence of the landfill in proximity to the water supply), the current proposal represents an additional discharge at the site that was not considered during the drafting of the previous October 2024 PDP report.

The ENGEO technical assessment relating to the current proposal is provided in their report titled Preliminary Hydrogeological Assessment – 287 Taylorville Road, Coal Creek, Greymouth, dated 19

September 2024 and which is appended to the main Planning report prepared by B&A. We understand that water from the retention pond will be piped to a proposed soakage area which will be located approximately 150 m east from the retention pond. ENGEO has carried out modelling to simulate the migration of contaminants in groundwater following the discharge. It is assumed that the discharge will occur to an approximately 10 m x 10 m soakage area constructed to a depth of at least 2 m below ground level (bgl).

ENGEO has presented the results of groundwater quality sampling in Appendix 5 of their report. This information has been collected at and in the vicinity of the site from January 2023 to present. The water quality monitoring includes samples collected at the following locations:

- Samples of Leachate or wastewater from landfill Cells A, B and C, sediment/settlement/retention ponds and sumps. These sample names include Leachate (Cell A), Leachate (Cell B/C), Sediment Pond, SWSDP, Settlement Stage 2, DC/C3 and Deep Sump.
- Upgradient groundwater spring/seep locations with sample names SPA, SPC and SPE.
- Downgradient spring/seep locations with sample names TCD1/Discharge, SP1, SP2 and SP3.
- Upgradient bore locations with sample names MB1, MB2s MB2d and MB3.
- Downgradient bore locations with sample names MB4s, MB4d, MB5 and TSB1.
- Upgradient drain locations with sample names TRD3 and TRD4.
- Downgradient drain locations with sample names SPF Pit/TRD1, TRD2 and TRD5
- Samples from Noname Creek to the west of the site on the opposite side of the road from the western site perimeter drain with sample names SPF US, SPF MS, SPF DS.

Based on our review of the water quality data we note leachate is being generated at the site and concentrations of many contaminants in leachate and wastewater are significantly elevated. We note that concentrations of dissolved manganese, arsenic and chromium have been recorded in leachate or wastewater well above the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 (DWSNZ), human health based Maximum Acceptable Value (MAV) concentrations. Arsenic has been recorded at nearly 100 x the MAV concentration in one leachate sample. In addition, there are a significant number of leachate or wastewater samples where parameters exceed or significantly exceed the relevant Taumata Arowai Aesthetic Values for Drinking Water Notice 2022 (AVDWN) Guideline Value (GV) concentrations and/or Australia and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG) Default Guideline Values (DGV) for ecological toxicants.

Samples to determine the impacts of the landfill on groundwater quality are very limited. We note that upgradient bore MB2d is drilled into mudstone and has significantly different water quality results than the other three upgradient bores. This indicates that the source rock may be impacting on the water quality results. As a result, downgradient bore MB4d (also drilled into mudstone) may not be a good bore for assessing the effects on groundwater migrating from the landfill through the more permeable overlying gravel strata (although much higher sulphate concentrations have been recorded in MB4d compared to MB2d which could be caused by leachate). Of the remaining three downgradient bores (MB4s, MB5 and TSB1), only TSB1 has intercepted groundwater and therefore this may be the only representative downgradient bore. As a result, there is significant uncertainty whether the potential effects on groundwater are well constrained. We note TSB1 has recorded dissolved aluminium at up to 19 times the concentrations recorded in the upgradient groundwater bores, however most other relevant parameters are not significantly different between the upgradient and downgradient gravel bores.

Of further significance to water quality we note the following:

- Samples collected from seeps SP1, SP2 and SP3 (below the landfill in the Taylorville Road cutting) typically show higher parameter concentrations than those measured from upgradient springs SPA, SPC and SPE. In particular, total hardness, electrical conductivity, dissolved calcium and magnesium, sulphate and Chemical Oxygen Demand are many times higher in the downgradient seep locations.

- Samples from downgradient seep TCD1/Discharge (the seep feeding the western perimeter drain) typically show poorer water quality than the Taylorville Road downgradient seeps, however it should be noted that there are only two individual samples that have been collected from the Taylorville Road seeps compared to nine samples from TCD1/Discharge.

- Dissolved manganese and dissolved arsenic have been measured at concentrations in TCD1/Discharge exceeding DWSNZ MAV concentrations, while dissolved arsenic, chromium, copper, zinc and manganese, in addition to electrical conductivity, total ammoniacal nitrogen and nitrate have been measured above or well above ecological DGV concentrations in this bore.

- Concentrations of dissolved aluminium and nitrate have been measured above ecological criteria in the upgradient springs, however significantly higher concentrations for these two parameters have been recorded in either TCD1/Discharge or the downgradient Taylorville Road Springs.

- Downgradient drain samples SPF Pit/TRD1, TRD2 and TRD5 have recorded higher concentrations for most parameters compared to samples collected from upgradient drains TRD3 and TRD4. All samples (upgradient and downgradient) have been collected from the roadside drain along Taylorville Road. We note dissolved arsenic in SPF Pit/TRD1 has been recorded on one occasion exceeding the DWSNZ MAV, while a significant number of ecological DGV exceedances have occurred for all three downstream drain locations.

Based on the above information, the landfill is generating leachate and it appears that this has impacted on the water quality in downgradient groundwater, springs/seeps and drains. We note that some sample locations have only a very limited number of samples.

Mounding Assessment

The infiltration basin will create a raised mounding of the underlying water table. Based on the proposed discharge of up to 800 m^3/day, ENGEO has estimated the potential mounding at the water table. We note the calculations are based on an assumed horizontal hydraulic conductivity (K) of 84 m/d, which is assumed based on text book values for various strata descriptions. We consider the adopted value may not sufficiently take into account the potential for fine grained silt and clay in the matrix and note that the mounding model will potentially predict much higher levels of mounding if K is actually significantly lower. We consider onsite testing would be required to confirm the hydraulic conductivity and typically this would involve pumping testing or slug testing. Infiltration testing would also be advisable to confirm the infiltration capacity of the soils. At present we consider the mounding assessment is highly uncertain. Significant mounding has the potential to impact on the flow direction of contaminants contained in the discharge.

Effects on Groundwater Quality

The level of impacts to groundwater quality onsite are currently not well constrained as there are only limited downgradient sampling results and, as noted above, potentially only one bore within the site with relevant data. Groundwater underlying the site likely discharges into surrounding springs and drains and there may not be hydraulic connection with groundwater on surrounding properties, although that would ultimately need to be confirmed by offsite drilling and monitoring. To date no offsite drilling or monitoring has been carried out.

Our concerns regarding the actual hydraulic conductivity of the strata underlying the site (mentioned above in our comment on the groundwater mounding assessment) apply equally to the RISC5 contaminant transport modelling carried out by ENGEO. We consider that lower values of hydraulic conductivity may result in higher predicted contaminant concentrations due to less dilution and dispersion in the aquifer and consider that to more comprehensively assess the potential for contaminant migration further simulations using lower values of hydraulic conductivity should be carried out.

We also note that the model source concentrations are stated to be the highest concentrations detected in samples collected from locations in the water treatment system in July 2024. However, we note much higher concentrations have been recorded in the past than the input concentrations that have been used. While the most recent sample results may potentially be relevant for an initial discharge, if discharges are still occurring for up to 6 months, these later discharges could contain much greater concentrations than those modelled, as the impacts of rainfall dilution may be less than the current situation.

Based on the above comments, we consider additional mounding and model simulations would be required, by undertaking a sensitivity analysis of the model input parameters, to adequately address the potential effects on groundwater quality and the resulting impacts on the natural surface water discharge areas. We consider the risk to offsite groundwater (from direct groundwater flow) is likely low due to an expected lack of hydraulic connection, however the level of information provided to date to confirm that is currently low.

We also consider that while there are a significant number of samples that have been collected at the site to date, some sample locations do not have a lot of data. In addition, VOC and SVOCs are not included in the parameters that are sampled and therefore we can't be sure that all potential contaminants are sufficiently characterised.

Effects on Groundwater Quantity

ENGEO has assessed the effects on groundwater quantity based on the results of their mounding assessment. As described above, we consider the mounding assessment is highly uncertain and recommend that further simulations based on lower hydraulic conductivity values should be carried out. Ideally those simulations should be based on testing data from the site to constrain the hydraulic conductivity.

Effects on Surface Water Quality

Effects on surface water quality have been assessed by ENGEO in Noname Creek and the Grey River. The potential lack of connection between groundwater at the site and surface water in Noname Creek is noted by ENGEO and we consider this is likely relevant (although if mounding from the discharge is very high there could be potential for discharge to Noname Creek). In addition, dilution in the Grey River will be very large with minimal impacts. However, ENGEO has not assessed the potential effects in the drain that begins at TCD1, the extension of that drain along Taylorville Road and the surface water bodies on the alluvial gravels on the south side of Taylorville Road that receive flow inputs from the roadside drain.

Discharges from the landfill have impacted on these drains in the past and we consider the proposed discharge will likely result in further exceedances (possibly by significant amounts) of ecological limits in the drains which have not been considered. Further ecological information has been requested in the past, relevant to a previous application by TRPL, but has not been provided. As a result, we are unsure of the ecological status of the roadside drain or the surface water bodies on the southern side of the road. Therefore, based on the information provided, we can't confirm that the effects on surface water quality or ecology within these surface water bodies will be less than minor.

Effects on GDC Water Supply

As per our October 2024 report, we expect the risk to the GDC water supply from the operation of the TRPL landfill is likely low. However, we also note the supply services around 10,000 people and a landfill operation would typically not be appropriate within such close proximity to a public water supply. The proposed discharge to ground results in an additional risk to the GDC supply compared to that considered by PDP previously, as the applicant now seeks to discharge a large quantity of contaminated water directly to ground over a short time period. In addition, the proposed discharge area will be closer to an upgradient location, relative to the water supply, than most of the landfill cells and treatment system.

We consider the risk to the water supply from direct groundwater flow is still likely low, as there is unlikely to be a connection between the gravels underlying the landfill and those south of Taylorville Road (where the GDC bores at located). However, that is based solely on an assumed conceptual understanding of the groundwater and surface water system on the southern side of Taylorville Road. It would be best to confirm that is the case via a drilling and monitoring programme which has not been carried out to date. In addition, this assumes there is no potential for fracture flow in the mudstone that underlies the gravels at the site. ENGEO has previously indicated that clay minerals within the mudstone will swell and seal any fractures that may be present, however they have not provided any information to confirm the clay content within the mudstone underlying the site. This information could be provide via X-Ray Diffraction (XRD) analysis.

While the risk from direct groundwater flow is likely low between the upper and lower terrace, there is the potential for transport of contaminants from the site to the southern terrace via the roadside drain on Taylorville Road and the culverts that transport the water under the road.

We expect any water that makes its way under the road at the location of TRD5 is unlikely to impact on the water supply as it will be further separated from the water supply bores by other surface water features on the lower terrace.

The main risk is likely from flow under the road via the culvert at TRD2. Figure 1 of the March 2024 EHS Support report shows that the drain at TRD2 could receive seepage and flow from the drain impacted by leachate. There is a potential transport mechanism via the associated stream on the southern side of Taylorville Road where losses of flow to the underlying gravels could allow contaminants to reach the strata from which the GDC supply bores abstract water. In reality we expect that the GDC bores will derive most of their water from the Grey River and the extent of input from the gravels on the landfill side of the aquifer will be very limited. This would likely significantly dilute any contaminants that may reach the southern side of Taylorville Road. However, we also note we have not been provided with any information to confirm the performance of the GDC bores (yield versus drawdown in individual supply bores and drawdown interference effects induced in other supply bores) to confirm that is the case. In addition, water quality sampling comparing the GDC supply bore water, Grey River water, groundwater and drain water would provide useful information to determine the potential for upgradient groundwater to reach the GDC supply bores.

Furthermore, it can't be ruled out that the concentrations of impacted water that reach the roadside drain as a result of the proposed discharge won't be higher than those that have reached the drain in the past, due to the discharge of a significantly increased mass of contaminants to ground over a short time period. We recommend further modelling simulations should be carried out to address than uncertainty. Even after that, detailed monitoring of the effects from any discharge is likely to be required.

Conclusion

Based on our review of the ENGEO assessments, we consider their assessments could potentially underestimate the effects of the proposed discharge. We consider the hydraulic conductivity used in their modelling could be too high and lower values of hydraulic conductivity would result in more mounding and may also result in higher contaminant concentrations in groundwater and surface water. In addition, we consider the input contaminant concentrations in their RISC5 model may be too low which will also result in lower output concentrations. As a result, further modelling could be provided.

We also consider that ENGEO should provide further information to confirm the potential surface water quality effects on the perimeter drains on the western boundary and along Taylorville Road and the potential ecological impacts on the drains surrounding the site and the downstream surface water features on the southern side of Taylorville Road.

Additional information should also be provided to confirm the potential for contamination of the GDC water supply via surface water impacted from the landfill which may cross Taylorville Road via the culvert at TRD2.

It is important to note that irrespective of the results of any further modelling, the assessment will still be highly theoretical and subject to uncertainty. The most certain way to assess the potential for impacts on the GDC water supply are via a detailed drilling and monitoring programme on the southern side of Taylorville Road. We have recommended such monitoring on a number of occasions but to date nothing has been carried out.

Without a site-specific monitoring programme on the GDC land and if WCRC decide to grant the consent application, it will be important that a robust monitoring programme is incorporated into consent conditions. We note the proposed monitoring programme set out in Section 7 of the ENGEO report recommends sampling from a number of groundwater monitoring bores downgradient of the discharge. We consider further bores should be added directly south of MB13 in case groundwater mounding is significant and affects groundwater flow direction. In addition, MB17 should also be monitored along with spring seeps and drain sample locations along Taylorville Road. It would be good for PDP to review any consent conditions prior to granting of a consent.

Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by West Coast Regional Council and others (not directly contracted by PDP for the work), including Planz, Engeo and Barkers and Associates. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of West Coast Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Prepared by

Carl Steffens

Technical Director - Water Resources

ENGEO

GEOLOGY
GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES

Site Memorandum

Project Name	Taylorville Resource Park		
Memo Topic	RC-2024-0122 and RC-2021-0097-V10 - RFI Response		
Memo Date	30 January 2025	**Date of Site Visit**	N/A
ENGEO Memo No.	08	**ENGEO Project No.**	26200.000.001
To	Taylorville Resource Park Limited	**Copy**	Barker and Associates
Author	Lyn Nugent	**Reviewer**	Dave Robotham

ENGEO has reviewed the further information request relating to Taylorville Resource Park Limited's (TRPL) application to discharge collected leachate and stormwater to land (RC-2024-0012) and the application (RC2021.0097-V10) to change consent condition 11 of consent RC2021.0097. The further information request was issued by the West Coast Regional Council (WCRC, dated 19-Dec-24) under section 92(1) of the Resource Management Act 1991.

WCRC's questions (in grey) and ENGEO responses (in blue) are provided below.

1. Hydraulic conductivity estimates from onsite testing (pump testing and/or slug testing). If slug testing is used, then please provide testing data from at least 3 bore locations on the upper terrace surface

To assess for the hydraulic conductivity in the Pleistocene gravels, aquifer testing was undertaken at three on-site groundwater monitoring bores (MB13, MB14, and MB19d). Based on an assessment of the slug testing data using the method for unconfined aquifers (Bouwer & Rice, 1976) (refer Appendix 1), the hydraulic conductivity of the Pleistocene gravels ranges from 1 x 10-6 m/s to 1 x 10-5 m/s.

2. Updated mounding and contaminant modelling simulations using the hydraulic conductivity estimates derived from the requested testing. Based on the testing results, please take into account that the results from testing (particularly slug testing) may provide local values for hydraulic conductivity but not necessarily be representative of the average hydraulic conductivity over the area of the landfill. Therefore, please provide multiple modelling simulations informed by the testing results using a realistic range of potential hydraulic conductivity values for the strata beneath the upper terrace surface (i.e. a sensitivity assessment based on varying the hydraulic conductivity that is informed by the testing results).

Updated mounding using the Hantush method (Hantush, 1967) is provided in Appendix 2. As stated in our memo dated 12 November 2024, the actual discharge volumes will depend on the infiltration capacity in the soakage area, rainfall and evaporation rates. Using the Green-Ampt equation and based on the proposed location and aerial extent of the soakage area, the anticipated infiltration capacity of the soakage is on the order of 200 m^3/d – 300 m^3/d. This generally corresponds to the maximum potential mounding beneath the soakage area (i.e., the mound height that will intersect with the base of the soakage area). To be conservative, the RISC5 model was updated to include a source area with a height of 8 m (assuming seasonal groundwater fluctuations and mounding to the base of the soakage area). Additionally, the RISC5 model was re-run using the maximum (1.0×10^{-5} m/s) and minimum (1.2×10^{-6} m/s) values for hydraulic conductivity. As shown in Appendix 3, concentrations at the boundary are highest in the maximum conductivity scenario; however, even under this scenario, the maximum modelled concentrations at the boundary are either not detectable or orders of magnitude below the human or ecological health-based criteria (0.0069 mg/L, nitrate-N; 0.0027 mg/L total aluminium).

3. Updated contaminant modelling simulations using input parameters more consistent with high parameter concentrations that have been measured in leachate and wastewater.

Whilst we think that it is highly unlikely that blended concentrations of leachate (in the soakage area) will contain concentrations equivalent to the highest parameter concentrations ENGEO detected at the site, the RISC5 model was re-run using the maximum concentrations detected in the water treatment system locations since sampling began. As shown in Appendix 3, the maximum modelled concentrations at the boundary are either not detectable or orders of magnitude below the human or ecological health-based criteria.

4. An ecological survey of the surface water features and aquatic habitat surrounding the site, including Noname Creek, the drain along Taylorville Road, including that part of the drain that begins at spring seep TCD1 and the streams on the southern side of Taylorville Road (excluding the Grey River) and an impact assessment on surface water quality and ecological values resulting from the proposed discharge.

The ecological survey will be provided as a separate memo (Appendix 4)

5. A water quality comparison between water samples collected from the GDC water supply, the Grey River, groundwater upgradient of the landfill north of Taylorville Road and surface water samples collected at TRD2 and TRD4. The samples should include analysis for anions and cations and nitrogen species, in addition to other parameters sampled to date by TRPL. The purpose of the sampling is to inform whether the GDC water supply source is dominantly Grey River water and that there is minimal input to the supply bores from upgradient groundwater and surface drainage.

Water quality samples were collected from the raw (untreated) water at GRE001 (PWT01) and the Grey River approximately 300 – 400 m upstream of GRE001 (GR-01; Figure A5.1). On the day of our sampling visit, all three active bores (Bore 1–Bore 3) were operating. The samples were submitted for laboratory analysis for dissolved metals and ions in solution (Table 5.1). These results were converted to milliequivalents and compared to the most recent (October 24) results for samples collected from monitoring wells along the southern side boundary adjacent to the current operations (MB4d, MB14, MB18; Figure A5.2) and the full boundary extent, including upgradient / cross-gradient of the operations (MB2s/d, MB3, MB4d, MB14, MB18; Figure A5.3).

As shown in Figure A5.2, the ion profile of PWT01 very closely matches that of GR-01, indicating that there is minimal input from waters downgradient of the site operations. When the samples collected from upgradient / cross-gradient wells are included (Figure A5.3) there is a greater distribution of profiles, with more similarity in anions between the upgradient / cross-gradient wells and PWT01. However, the ion profile of PWT-1 is still most closely matched to that of GR-01 and broad similarity is expected, as all samples were collected from the same catchment.

We do note that the profile of MB2d was anomalous relative to the other samples. Water quality results from deep upgradient wells (MB2d and MB19d) are noticeably different from other locations at the site—including shallow wells MB2s and MB19s (Table 5.1)—potentially due to inputs from the underlying Kaiata Mudstone formation. The remaining cross-gradients wells cluster tightly, indicating general homogeneity in the waters above the mudstone contact. As such, MB2d was not considered further in this assessment.

The concentrations of ions in solution indicates that water quality at PWT01 is dominantly influenced by the Grey River, with no demonstrable input from the site. We do note the concentrations of dissolved metals (copper, lead, nickel, zinc) in PWT01 differed significantly from GR-01 and samples collected along the southern site boundary. The cause of this has not been assessed but may be naturally occurring (e.g., concentrations in the Holocene gravels) or may indicate the influence of waters originating at another (offsite) source area.

6. Yield versus drawdown data from the GDC supply bores to confirm the gravel deposits immediately adjacent to the Grey River are of high permeability with a high hydraulic connection to the Grey River.

Based on aquifer testing information provided by GDC (Appendix 6), the hydraulic conductivity in the Holocene river gravels at BH02 (abstraction well for public supply GRE001) is between 3.42 x 10-2 m/s (Boulton method) and 1.58 x 10-2 m/s (Neuman method). Pumping test analysis reports are provided in Appendix 6.

7. XRD sample analysis from the Kaiata mudstone underlying the landfill to confirm clay mineralogy in the mudstone and confirm ENGEO comments that swelling within any fractures that may be present in the mudstone will block the transmission of groundwater via a fracture network.

XRD analysis of two mudstone outcrops (Leaver, 1999) show that it is comprised of a mixture of kaolinite, illite, and vermiculite (Appendix 6). As the minerology of the Kaiata Mudstone comprises a mixture of swelling and non-swelling clay minerals, it is inferred that there is negligible flow through defects (e.g., microfractures) due to clay swelling. There is potential for preferential pathways through interbedded layers of non-clay materials (e.g., silts, sands). Groundwater that intersects with these layers will most likely be transported west-southwest, along the dip of the mudstone bedding planes and away from GRE001.

Based on our assessment works to date and in conjunction with the proposed conditions of consent, it is deemed *highly unlikely* that the proposed discharges will have a deleterious effect on human or ecological health.

References

Bouwer, H., & Rice, R. (1976). A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. *Water Resources Research, V12:3*, 423-428.

Hantush, M. (1967). Growth and Decay of Groundwater Mounds in Response to Uniform Percolation. *Water Resources Journal (3)*, 227-234.

Leaver, H. (1999). *Paleogeography, sedimentology and basin development of the Eocene Rapahoe Group in the Punakaiki-Westport area.* Christchurch: University of Canterbury.

APPENDIX 1

Slug Testing Reports

McMILLAN Drilling	Client: ENGEO	Bore No.: BH013
	Project: 287 Taylorville Road, Coal Creek	Job No.: 22638

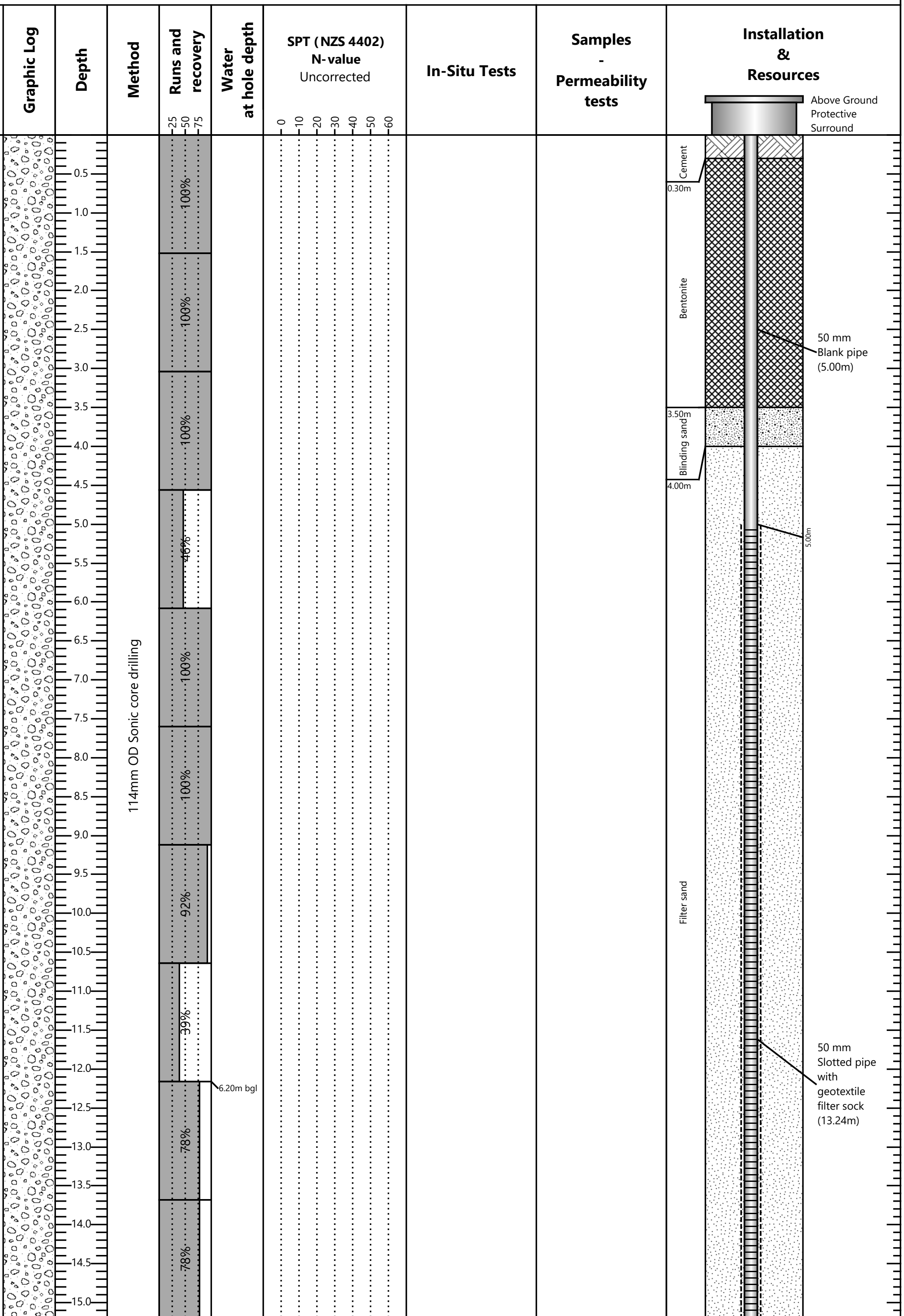
Site Location: 287 Taylorville Road, Coal Creek **Date:** 3/10/2024 - 3/10/2024

Grid Reference: 1457182.23m E, 5299473.42m N (NZTM) - Handheld GPS **Rig Operator:** E. Diaz Farias

Elevation: 0.00m **Datum:** Ground **Equipment:** Geoprobe 8140LC - track

Description

Sandy fine to coarse GRAVEL with minor cobbles; light brown. Well graded.



Remarks

Additional Resources:

Core boxes: 7
Water added: 2000 liters
Concrete: 3 bags
Bentonite: 2 bags
Blinding sand: 0.25 bag
Filter sand: 6 bags

120 High Street, Southbridge 7602, Canterbury, New Zealand ph: (03) 324 2571 fax: (03) 324 2431 web: www.drilling.co.nz

Hole Depth: 18.24m

Created: 7/10/2024 12:05:12 pm

McMILLAN Drilling	Client: ENGEO	Bore No.: **BH013**
	Project: 287 Taylorville Road, Coal Creek	Job No.: **22638**

Site Location: 287 Taylorville Road, Coal Creek **Date:** 3/10/2024 - 3/10/2024

Grid Reference: 1457182.23m E, 5299473.42m N (NZTM) - Handheld GPS **Rig Operator:** E. Diaz Farias

Elevation: 0.00m **Datum:** Ground **Equipment:** Geoprobe 8140LC - track

Description	Graphic Log	Depth	Method	Runs and recovery (25 50 75)	Water at hole depth	SPT (NZS 4402) N-value Uncorrected (0 10 20 30 40 50 60)	In-Situ Tests	Samples - Permeability tests	Installation & Resources
Sandy fine to coarse GRAVEL with minor cobbles; light brown. Well graded.		15.5, 16.0, 16.5	114mm OD Sonic core drilling	39%					Filter sand
17.00m Grey MUDSTONE.		17.0, 17.5, 18.0		78%					18.24m

EOH: 18.24m

Remarks

Additional Resources:
Core boxes: 7
Water added: 2000 liters
Concrete: 3 bags
Bentonite: 2 bags
Blinding sand: 0.25 bag
Filter sand: 6 bags

McMILLAN Drilling

Client: ENGEO	Bore No.: **BH014**
Project: 287 Taylorville Road, Coal Creek	Job No.: **22638**

Site Location: 287 Taylorville Road, Coal Creek
Date: 23/9/2024 - 25/9/2024
Grid Reference: 1456883.14m E, 5299346.95m N (NZTM) - Handheld GPS
Rig Operator: E. Diaz Farias
Elevation: 0.00m **Datum:** Ground
Equipment: Geoprobe 8140LC - track

Description	Depth	Method	Runs and recovery	In-Situ Tests
Sandy fine to coarse GRAVEL; light brown. Well graded.	0.00–1.00m	114mm OD Sonic core drilling 6" overdrilling 4½" DT	65%	
WOOD with some rubbish.	1.00m		59%	
Sandy fine to coarse GRAVEL with minor cobbles; light brown. Well graded.	2.50m		59%, 100%, 32%, 26%, 32%	SPT (C) 7.60m 3, 4 / 5, 5, 6, 6 450mm N = **22**; SPT (C) 9.12m 4, 6 / 6, 7, 6, 6 450mm N = **25**
Silty fine to coarse GRAVEL; reddish brown. Well graded.	10.30m		100%	SPT (C) 10.64m 5, 4 / 5, 6, 6, 8 450mm N = **25**
Grey MUDSTONE.	11.40m	114mm OD Sonic core drilling	100%	

EOH: 13.68m

Water at hole depth: 5.70m bgl

SPT (NZS 4402) N-value Uncorrected: 0 10 20 30 40 50 60

Samples - Permeability tests

Installation & Resources

Above Ground Protective Surround

Cement; 0.30m

Bentonite

50 mm Blank pipe (4.00m)

2.50m; Blinding sand; 3.00m

4.00m

Filter sand

50 mm Slotted pipe with geotextile filter sock (9.60m)

13.60m

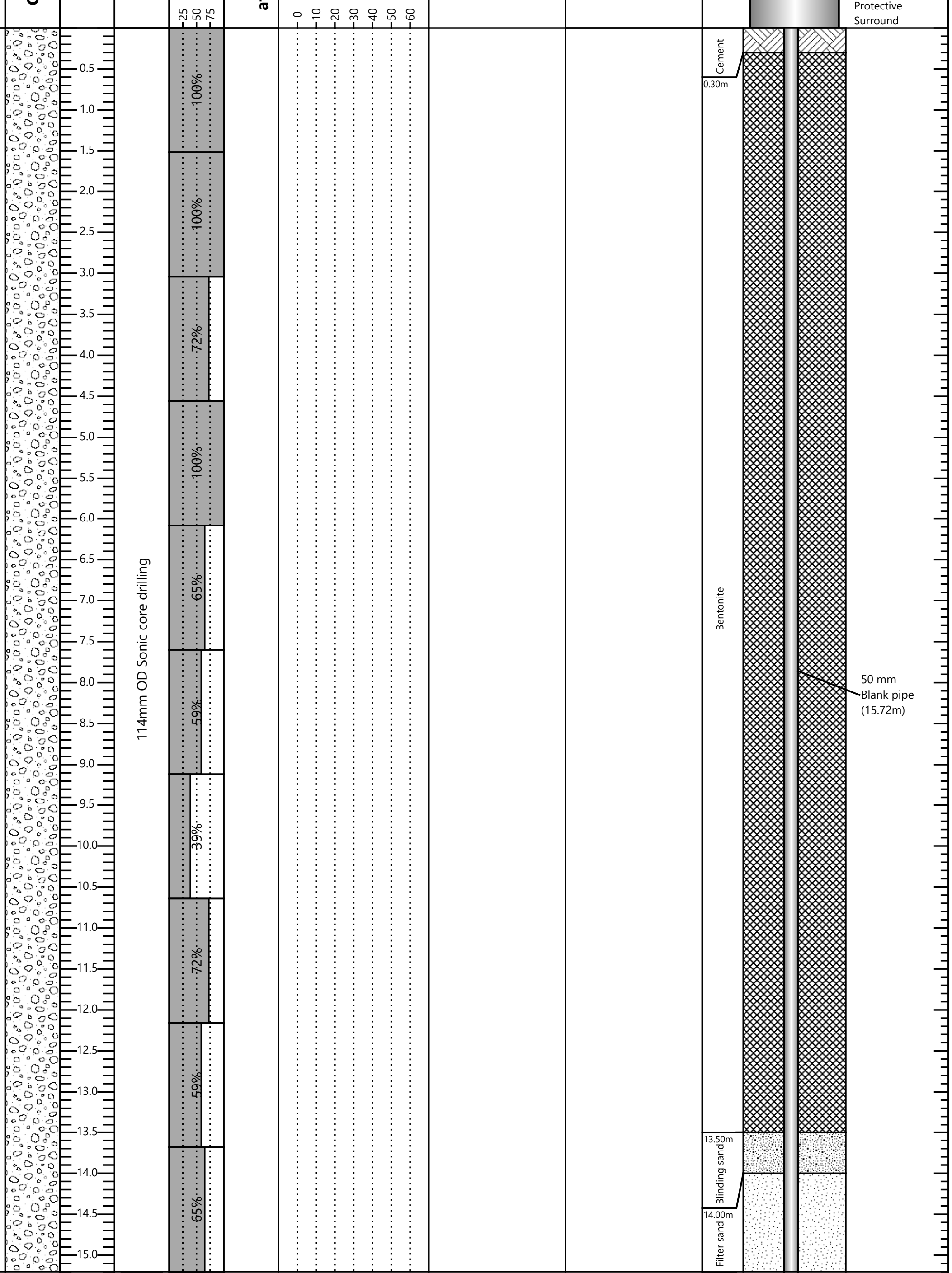
Remarks
Hammer energy ratio 84.3%

Additional Resources:
Core boxes: 5
Water added: 6000 liters
Concrete: 3 bags
Bentonite: 1.5 bags
Blinding sand: 0.25 bag
Filter sand: 5 bags

McMILLAN Drilling	**Client:** ENGEO	**Bore No.:** **BH019**
	Project: 287 Taylorville Road, Coal Creek	**Job No.:** **22638**

Site Location: 287 Taylorville Road, Coal Creek
Date: 1/10/2024 - 2/10/2024
Grid Reference: 1457351.03m E, 5299489.22m N (NZTM) - Handheld GPS
Rig Operator: E. Diaz Farias
Elevation: 0.00m
Datum: Ground
Equipment: Geoprobe 8140LC - track

Description	Graphic Log	Depth	Method	Runs and recovery	Water at hole depth	SPT (NZS 4402) N-value Uncorrected	In-Situ Tests	Samples - Permeability tests	Installation & Resources
Sandy fine to coarse GRAVEL with minor cobbles; light brown. Well graded.		0.0–15.0	114mm OD Sonic core drilling	100%, 100%, 72%, 100%, 65%, 59%, 39%, 72%, 59%, 65%					



Remarks

Additional Resources:
Core boxes: 6
Water added: 1500 liters
Concrete: 3 bags
Bentonite: 1.5 bags
Blinding sand: 0.25 bag
Filter sand: 6 bags

McMILLAN Drilling	Client: ENGEO	Bore No.: BH019
	Project: 287 Taylorville Road, Coal Creek	Job No.: 22638

Site Location: 287 Taylorville Road, Coal Creek **Date:** 1/10/2024 - 2/10/2024

Grid Reference: 1457351.03m E, 5299489.22m N (NZTM) - Handheld GPS **Rig Operator:** E. Diaz Farias

Elevation: 0.00m **Datum:** Ground **Equipment:** Geoprobe 8140LC - track

Description	Graphic Log	Depth	Method	Runs and recovery (25 50 75)	Water at hole depth	SPT (NZS 4402) N-value Uncorrected (0 10 20 30 40 50 60)	In-Situ Tests	Samples - Permeability tests	Installation & Resources
Sandy fine to coarse GRAVEL with minor cobbles; light brown. Well graded.		15.5	114mm OD Sonic core drilling	78%					Filter sand; 15.72m
Grey MUDSTONE. (16.00m)		16.0 16.5							50 mm Slotted pipe with geotextile filter sock (1.00m); 16.72m

EOH: 16.72m

Remarks

Additional Resources:
Core boxes: 6
Water added: 1500 liters
Concrete: 3 bags
Bentonite: 1.5 bags
Blinding sand: 0.25 bag
Filter sand: 6 bags

Slug Test - Water Level Data	
Project: TRP	
Number: 26200.000.001	
Client: TRPL	

Location: Taylorville, Coal Creek	Slug Test: MB19d in	Test Well: MB19d
Test Conducted by: J. Green / M. Knopick	Test Date: 16/10/2024	
Water level at t=0 [m]: 4.23	Static Water Level [m]: 4.91	Water level change at t=0 [m]: -0.68

	Time [s]	Water Level [m]	WL Change [m]
1	1	4.2273	-0.6827
2	2	4.2985	-0.6115
3	3	4.3191	-0.5909
4	4	4.329	-0.581
5	5	4.3895	-0.5205
6	6	4.403	-0.507
7	7	4.4656	-0.4444
8	8	4.5254	-0.3846
9	9	4.5403	-0.3697
10	10	4.5503	-0.3597
11	11	4.5695	-0.3405
12	12	4.5951	-0.3149
13	13	4.6093	-0.3007
14	14	4.5958	-0.3142
15	15	4.6022	-0.3078
16	16	4.6178	-0.2922
17	17	4.6306	-0.2794
18	18	4.6242	-0.2858
19	19	4.583	-0.327
20	20	4.6257	-0.2843
21	21	4.6392	-0.2708
22	22	4.6555	-0.2545
23	23	4.6655	-0.2445
24	24	4.6726	-0.2374
25	25	4.6783	-0.2317
26	26	4.6833	-0.2267
27	27	4.6882	-0.2218
28	28	4.6918	-0.2182
29	29	4.6961	-0.2139
30	30	4.6939	-0.2161
31	31	4.6761	-0.2339
32	32	4.6889	-0.2211
33	33	4.7025	-0.2075
34	34	4.7032	-0.2068
35	35	4.6897	-0.2203
36	36	4.664	-0.246
37	37	4.7032	-0.2068
38	38	4.7188	-0.1912
39	39	4.7295	-0.1805
40	40	4.7366	-0.1734
41	41	4.7423	-0.1677
42	42	4.7458	-0.1642
43	43	4.7494	-0.1606
44	44	4.7522	-0.1578
45	45	4.7551	-0.1549
46	46	4.7579	-0.1521
47	47	4.7608	-0.1492
48	48	4.7629	-0.1471
49	49	4.7658	-0.1442
50	50	4.7679	-0.1421
51	51	4.77	-0.14
52	52	4.7722	-0.1378

			Slug Test - Water Level Data	Page 2 of 8
			Project: TRP	
			Number: 26200.000.001	
			Client: TRPL	

	Time [s]	Water Level [m]	WL Change [m]
53	53	4.7743	-0.1357
54	54	4.7764	-0.1336
55	55	4.7786	-0.1314
56	56	4.7807	-0.1293
57	57	4.7828	-0.1272
58	58	4.7842	-0.1258
59	59	4.7864	-0.1236
60	60	4.7885	-0.1215
61	61	4.7899	-0.1201
62	62	4.7921	-0.1179
63	63	4.7935	-0.1165
64	64	4.7956	-0.1144
65	65	4.797	-0.113
66	66	4.7992	-0.1108
67	67	4.8013	-0.1087
68	68	4.8027	-0.1073
69	69	4.8041	-0.1059
70	70	4.8056	-0.1044
71	71	4.807	-0.103
72	72	4.8091	-0.1009
73	73	4.8105	-0.0995
74	74	4.812	-0.098
75	75	4.8134	-0.0966
76	76	4.8148	-0.0952
77	77	4.8162	-0.0938
78	78	4.8177	-0.0923
79	79	4.8191	-0.0909
80	80	4.8205	-0.0895
81	81	4.8219	-0.0881
82	82	4.8205	-0.0895
83	83	4.8226	-0.0874
84	84	4.8248	-0.0852
85	85	4.8262	-0.0838
86	86	4.8276	-0.0824
87	87	4.829	-0.081
88	88	4.8297	-0.0803
89	89	4.8312	-0.0788
90	90	4.8319	-0.0781
91	91	4.8333	-0.0767
92	92	4.834	-0.076
93	93	4.8354	-0.0746
94	94	4.8368	-0.0732
95	95	4.8376	-0.0724
96	96	4.839	-0.071
97	97	4.8397	-0.0703
98	98	4.8404	-0.0696
99	99	4.8411	-0.0689
100	100	4.8418	-0.0682
101	101	4.8432	-0.0668
102	102	4.844	-0.066
103	103	4.8454	-0.0646
104	104	4.8461	-0.0639
105	105	4.8468	-0.0632
106	106	4.8475	-0.0625
107	107	4.8482	-0.0618
108	108	4.8489	-0.0611
109	109	4.8496	-0.0604

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	Time [s]	Water Level [m]	WL Change [m]
110	110	4.8511	-0.0589
111	111	4.8518	-0.0582
112	112	4.8525	-0.0575
113	113	4.8532	-0.0568
114	114	4.8539	-0.0561
115	115	4.8546	-0.0554
116	116	4.8553	-0.0547
117	117	4.856	-0.054
118	118	4.8568	-0.0532
119	119	4.8575	-0.0525
120	120	4.8582	-0.0518
121	121	4.8589	-0.0511
122	122	4.8589	-0.0511
123	123	4.8596	-0.0504
124	124	4.8603	-0.0497
125	125	4.861	-0.049
126	126	4.8617	-0.0483
127	127	4.8624	-0.0476
128	128	4.8631	-0.0469
129	129	4.8639	-0.0461
130	130	4.8639	-0.0461
131	131	4.8646	-0.0454
132	132	4.8653	-0.0447
133	133	4.866	-0.044
134	134	4.866	-0.044
135	135	4.8667	-0.0433
136	136	4.8674	-0.0426
137	137	4.8674	-0.0426
138	138	4.8681	-0.0419
139	139	4.8688	-0.0412
140	140	4.8695	-0.0405
141	141	4.8695	-0.0405
142	142	4.8703	-0.0397
143	143	4.871	-0.039
144	144	4.871	-0.039
145	145	4.8717	-0.0383
146	146	4.8695	-0.0405
147	147	4.871	-0.039
148	148	4.8717	-0.0383
149	149	4.8731	-0.0369
150	150	4.8738	-0.0362
151	151	4.8738	-0.0362
152	152	4.8745	-0.0355
153	153	4.8752	-0.0348
154	154	4.8752	-0.0348
155	155	4.8759	-0.0341
156	156	4.8766	-0.0334
157	157	4.8766	-0.0334
158	158	4.8766	-0.0334
159	159	4.8774	-0.0326
160	160	4.8781	-0.0319
161	161	4.8781	-0.0319
162	162	4.8781	-0.0319
163	163	4.8788	-0.0312
164	164	4.8788	-0.0312
165	165	4.8788	-0.0312
166	166	4.8795	-0.0305

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	Time [s]	Water Level [m]	WL Change [m]
167	167	4.8802	-0.0298
168	168	4.8802	-0.0298
169	169	4.8809	-0.0291
170	170	4.8809	-0.0291
171	171	4.8809	-0.0291
172	172	4.8816	-0.0284
173	173	4.8823	-0.0277
174	174	4.8823	-0.0277
175	175	4.8823	-0.0277
176	176	4.883	-0.027
177	177	4.883	-0.027
178	178	4.8838	-0.0262
179	179	4.8837	-0.0263
180	180	4.8837	-0.0263
181	181	4.8845	-0.0255
182	182	4.8845	-0.0255
183	183	4.8852	-0.0248
184	184	4.8852	-0.0248
185	185	4.8852	-0.0248
186	186	4.8852	-0.0248
187	187	4.8859	-0.0241
188	188	4.8859	-0.0241
189	189	4.8859	-0.0241
190	190	4.8866	-0.0234
191	191	4.8866	-0.0234
192	192	4.8866	-0.0234
193	193	4.8866	-0.0234
194	194	4.8873	-0.0227
195	195	4.888	-0.022
196	196	4.888	-0.022
197	197	4.888	-0.022
198	198	4.888	-0.022
199	199	4.8887	-0.0213
200	200	4.8887	-0.0213
201	201	4.8887	-0.0213
202	202	4.8894	-0.0206
203	203	4.8894	-0.0206
204	204	4.8894	-0.0206
205	205	4.8894	-0.0206
206	206	4.8901	-0.0199
207	207	4.8901	-0.0199
208	208	4.8901	-0.0199
209	209	4.8901	-0.0199
210	210	4.888	-0.022
211	211	4.8894	-0.0206
212	212	4.8894	-0.0206
213	213	4.8901	-0.0199
214	214	4.8908	-0.0192
215	215	4.8908	-0.0192
216	216	4.8916	-0.0184
217	217	4.8916	-0.0184
218	218	4.8916	-0.0184
219	219	4.8916	-0.0184
220	220	4.8923	-0.0177
221	221	4.8923	-0.0177
222	222	4.8923	-0.0177
223	223	4.893	-0.017

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Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
224	224	4.893	-0.017
225	225	4.893	-0.017
226	226	4.893	-0.017
227	227	4.8937	-0.0163
228	228	4.8937	-0.0163
229	229	4.8937	-0.0163
230	230	4.8937	-0.0163
231	231	4.8937	-0.0163
232	232	4.8944	-0.0156
233	233	4.8937	-0.0163
234	234	4.8944	-0.0156
235	235	4.8944	-0.0156
236	236	4.8944	-0.0156
237	237	4.8951	-0.0149
238	238	4.8951	-0.0149
239	239	4.8951	-0.0149
240	240	4.8951	-0.0149
241	241	4.8951	-0.0149
242	242	4.8951	-0.0149
243	243	4.8958	-0.0142
244	244	4.8958	-0.0142
245	245	4.8951	-0.0149
246	246	4.8958	-0.0142
247	247	4.8958	-0.0142
248	248	4.8958	-0.0142
249	249	4.8965	-0.0135
250	250	4.8965	-0.0135
251	251	4.8965	-0.0135
252	252	4.8965	-0.0135
253	253	4.8965	-0.0135
254	254	4.8965	-0.0135
255	255	4.8965	-0.0135
256	256	4.8965	-0.0135
257	257	4.8972	-0.0128
258	258	4.8972	-0.0128
259	259	4.8972	-0.0128
260	260	4.8972	-0.0128
261	261	4.8972	-0.0128
262	262	4.8979	-0.0121
263	263	4.8979	-0.0121
264	264	4.8972	-0.0128
265	265	4.8979	-0.0121
266	266	4.8979	-0.0121
267	267	4.8979	-0.0121
268	268	4.8979	-0.0121
269	269	4.8979	-0.0121
270	270	4.8987	-0.0113
271	271	4.8987	-0.0113
272	272	4.8987	-0.0113
273	273	4.8987	-0.0113
274	274	4.8958	-0.0142
275	275	4.8972	-0.0128
276	276	4.8979	-0.0121
277	277	4.8987	-0.0113
278	278	4.8987	-0.0113
279	279	4.8987	-0.0113
280	280	4.8987	-0.0113

Project: TRP

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Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
281	281	4.8987	-0.0113
282	282	4.8994	-0.0106
283	283	4.8994	-0.0106
284	284	4.8994	-0.0106
285	285	4.8994	-0.0106
286	286	4.8994	-0.0106
287	287	4.8994	-0.0106
288	288	4.8994	-0.0106
289	289	4.8994	-0.0106
290	290	4.9001	-0.0099
291	291	4.9001	-0.0099
292	292	4.9001	-0.0099
293	293	4.9001	-0.0099
294	294	4.9001	-0.0099
295	295	4.9001	-0.0099
296	296	4.9008	-0.0092
297	297	4.9008	-0.0092
298	298	4.9008	-0.0092
299	299	4.9008	-0.0092
300	300	4.9008	-0.0092
301	301	4.9008	-0.0092
302	302	4.9008	-0.0092
303	303	4.9008	-0.0092
304	304	4.9008	-0.0092
305	305	4.9008	-0.0092
306	306	4.9008	-0.0092
307	307	4.9008	-0.0092
308	308	4.9008	-0.0092
309	309	4.9015	-0.0085
310	310	4.9015	-0.0085
311	311	4.9015	-0.0085
312	312	4.9015	-0.0085
313	313	4.9015	-0.0085
314	314	4.9015	-0.0085
315	315	4.9015	-0.0085
316	316	4.9015	-0.0085
317	317	4.9015	-0.0085
318	318	4.9022	-0.0078
319	319	4.9015	-0.0085
320	320	4.9022	-0.0078
321	321	4.9022	-0.0078
322	322	4.9022	-0.0078
323	323	4.9022	-0.0078
324	324	4.9022	-0.0078
325	325	4.9022	-0.0078
326	326	4.9022	-0.0078
327	327	4.9022	-0.0078
328	328	4.9022	-0.0078
329	329	4.9022	-0.0078
330	330	4.9022	-0.0078
331	331	4.9022	-0.0078
332	332	4.9022	-0.0078
333	333	4.9022	-0.0078
334	334	4.9022	-0.0078
335	335	4.9022	-0.0078
336	336	4.9029	-0.0071
337	337	4.9022	-0.0078

Project: TRP

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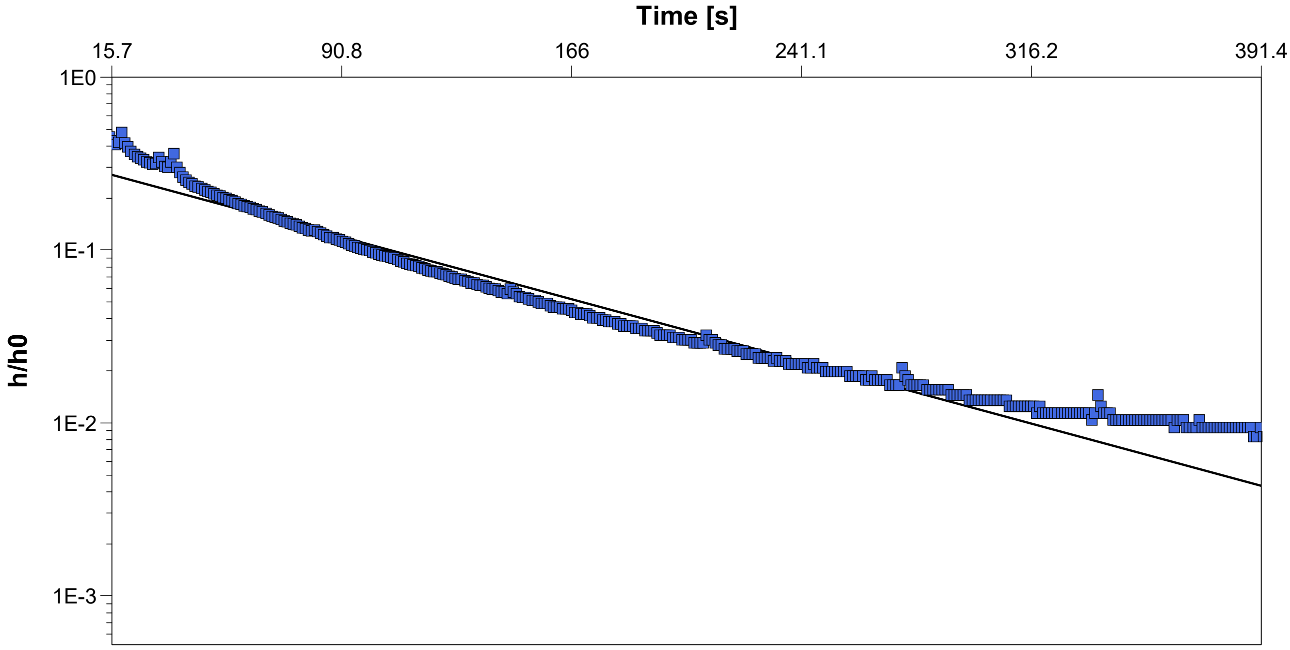
	Time [s]	Water Level [m]	WL Change [m]
338	338	4.9001	-0.0099
339	339	4.9015	-0.0085
340	340	4.9022	-0.0078
341	341	4.9022	-0.0078
342	342	4.9022	-0.0078
343	343	4.9029	-0.0071
344	344	4.9029	-0.0071
345	345	4.9029	-0.0071
346	346	4.9029	-0.0071
347	347	4.9029	-0.0071
348	348	4.9029	-0.0071
349	349	4.9029	-0.0071
350	350	4.9029	-0.0071
351	351	4.9029	-0.0071
352	352	4.9029	-0.0071
353	353	4.9029	-0.0071
354	354	4.9029	-0.0071
355	355	4.9029	-0.0071
356	356	4.9029	-0.0071
357	357	4.9029	-0.0071
358	358	4.9029	-0.0071
359	359	4.9029	-0.0071
360	360	4.9029	-0.0071
361	361	4.9029	-0.0071
362	362	4.9029	-0.0071
363	363	4.9036	-0.0064
364	364	4.9029	-0.0071
365	365	4.9029	-0.0071
366	366	4.9029	-0.0071
367	367	4.9036	-0.0064
368	368	4.9036	-0.0064
369	369	4.9036	-0.0064
370	370	4.9036	-0.0064
371	371	4.9029	-0.0071
372	372	4.9036	-0.0064
373	373	4.9036	-0.0064
374	374	4.9036	-0.0064
375	375	4.9036	-0.0064
376	376	4.9036	-0.0064
377	377	4.9036	-0.0064
378	378	4.9036	-0.0064
379	379	4.9036	-0.0064
380	380	4.9036	-0.0064
381	381	4.9036	-0.0064
382	382	4.9036	-0.0064
383	383	4.9036	-0.0064
384	384	4.9036	-0.0064
385	385	4.9036	-0.0064
386	386	4.9036	-0.0064
387	387	4.9036	-0.0064
388	388	4.9036	-0.0064
389	389	4.9043	-0.0057
390	390	4.9043	-0.0057
391	391	4.9036	-0.0064
392	392	4.9043	-0.0057
393	393	4.9043	-0.0057
394	394	4.9036	-0.0064

	Time [s]	Water Level [m]	WL Change [m]
395	395	4.9036	-0.0064
396	396	4.9036	-0.0064
397	397	4.9036	-0.0064
398	398	4.9043	-0.0057
399	399	4.9043	-0.0057
400	400	4.9043	-0.0057
401	401	4.9043	-0.0057
402	402	4.9015	-0.0085
403	403	4.9029	-0.0071
404	404	4.9036	-0.0064
405	405	4.9036	-0.0064
406	406	4.9043	-0.0057
407	407	4.9043	-0.0057
408	408	4.905	-0.005
409	409	4.9043	-0.0057
410	410	4.905	-0.005

	Slug Test Analysis Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB19d in	Test Well: MB19d
Test Conducted by: J. Green / M. Knopick		Test Date: 16/10/2024
Analysis Performed by: L. Nugent	MB19d slug in	Analysis Date: 11/11/2024
Aquifer Thickness: 11.81 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB19d	9.76×10^{-6}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB19d in	Test Well: MB19d
Test Conducted by: J. Green / M. Knopick		Test Date: 16/10/2024
Aquifer Thickness: 11.81 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB19d slug in	L. Nugent	11/11/2024	Bouwer & Rice	MB19d		9.76×10^{-6}	

	Slug Test - Water Level Data
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB19d out	Test Well: MB19d
Test Conducted by: J. Green / M. Knopick	Test Date: 16/10/2024	
Water level at t=0 [m]: 5.42	Static Water Level [m]: 4.91	Water level change at t=0 [m]: 0.51

	Time [s]	Water Level [m]	WL Change [m]
1	1	5.4165	0.5065
2	2	5.4122	0.5022
3	3	5.4058	0.4958
4	4	5.3952	0.4852
5	5	5.3852	0.4752
6	6	5.3731	0.4631
7	7	5.3631	0.4531
8	8	5.3511	0.4411
9	9	5.3418	0.4318
10	10	5.3304	0.4204
11	11	5.3197	0.4097
12	12	5.3084	0.3984
13	13	5.2991	0.3891
14	14	5.2906	0.3806
15	15	5.282	0.372
16	16	5.2742	0.3642
17	17	5.2664	0.3564
18	18	5.2593	0.3493
19	19	5.2522	0.3422
20	20	5.2451	0.3351
21	21	5.2386	0.3286
22	22	5.2322	0.3222
23	23	5.2258	0.3158
24	24	5.2194	0.3094
25	25	5.2138	0.3038
26	26	5.2081	0.2981
27	27	5.2024	0.2924
28	28	5.1938	0.2838
29	29	5.1896	0.2796
30	30	5.1853	0.2753
31	31	5.1803	0.2703
32	32	5.1753	0.2653
33	33	5.1704	0.2604
34	34	5.1661	0.2561
35	35	5.1611	0.2511
36	36	5.1568	0.2468
37	37	5.1519	0.2419
38	38	5.1476	0.2376
39	39	5.1433	0.2333
40	40	5.1391	0.2291
41	41	5.1348	0.2248
42	42	5.1312	0.2212
43	43	5.127	0.217
44	44	5.1234	0.2134
45	45	5.1191	0.2091
46	46	5.1156	0.2056
47	47	5.112	0.202
48	48	5.1085	0.1985
49	49	5.1049	0.1949
50	50	5.1013	0.1913
51	51	5.0985	0.1885
52	52	5.0949	0.1849

	Time [s]	Water Level [m]	WL Change [m]
53	53	5.0921	0.1821
54	54	5.0893	0.1793
55	55	5.0857	0.1757
56	56	5.0829	0.1729
57	57	5.08	0.17
58	58	5.0772	0.1672
59	59	5.0743	0.1643
60	60	5.0715	0.1615
61	61	5.0686	0.1586
62	62	5.0658	0.1558
63	63	5.0636	0.1536
64	64	5.0608	0.1508
65	65	5.058	0.148
66	66	5.0558	0.1458
67	67	5.053	0.143
68	68	5.0508	0.1408
69	69	5.0487	0.1387
70	70	5.0466	0.1366
71	71	5.0444	0.1344
72	72	5.0423	0.1323
73	73	5.0402	0.1302
74	74	5.038	0.128
75	75	5.0359	0.1259
76	76	5.0338	0.1238
77	77	5.0316	0.1216
78	78	5.0302	0.1202
79	79	5.0281	0.1181
80	80	5.0259	0.1159
81	81	5.0245	0.1145
82	82	5.0224	0.1124
83	83	5.021	0.111
84	84	5.0188	0.1088
85	85	5.0174	0.1074
86	86	5.016	0.106
87	87	5.0138	0.1038
88	88	5.0124	0.1024
89	89	5.011	0.101
90	90	5.0089	0.0989
91	91	5.0074	0.0974
92	92	5.0039	0.0939
93	93	5.0032	0.0932
94	94	5.0025	0.0925
95	95	5.0018	0.0918
96	96	5.0003	0.0903
97	97	4.9989	0.0889
98	98	4.9975	0.0875
99	99	4.9961	0.0861
100	100	4.9946	0.0846
101	101	4.9939	0.0839
102	102	4.9925	0.0825
103	103	4.9918	0.0818
104	104	4.9904	0.0804
105	105	4.9889	0.0789
106	106	4.9875	0.0775
107	107	4.9868	0.0768
108	108	4.9854	0.0754
109	109	4.984	0.074

Project: TRP

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Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
110	110	4.9833	0.0733
111	111	4.9818	0.0718
112	112	4.9811	0.0711
113	113	4.9797	0.0697
114	114	4.979	0.069
115	115	4.9783	0.0683
116	116	4.9769	0.0669
117	117	4.9761	0.0661
118	118	4.9754	0.0654
119	119	4.9747	0.0647
120	120	4.9733	0.0633
121	121	4.9726	0.0626
122	122	4.9719	0.0619
123	123	4.9712	0.0612
124	124	4.9705	0.0605
125	125	4.969	0.059
126	126	4.9683	0.0583
127	127	4.9676	0.0576
128	128	4.9662	0.0562
129	129	4.9655	0.0555
130	130	4.9648	0.0548
131	131	4.964	0.054
132	132	4.9633	0.0533
133	133	4.9626	0.0526
134	134	4.9619	0.0519
135	135	4.9612	0.0512
136	136	4.9605	0.0505
137	137	4.9598	0.0498
138	138	4.9591	0.0491
139	139	4.9584	0.0484
140	140	4.9576	0.0476
141	141	4.9569	0.0469
142	142	4.9562	0.0462
143	143	4.9562	0.0462
144	144	4.9555	0.0455
145	145	4.9548	0.0448
146	146	4.9541	0.0441
147	147	4.9541	0.0441
148	148	4.9534	0.0434
149	149	4.9527	0.0427
150	150	4.952	0.042
151	151	4.9512	0.0412
152	152	4.9505	0.0405
153	153	4.9505	0.0405
154	154	4.9498	0.0398
155	155	4.9491	0.0391
156	156	4.9463	0.0363
157	157	4.947	0.037
158	158	4.947	0.037
159	159	4.9463	0.0363
160	160	4.9463	0.0363
161	161	4.9456	0.0356
162	162	4.9456	0.0356
163	163	4.9448	0.0348
164	164	4.9448	0.0348
165	165	4.9448	0.0348
166	166	4.9441	0.0341

				Slug Test - Water Level Data	Page 4 of 7
				Project: TRP	
				Number: 26200.000.001	
				Client: TRPL	

	Time [s]	Water Level [m]	WL Change [m]
167	167	4.9434	0.0334
168	168	4.9427	0.0327
169	169	4.942	0.032
170	170	4.942	0.032
171	171	4.942	0.032
172	172	4.9413	0.0313
173	173	4.9406	0.0306
174	174	4.9406	0.0306
175	175	4.9399	0.0299
176	176	4.9391	0.0291
177	177	4.9391	0.0291
178	178	4.9391	0.0291
179	179	4.9384	0.0284
180	180	4.9384	0.0284
181	181	4.9377	0.0277
182	182	4.9377	0.0277
183	183	4.9377	0.0277
184	184	4.937	0.027
185	185	4.937	0.027
186	186	4.9363	0.0263
187	187	4.9363	0.0263
188	188	4.9363	0.0263
189	189	4.9356	0.0256
190	190	4.9349	0.0249
191	191	4.9349	0.0249
192	192	4.9342	0.0242
193	193	4.9342	0.0242
194	194	4.9342	0.0242
195	195	4.9335	0.0235
196	196	4.9335	0.0235
197	197	4.9327	0.0227
198	198	4.9327	0.0227
199	199	4.9327	0.0227
200	200	4.932	0.022
201	201	4.932	0.022
202	202	4.932	0.022
203	203	4.932	0.022
204	204	4.9313	0.0213
205	205	4.9306	0.0206
206	206	4.9306	0.0206
207	207	4.9306	0.0206
208	208	4.9306	0.0206
209	209	4.9299	0.0199
210	210	4.9299	0.0199
211	211	4.9292	0.0192
212	212	4.9292	0.0192
213	213	4.9292	0.0192
214	214	4.9292	0.0192
215	215	4.9285	0.0185
216	216	4.9285	0.0185
217	217	4.9285	0.0185
218	218	4.9278	0.0178
219	219	4.9278	0.0178
220	220	4.9249	0.0149
221	221	4.9263	0.0163
222	222	4.9263	0.0163
223	223	4.9263	0.0163

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
224	224	4.9271	0.0171
225	225	4.9263	0.0163
226	226	4.9263	0.0163
227	227	4.9263	0.0163
228	228	4.9263	0.0163
229	229	4.9263	0.0163
230	230	4.9263	0.0163
231	231	4.9256	0.0156
232	232	4.9256	0.0156
233	233	4.9256	0.0156
234	234	4.9249	0.0149
235	235	4.9249	0.0149
236	236	4.9249	0.0149
237	237	4.9249	0.0149
238	238	4.9242	0.0142
239	239	4.9242	0.0142
240	240	4.9242	0.0142
241	241	4.9242	0.0142
242	242	4.9242	0.0142
243	243	4.9242	0.0142
244	244	4.9235	0.0135
245	245	4.9235	0.0135
246	246	4.9228	0.0128
247	247	4.9228	0.0128
248	248	4.9228	0.0128
249	249	4.9228	0.0128
250	250	4.9228	0.0128
251	251	4.9221	0.0121
252	252	4.9221	0.0121
253	253	4.9221	0.0121
254	254	4.9221	0.0121
255	255	4.9221	0.0121
256	256	4.9221	0.0121
257	257	4.9221	0.0121
258	258	4.9214	0.0114
259	259	4.9214	0.0114
260	260	4.9214	0.0114
261	261	4.9214	0.0114
262	262	4.9214	0.0114
263	263	4.9214	0.0114
264	264	4.9207	0.0107
265	265	4.9207	0.0107
266	266	4.9207	0.0107
267	267	4.9199	0.0099
268	268	4.9207	0.0107
269	269	4.9207	0.0107
270	270	4.9199	0.0099
271	271	4.9199	0.0099
272	272	4.9199	0.0099
273	273	4.9199	0.0099
274	274	4.9199	0.0099
275	275	4.9199	0.0099
276	276	4.9199	0.0099
277	277	4.9192	0.0092
278	278	4.9192	0.0092
279	279	4.9192	0.0092
280	280	4.9192	0.0092

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
281	281	4.9185	0.0085
282	282	4.9185	0.0085
283	283	4.9185	0.0085
284	284	4.9157	0.0057
285	285	4.9171	0.0071
286	286	4.9178	0.0078
287	287	4.9178	0.0078
288	288	4.9185	0.0085
289	289	4.9185	0.0085
290	290	4.9185	0.0085
291	291	4.9185	0.0085
292	292	4.9185	0.0085
293	293	4.9185	0.0085
294	294	4.9178	0.0078
295	295	4.9178	0.0078
296	296	4.9178	0.0078
297	297	4.9178	0.0078
298	298	4.9178	0.0078
299	299	4.9178	0.0078
300	300	4.9178	0.0078
301	301	4.9171	0.0071
302	302	4.9171	0.0071
303	303	4.9171	0.0071
304	304	4.9171	0.0071
305	305	4.9171	0.0071
306	306	4.9171	0.0071
307	307	4.9171	0.0071
308	308	4.9171	0.0071
309	309	4.9171	0.0071
310	310	4.9171	0.0071
311	311	4.9164	0.0064
312	312	4.9164	0.0064
313	313	4.9164	0.0064
314	314	4.9164	0.0064
315	315	4.9171	0.0071
316	316	4.9164	0.0064
317	317	4.9164	0.0064
318	318	4.9164	0.0064
319	319	4.9164	0.0064
320	320	4.9164	0.0064
321	321	4.9164	0.0064
322	322	4.9164	0.0064
323	323	4.9164	0.0064
324	324	4.9157	0.0057
325	325	4.9164	0.0064
326	326	4.9164	0.0064
327	327	4.9164	0.0064
328	328	4.9157	0.0057
329	329	4.9157	0.0057
330	330	4.9157	0.0057
331	331	4.9157	0.0057
332	332	4.9157	0.0057
333	333	4.9157	0.0057
334	334	4.9157	0.0057
335	335	4.9157	0.0057
336	336	4.9157	0.0057
337	337	4.9157	0.0057

Project: TRP

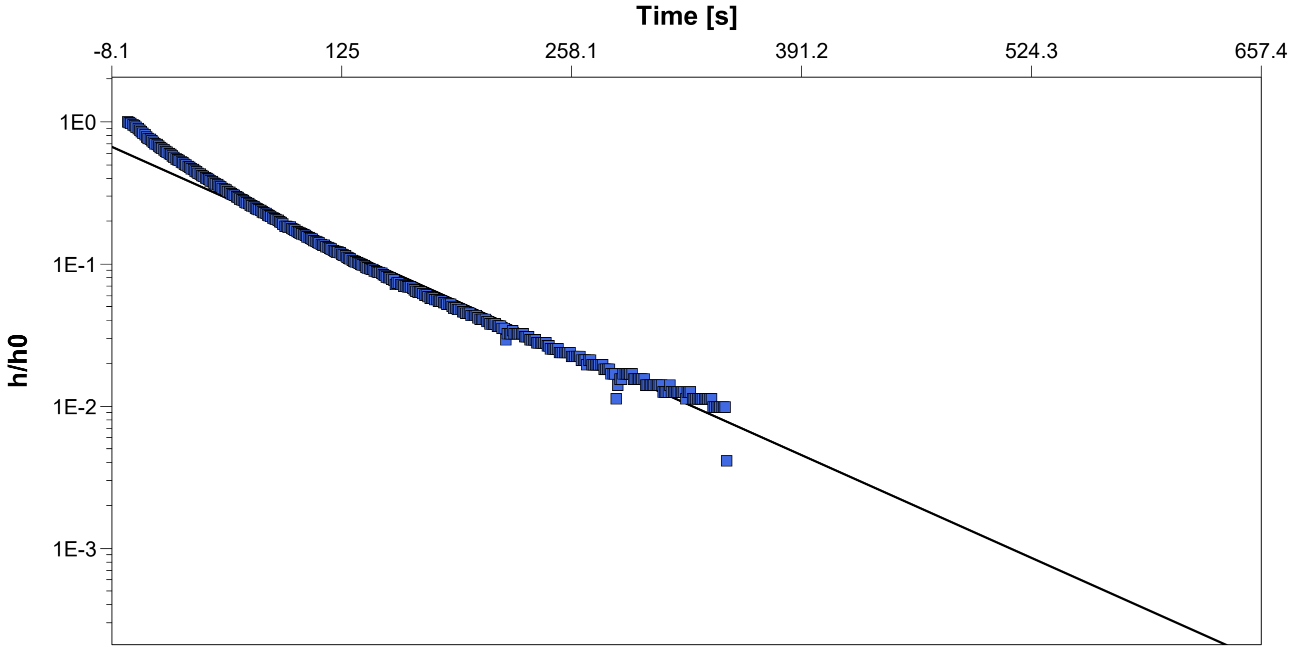
Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
338	338	4.9157	0.0057
339	339	4.9157	0.0057
340	340	4.915	0.005
341	341	4.915	0.005
342	342	4.915	0.005
343	343	4.915	0.005
344	344	4.915	0.005
345	345	4.915	0.005
346	346	4.915	0.005
347	347	4.915	0.005
348	348	4.9121	0.0021

Slug Test Analysis Report	
Project:	TRP
Number:	26200.000.001
Client:	TRPL

Location: Taylorville, Coal Creek	Slug Test: MB19d out	Test Well: MB19d
Test Conducted by: J. Green / M. Knopick		Test Date: 16/10/2024
Analysis Performed by: L. Nugent	MB19d slug out	Analysis Date: 11/11/2024
Aquifer Thickness: 11.81 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB19d	1.11×10^{-5}	

Slug Test - Analyses Report
Project: TRP
Number: 26200.000.001
Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB19d out	Test Well: MB19d
Test Conducted by: J. Green / M. Knopick		Test Date: 16/10/2024
Aquifer Thickness: 11.81 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB19d slug out	L. Nugent	11/11/2024	Bouwer & Rice	MB19d		1.11×10^{-5}	

Slug Test - Water Level Data	
Project: TRP	
Number: 26200.000.001	
Client: TRPL	

Location: Taylorville, Coal Creek	Slug Test: MB13 in	Test Well: MB13
Test Conducted by: J. Green / M. Knopick	Test Date: 16/10/2024	
Water level at t=0 [m]: 7.58	Static Water Level [m]: 7.93	Water level change at t=0 [m]: -0.35

	Time [s]	Water Level [m]	WL Change [m]
1	1	7.5785	-0.3515
2	2	7.6134	-0.3166
3	3	7.6767	-0.2533
4	4	7.7415	-0.1885
5	5	7.7841	-0.1459
6	6	7.809	-0.121
7	7	7.8218	-0.1082
8	8	7.8332	-0.0968
9	9	7.8389	-0.0911
10	10	7.8432	-0.0868
11	11	7.846	-0.084
12	12	7.8489	-0.0811
13	13	7.8503	-0.0797
14	14	7.8517	-0.0783
15	15	7.8524	-0.0776
16	16	7.8539	-0.0761
17	17	7.8553	-0.0747
18	18	7.8567	-0.0733
19	19	7.8574	-0.0726
20	20	7.8588	-0.0712
21	21	7.8595	-0.0705
22	22	7.861	-0.069
23	23	7.861	-0.069
24	24	7.8617	-0.0683
25	25	7.8624	-0.0676
26	26	7.8638	-0.0662
27	27	7.8652	-0.0648
28	28	7.8659	-0.0641
29	29	7.8638	-0.0662
30	30	7.8659	-0.0641
31	31	7.8674	-0.0626
32	32	7.8688	-0.0612
33	33	7.8702	-0.0598
34	34	7.8709	-0.0591
35	35	7.8724	-0.0576
36	36	7.8731	-0.0569
37	37	7.8738	-0.0562
38	38	7.8745	-0.0555
39	39	7.8752	-0.0548
40	40	7.8759	-0.0541
41	41	7.8766	-0.0534
42	42	7.8773	-0.0527
43	43	7.8773	-0.0527
44	44	7.8788	-0.0512
45	45	7.8795	-0.0505
46	46	7.8802	-0.0498
47	47	7.8816	-0.0484
48	48	7.8823	-0.0477
49	49	7.883	-0.047
50	50	7.8837	-0.0463
51	51	7.8837	-0.0463
52	52	7.8844	-0.0456

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
53	53	7.8852	-0.0448
54	54	7.8859	-0.0441
55	55	7.8866	-0.0434
56	56	7.8873	-0.0427
57	57	7.888	-0.042
58	58	7.8887	-0.0413
59	59	7.8894	-0.0406
60	60	7.8894	-0.0406
61	61	7.8908	-0.0392
62	62	7.8908	-0.0392
63	63	7.8916	-0.0384
64	64	7.8923	-0.0377
65	65	7.893	-0.037
66	66	7.893	-0.037
67	67	7.8937	-0.0363
68	68	7.8944	-0.0356
69	69	7.8951	-0.0349
70	70	7.8958	-0.0342
71	71	7.8958	-0.0342
72	72	7.8965	-0.0335
73	73	7.8972	-0.0328
74	74	7.8972	-0.0328
75	75	7.898	-0.032
76	76	7.8987	-0.0313
77	77	7.8987	-0.0313
78	78	7.8994	-0.0306
79	79	7.9001	-0.0299
80	80	7.9001	-0.0299
81	81	7.9008	-0.0292
82	82	7.9008	-0.0292
83	83	7.9015	-0.0285
84	84	7.9022	-0.0278
85	85	7.9022	-0.0278
86	86	7.9029	-0.0271
87	87	7.9037	-0.0263
88	88	7.9037	-0.0263
89	89	7.9044	-0.0256
90	90	7.9044	-0.0256
91	91	7.9051	-0.0249
92	92	7.9051	-0.0249
93	93	7.9029	-0.0271
94	94	7.9044	-0.0256
95	95	7.9051	-0.0249
96	96	7.9058	-0.0242
97	97	7.9065	-0.0235
98	98	7.9072	-0.0228
99	99	7.9079	-0.0221
100	100	7.9079	-0.0221
101	101	7.9086	-0.0214
102	102	7.9086	-0.0214
103	103	7.9093	-0.0207
104	104	7.9093	-0.0207
105	105	7.9093	-0.0207
106	106	7.9101	-0.0199
107	107	7.9108	-0.0192
108	108	7.9108	-0.0192
109	109	7.9108	-0.0192

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
110	110	7.9115	-0.0185
111	111	7.9122	-0.0178
112	112	7.9129	-0.0171
113	113	7.9136	-0.0164
114	114	7.9143	-0.0157
115	115	7.9143	-0.0157
116	116	7.915	-0.015
117	117	7.915	-0.015
118	118	7.9157	-0.0143
119	119	7.9157	-0.0143
120	120	7.9157	-0.0143
121	121	7.9157	-0.0143
122	122	7.9157	-0.0143
123	123	7.9172	-0.0128
124	124	7.9172	-0.0128
125	125	7.9179	-0.0121
126	126	7.9186	-0.0114
127	127	7.9186	-0.0114
128	128	7.9186	-0.0114
129	129	7.9193	-0.0107
130	130	7.9193	-0.0107
131	131	7.9193	-0.0107
132	132	7.9193	-0.0107
133	133	7.92	-0.01
134	134	7.92	-0.01
135	135	7.92	-0.01
136	136	7.9207	-0.0093
137	137	7.9207	-0.0093
138	138	7.9207	-0.0093
139	139	7.9207	-0.0093
140	140	7.9207	-0.0093
141	141	7.9207	-0.0093
142	142	7.9207	-0.0093
143	143	7.9214	-0.0086
144	144	7.9214	-0.0086
145	145	7.9214	-0.0086
146	146	7.9214	-0.0086
147	147	7.9214	-0.0086
148	148	7.9221	-0.0079
149	149	7.9229	-0.0071
150	150	7.9229	-0.0071
151	151	7.9229	-0.0071
152	152	7.9221	-0.0079
153	153	7.9229	-0.0071
154	154	7.9221	-0.0079
155	155	7.9229	-0.0071
156	156	7.9236	-0.0064
157	157	7.9207	-0.0093
158	158	7.9221	-0.0079
159	159	7.9229	-0.0071
160	160	7.9236	-0.0064
161	161	7.9236	-0.0064
162	162	7.9236	-0.0064
163	163	7.9236	-0.0064
164	164	7.9243	-0.0057
165	165	7.9243	-0.0057
166	166	7.9243	-0.0057

Project: TRP

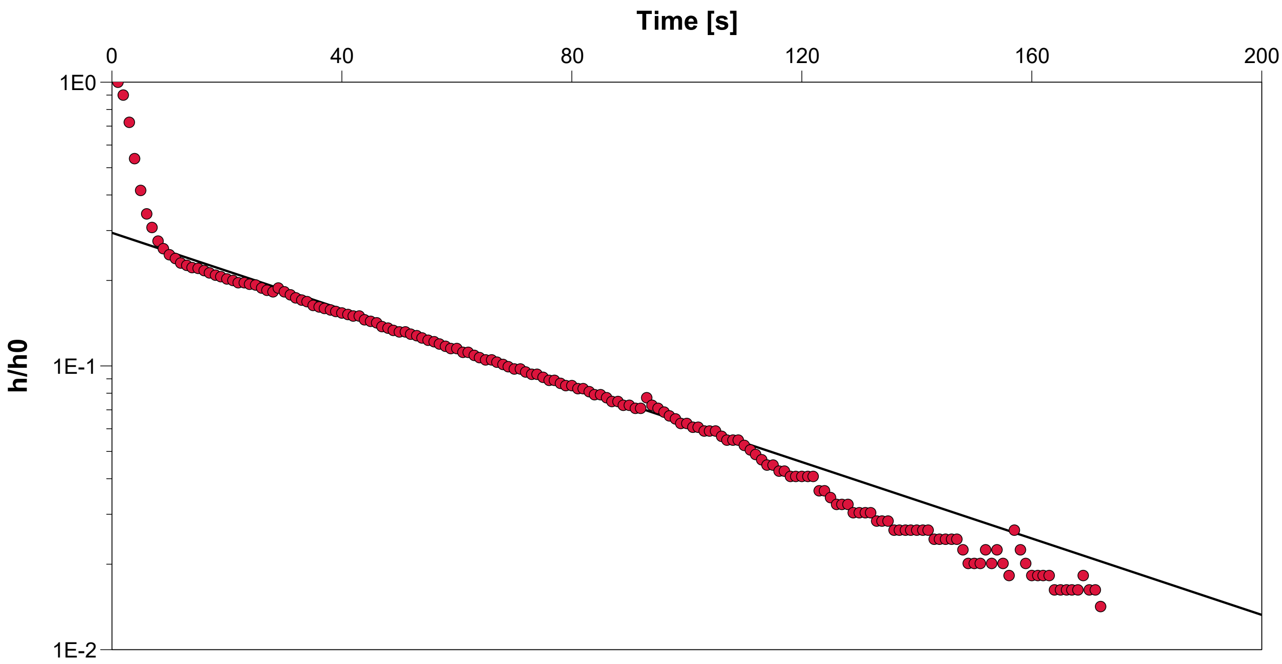
Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
167	167	7.9243	-0.0057
168	168	7.9243	-0.0057
169	169	7.9236	-0.0064
170	170	7.9243	-0.0057
171	171	7.9243	-0.0057
172	172	7.925	-0.005

Slug Test Analysis Report	
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB13 in	Test Well: MB13
Test Conducted by: J. Green / M. Knopick		Test Date: 16/10/2024
Analysis Performed by: L. Nugent	MB13 slug in	Analysis Date: 11/11/2024
Aquifer Thickness: 10.31 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB13	1.88×10^{-6}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB13 in	Test Well: MB13
Test Conducted by: J. Green / M. Knopick		Test Date: 16/10/2024
Aquifer Thickness: 10.31 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB13 slug in	L. Nugent	11/11/2024	Bouwer & Rice	MB13		1.88×10^{-6}	

Slug Test - Water Level Data	
Project: TRP	
Number: 26200.000.001	
Client: TRPL	

Location: Taylorville, Coal Creek	Slug Test: MB13 out	Test Well: MB13
Test Conducted by: MK/ JG	Test Date: 16/10/2024	
Water level at t=0 [m]: 8.85	Static Water Level [m]: 7.93	Water level change at t=0 [m]: 0.92

	Time [s]	Water Level [m]	WL Change [m]
1	1	8.8491	0.9191
2	2	8.551	0.621
3	3	8.3355	0.4055
4	4	8.2209	0.2909
5	5	8.1519	0.2219
6	6	8.1121	0.1821
7	7	8.0886	0.1586
8	8	8.073	0.143
9	9	8.0623	0.1323
10	10	8.0552	0.1252
11	11	8.0502	0.1202
12	12	8.0466	0.1166
13	13	8.0438	0.1138
14	14	8.0417	0.1117
15	15	8.0424	0.1124
16	16	8.0409	0.1109
17	17	8.036	0.106
18	18	8.031	0.101
19	19	8.0281	0.0981
20	20	8.0253	0.0953
21	21	8.0239	0.0939
22	22	8.0217	0.0917
23	23	8.0203	0.0903
24	24	8.0189	0.0889
25	25	8.0175	0.0875
26	26	8.016	0.086
27	27	8.0146	0.0846
28	28	8.0132	0.0832
29	29	8.0118	0.0818
30	30	8.0111	0.0811
31	31	8.0096	0.0796
32	32	8.0082	0.0782
33	33	8.0075	0.0775
34	34	8.0061	0.0761
35	35	8.0047	0.0747
36	36	8.004	0.074
37	37	8.0032	0.0732
38	38	8.0018	0.0718
39	39	8.0011	0.0711
40	40	7.9997	0.0697
41	41	7.999	0.069
42	42	7.9975	0.0675
43	43	7.994	0.064
44	44	7.9947	0.0647
45	45	7.994	0.064
46	46	7.9933	0.0633
47	47	7.9926	0.0626
48	48	7.9919	0.0619
49	49	7.9911	0.0611
50	50	7.9904	0.0604
51	51	7.9897	0.0597
52	52	7.9883	0.0583

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
53	53	7.9876	0.0576
54	54	7.9869	0.0569
55	55	7.9862	0.0562
56	56	7.9855	0.0555
57	57	7.9847	0.0547
58	58	7.984	0.054
59	59	7.9826	0.0526
60	60	7.9819	0.0519
61	61	7.9812	0.0512
62	62	7.9805	0.0505
63	63	7.9798	0.0498
64	64	7.9791	0.0491
65	65	7.9783	0.0483
66	66	7.9783	0.0483
67	67	7.9776	0.0476
68	68	7.9769	0.0469
69	69	7.9762	0.0462
70	70	7.9755	0.0455
71	71	7.9748	0.0448
72	72	7.9741	0.0441
73	73	7.9741	0.0441
74	74	7.9734	0.0434
75	75	7.9726	0.0426
76	76	7.9719	0.0419
77	77	7.9712	0.0412
78	78	7.9705	0.0405
79	79	7.9705	0.0405
80	80	7.9698	0.0398
81	81	7.9691	0.0391
82	82	7.9684	0.0384
83	83	7.9677	0.0377
84	84	7.9677	0.0377
85	85	7.967	0.037
86	86	7.967	0.037
87	87	7.9662	0.0362
88	88	7.9655	0.0355
89	89	7.9648	0.0348
90	90	7.9648	0.0348
91	91	7.9641	0.0341
92	92	7.9634	0.0334
93	93	7.9634	0.0334
94	94	7.9627	0.0327
95	95	7.9627	0.0327
96	96	7.962	0.032
97	97	7.9613	0.0313
98	98	7.9613	0.0313
99	99	7.9606	0.0306
100	100	7.9606	0.0306
101	101	7.9598	0.0298
102	102	7.9598	0.0298
103	103	7.9591	0.0291
104	104	7.9591	0.0291
105	105	7.9591	0.0291
106	106	7.9584	0.0284
107	107	7.9556	0.0256
108	108	7.9563	0.0263
109	109	7.9563	0.0263

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
110	110	7.9563	0.0263
111	111	7.9563	0.0263
112	112	7.9556	0.0256
113	113	7.9556	0.0256
114	114	7.9556	0.0256
115	115	7.9549	0.0249
116	116	7.9549	0.0249
117	117	7.9549	0.0249
118	118	7.9549	0.0249
119	119	7.9542	0.0242
120	120	7.9542	0.0242
121	121	7.9542	0.0242
122	122	7.9534	0.0234
123	123	7.9534	0.0234
124	124	7.9527	0.0227
125	125	7.9527	0.0227
126	126	7.9527	0.0227
127	127	7.952	0.022
128	128	7.9513	0.0213
129	129	7.9513	0.0213
130	130	7.9513	0.0213
131	131	7.9506	0.0206
132	132	7.9506	0.0206
133	133	7.9506	0.0206
134	134	7.9499	0.0199
135	135	7.9499	0.0199
136	136	7.9499	0.0199
137	137	7.9492	0.0192
138	138	7.9492	0.0192
139	139	7.9492	0.0192
140	140	7.9492	0.0192
141	141	7.9492	0.0192
142	142	7.9485	0.0185
143	143	7.9485	0.0185
144	144	7.9485	0.0185
145	145	7.9485	0.0185
146	146	7.9477	0.0177
147	147	7.9477	0.0177
148	148	7.9477	0.0177
149	149	7.9477	0.0177
150	150	7.947	0.017
151	151	7.947	0.017
152	152	7.947	0.017
153	153	7.947	0.017
154	154	7.9463	0.0163
155	155	7.9463	0.0163
156	156	7.9463	0.0163
157	157	7.9463	0.0163
158	158	7.9463	0.0163
159	159	7.9463	0.0163
160	160	7.9456	0.0156
161	161	7.9456	0.0156
162	162	7.9456	0.0156
163	163	7.9456	0.0156
164	164	7.9456	0.0156
165	165	7.9456	0.0156
166	166	7.9456	0.0156

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
167	167	7.9449	0.0149
168	168	7.9449	0.0149
169	169	7.9449	0.0149
170	170	7.9449	0.0149
171	171	7.9421	0.0121
172	172	7.9428	0.0128
173	173	7.9435	0.0135
174	174	7.9442	0.0142
175	175	7.9442	0.0142
176	176	7.9442	0.0142
177	177	7.9442	0.0142
178	178	7.9435	0.0135
179	179	7.9435	0.0135
180	180	7.9435	0.0135
181	181	7.9428	0.0128
182	182	7.9435	0.0135
183	183	7.9428	0.0128
184	184	7.9428	0.0128
185	185	7.9428	0.0128
186	186	7.9428	0.0128
187	187	7.9428	0.0128
188	188	7.9428	0.0128
189	189	7.9421	0.0121
190	190	7.9421	0.0121
191	191	7.9428	0.0128
192	192	7.9428	0.0128
193	193	7.9428	0.0128
194	194	7.9428	0.0128
195	195	7.9421	0.0121
196	196	7.9421	0.0121
197	197	7.9421	0.0121
198	198	7.9421	0.0121
199	199	7.9421	0.0121
200	200	7.9421	0.0121
201	201	7.9421	0.0121
202	202	7.9421	0.0121
203	203	7.9421	0.0121
204	204	7.9421	0.0121
205	205	7.9421	0.0121
206	206	7.9413	0.0113
207	207	7.9413	0.0113
208	208	7.9413	0.0113
209	209	7.9413	0.0113
210	210	7.9413	0.0113
211	211	7.9413	0.0113
212	212	7.9413	0.0113
213	213	7.9413	0.0113
214	214	7.9406	0.0106
215	215	7.9413	0.0113
216	216	7.9406	0.0106
217	217	7.9406	0.0106
218	218	7.9406	0.0106
219	219	7.9406	0.0106
220	220	7.9406	0.0106
221	221	7.9406	0.0106
222	222	7.9406	0.0106
223	223	7.9406	0.0106

	Time [s]	Water Level [m]	WL Change [m]
224	224	7.9406	0.0106
225	225	7.9406	0.0106
226	226	7.9406	0.0106
227	227	7.9399	0.0099
228	228	7.9399	0.0099
229	229	7.9399	0.0099
230	230	7.9399	0.0099
231	231	7.9399	0.0099
232	232	7.9399	0.0099
233	233	7.9399	0.0099
234	234	7.9399	0.0099
235	235	7.9371	0.0071
236	236	7.9378	0.0078
237	237	7.9385	0.0085
238	238	7.9385	0.0085
239	239	7.9392	0.0092
240	240	7.9392	0.0092
241	241	7.9392	0.0092
242	242	7.9392	0.0092
243	243	7.9392	0.0092
244	244	7.9392	0.0092
245	245	7.9392	0.0092
246	246	7.9392	0.0092
247	247	7.9392	0.0092
248	248	7.9392	0.0092
249	249	7.9392	0.0092
250	250	7.9392	0.0092
251	251	7.9385	0.0085
252	252	7.9392	0.0092
253	253	7.9385	0.0085
254	254	7.9392	0.0092
255	255	7.9392	0.0092
256	256	7.9392	0.0092
257	257	7.9385	0.0085
258	258	7.9385	0.0085
259	259	7.9385	0.0085
260	260	7.9385	0.0085
261	261	7.9385	0.0085
262	262	7.9385	0.0085
263	263	7.9385	0.0085
264	264	7.9385	0.0085
265	265	7.9385	0.0085
266	266	7.9385	0.0085
267	267	7.9385	0.0085
268	268	7.9385	0.0085
269	269	7.9385	0.0085
270	270	7.9385	0.0085
271	271	7.9385	0.0085
272	272	7.9385	0.0085
273	273	7.9378	0.0078
274	274	7.9378	0.0078
275	275	7.9378	0.0078
276	276	7.9385	0.0085
277	277	7.9385	0.0085
278	278	7.9378	0.0078
279	279	7.9378	0.0078
280	280	7.9385	0.0085

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
281	281	7.9378	0.0078
282	282	7.9385	0.0085
283	283	7.9378	0.0078
284	284	7.9378	0.0078
285	285	7.9378	0.0078
286	286	7.9378	0.0078
287	287	7.9378	0.0078
288	288	7.9378	0.0078
289	289	7.9378	0.0078
290	290	7.9378	0.0078
291	291	7.9378	0.0078
292	292	7.9378	0.0078
293	293	7.9378	0.0078
294	294	7.9378	0.0078
295	295	7.9378	0.0078
296	296	7.9378	0.0078
297	297	7.9378	0.0078
298	298	7.9378	0.0078
299	299	7.9349	0.0049
300	300	7.9364	0.0064
301	301	7.9371	0.0071
302	302	7.9371	0.0071
303	303	7.9378	0.0078
304	304	7.9378	0.0078
305	305	7.9378	0.0078
306	306	7.9371	0.0071
307	307	7.9378	0.0078
308	308	7.9378	0.0078
309	309	7.9378	0.0078
310	310	7.9378	0.0078
311	311	7.9378	0.0078
312	312	7.9371	0.0071
313	313	7.9371	0.0071
314	314	7.9371	0.0071
315	315	7.9371	0.0071
316	316	7.9371	0.0071
317	317	7.9371	0.0071
318	318	7.9371	0.0071
319	319	7.9371	0.0071
320	320	7.9371	0.0071
321	321	7.9371	0.0071
322	322	7.9371	0.0071
323	323	7.9371	0.0071
324	324	7.9371	0.0071
325	325	7.9371	0.0071
326	326	7.9371	0.0071
327	327	7.9371	0.0071
328	328	7.9371	0.0071
329	329	7.9371	0.0071
330	330	7.9371	0.0071
331	331	7.9371	0.0071
332	332	7.9371	0.0071
333	333	7.9371	0.0071
334	334	7.9371	0.0071
335	335	7.9371	0.0071
336	336	7.9371	0.0071
337	337	7.9371	0.0071

Project: TRP

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Client: TRPL

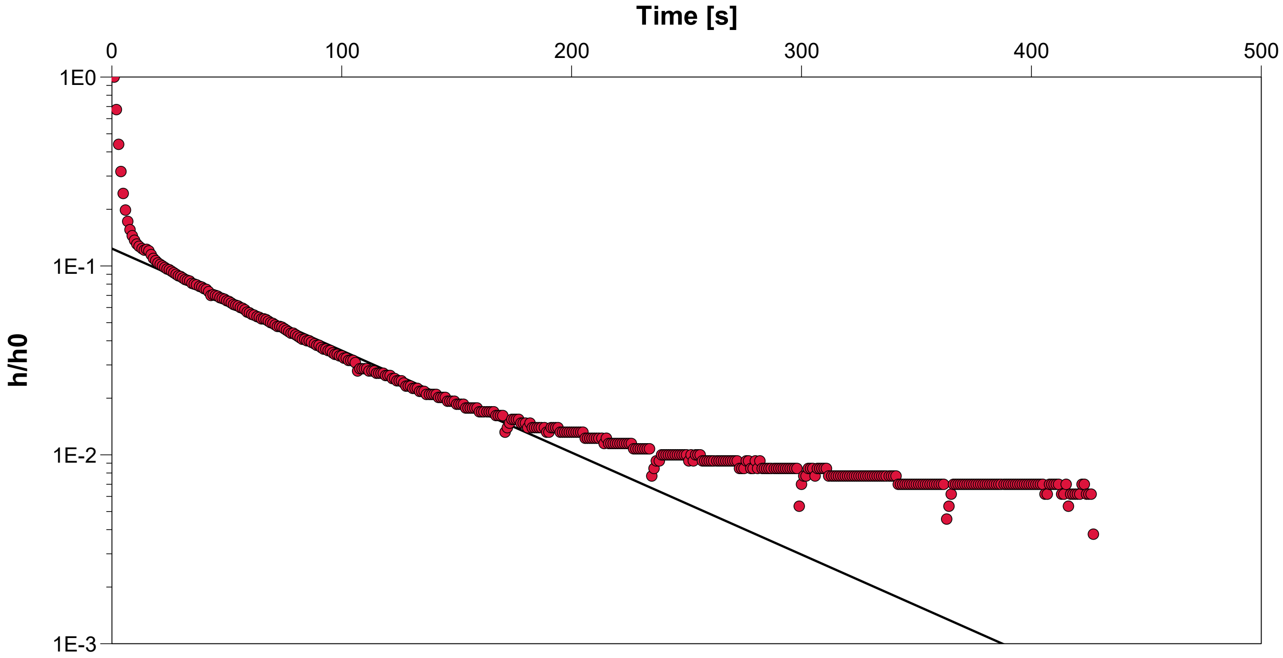
	Time [s]	Water Level [m]	WL Change [m]
338	338	7.9371	0.0071
339	339	7.9371	0.0071
340	340	7.9371	0.0071
341	341	7.9371	0.0071
342	342	7.9364	0.0064
343	343	7.9364	0.0064
344	344	7.9364	0.0064
345	345	7.9364	0.0064
346	346	7.9364	0.0064
347	347	7.9364	0.0064
348	348	7.9364	0.0064
349	349	7.9364	0.0064
350	350	7.9364	0.0064
351	351	7.9364	0.0064
352	352	7.9364	0.0064
353	353	7.9364	0.0064
354	354	7.9364	0.0064
355	355	7.9364	0.0064
356	356	7.9364	0.0064
357	357	7.9364	0.0064
358	358	7.9364	0.0064
359	359	7.9364	0.0064
360	360	7.9364	0.0064
361	361	7.9364	0.0064
362	362	7.9364	0.0064
363	363	7.9342	0.0042
364	364	7.9349	0.0049
365	365	7.9357	0.0057
366	366	7.9364	0.0064
367	367	7.9364	0.0064
368	368	7.9364	0.0064
369	369	7.9364	0.0064
370	370	7.9364	0.0064
371	371	7.9364	0.0064
372	372	7.9364	0.0064
373	373	7.9364	0.0064
374	374	7.9364	0.0064
375	375	7.9364	0.0064
376	376	7.9364	0.0064
377	377	7.9364	0.0064
378	378	7.9364	0.0064
379	379	7.9364	0.0064
380	380	7.9364	0.0064
381	381	7.9364	0.0064
382	382	7.9364	0.0064
383	383	7.9364	0.0064
384	384	7.9364	0.0064
385	385	7.9364	0.0064
386	386	7.9364	0.0064
387	387	7.9364	0.0064
388	388	7.9364	0.0064
389	389	7.9364	0.0064
390	390	7.9364	0.0064
391	391	7.9364	0.0064
392	392	7.9364	0.0064
393	393	7.9364	0.0064
394	394	7.9364	0.0064

	Slug Test - Water Level Data	
	Project: TRP	
	Number: 26200.000.001	
	Client: TRPL	

	Time [s]	Water Level [m]	WL Change [m]
395	395	7.9364	0.0064
396	396	7.9364	0.0064
397	397	7.9364	0.0064
398	398	7.9364	0.0064
399	399	7.9364	0.0064
400	400	7.9364	0.0064
401	401	7.9364	0.0064
402	402	7.9364	0.0064
403	403	7.9364	0.0064
404	404	7.9364	0.0064
405	405	7.9364	0.0064
406	406	7.9357	0.0057
407	407	7.9357	0.0057
408	408	7.9364	0.0064
409	409	7.9364	0.0064
410	410	7.9364	0.0064
411	411	7.9364	0.0064
412	412	7.9364	0.0064
413	413	7.9357	0.0057
414	414	7.9357	0.0057
415	415	7.9364	0.0064
416	416	7.9349	0.0049
417	417	7.9357	0.0057
418	418	7.9357	0.0057
419	419	7.9357	0.0057
420	420	7.9357	0.0057
421	421	7.9357	0.0057
422	422	7.9364	0.0064
423	423	7.9364	0.0064
424	424	7.9357	0.0057
425	425	7.9357	0.0057
426	426	7.9357	0.0057
427	427	7.9335	0.0035

	Slug Test Analysis Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB13 out	Test Well: MB13
Test Conducted by: MK/ JG		Test Date: 16/10/2024
Analysis Performed by: L. Nugent	MB13 slug out	Analysis Date: 11/11/2024
Aquifer Thickness: 10.81 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB13	1.51×10^{-6}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB13 out	Test Well: MB13
Test Conducted by: MK/ JG		Test Date: 16/10/2024
Aquifer Thickness: 10.81 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB13 slug out	L. Nugent	11/11/2024	Bouwer & Rice	MB13		1.51×10^{-6}	

Project:	TRP
Number:	26200.000.001
Client:	TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 in	Test Well: MB14
Test Conducted by: J. Green	Test Date: 16/01/2025	
Water level at t=0 [m]: 7.86	Static Water Level [m]: 8.70	Water level change at t=0 [m]: -0.84

	Time [s]	Water Level [m]	WL Change [m]
1	1	7.855	-0.845
2	2	7.867	-0.833
3	3	7.907	-0.793
4	4	7.958	-0.742
5	5	8.012	-0.688
6	6	8.061	-0.639
7	7	8.106	-0.594
8	8	8.148	-0.552
9	9	8.183	-0.517
10	10	8.211	-0.489
11	11	8.234	-0.466
12	12	8.253	-0.447
13	13	8.267	-0.433
14	14	8.278	-0.422
15	15	8.287	-0.413
16	16	8.295	-0.405
17	17	8.302	-0.398
18	18	8.309	-0.391
19	19	8.316	-0.384
20	20	8.322	-0.378
21	21	8.328	-0.372
22	22	8.334	-0.366
23	23	8.34	-0.36
24	24	8.345	-0.355
25	25	8.351	-0.349
26	26	8.356	-0.344
27	27	8.36	-0.34
28	28	8.365	-0.335
29	29	8.369	-0.331
30	30	8.37	-0.33
31	31	8.376	-0.324
32	32	8.381	-0.319
33	33	8.386	-0.314
34	34	8.39	-0.31
35	35	8.394	-0.306
36	36	8.399	-0.301
37	37	8.404	-0.296
38	38	8.408	-0.292
39	39	8.413	-0.287
40	40	8.417	-0.283
41	41	8.421	-0.279
42	42	8.425	-0.275
43	43	8.429	-0.271
44	44	8.434	-0.266
45	45	8.438	-0.262
46	46	8.442	-0.258
47	47	8.447	-0.253
48	48	8.451	-0.249
49	49	8.456	-0.244
50	50	8.46	-0.24
51	51	8.465	-0.235
52	52	8.469	-0.231

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
53	53	8.473	-0.227
54	54	8.477	-0.223
55	55	8.48	-0.22
56	56	8.484	-0.216
57	57	8.487	-0.213
58	58	8.491	-0.209
59	59	8.494	-0.206
60	60	8.497	-0.203
61	61	8.50	-0.20
62	62	8.504	-0.196
63	63	8.508	-0.192
64	64	8.511	-0.189
65	65	8.515	-0.185
66	66	8.518	-0.182
67	67	8.52	-0.18
68	68	8.523	-0.177
69	69	8.526	-0.174
70	70	8.528	-0.172
71	71	8.531	-0.169
72	72	8.534	-0.166
73	73	8.537	-0.163
74	74	8.54	-0.16
75	75	8.543	-0.157
76	76	8.545	-0.155
77	77	8.548	-0.152
78	78	8.551	-0.149
79	79	8.554	-0.146
80	80	8.555	-0.145
81	81	8.559	-0.141
82	82	8.561	-0.139
83	83	8.564	-0.136
84	84	8.566	-0.134
85	85	8.568	-0.132
86	86	8.57	-0.13
87	87	8.572	-0.128
88	88	8.574	-0.126
89	89	8.575	-0.125
90	90	8.577	-0.123
91	91	8.579	-0.121
92	92	8.58	-0.12
93	93	8.582	-0.118
94	94	8.582	-0.118
95	95	8.585	-0.115
96	96	8.587	-0.113
97	97	8.589	-0.111
98	98	8.591	-0.109
99	99	8.593	-0.107
100	100	8.595	-0.105
101	101	8.596	-0.104
102	102	8.598	-0.102
103	103	8.60	-0.10
104	104	8.602	-0.098
105	105	8.603	-0.097
106	106	8.605	-0.095
107	107	8.607	-0.093
108	108	8.609	-0.091
109	109	8.611	-0.089

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
110	110	8.613	-0.087
111	111	8.615	-0.085
112	112	8.616	-0.084
113	113	8.618	-0.082
114	114	8.619	-0.081
115	115	8.621	-0.079
116	116	8.622	-0.078
117	117	8.623	-0.077
118	118	8.625	-0.075
119	119	8.626	-0.074
120	120	8.627	-0.073
121	121	8.628	-0.072
122	122	8.63	-0.07
123	123	8.631	-0.069
124	124	8.632	-0.068
125	125	8.633	-0.067
126	126	8.634	-0.066
127	127	8.635	-0.065
128	128	8.636	-0.064
129	129	8.637	-0.063
130	130	8.638	-0.062
131	131	8.639	-0.061
132	132	8.64	-0.06
133	133	8.641	-0.059
134	134	8.641	-0.059
135	135	8.642	-0.058
136	136	8.643	-0.057
137	137	8.643	-0.057
138	138	8.644	-0.056
139	139	8.644	-0.056
140	140	8.645	-0.055
141	141	8.645	-0.055
142	142	8.646	-0.054
143	143	8.647	-0.053
144	144	8.647	-0.053
145	145	8.648	-0.052
146	146	8.649	-0.051
147	147	8.65	-0.05
148	148	8.65	-0.05
149	149	8.651	-0.049
150	150	8.651	-0.049
151	151	8.652	-0.048
152	152	8.653	-0.047
153	153	8.653	-0.047
154	154	8.654	-0.046
155	155	8.654	-0.046
156	156	8.655	-0.045
157	157	8.656	-0.044
158	158	8.653	-0.047
159	159	8.655	-0.045
160	160	8.655	-0.045
161	161	8.656	-0.044
162	162	8.657	-0.043
163	163	8.658	-0.042
164	164	8.658	-0.042
165	165	8.659	-0.041
166	166	8.659	-0.041

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
167	167	8.66	-0.04
168	168	8.66	-0.04
169	169	8.66	-0.04
170	170	8.661	-0.039
171	171	8.661	-0.039
172	172	8.661	-0.039
173	173	8.662	-0.038
174	174	8.662	-0.038
175	175	8.663	-0.037
176	176	8.663	-0.037
177	177	8.663	-0.037
178	178	8.663	-0.037
179	179	8.664	-0.036
180	180	8.664	-0.036
181	181	8.665	-0.035
182	182	8.665	-0.035
183	183	8.666	-0.034
184	184	8.666	-0.034
185	185	8.666	-0.034
186	186	8.667	-0.033
187	187	8.667	-0.033
188	188	8.667	-0.033
189	189	8.668	-0.032
190	190	8.668	-0.032
191	191	8.669	-0.031
192	192	8.669	-0.031
193	193	8.669	-0.031
194	194	8.67	-0.03
195	195	8.67	-0.03
196	196	8.67	-0.03
197	197	8.671	-0.029
198	198	8.671	-0.029
199	199	8.671	-0.029
200	200	8.671	-0.029
201	201	8.671	-0.029
202	202	8.672	-0.028
203	203	8.672	-0.028
204	204	8.673	-0.027
205	205	8.673	-0.027
206	206	8.673	-0.027
207	207	8.674	-0.026
208	208	8.674	-0.026
209	209	8.674	-0.026
210	210	8.674	-0.026
211	211	8.675	-0.025
212	212	8.675	-0.025
213	213	8.675	-0.025
214	214	8.675	-0.025
215	215	8.676	-0.024
216	216	8.676	-0.024
217	217	8.676	-0.024
218	218	8.676	-0.024
219	219	8.677	-0.023
220	220	8.677	-0.023
221	221	8.677	-0.023
222	222	8.675	-0.025
223	223	8.677	-0.023

Project: TRP

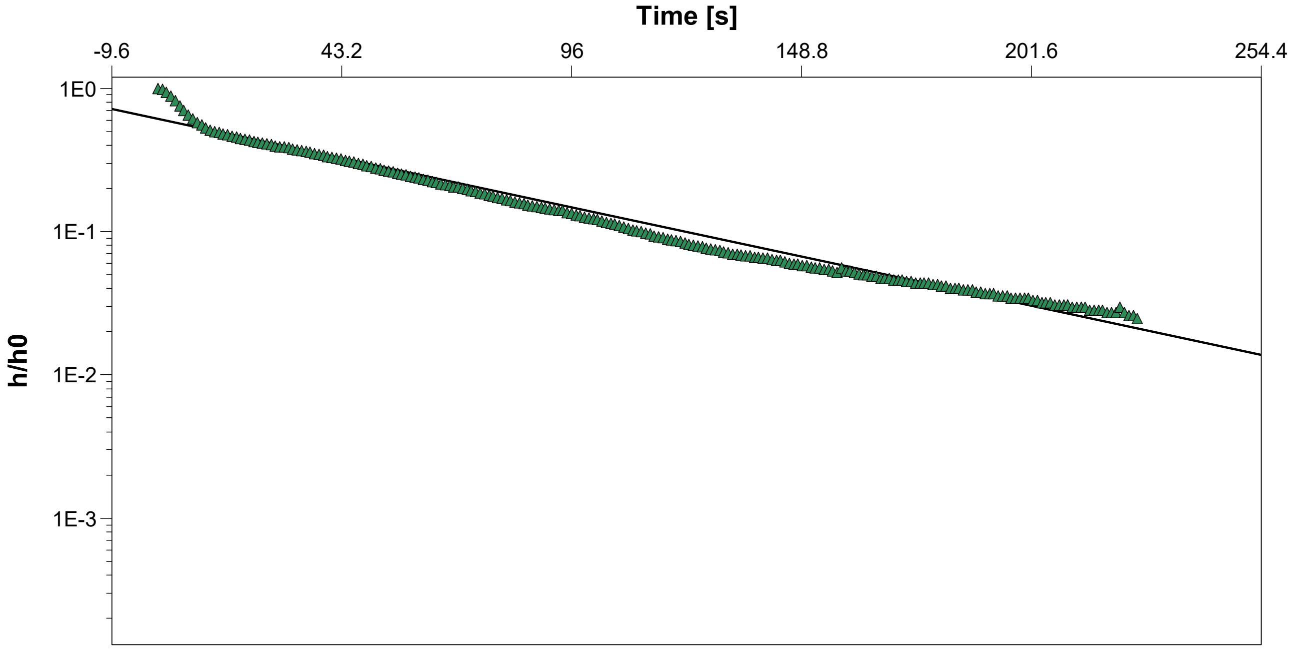
Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
224	224	8.678	-0.022
225	225	8.678	-0.022
226	226	8.679	-0.021

	Slug Test Analysis Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 in	Test Well: MB14
Test Conducted by: J. Green		Test Date: 16/01/2025
Analysis Performed by: L Nugent	MB14 slug in	Analysis Date: 21/01/2025
Aquifer Thickness: 4.92 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB14	2.33×10^{-6}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 in	Test Well: MB14
Test Conducted by: J. Green		Test Date: 16/01/2025
Aquifer Thickness: 4.92 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB14 slug in	L Nugent	21/01/2025	Bouwer & Rice	MB14		2.33×10^{-6}	

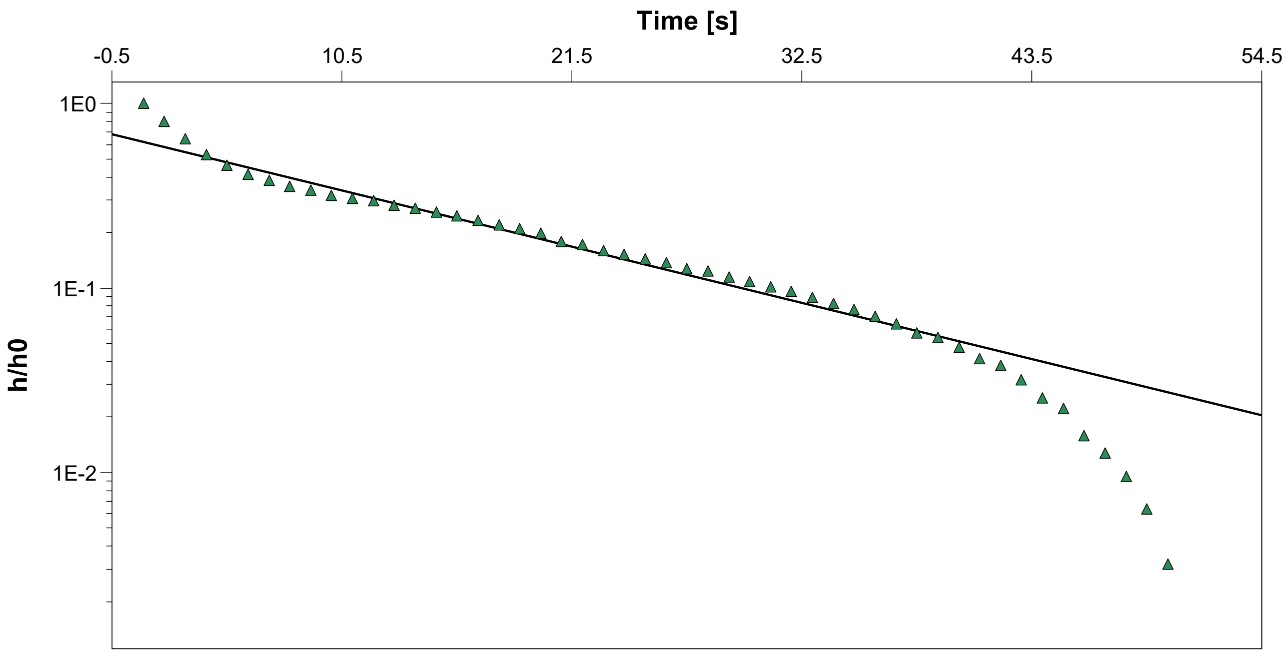
	Slug Test - Water Level Data Page 1 of 1
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 out	Test Well: MB14
Test Conducted by:	Test Date: 16/01/2025	
Water level at t=0 [m]: 9.01	Static Water Level [m]: 8.70	Water level change at t=0 [m]: 0.31

	Time [s]	Water Level [m]	WL Change [m]
1	1	9.014	0.314
2	2	8.952	0.252
3	3	8.903	0.203
4	4	8.866	0.166
5	5	8.846	0.146
6	6	8.83	0.13
7	7	8.821	0.121
8	8	8.812	0.112
9	9	8.807	0.107
10	10	8.80	0.10
11	11	8.796	0.096
12	12	8.793	0.093
13	13	8.788	0.088
14	14	8.785	0.085
15	15	8.781	0.081
16	16	8.777	0.077
17	17	8.773	0.073
18	18	8.769	0.069
19	19	8.766	0.066
20	20	8.762	0.062
21	21	8.756	0.056
22	22	8.754	0.054
23	23	8.75	0.05
24	24	8.748	0.048
25	25	8.745	0.045
26	26	8.743	0.043
27	27	8.74	0.04
28	28	8.739	0.039
29	29	8.736	0.036
30	30	8.734	0.034
31	31	8.732	0.032
32	32	8.73	0.03
33	33	8.728	0.028
34	34	8.726	0.026
35	35	8.724	0.024
36	36	8.722	0.022
37	37	8.72	0.02
38	38	8.718	0.018
39	39	8.717	0.017
40	40	8.715	0.015
41	41	8.713	0.013
42	42	8.712	0.012
43	43	8.71	0.01
44	44	8.708	0.008
45	45	8.707	0.007
46	46	8.705	0.005
47	47	8.704	0.004
48	48	8.703	0.003
49	49	8.702	0.002
50	50	8.701	0.001
51	51	8.70	0.00

Slug Test Analysis Report	
Project:	TRP
Number:	26200.000.001
Client:	TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 out	Test Well: MB14
Test Conducted by:		Test Date: 16/01/2025
Analysis Performed by: L. Nugent	MB14 slug out	Analysis Date: 21/01/2025
Aquifer Thickness: 4.92 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB14	9.93×10^{-6}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 out	Test Well: MB14
Test Conducted by:		Test Date: 16/01/2025
Aquifer Thickness: 4.92 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB14 slug out	L. Nugent	21/01/2025	Bouwer & Rice	MB14		9.93×10^{-6}	

Slug Test - Water Level Data	
Project:	TRP
Number:	26200.000.001
Client:	TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 in.2	Test Well: MB14
Test Conducted by: J. Green	Test Date: 16/01/2025	
Water level at t=0 [m]: 8.11	Static Water Level [m]: 8.70	Water level change at t=0 [m]: -0.59

	Time [s]	Water Level [m]	WL Change [m]
1	1	8.106	-0.594
2	2	8.171	-0.529
3	3	8.251	-0.449
4	4	8.297	-0.403
5	5	8.319	-0.381
6	6	8.343	-0.357
7	7	8.356	-0.344
8	8	8.365	-0.335
9	9	8.373	-0.327
10	10	8.38	-0.32
11	11	8.387	-0.313
12	12	8.391	-0.309
13	13	8.398	-0.302
14	14	8.403	-0.297
15	15	8.407	-0.293
16	16	8.412	-0.288
17	17	8.417	-0.283
18	18	8.421	-0.279
19	19	8.425	-0.275
20	20	8.429	-0.271
21	21	8.433	-0.267
22	22	8.437	-0.263
23	23	8.442	-0.258
24	24	8.445	-0.255
25	25	8.449	-0.251
26	26	8.453	-0.247
27	27	8.457	-0.243
28	28	8.46	-0.24
29	29	8.463	-0.237
30	30	8.466	-0.234
31	31	8.468	-0.232
32	32	8.471	-0.229
33	33	8.474	-0.226
34	34	8.477	-0.223
35	35	8.479	-0.221
36	36	8.482	-0.218
37	37	8.484	-0.216
38	38	8.466	-0.234
39	39	8.482	-0.218
40	40	8.487	-0.213
41	41	8.491	-0.209
42	42	8.495	-0.205
43	43	8.497	-0.203
44	44	8.50	-0.20
45	45	8.502	-0.198
46	46	8.505	-0.195
47	47	8.507	-0.193
48	48	8.509	-0.191
49	49	8.511	-0.189
50	50	8.513	-0.187
51	51	8.515	-0.185
52	52	8.517	-0.183

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
53	53	8.519	-0.181
54	54	8.521	-0.179
55	55	8.523	-0.177
56	56	8.525	-0.175
57	57	8.528	-0.172
58	58	8.53	-0.17
59	59	8.531	-0.169
60	60	8.533	-0.167
61	61	8.535	-0.165
62	62	8.537	-0.163
63	63	8.538	-0.162
64	64	8.54	-0.16
65	65	8.539	-0.161
66	66	8.542	-0.158
67	67	8.544	-0.156
68	68	8.546	-0.154
69	69	8.547	-0.153
70	70	8.549	-0.151
71	71	8.551	-0.149
72	72	8.552	-0.148
73	73	8.554	-0.146
74	74	8.555	-0.145
75	75	8.556	-0.144
76	76	8.557	-0.143
77	77	8.558	-0.142
78	78	8.559	-0.141
79	79	8.561	-0.139
80	80	8.562	-0.138
81	81	8.563	-0.137
82	82	8.564	-0.136
83	83	8.565	-0.135
84	84	8.567	-0.133
85	85	8.568	-0.132
86	86	8.569	-0.131
87	87	8.57	-0.13
88	88	8.572	-0.128
89	89	8.573	-0.127
90	90	8.574	-0.126
91	91	8.575	-0.125
92	92	8.577	-0.123
93	93	8.578	-0.122
94	94	8.579	-0.121
95	95	8.577	-0.123
96	96	8.577	-0.123
97	97	8.579	-0.121
98	98	8.583	-0.117
99	99	8.585	-0.115
100	100	8.587	-0.113
101	101	8.588	-0.112
102	102	8.589	-0.111
103	103	8.591	-0.109
104	104	8.592	-0.108
105	105	8.594	-0.106
106	106	8.595	-0.105
107	107	8.596	-0.104
108	108	8.597	-0.103
109	109	8.598	-0.102

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
110	110	8.60	-0.10
111	111	8.60	-0.10
112	112	8.601	-0.099
113	113	8.602	-0.098
114	114	8.603	-0.097
115	115	8.604	-0.096
116	116	8.604	-0.096
117	117	8.605	-0.095
118	118	8.606	-0.094
119	119	8.607	-0.093
120	120	8.608	-0.092
121	121	8.608	-0.092
122	122	8.609	-0.091
123	123	8.61	-0.09
124	124	8.611	-0.089
125	125	8.612	-0.088
126	126	8.612	-0.088
127	127	8.613	-0.087
128	128	8.614	-0.086
129	129	8.612	-0.088
130	130	8.614	-0.086
131	131	8.615	-0.085
132	132	8.616	-0.084
133	133	8.616	-0.084
134	134	8.618	-0.082
135	135	8.618	-0.082
136	136	8.619	-0.081
137	137	8.62	-0.08
138	138	8.62	-0.08
139	139	8.621	-0.079
140	140	8.621	-0.079
141	141	8.622	-0.078
142	142	8.622	-0.078
143	143	8.623	-0.077
144	144	8.623	-0.077
145	145	8.624	-0.076
146	146	8.624	-0.076
147	147	8.625	-0.075
148	148	8.625	-0.075
149	149	8.626	-0.074
150	150	8.626	-0.074
151	151	8.627	-0.073
152	152	8.627	-0.073
153	153	8.628	-0.072
154	154	8.628	-0.072
155	155	8.629	-0.071
156	156	8.629	-0.071
157	157	8.629	-0.071
158	158	8.63	-0.07
159	159	8.63	-0.07
160	160	8.63	-0.07
161	161	8.63	-0.07
162	162	8.631	-0.069
163	163	8.631	-0.069
164	164	8.632	-0.068
165	165	8.632	-0.068
166	166	8.633	-0.067

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
167	167	8.633	-0.067
168	168	8.633	-0.067
169	169	8.634	-0.066
170	170	8.634	-0.066
171	171	8.634	-0.066
172	172	8.635	-0.065
173	173	8.635	-0.065
174	174	8.636	-0.064
175	175	8.636	-0.064
176	176	8.637	-0.063
177	177	8.637	-0.063
178	178	8.637	-0.063
179	179	8.637	-0.063
180	180	8.638	-0.062
181	181	8.638	-0.062
182	182	8.638	-0.062
183	183	8.639	-0.061
184	184	8.639	-0.061
185	185	8.639	-0.061
186	186	8.64	-0.06
187	187	8.64	-0.06
188	188	8.64	-0.06
189	189	8.64	-0.06
190	190	8.641	-0.059
191	191	8.641	-0.059
192	192	8.641	-0.059
193	193	8.639	-0.061
194	194	8.64	-0.06
195	195	8.641	-0.059
196	196	8.641	-0.059
197	197	8.642	-0.058
198	198	8.642	-0.058
199	199	8.642	-0.058
200	200	8.642	-0.058
201	201	8.643	-0.057
202	202	8.643	-0.057
203	203	8.643	-0.057
204	204	8.643	-0.057
205	205	8.644	-0.056
206	206	8.644	-0.056
207	207	8.644	-0.056
208	208	8.644	-0.056
209	209	8.644	-0.056
210	210	8.644	-0.056
211	211	8.645	-0.055
212	212	8.645	-0.055
213	213	8.645	-0.055
214	214	8.647	-0.053
215	215	8.647	-0.053
216	216	8.647	-0.053
217	217	8.647	-0.053
218	218	8.647	-0.053
219	219	8.647	-0.053
220	220	8.648	-0.052
221	221	8.648	-0.052
222	222	8.648	-0.052
223	223	8.649	-0.051

Project: TRP

Number: 26200.000.001

Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
224	224	8.649	-0.051
225	225	8.649	-0.051
226	226	8.65	-0.05
227	227	8.65	-0.05
228	228	8.651	-0.049
229	229	8.651	-0.049
230	230	8.652	-0.048
231	231	8.652	-0.048
232	232	8.652	-0.048
233	233	8.653	-0.047
234	234	8.653	-0.047
235	235	8.653	-0.047
236	236	8.654	-0.046
237	237	8.654	-0.046
238	238	8.654	-0.046
239	239	8.655	-0.045
240	240	8.655	-0.045
241	241	8.656	-0.044
242	242	8.656	-0.044
243	243	8.656	-0.044
244	244	8.657	-0.043
245	245	8.657	-0.043
246	246	8.657	-0.043
247	247	8.658	-0.042
248	248	8.658	-0.042
249	249	8.658	-0.042
250	250	8.659	-0.041
251	251	8.659	-0.041
252	252	8.659	-0.041
253	253	8.66	-0.04
254	254	8.66	-0.04
255	255	8.66	-0.04
256	256	8.661	-0.039
257	257	8.659	-0.041
258	258	8.661	-0.039
259	259	8.661	-0.039
260	260	8.662	-0.038
261	261	8.663	-0.037
262	262	8.663	-0.037
263	263	8.663	-0.037
264	264	8.663	-0.037
265	265	8.664	-0.036
266	266	8.664	-0.036
267	267	8.665	-0.035
268	268	8.665	-0.035
269	269	8.665	-0.035
270	270	8.666	-0.034
271	271	8.666	-0.034
272	272	8.666	-0.034
273	273	8.667	-0.033
274	274	8.667	-0.033
275	275	8.667	-0.033
276	276	8.668	-0.032
277	277	8.668	-0.032
278	278	8.669	-0.031
279	279	8.669	-0.031
280	280	8.669	-0.031

Project: TRP

Number: 26200.000.001

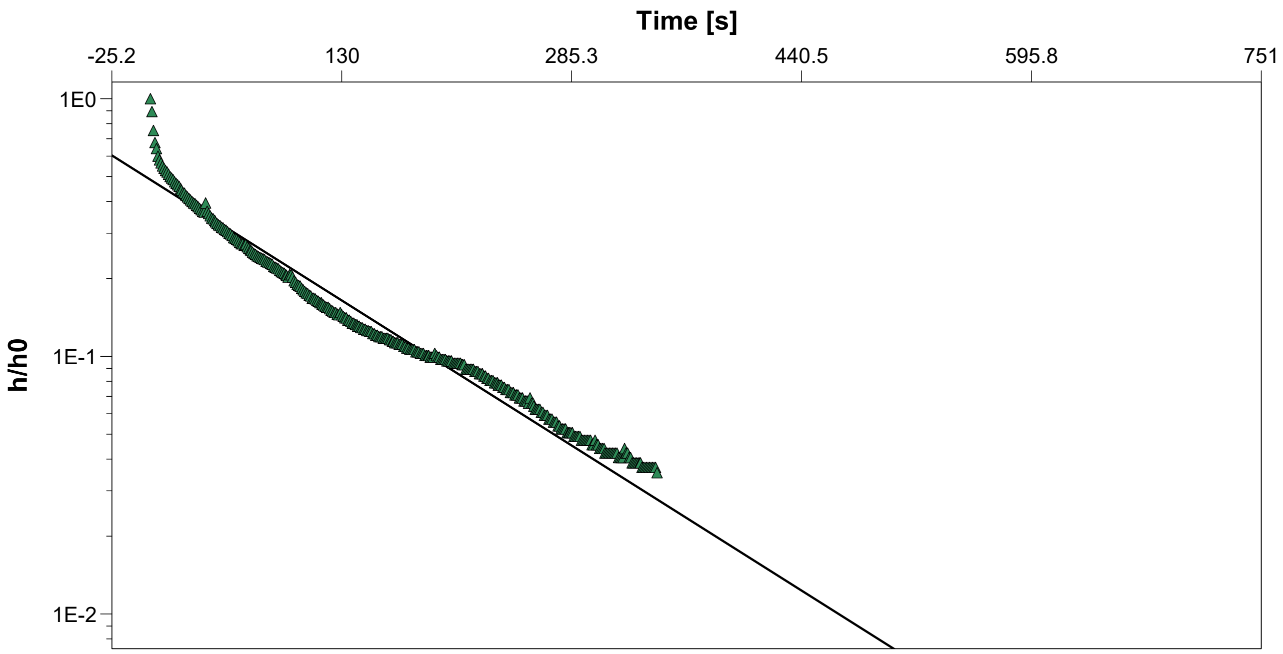
Client: TRPL

	Time [s]	Water Level [m]	WL Change [m]
281	281	8.669	-0.031
282	282	8.67	-0.03
283	283	8.67	-0.03
284	284	8.67	-0.03
285	285	8.67	-0.03
286	286	8.67	-0.03
287	287	8.671	-0.029
288	288	8.671	-0.029
289	289	8.671	-0.029
290	290	8.671	-0.029
291	291	8.671	-0.029
292	292	8.672	-0.028
293	293	8.672	-0.028
294	294	8.672	-0.028
295	295	8.672	-0.028
296	296	8.672	-0.028
297	297	8.672	-0.028
298	298	8.672	-0.028
299	299	8.673	-0.027
300	300	8.673	-0.027
301	301	8.672	-0.028
302	302	8.673	-0.027
303	303	8.673	-0.027
304	304	8.674	-0.026
305	305	8.674	-0.026
306	306	8.674	-0.026
307	307	8.674	-0.026
308	308	8.675	-0.025
309	309	8.675	-0.025
310	310	8.675	-0.025
311	311	8.675	-0.025
312	312	8.675	-0.025
313	313	8.675	-0.025
314	314	8.675	-0.025
315	315	8.675	-0.025
316	316	8.675	-0.025
317	317	8.676	-0.024
318	318	8.676	-0.024
319	319	8.676	-0.024
320	320	8.676	-0.024
321	321	8.674	-0.026
322	322	8.675	-0.025
323	323	8.675	-0.025
324	324	8.676	-0.024
325	325	8.676	-0.024
326	326	8.677	-0.023
327	327	8.677	-0.023
328	328	8.677	-0.023
329	329	8.677	-0.023
330	330	8.677	-0.023
331	331	8.677	-0.023
332	332	8.677	-0.023
333	333	8.678	-0.022
334	334	8.678	-0.022
335	335	8.678	-0.022
336	336	8.678	-0.022
337	337	8.678	-0.022

	Time [s]	Water Level [m]	WL Change [m]
338	338	8.678	-0.022
339	339	8.678	-0.022
340	340	8.678	-0.022
341	341	8.678	-0.022
342	342	8.678	-0.022
343	343	8.679	-0.021

	Slug Test Analysis Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 in.2	Test Well: MB14
Test Conducted by: J. Green		Test Date: 16/01/2025
Analysis Performed by: L. Nugent	MB14 slug in (2)	Analysis Date: 21/01/2025
Aquifer Thickness: 6.80 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB14	1.30×10^{-6}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 in.2	Test Well: MB14
Test Conducted by: J. Green		Test Date: 16/01/2025
Aquifer Thickness: 6.80 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB14 slug in (2)	L. Nugent	21/01/2025	Bouwer & Rice	MB14		1.30×10^{-6}	

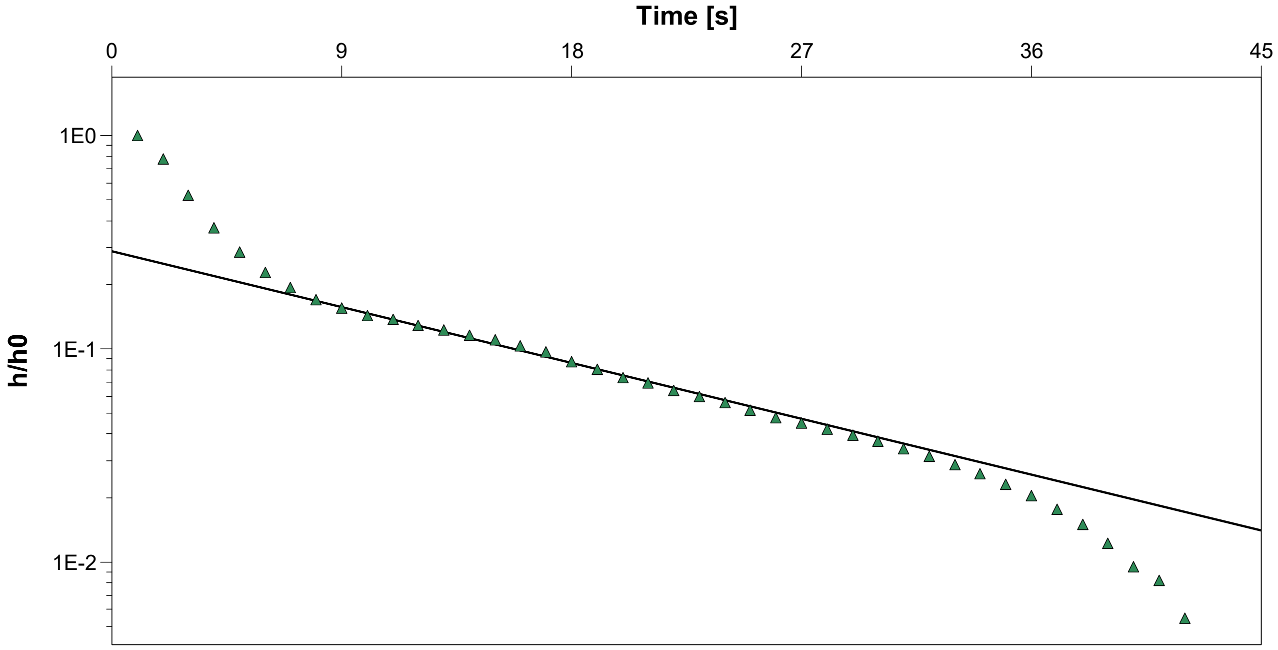
Slug Test - Water Level Data	Page 1 of 1
Project: TRP	
Number: 26200.000.001	
Client: TRPL	

Location: Taylorville, Coal Creek	Slug Test: MB14 out.2	Test Well: MB14
Test Conducted by: J. Green	Test Date: 16/01/2025	
Water level at t=0 [m]: 9.43	Static Water Level [m]: 8.70	Water level change at t=0 [m]: 0.73

	Time [s]	Water Level [m]	WL Change [m]
1	1	9.433	0.733
2	2	9.271	0.571
3	3	9.085	0.385
4	4	8.972	0.272
5	5	8.909	0.209
6	6	8.867	0.167
7	7	8.842	0.142
8	8	8.825	0.125
9	9	8.814	0.114
10	10	8.805	0.105
11	11	8.801	0.101
12	12	8.795	0.095
13	13	8.79	0.09
14	14	8.785	0.085
15	15	8.781	0.081
16	16	8.776	0.076
17	17	8.771	0.071
18	18	8.764	0.064
19	19	8.759	0.059
20	20	8.754	0.054
21	21	8.751	0.051
22	22	8.747	0.047
23	23	8.744	0.044
24	24	8.741	0.041
25	25	8.738	0.038
26	26	8.735	0.035
27	27	8.733	0.033
28	28	8.731	0.031
29	29	8.729	0.029
30	30	8.727	0.027
31	31	8.725	0.025
32	32	8.723	0.023
33	33	8.721	0.021
34	34	8.719	0.019
35	35	8.717	0.017
36	36	8.715	0.015
37	37	8.713	0.013
38	38	8.711	0.011
39	39	8.709	0.009
40	40	8.707	0.007
41	41	8.706	0.006
42	42	8.704	0.004
43	43	8.702	0.002
44	44	8.701	0.001

	Slug Test Analysis Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 out.2	Test Well: MB14
Test Conducted by: J. Green		Test Date: 16/01/2025
Analysis Performed by: L. Nugent	MB14 slug out (2)	Analysis Date: 21/01/2025
Aquifer Thickness: 6.80 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MB14	1.04×10^{-5}	

	Slug Test - Analyses Report
	Project: TRP
	Number: 26200.000.001
	Client: TRPL

Location: Taylorville, Coal Creek	Slug Test: MB14 out.2	Test Well: MB14
Test Conducted by: J. Green		Test Date: 16/01/2025
Aquifer Thickness: 6.80 m		

	Analysis Name	Analysis Performed	Analysis Date	Method name	Well	T [m²/s]	K [m/s]	S
1	MB14 slug out (2)	L. Nugent	21/01/2025	Bouwer & Rice	MB14		1.04×10^{-5}	

APPENDIX 2

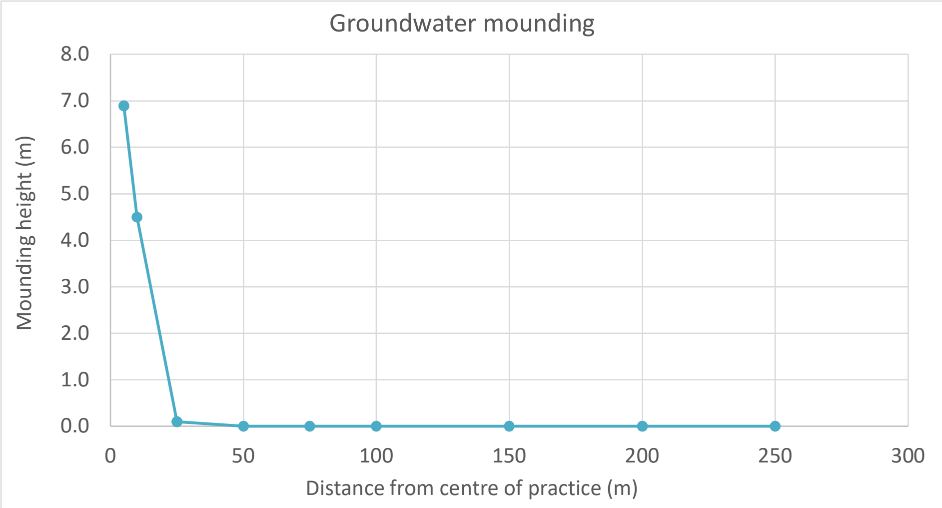
Updated Hantush Model

This spreadsheet will calculate the height of a groundwater mound beneath an stormwater infiltration BMP.
More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102
"Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

Go to the USGS report

	Input Values	
Recharge (infiltration) rate (m/day)	*2.000*	*R*
Specific yield, S_y (dimensionless)	*0.190*	Sy
Horizontal hydraulic conductivity, K_h (m/day)	0.860000	K
1/2 length of basin (x direction, in m)	10.0	x
1/2 width of basin (y direction, in m)	10.0	y
Duration of infiltration period (days)	1	t
Initial thickness of saturated zone (m)	8.0	hi(0)

CALCULATE



Distance from center of infiltration BMP (m)	Ground-water mounding (m)
5	6.89
10	4.50
25	0.10
25	0.10
50	0.00
75	0.00
100	0.00
150	0.00
200	0.00
250	0.00

IF YOU CHANGE THE SCALE OF THE DISTANCE MEASUREMENTS (OR ANY OTHER PARAMETER), YOU MUST RECALCULATE!!

APPENDIX 3

Updated RISC5 Model

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

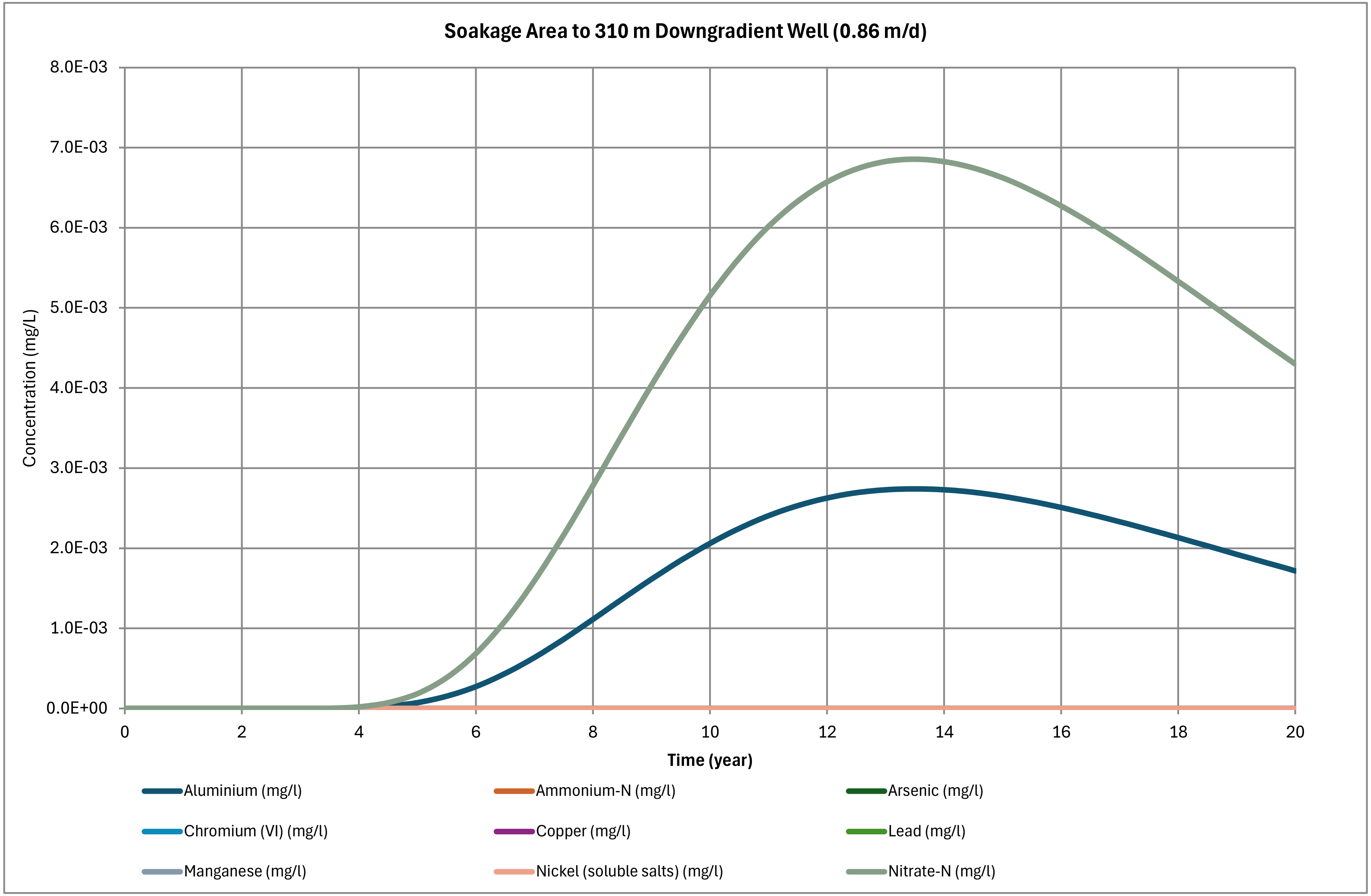
Aquifer Properties		
Effective porosity	cm3/cm3	3.0E-01
Fraction organic carbon	g oc/g soil	1.0E-03
Hydraulic conductivity	m/d	8.6E-01
Soil bulk density	g/cm3	1.6E+00
Hydraulic gradient	m/m	1.8E-02

Groundwater Source Geometry		
*****Pulse Source. Length of pulse:**	**yr**	**5.0E-01**
Total thickness of source	m	8.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Receptor Well Location		
Distance downgradient	m	3.1E+02
Distance cross-gradient	m	0.0E+00
Depth to top of well screen	m	0.0E+00
Depth to bottom of well screen	m	5.0E+00
Number of vertical points used to calculate conc.	-	5.0E+00
Longitudinal dispersivity code calculated. See output file.		
Transverse dispersivity code calculated. See output file.		
Vertical dispersivity code calculated. See output file.		

Source for Groundwater Model [mg/l]		
Total Aluminium	mg/l	2.6E+00
Ammonium-N	mg/l	9.8E+01
Total Arsenic	mg/l	9.8E-01
Total Chromium	mg/l	2.2E-01
Total Copper	mg/l	1.9E-01
Total Lead	mg/l	1.3E-02
Total Manganese	mg/l	6.7E+00
Total Nickel	mg/l	1.6E-01
Nitrate-N	mg/l	6.5E+00

Chemical Properties	Units	Aluminium	Ammonium-N	Arsenic	Chromium (VI)	Copper	Lead	Manganese	Nickel (soluble salts)	Nitrate-N
Diffusion coefficient in air	cm2/s	ND	4.2E-02	ND	ND	ND	ND	ND	ND	ND
Diffusion coefficient in water	cm2/s	ND	7.7E-06	ND	ND	ND	ND	ND	ND	ND
Solubility	mg/l	1.3E+03	4.2E+00	1.8E+04	1.7E+06	0.0E+00	0.0E+00	0.0E+00	ND	1.0E+04
Kd (total soil partition coefficient)	L/kg	ND	ND	2.9E+01	1.9E+01	2.9E+01	4.5E+01	9.9E+00	6.5E+01	ND
KOC (organiChem carbon partition coefficient	L/kg	ND	7.1E+03	ND	ND	ND	ND	ND	ND	ND
Henry's Law coefficient	m3-H2O)/(m3-air	0.0E+00	6.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	ND	ND
Molecular weight	g/mol	ND	1.5E+02	7.8E+01	5.2E+01	6.4E+01	8.2E+01	2.5E+01	5.9E+01	6.5E+01
Degradation rate, saturated zone	1/d	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00



Soakage Area to 310 m Downgradient Well (0.86 m/d)
Concentration (mg/L)
8.0E-03
7.0E-03
6.0E-03
5.0E-03
4.0E-03
3.0E-03
2.0E-03
1.0E-03
0.0E+00
0
2
4
6
8
10
12
14
16
18
20
Time (year)
Aluminium (mg/l)
Ammonium-N (mg/l)
Arsenic (mg/l)
Chromium (VI) (mg/l)
Copper (mg/l)
Lead (mg/l)
Manganese (mg/l)
Nickel (soluble salts) (mg/l)
Nitrate-N (mg/l)

Time (year)	Aluminium (mg/l)	Ammonium-N (mg/l)	Arsenic (mg/l)	Chromium (VI) (mg/l)	Copper (mg/l)	Lead (mg/l)	Manganese (mg/l)	Nickel (soluble salts) (mg/l)	Nitrate-N (mg/l)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
1.5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
2	6.8E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-10
2.5	8.1E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-08
3	1.9E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-07
3.5	1.7E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E-06
4	8.8E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-05
4.5	2.9E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-05
5	7.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-04
5.5	1.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.9E-04
6	2.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.9E-04
6.5	4.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-03
7	6.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-03
7.5	8.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-03
8	1.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E-03
8.5	1.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-03
9	1.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-03
9.5	1.8E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.6E-03
10	2.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.2E-03
10.5	2.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-03
11	2.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-03
11.5	2.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.3E-03
12	2.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.6E-03
12.5	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E-03
13	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-03
13.5	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.9E-03
14	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-03
14.5	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E-03
15	2.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.6E-03
15.5	2.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.5E-03
16	2.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.3E-03
16.5	2.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-03
17	2.3E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.8E-03
17.5	2.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-03
18	2.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.3E-03
18.5	2.0E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-03
19	1.9E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-03
19.5	1.8E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.6E-03
20	1.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-03

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

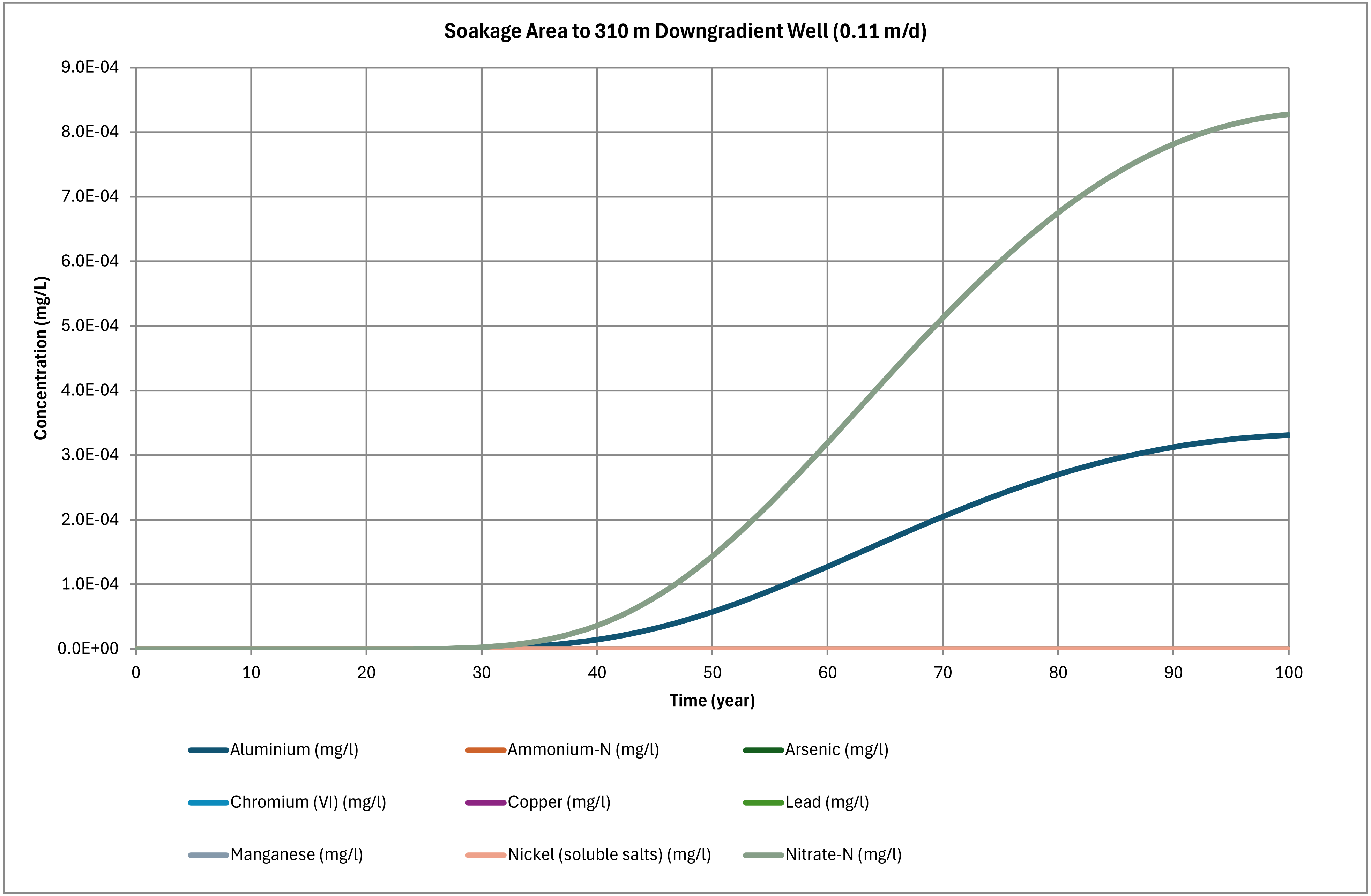
Aquifer Properties		
Effective porosity	cm3/cm3	3.0E-01
Fraction organic carbon	g oc/g soil	1.0E-03
Hydraulic conductivity	m/d	1.1E-01
Soil bulk density	g/cm3	1.6E+00
Hydraulic gradient	m/m	1.8E-02

Groundwater Source Geometry		
*****Pulse Source. Length of pulse:**	**yr**	**5.0E-01**
Total thickness of source	m	8.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Receptor Well Location		
Distance downgradient	m	3.1E+02
Distance cross-gradient	m	0.0E+00
Depth to top of well screen	m	0.0E+00
Depth to bottom of well screen	m	5.0E+00
Number of vertical points used to calculate conc.	-	5.0E+00
Longitudinal dispersivity code calculated. See output file.		
Transverse dispersivity code calculated. See output file.		
Vertical dispersivity code calculated. See output file.		

Dissolved Source for Groundwater Model [mg/l]		
Total Aluminium	mg/l	2.6E+00
Ammonium-N	mg/l	9.8E+01
Total Arsenic	mg/l	9.8E-01
Total Chromium	mg/l	2.2E-01
Total Copper	mg/l	1.9E-01
Total Lead	mg/l	1.3E-02
Total Manganese	mg/l	6.7E+00
Total Nickel	mg/l	1.6E-01
Nitrate-N	mg/l	6.5E+00

Chemical Properties	Units	Aluminium	Ammonium-N	Arsenic	Chromium (VI)	Copper	Lead	Manganese	Nickel (soluble salts)	Nitrate-N
Diffusion coefficient in air	cm2/s	ND	4.2E-02	ND	ND	ND	ND	ND	ND	ND
Diffusion coefficient in water	cm2/s	ND	7.7E-06	ND	ND	ND	ND	ND	ND	ND
Solubility	mg/l	1.3E+03	4.2E+00	1.8E+04	1.7E+06	0.0E+00	0.0E+00	0.0E+00	ND	1.0E+04
Kd (total soil partition coefficient)	L/kg	ND	ND	2.9E+01	1.9E+01	2.9E+01	4.5E+01	9.9E+00	6.5E+01	ND
KOC (organiChem carbon partition coefficient	L/kg	ND	7.1E+03	ND	ND	ND	ND	ND	ND	ND
Henry's Law coefficient	m3-H2O)/(m3-air	0.0E+00	6.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	ND	ND
Molecular weight	g/mol	ND	1.5E+02	7.8E+01	5.2E+01	6.4E+01	8.2E+01	2.5E+01	5.9E+01	6.5E+01
Degradation rate, saturated zone	1/d	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00



Soakage Area to 310 m Downgradient Well (0.11 m/d)
9.0E-04
8.0E-04
7.0E-04
6.0E-04
5.0E-04
4.0E-04
3.0E-04
2.0E-04
1.0E-04
0.0E+00
Concentration (mg/L)
0
10
20
30
40
50
60
70
80
90
100
Time (year)
Aluminium (mg/l)
Ammonium-N (mg/l)
Arsenic (mg/l)
Chromium (VI) (mg/l)
Copper (mg/l)
Lead (mg/l)
Manganese (mg/l)
Nickel (soluble salts) (mg/l)
Nitrate-N (mg/l)

Time (year)	Aluminium (mg/l)	Ammonium-N (mg/l)	Arsenic (mg/l)	Chromium (VI) (mg/l)	Copper (mg/l)	Lead (mg/l)	Manganese (mg/l)	Nickel (soluble salts) (mg/l)	Nitrate-N (mg/l)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
4	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
8	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
9	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
12	2.8E-14	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.0E-14
13	3.4E-13	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.4E-13
14	2.4E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-12
15	1.3E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.3E-11
16	5.7E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-10
17	2.1E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.2E-10
18	6.5E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-09
19	1.8E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.5E-09
20	4.4E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.1E-08
21	1.0E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-08
22	2.1E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.2E-08
23	4.1E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-07
24	7.4E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-07
25	1.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E-07
26	2.2E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.4E-07
27	3.4E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-07
28	5.3E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-06
29	7.9E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-06
30	1.1E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E-06
31	1.6E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-06
32	2.2E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-06
33	3.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.4E-06
34	3.9E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.7E-06
35	5.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-05
36	6.4E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-05
37	8.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-05
38	9.9E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-05
39	1.2E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-05
40	1.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-05
41	1.7E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-05
42	2.0E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-05
43	2.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-05
44	2.8E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.9E-05
45	3.2E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.0E-05
46	3.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-05
47	4.1E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-04
48	4.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-04

49	5.2E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-04
50	5.8E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-04
51	6.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-04
52	7.0E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-04
53	7.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-04
54	8.3E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E-04
55	9.0E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-04
56	9.8E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.4E-04
57	1.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.6E-04
58	1.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E-04
59	1.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-04
60	1.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E-04
61	1.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04
62	1.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-04
63	1.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.8E-04
64	1.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04
65	1.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04
66	1.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.4E-04
67	1.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.6E-04
68	1.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-04
69	2.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.9E-04
70	2.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-04
71	2.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.3E-04
72	2.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-04
73	2.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.7E-04
74	2.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.8E-04
75	2.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.0E-04
76	2.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04
77	2.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.3E-04
78	2.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.5E-04
79	2.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.6E-04
80	2.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-04
81	2.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.9E-04
82	2.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.0E-04
83	2.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.1E-04
84	2.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.3E-04
85	2.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.4E-04
86	3.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.5E-04
87	3.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.6E-04
88	3.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04
89	3.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04
90	3.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.8E-04
91	3.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.9E-04
92	3.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.0E-04
93	3.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.0E-04
94	3.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.1E-04
95	3.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.1E-04
96	3.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.2E-04
97	3.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.2E-04
98	3.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.2E-04
99	3.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E-04
100	3.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.3E-04

APPENDIX 4

Ecological Survey

APPENDIX 5

Water Quality Comparison

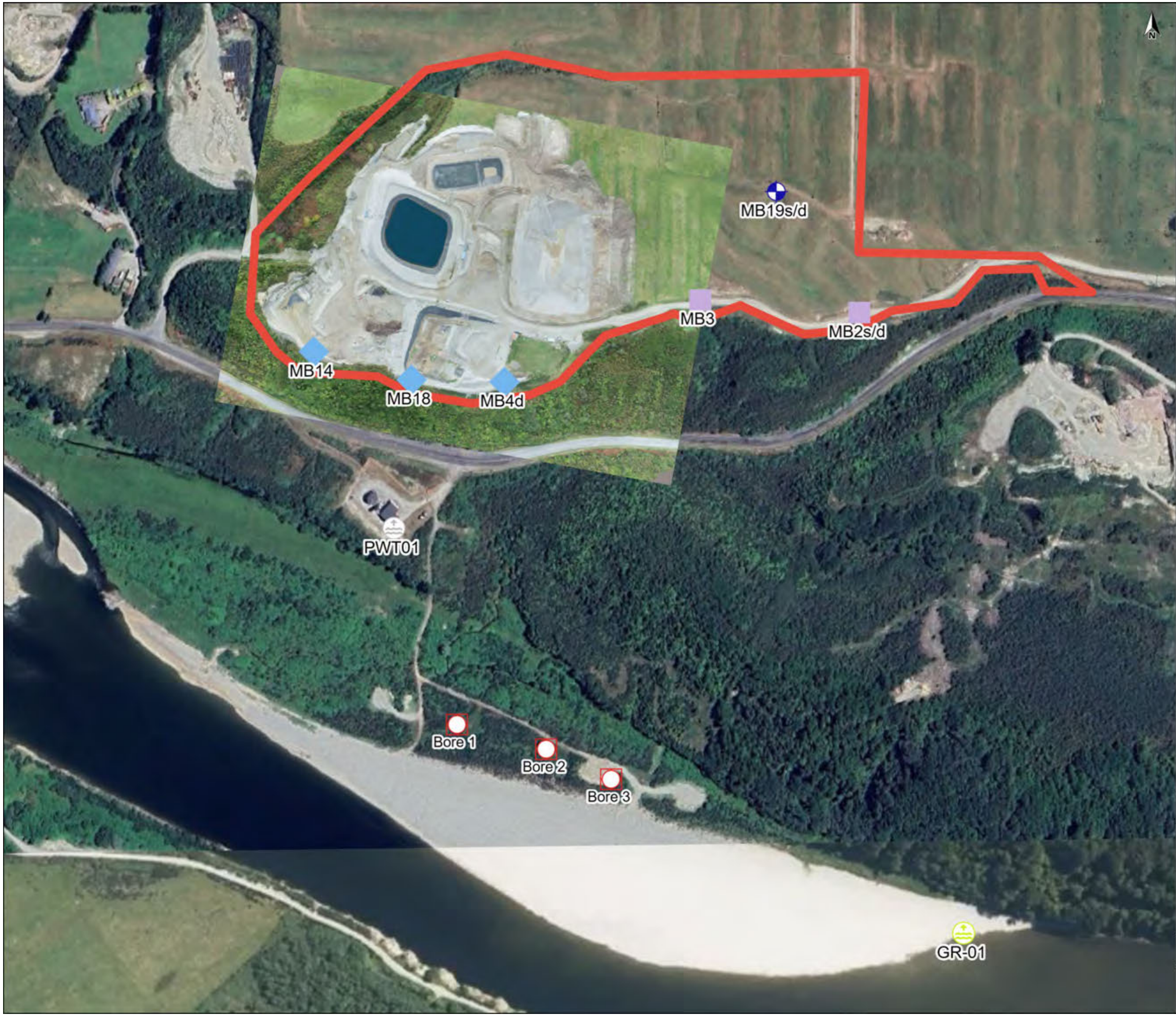
Table A5.1: Excerpt of Sample Results

	GRE001	Grey River	Upgradient / Cross-Gradient of Operations						Downgradient of Operations				Upgradient	
	PWT01	GR-01	MB2s		MB2d		MB3		MB4d		MB14	MB18	MB19s	MB19d
	16/01/25	16/01/25	30/07/24	14/10/24	30/07/24	14/10/24	30/07/24	14/10/24	30/07/24	16/10/24	14/10/24	10/11/24	15/10/24	15/10/24
Sum of Anions	0.63	0.67	0.84	0.84	3.9	3.7	0.74	0.77	1.8	1.12	11	17.3	2.9	9.7
Sum of Cations	0.63	0.65	0.89	0.89	3.9	3.9	0.8	0.8	1.91	1.16	11.8	18.7	3.2	10.5
An/Cat balance (%)	0%	2%	-3%	-3%	0%	-3%	-4%	-2%	-3%	-2%	-4%	-4%	-5%	-4%
pH	6.4	7.2	6.1	5.6	6.8	6.7	6	5.7	6.5	6.2	7.3	6.5	6.2	7.1
Total Alkalinity	20	24	19.2	18.7	176	169	16.2	16	43	24	350	330	54	290
Carbonate	< 1.0	< 1.0	-	< 1.0	-	< 1.0	-	< 1.0	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bicarbonate	24	29	23	23	210	210	19.8	19.6	53	29	430	400	66	360
Total Hardness	21	22	32	32	50	50	28	28	76	43	470	690	113	330
Electrical conductivity (mS/m)	6.6	6.6	9.8	9.9	35.8	34.9	8.9	9.1	19.9	12.7	100.7	157.9	30.5	89.7
Dissolved calcium	6.7	7.2	11.1	11.3	13.3	13.2	9.4	9.6	28	15.8	173	240	34	102
Dissolved magnesium	0.98	1.08	1.1	1.04	4.1	4.1	1.04	1.03	1.64	1	9.4	23	6.6	18.5
Dissolved potassium	0.84	0.77	0.89	0.86	1.59	1.65	0.69	0.69	0.79	0.94	16.4	22	2.2	8.3
Dissolved sodium	4.2	4.3	4.9	4.6	64	64	4.9	4.8	8.4	5.9	27	62	18.6	71
Chloride	4.4	4.5	7.8	7.8	11.1	11.8	7	7.8	7	6.7	24	33	10	15.2
Total-N	0.2	0.15		1.2		0.71		1.54		1.53	6.3	21	1.97	10.7
Total Ammoniacal-N	< 0.010	< 0.010	< 0.010	< 0.010	0.25	0.27	< 0.010	< 0.010	0.039	< 0.010	4.1	18.7	0.5	3.0
Nitrite-N	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002	0.034	< 0.002	< 0.02	< 0.002	0.009	< 0.002
Nitrate-N	0.17	0.091	1.23	1.12	< 0.002	0.007	1.42	1.43	1.92	1.41	< 0.02	< 0.002	0.36	< 0.002
Nitrite+Nitrate-N	0.17	0.091	1.23	1.12	< 0.002	0.01	1.42	1.43	1.95	1.41	< 0.02	< 0.002	0.37	< 0.002
TKN	< 0.10	< 0.10		< 0.10		0.7		0.1		0.11	6.3	21	1.6	10.7
Sulphate	4.3	2.4	6.9	7.9	0.6	0.9	5.8	6.3	29	17	158	470	71	165
Dissolved arsenic	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0075	0.017	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.026	0.12	0.0049	0.014
Dissolved cadmium	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved chromium	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.013	0.0047	0.0017	0.0055
Dissolved copper	0.193	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0013	0.0007
Dissolved lead	0.006	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.0003	0.00014	0.00036
Dissolved nickel	0.001	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0019	0.0039	0.002	0.0044
Dissolved zinc	0.15	< 0.0010	0.0034	0.0021	< 0.0010	0.0014	0.0033	0.0018	0.0018	0.0014	0.0091	0.0087	0.0027	0.008

Notes:

All values provided in units of miligrams per liter (mg/L) unless otherwise specified.

< Below the laboratory reporting limit (<RL)



Legend

- GRE001
- Grey River Sample Location
- Upgradient Monitoring Well
- Crossgradient Sample Locations
- Downgradient Sample Locations
- GRE001 Abstraction Wells
- Approximate Site Boundary

0 50 m 100 m

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ENGEO

Produced by **Datanest.earth**

Title: Ion Assessment Sample Locations		
Client: Taylorville Resource Park Ltd		Size: A4
Project: Taylorville Resource Park	Drawn: LN	Figure: A5.1
Date: 28-01-2025	Checked: DR	
Proj No: 26200.000.001	Scale: 1:5000	Version: 1.0

Figure A5.2 Extended Durov Class Scatter

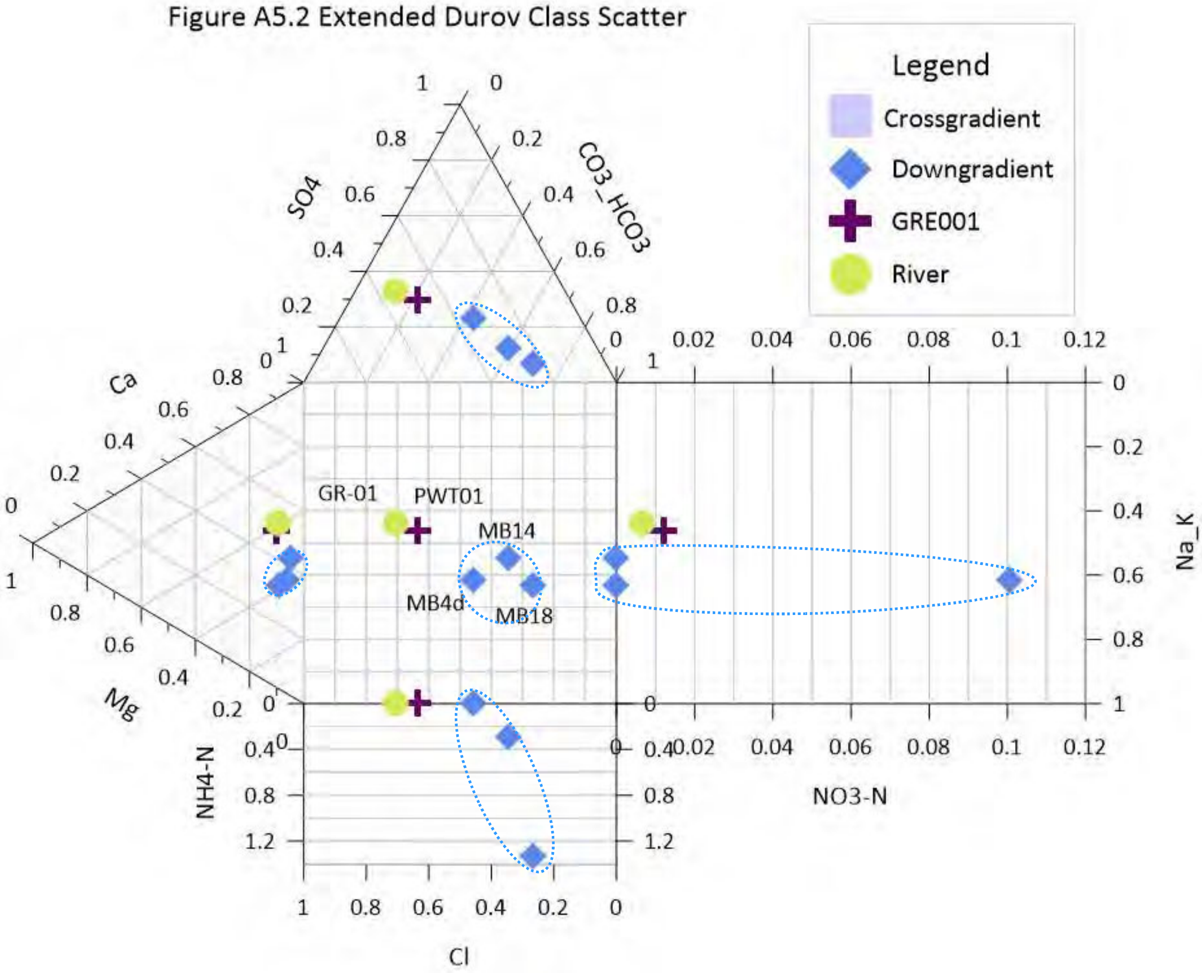
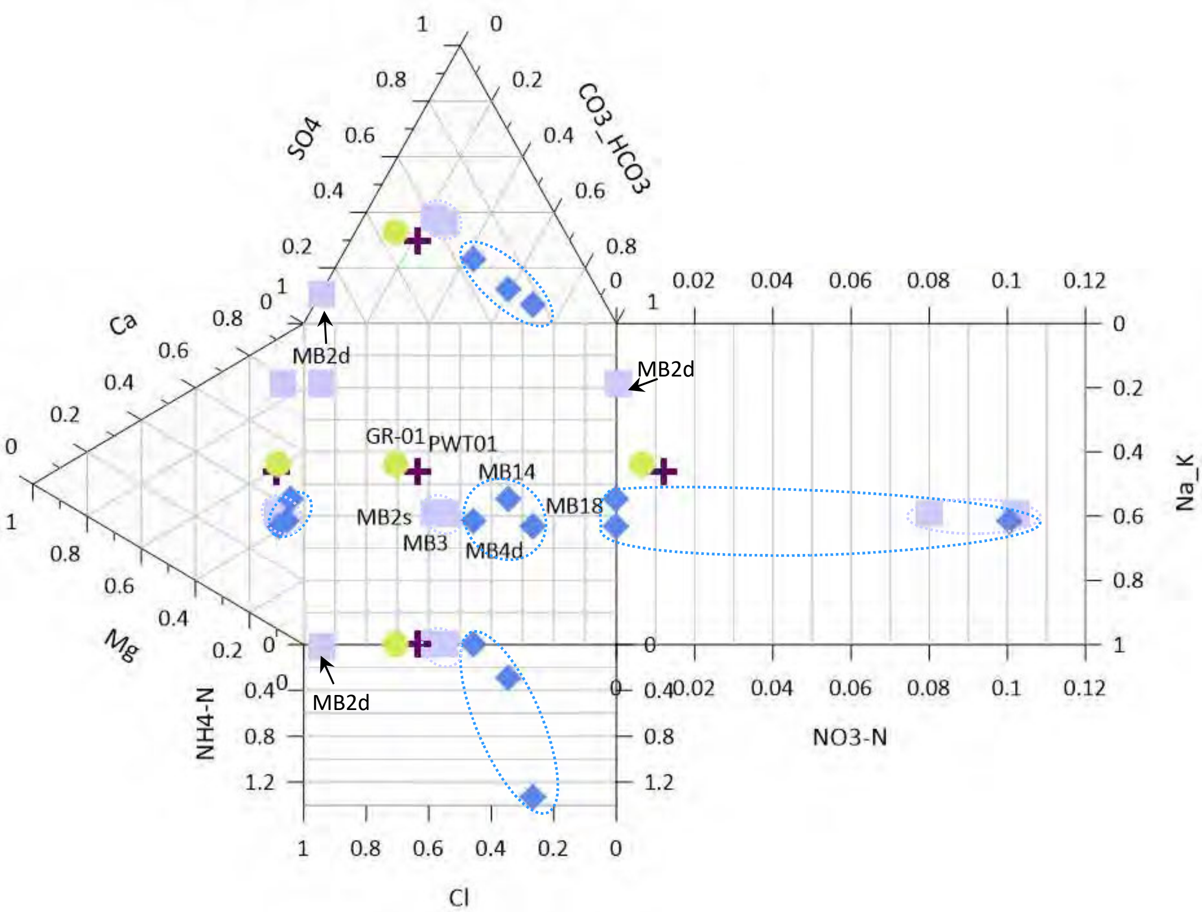


Figure A5.3 Extended Durov Class Scatter



APPENDIX 6

Aquifer Testing Information

McMILLAN Drilling

FINAL DELIVERABLES FOR GREY DISTRICT COUNCIL

Coal Creek WTP Bore Installation (2021-22-26a) - Drilling and testing of one new production bore

MĀWHERA GREY DISTRICT COUNCIL

Iain Haycock
ihaycock@drilling.co.nz

Job No. 20012

Handover Documentation

Coal Creek WTP Bore Installation (2021-22-26a)

☑ Producer Statement

BH01 (decommissioned)

☑ Final Bore Log

BH02 (production)

☑ Final Bore Log

☑ Step Rate Pumping Test - 9/05/2023

- Graphs
- Manual readings - pumped bore

☑ Constant Discharge Pumping Test - 9/05/2023 - 10/05/2023

- Graphs
- Manual readings - pumped bore

☑ Mill Test Certificate

- DN300 casing - stainless steel

Separate Files

☑ Sentinel Data includes drawdowns and flowrates (vented level transducer)

SIXTH SCHEDULE

FORM OF PRODUCER STATEMENT - CONSTRUCTION

ISSUED BY: ....McMillan Drilling Ltd (Contractor)

TO: ....Grey District Council (Principal)

IN RESPECT OF:.. Drilling of one New Well

AT: .... Coal Creek, Greymouth

McMillan Drilling Ltd (Contractor) has contracted to Grey District Council (Principal) to carry out and complete works in accordance with the contract documents titled **GDC 2021-22-26a Coal Creek WTP Bore Installation - Drilling Investigation**.

- *BH01 - 10.8m deep (decommissioned)*
- *BH02 - 10.5m deep (production)*

I Iain Haycock a duly authorised representative of McMillan Drilling Ltd believe on reasonable grounds that McMillan Drilling Ltd has carried out and completed:

☒ All works as specified in the contract and all works were carried out in accordance with NZS 4411:2001 (Environmental Standard for Drilling of Soil and Rock) and that the wells have been adequately sealed to prevent ingress of contaminants from the surface.

☐ Part only as specified in the attached particulars of the contract works in accordance with the Contract.

(Signature of Authorized Agent on behalf of) Date: 11/05/2023

McMillan Drilling Ltd
(Contractor)

120 High Street Southbridge, 7602
(Address)

McMILLAN Drilling

Client:	Bore No.:
Grey District Council	BH01
Project:	**Job No.:**
Drilling of New 12" (300mm) Well	20874

Site Location: Coal Creek, GREYMOUTH
Date: 2/12/2022
Grid Reference: 1457012m E, 5298980m N (NZTM) Map or aerial photograph
Rig Operator: A. Harkerss
Lot Number:
Method / Rig: Cable Tool

Material Description	Depth (top)
FILL.	
CLAY; brown.	0.40m
Sandy fine to coarse GRAVEL.	0.80m
Coarse SAND, with gravel and boulders; grey.	2.90m
Sandy fine to coarse GRAVEL; grey. Some staining.	8.00m
Clayey GRAVEL; brown.	8.60m
Silty CLAY; grey. Dry; Mudstone.	8.70m

Graphic Log | Depth (m): 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Casing & Screen Installation

Remarks:
Insufficient water found - all casing removed, backfilled & sealed to surface.

Bore Diameter: 450mm
Static Water Level: -
Total Bore Depth: -
Total Depth Drilled: 10.80m bgl

Development Duration (hr):

Pumping Duration (hr):

Flow Rate (gpm)	Flow Rate (l/sec)	Draw Down (m)	Duration (hr)

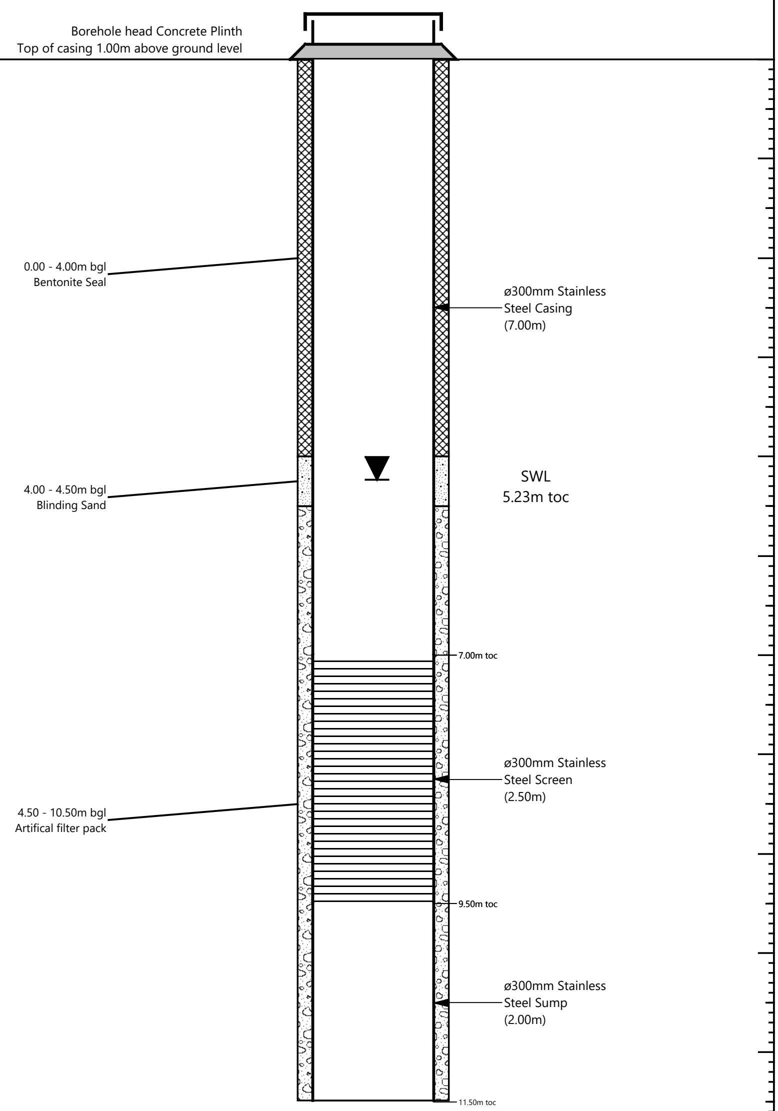
McMILLAN Drilling

Client: Grey District Council		**Bore No.:** BH02
Project: Drilling of New 12" (300mm) Well		**Job No.:** 20874

Site Location: Coal Creek, GREYMOUTH
Grid Reference: 1457266m E, 5298901m N (NZTM) Map or aerial photograph
Lot Number:
Date: 11/5/2023
Rig Operator: A. Harkerss, Z. Luxton
Method / Rig: Cable Tool

Material Description	Depth (m)
FILL.	
SAND.	0.20m
Sandy fine to coarse GRAVEL, with boulders.	1.30m
Fine and coarse GRAVEL.	3.60m
Fine to coarse GRAVEL, with sand.	4.60m
Fine and coarse GRAVEL. Saturated.	6.50m
Sandy fine to coarse GRAVEL, with boulders.	7.40m
Silty CLAY; grey. Dry; Hard; Mudstone.	8.80m

Casing & Screen Installation



Remarks:

Production Bore
Bore completed with DN300 table E flange, blank and dressing kit.
24hr constant rate test influenced by rising river levels - resultant draw down not reported (refer electronic data & graphs)

Bore Diameter: 450mm **Static Water Level:** 5.23m btoc
Total Bore Depth: 11.50m toc **Total Depth Drilled:** 10.50m bgl

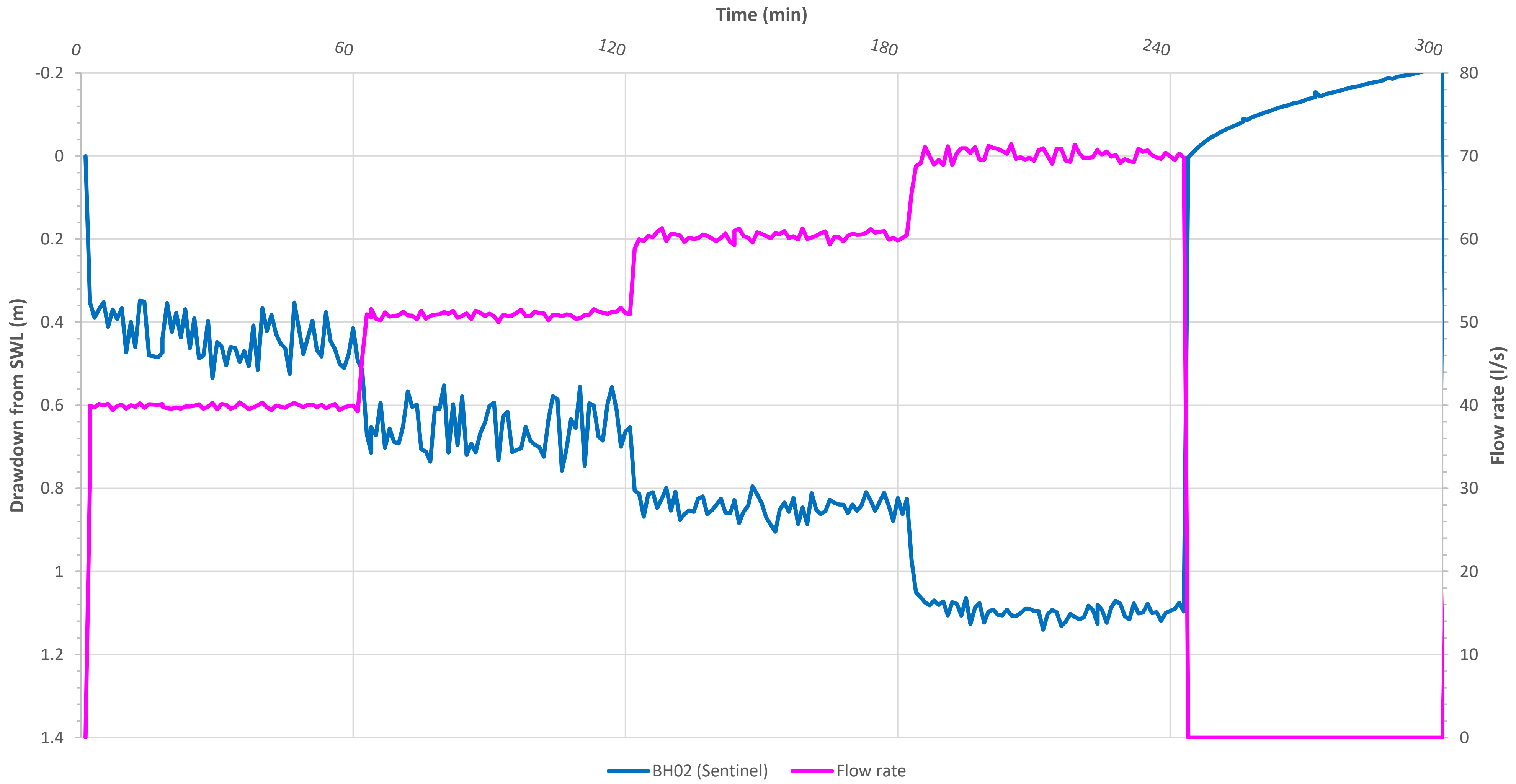
Development Duration (hr): 17.25
Pumping Duration (hr): 28

Flow Rate (gpm)	Flow Rate (l/sec)	Draw Down (m)	Duration (hr)
528	40.0	0.41	1.00
660	50.0	0.61	1.00
792	60.0	0.79	1.00
924	70.0	1.03	1.00

McMILLAN Drilling	Client: Grey District Council	Bore No.: BH02 - Production
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	Job No.: 20874

Stepped Drawdown and Sand Test

Site Location: Coal Creek, GREYMOUTH **Static water level:** 4.77m btoc **Date:** 9/5/2023

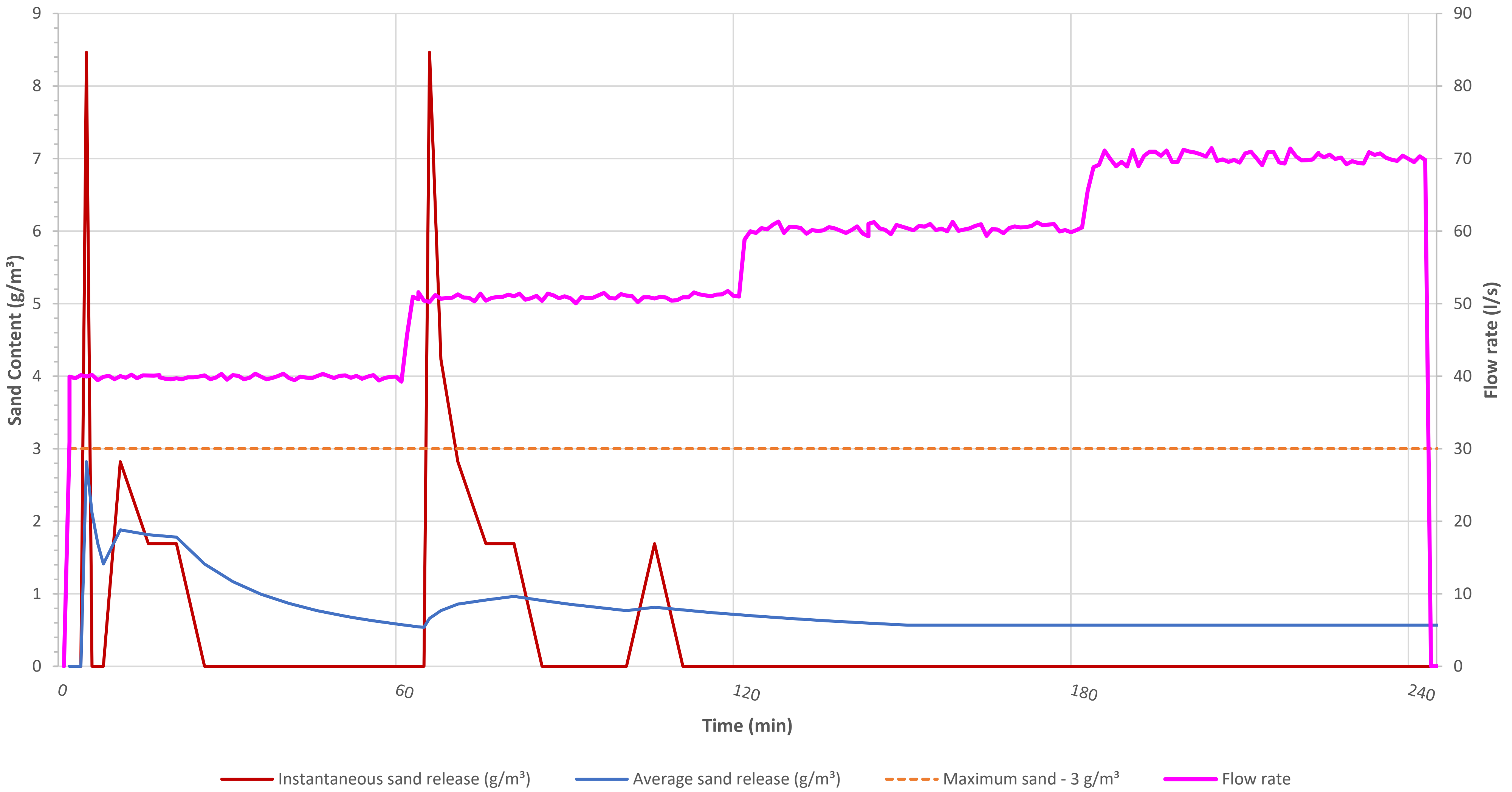


Date: 19/05/2023

McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:**	**BH02 - Production**
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:**	**20874**

Sand release test

Site Location: Coal Creek, GREYMOUTH **Date:** 9/5/2023



McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:** **BH02 - Production**
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:** **20874**

Stepped Drawdown and Sand Test

Site Location: Coal Creek, GREYMOUTH

Water level: 4.77m btoc (SWL)

Top of casing: 1.00m agl

Start date: 9/5/2023

Finish date: 9/5/2023

Well depth: 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
1 / 1	9/5/2023	8:01	5.15	0.38	40.09	0.000	
1 / 2	9/5/2023	8:02	5.15	0.38	40.07	0.000	
1 / 3	9/5/2023	8:03	5.15	0.38	40.07	0.000	
1 / 4	9/5/2023	8:04	5.15	0.38	40.00	0.010	
1 / 5	9/5/2023	8:05	5.15	0.38	40.30	0.010	
1 / 6	9/5/2023	8:06	5.15	0.38	40.01	0.010	
1 / 7	9/5/2023	8:07	5.15	0.38	40.00	0.010	
1 / 10	9/5/2023	8:10	5.15	0.38	40.30	0.010	
1 / 15	9/5/2023	8:15	5.16	0.39	40.20	0.010	
1 / 20	9/5/2023	8:20	5.17	0.40	40.10	0.010	
1 / 25	9/5/2023	8:25	5.17	0.40	40.00	0.010	
1 / 30	9/5/2023	8:30	5.17	0.40	40.40	0.010	
1 / 35	9/5/2023	8:35	5.17	0.40	40.10	0.010	
1 / 40	9/5/2023	8:40	5.18	0.41	40.00	0.010	
1 / 45	9/5/2023	8:45	5.18	0.41	40.10	0.010	
1 / 50	9/5/2023	8:50	5.18	0.41	39.90	0.010	
1 / 55	9/5/2023	8:55	5.18	0.41	39.90	0.010	
1 / 60	9/5/2023	9:00	5.18	0.41	40.00	0.010	

McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:** **BH02 - Production**
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:** **20874**

Stepped Drawdown and Sand Test

Site Location: Coal Creek, GREYMOUTH

Start date: 9/5/2023

Water level: 4.77m btoc (SWL)

Finish date: 9/5/2023

Top of casing: 1.00m agl

Well depth: 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
2 / 1	9/5/2023	9:01	5.35	0.58	49.80	0.000	
2 / 2	9/5/2023	9:02	5.36	0.59	51.80	0.000	
2 / 3	9/5/2023	9:03	5.36	0.59	50.90	0.000	
2 / 4	9/5/2023	9:04	5.37	0.60	50.70	0.000	
2 / 5	9/5/2023	9:05	5.37	0.60	50.70	0.010	
2 / 7	9/5/2023	9:07	5.37	0.60	50.90	0.010	
2 / 10	9/5/2023	9:10	5.37	0.60	51.30	0.010	
2 / 15	9/5/2023	9:15	5.37	0.60	51.00	0.010	
2 / 20	9/5/2023	9:20	5.37	0.60	51.20	0.010	
2 / 25	9/5/2023	9:25	5.37	0.60	51.00	0.010	
2 / 30	9/5/2023	9:30	5.38	0.61	50.90	0.010	
2 / 35	9/5/2023	9:35	5.38	0.61	51.10	0.010	
2 / 40	9/5/2023	9:40	5.38	0.61	51.30	0.010	
2 / 45	9/5/2023	9:45	5.38	0.61	51.80	0.020	
2 / 50	9/5/2023	9:50	5.38	0.61	51.00	0.020	
2 / 55	9/5/2023	9:55	5.38	0.61	51.80	0.020	
2 / 60	9/5/2023	10:00	5.38	0.61	50.50	0.020	

McMILLAN Drilling	Client: Grey District Council	Bore No.: BH02 - Production
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	Job No.: 20874

Stepped Drawdown and Sand Test

Site Location: Coal Creek, GREYMOUTH

Start date: 9/5/2023

Water level: 4.77m btoc (SWL)

Finish date: 9/5/2023

Top of casing: 1.00m agl

Well depth: 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
3 / 1	9/5/2023	10:01	5.54	0.77	60.10	0.000	
3 / 2	9/5/2023	10:02	5.55	0.78	60.60	0.000	
3 / 3	9/5/2023	10:03	5.55	0.78	60.50	0.000	
3 / 4	9/5/2023	10:04	5.55	0.78	60.30	0.000	
3 / 5	9/5/2023	10:05	5.55	0.78	61.10	0.000	
3 / 7	9/5/2023	10:07	5.55	0.78	59.90	0.000	
3 / 10	9/5/2023	10:10	5.56	0.79	60.60	0.000	
3 / 15	9/5/2023	10:15	5.56	0.79	60.90	0.000	
3 / 20	9/5/2023	10:20	5.56	0.79	61.30	0.000	
3 / 25	9/5/2023	10:25	5.56	0.79	60.80	0.000	
3 / 30	9/5/2023	10:30	5.56	0.79	61.00	0.000	
3 / 35	9/5/2023	10:35	5.56	0.79	60.50		
3 / 40	9/5/2023	10:40	5.56	0.79	61.00		
3 / 45	9/5/2023	10:45	5.56	0.79	60.70		
3 / 50	9/5/2023	10:50	5.56	0.79	60.90		
3 / 55	9/5/2023	10:55	5.56	0.79	60.90		
3 / 60	9/5/2023	11:00	5.56	0.79	60.90		

McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:** **BH02 - Production**
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:** **20874**

Stepped Drawdown and Sand Test

Site Location: Coal Creek, GREYMOUTH

Start date: 9/5/2023

Water level: 4.77m btoc (SWL)

Finish date: 9/5/2023

Top of casing: 1.00m agl

Well depth: 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
4 / 1	9/5/2023	11:02	5.74	0.97	70.00		
4 / 2	9/5/2023	11:03	5.76	0.99	69.70		
4 / 3	9/5/2023	11:04	5.77	1.00	70.00		
4 / 4	9/5/2023	11:05	5.77	1.00	70.30		
4 / 5	9/5/2023	11:06	5.77	1.00	69.70		
4 / 7	9/5/2023	11:08	5.78	1.01	70.10		
4 / 10	9/5/2023	11:11	5.78	1.01	70.70		
4 / 15	9/5/2023	11:16	5.78	1.01	70.40		
4 / 20	9/5/2023	11:21	5.79	1.02	70.40		
4 / 25	9/5/2023	11:26	5.80	1.03	70.90		
4 / 30	9/5/2023	11:31	5.80	1.03	71.30		
4 / 35	9/5/2023	11:36	5.80	1.03	71.00		
4 / 40	9/5/2023	11:41	5.80	1.03	70.60		
4 / 45	9/5/2023	11:46	5.80	1.03	70.60		
4 / 50	9/5/2023	11:51	5.80	1.03	71.10		
4 / 55	9/5/2023	11:56	5.80	1.03	69.80		
4 / 60	9/5/2023	12:01	5.80	1.03	70.50		

McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:** **BH02 - Production**
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:** **20874**

Stepped Drawdown and Sand Test

Site Location: Coal Creek, GREYMOUTH — **Start date:** 9/5/2023

Water level: 4.77m btoc (SWL) — **Finish date:** 9/5/2023

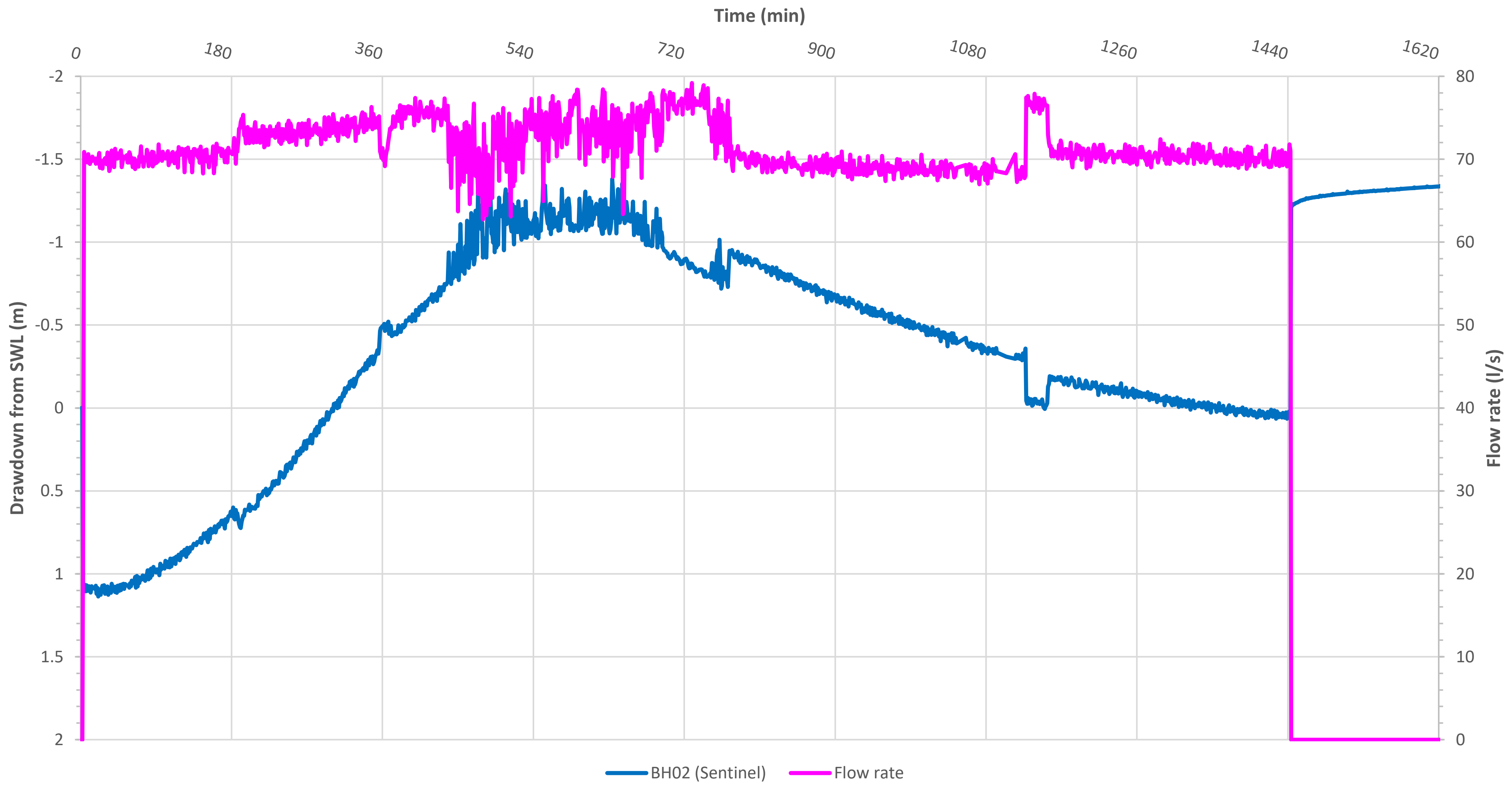
Top of casing: 1.00m agl — **Well depth:** 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
Rec / 1	9/5/2023	12:03	4.78	0.01			
Rec / 2	9/5/2023	12:04	4.75	-0.02			
Rec / 3	9/5/2023	12:05	4.76	-0.01			
Rec / 4	9/5/2023	12:06	4.74	-0.03			
Rec / 5	9/5/2023	12:07	4.72	-0.05			
Rec / 7	9/5/2023	12:09	4.70	-0.07			
Rec / 10	9/5/2023	12:12	4.69	-0.08			
Rec / 15	9/5/2023	12:17	4.68	-0.09			
Rec / 20	9/5/2023	12:22	4.67	-0.10			
Rec / 25	9/5/2023	12:27	4.65	-0.12			
Rec / 30	9/5/2023	12:32	4.64	-0.13			
Rec / 35	9/5/2023	12:37	4.62	-0.15			
Rec / 40	9/5/2023	12:42	4.61	-0.16			
Rec / 45	9/5/2023	12:47	4.60	-0.17			
Rec / 50	9/5/2023	12:52	4.60	-0.17			
Rec / 55	9/5/2023	12:57	4.60	-0.17			
Rec / 60	9/5/2023	13:02	4.59	-0.18			

McMILLAN Drilling	Client: Grey District Council	Bore No.: BH02 - Production
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	Job No.: 20874

Constant Rate and Sand Test

Site Location: Coal Creek, GREYMOUTH **Static water level:** 4.60m btoc **Date:** 9/5/2023



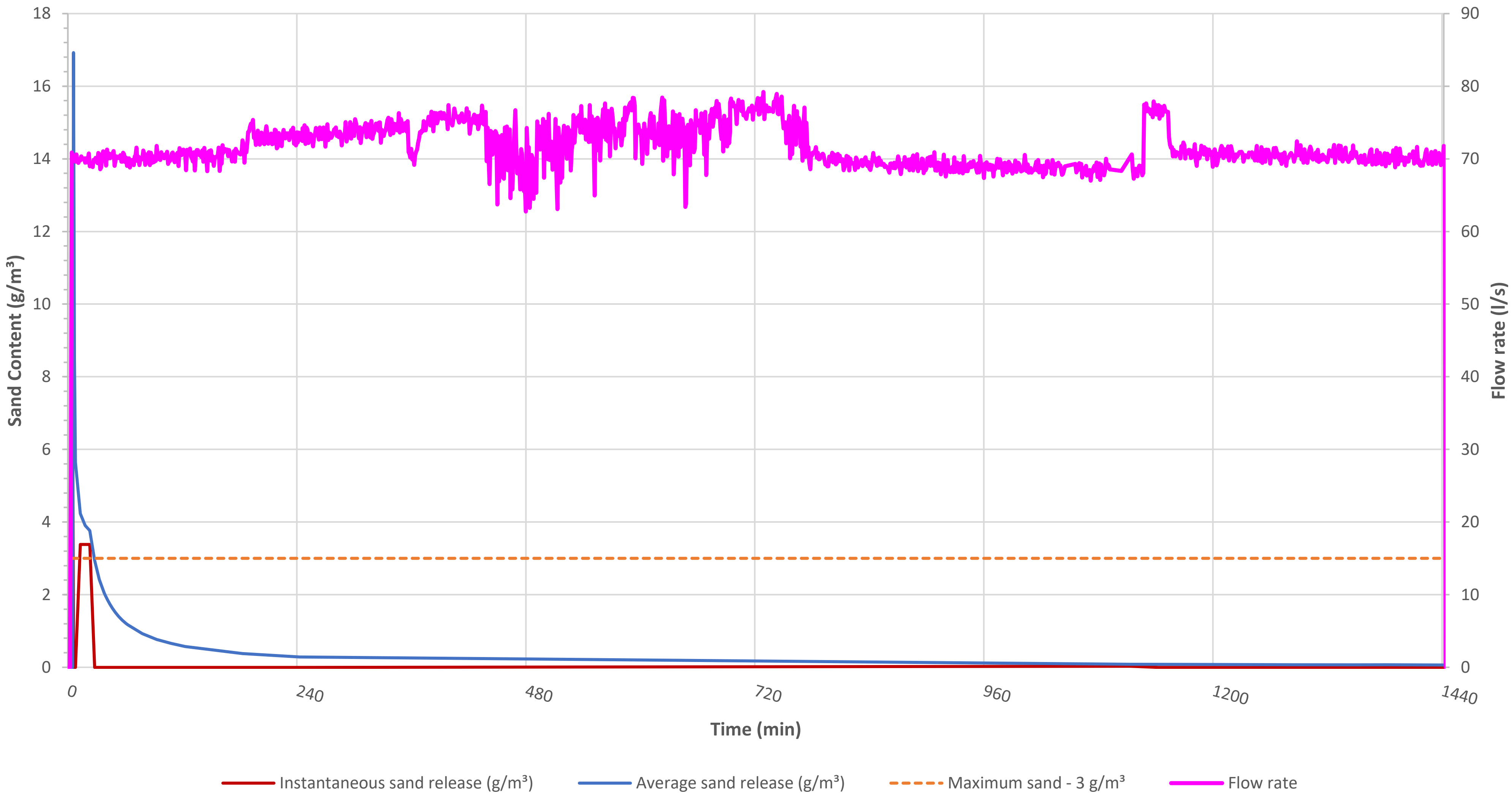
Date: 19/05/2023

McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:**	**BH02 - Production**
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:**	**20874**

Sand release test

Site Location: Coal Creek, GREYMOUTH

Date: 9/5/2023



Date: 19/05/2023

McMILLAN Drilling	Client: Grey District Council	Bore No.: BH02 - Production
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	Job No.: 20874

Constant Rate and Sand Test

Site Location: Coal Creek, GREYMOUTH

Start date: 9/5/2023

Water level: 4.60m btoc (SWL)

Finish date: 11/5/2023

Top of casing: 1.00m agl

Well depth: 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
Constant rate	9/5/2023	13:01	5.58	0.98	70.8	0.010	
Constant rate	9/5/2023	13:02	5.58	0.98	70.70	0.020	
Constant rate	9/5/2023	13:03	5.59	0.99	70.00	0.020	
Constant rate	9/5/2023	13:04	5.59	0.99	70.10	0.020	
Constant rate	9/5/2023	13:05	5.60	1.00	70.90	0.020	
Constant rate	9/5/2023	13:10	5.60	1.00	70.40	0.020	
Constant rate	9/5/2023	13:15	5.60	1.00	70.60	0.020	
Constant rate	9/5/2023	13:20	5.60	1.00	70.20	0.020	
Constant rate	9/5/2023	13:25	5.60	1.00	70.80	0.020	
Constant rate	9/5/2023	13:30	5.60	1.00	69.90	0.020	
Constant rate	9/5/2023	13:35	5.60	1.00	70.40	0.020	
Constant rate	9/5/2023	13:40	5.60	1.00	70.10	0.020	
Constant rate	9/5/2023	13:45	5.60	1.00	70.40	0.020	
Constant rate	9/5/2023	13:50	5.60	1.00	70.60	0.020	
Constant rate	9/5/2023	13:55	5.60	1.00	70.00	0.020	
Constant rate	9/5/2023	14:00	5.59	0.99	70.20	0.020	
Constant rate	9/5/2023	14:15	5.55	0.95	71.40	0.020	*Heavy rain - water in river rising*
Constant rate	9/5/2023	14:30	5.50	0.90	70.90	0.020	
Constant rate	9/5/2023	14:45	5.45	0.85	70.60	0.020	
Constant rate	9/5/2023	15:00	5.40	0.80	70.30	0.020	
Constant rate	9/5/2023	16:00	5.20	0.60	71.40	0.020	
Constant rate	9/5/2023	17:00	4.94	0.34	72.60	0.020	
Constant rate	10/5/2023	7:30	4.31	-0.29	69.10	0.050	
Constant rate	10/5/2023	8:00	4.58	-0.02	75.10	0.050	*Flowrate adjusted*
Constant rate	10/5/2023	9:00	4.47	-0.13	69.90	0.050	
Constant rate	10/5/2023	10:00	4.51	-0.09	71.50	0.050	
Constant rate	10/5/2023	11:00	4.58	-0.02	71.10	0.050	
Constant rate	10/5/2023	12:00	4.61	0.01	71.00	0.050	
Constant rate	10/5/2023	13:00	4.65	0.05	69.90	0.050	

McMILLAN Drilling	**Client:** Grey District Council	**Bore No.:** BH02 - Production
	Project: Coal Creek WTP Bore Installation (2021-22-26a)	**Job No.:** 20874

Constant Rate and Sand Test

Site Location: Coal Creek, GREYMOUTH — **Start date:** 9/5/2023

Water level: 4.60m btoc (SWL) — **Finish date:** 11/5/2023

Top of casing: 1.00m agl — **Well depth:** 10.50m toc

Step / min	Date	Time	Water depth (m)	Drawdown (m)	Pumping rate (l/s)	Sand (ml)	Comments
Rec / 1	10/5/2023	13:01	3.50	-1.10			
Rec / 2	10/5/2023	13:02	3.45	-1.15			
Rec / 3	10/5/2023	13:03	3.44	-1.16			
Rec / 4	10/5/2023	13:04	3.44	-1.16			
Rec / 5	10/5/2023	13:05	3.44	-1.16			
Rec / 7	10/5/2023	13:07	3.45	-1.15			
Rec / 10	10/5/2023	13:10	3.45	-1.15			
Rec / 15	10/5/2023	13:15	3.43	-1.17			
Rec / 20	10/5/2023	13:20	3.44	-1.16			
Rec / 25	10/5/2023	13:25	3.43	-1.17			
Rec / 30	10/5/2023	13:30	3.40	-1.20			
Rec / 35	10/5/2023	13:35	3.40	-1.20			
Rec / 40	10/5/2023	13:40	3.40	-1.20			
Rec / 45	10/5/2023	13:45	3.39	-1.21			
Rec / 50	10/5/2023	13:50	3.39	-1.21			
Rec / 55	10/5/2023	13:55	3.38	-1.22			
Rec / 60	10/5/2023	14:00	3.38	-1.22			
Rec / 90	10/5/2023	14:30	3.37	-1.23			
Rec / 120	10/5/2023	15:00	3.36	-1.24			
Rec / 150	10/5/2023	15:30	3.34	-1.26			
Rec / 180	10/5/2023	16:00	3.34	-1.26			
Rec / 1140	11/5/2023	8:00	3.45	-1.15			

YC INOX CO., LTD.

No.270,Sec.4,Jungshan Rd.,Shijou Shiang,
Chang-Hwa,Taiwan,R.O.C
http://www.ycinox.com
TEL：+886-4-8899666 FAX：+886-4-8899770

INSPECTION CERTIFICATE

EN 10204-3.1:2004

Customer	STAINLESS PRODUCTS LTD	Customer No.	FHK076	Certificate No.	211220P0123
Product	STAINLESS STEEL WELDED PIPE	Commercial Invoice No.	J21110271	Date of Issue	2021/12/20
Specification	ASTM A312/A312M-21	PO No.	6853	Order No.	EP21100179-1
Steel Grade	TP304/304L Finish PICKLED	P.I.No.	PI 2110-114	Weight No.	C21120150

Item No.	Heat No.	Product Description		Chemical Composition(%)							Tension Test			*01 HR	*02 HT	*03 HY	*04 ET	*05 F1
		Dimension	Quantity Pcs	C	Si	Mn	P	S	Ni	Cr	0.2% Y.S.	T.S.	E.L.					
				X10^{-3}	X10^{-2}	X10^{-2}	X10^{-3}	X10^{-3}	X10^{-2}	X10^{-2}	MPa		%	HRB	°C	MPa		
Specification			Min.						800	1800	205	515	35		1040			
			Max.	35	100	200	45	30	1100	2000								
1	VCB111262	12"(323.9mm) x SCH-10S(4.57mm) x 6M	1	20	37	140	29	1	801	1830	307	650	58	86	1060	3.0	-	OK
2	VCB111696	12"(323.9mm) x SCH-10S(4.57mm) x 6M	3	24	43	141	32	1	801	1803	305	632	56	85	1060	3.0	-	OK
3	VCB111910	12"(323.9mm) x SCH-10S(4.57mm) x 6M	1	20	37	140	29	1	801	1830	307	650	58	86	1060	3.0	-	OK
4	PCB110416	1"(33.4mm) x SCH-40S(3.38mm) x 6M	35	23	42	141	29	2	802	1805	304	655	56	86	1060	-	OK	OK
5	PCB110479	1"(33.4mm) x SCH-40S(3.38mm) x 6M	5	26	39	139	37	1	801	1820	292	625	56	86	1060	-	OK	OK
6	PCB100754	1 1/4"(42.2mm) x SCH-40S(3.56mm) x 6M	15	20	39	138	28	2	802	1825	286	643	59	86	1060	-	OK	OK
7	PCB110792	1 1/2"(48.3mm) x SCH-40S(3.68mm) x 6M	15	25	35	138	33	2	801	1811	285	629	56	85	1060	-	OK	OK
8	PCB110262	3"(88.9mm) x SCH-40S(5.49mm) x 6M	15	22	35	137	32	1	801	1820	293	623	59	84	1060	-	OK	OK
9	PCB110605	6"(168.3mm) x SCH-40S(7.11mm) x 6M	2	25	39	129	30	1	801	1831	331	654	54	87	1060	9.0	-	OK
		TOTAL:	92															

Remark

Note

Hardness according to NACE MR0175 / ISO 15156-3:2015 : Satisfactory.

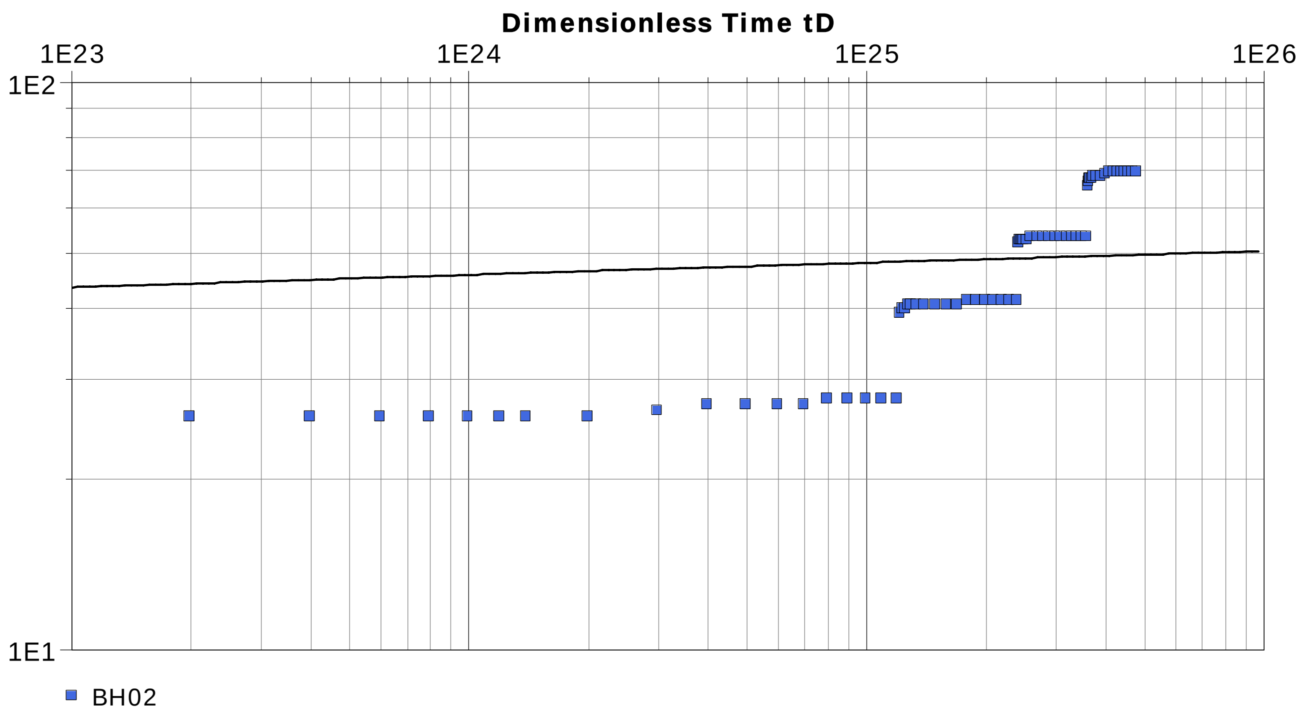
*01= Hardness Test
*02= Heat Treatment(W.Q.)
*03= Hydrostatic Test
*04= Eddy-Current Test
*05= Flattening Test
*Gauge Length: 50mm

Visual Inspection(Surface) and Dimension Check：OK

1MPa=1N/mm^2=10bar=145psi=10.2kgf/cm^2

Surveyor By			Manager of Quality Assurance Department
N/A	We hereby certify that material described herein has been manufactured and tested with satisfactory results in accordance with the requirement of the above material specification. The material described above has been found free of radiation by raw material supplier.	1.ISO 9001:2015 (No.01 100 056299) 2.PED / AD2000 (No.01 202 TWN/Q-05 0105) 3.ISO 14001:2015 (No.01 104 822 096385) 4.ISO 45001:2018 (No.01 113 822 096385)	Russell Wu

	Pumping Test Analysis Report	
	Project: Taylorville Resource Park	
	Number: 26200.000.001	
	Client: Taylorville Resource Park Limited	
Location: Greymouth	Pumping Test: Coal Creek BH02	Pumping Well: BH02
Test Conducted by: McMillan Drilling Ltd		Test Date: 5/9/2023
Analysis Performed by: S. Berry	Bolton	Analysis Date: 1/16/2025
Aquifer Thickness: 8.80 m	Discharge: variable, average rate 0.055651 [m³/s]	

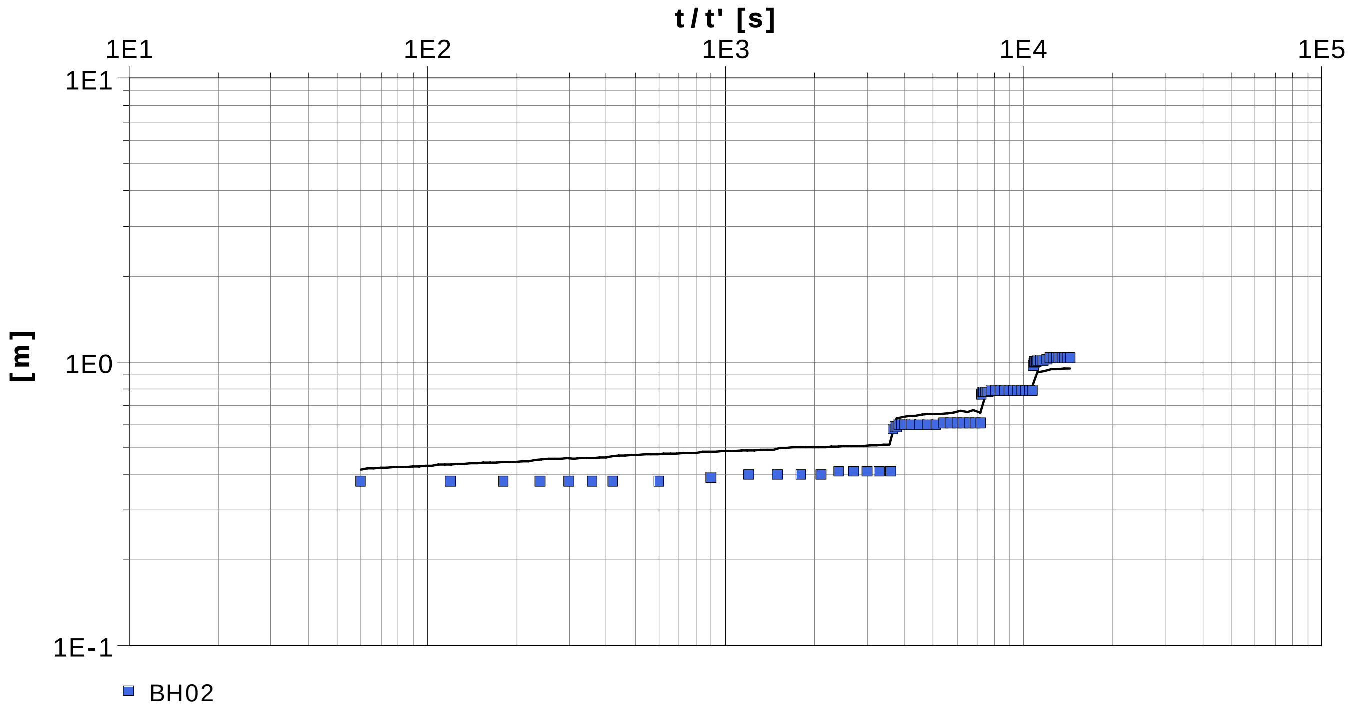


Calculation using Boulton

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Specific Yield	Drainage factor	Ratio Sy/S	Radial Distance to PW [m]
BH02	3.01×10^{-1}	3.42×10^{-2}	1.10×10^{-16}	5.11×10^{-1}	2.72×10^{4}	0.15

	Pumping Test Analysis Report
	Project: Taylorville Resource Park
	Number: 26200.000.001
	Client: Taylorville Resource Park Limited

Location: Greymouth	Pumping Test: Coal Creek BH02	Pumping Well: BH02
Test Conducted by: McMillan Drilling Ltd		Test Date: 5/9/2023
Analysis Performed by: S. Berry	Neuman	Analysis Date: 1/16/2025
Aquifer Thickness: 8.80 m	Discharge: variable, average rate 0.055651 [m³/s]	



Calculation using Neuman

Observation Well	Transmissivity [m²/s]	Hydraulic Conductivity [m/s]	Ratio K(v)/K(h)	Ratio Sy/S	Radial Distance to PW [m]
BH02	1.39×10^{-1}	1.58×10^{-2}	2.46×10^{-2}	1.00×10^{1}	0.15

APPENDIX 7

XRD Analysis

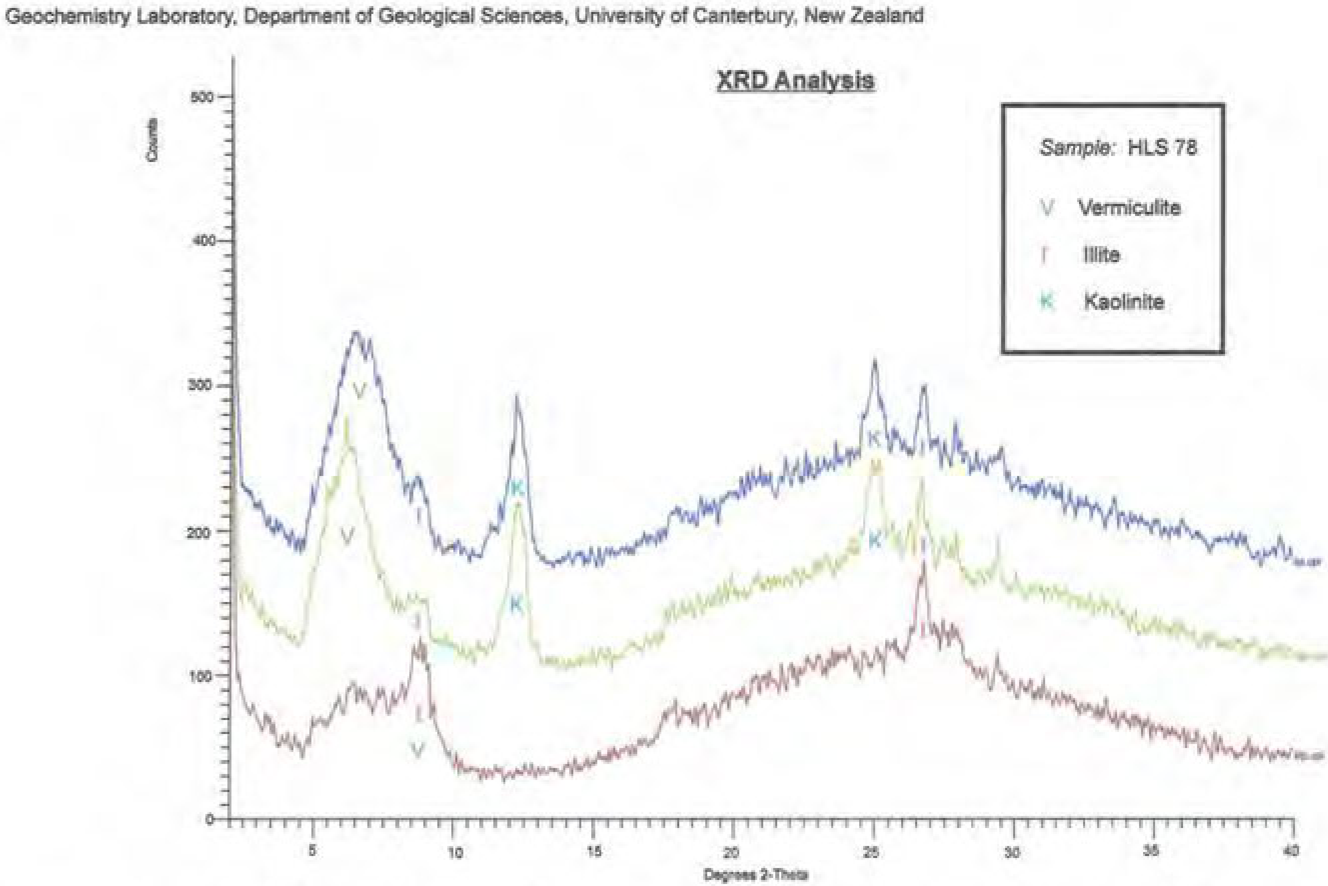


Figure 4.12: XRD analysis of Kaiata Mudstone sample HLS 78 from the Punakaiki River Gorge. Another sample, HLS 34 ur Mile River, gave the same results at a lesser concentration.

MEMORANDUM

Bioresearches
A Babbage Company

TO:	Taylorville Resource Park	Date:	7 February 2025
COPY TO:	Jimmy Whitmore (Engeo)	Job No:	67662
FROM:	Laura Drummond		

TAYLORVILLE RESOUCE PARK S92 RESPONSE - ECOLOGY

Bioresearches were engaged by Engeo, on behalf of their client Taylorville Resource Park (TRP), to undertake an ecological impact assessment for the discharge of water associated with landfill operations, for the temporary discharge of leachate contaminated water to land (RC-2024-0122).

This memorandum addresses the questions raised under Section 92 (S92) of the RMA by Pattle Delmore Partners (PDP), on behalf of West Coast Regional Council.

The S92 ecology related question is copied in blue italics below, with the responses in black:

4. [West Coast Regional Council requests] An ecological survey of the surface water features and aquatic habitat surrounding the site, including Noname Creek, the drain along Taylorville Road, including that part of the drain that begins at spring seep TCD1 and the streams on the southern side of Taylorville Road (excluding the Grey River) and an impact assessment on surface water quality and ecological values resulting from the proposed discharge.

The Ecological Impact Assessment (EcIA) assessed the ecological values of the roadside drain, Noname Creek, and the tributary of the Grey River (Grey Tributary) which receives surface water from the surrounding environment (including the roadside drain, any stormwater runoff etc). This assessment generally follows the EcIA Guidelines for use in New Zealand published by the Environmental Institute of Australia and New Zealand (EIANZ) (Roper-Lindsay *et al.*, 2017[1])). The EcIA Guidelines provide a standardised matrix framework that allows ecological effects assessments to be clear, transparent, and consistent. The EcIAG framework is generally used in Ecological Impact Assessments in New Zealand as good practice, and a detailed analysis of this methodology is presented Appendix A.

[1] Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018). Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

Ecological Values

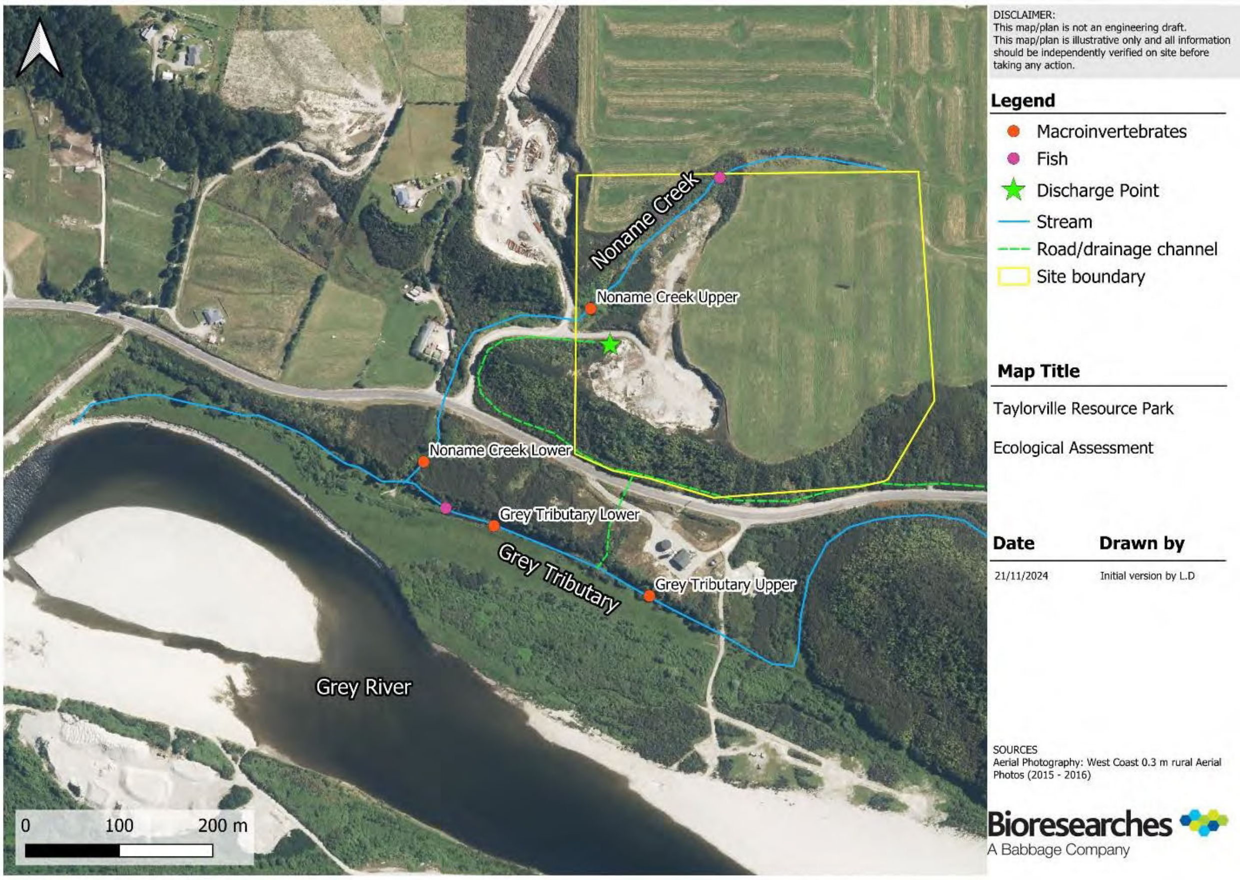


Figure 1. Map of the site and surrounding river systems

Noname Creek

Noname Creek was considered to be of **low** ecological value.

The creek originates on the northern boundary of the site and flows in a west to south-west direction for approximately 590 m before entering a culvert under Taylorville Road. It then continues for a further 91 m before discharging into the Grey Tributary.

Noname Creek consisted of a narrow (average 0.40 m), shallow (average 0.10 m) waterway. The substrate is primarily hard bottomed, dominated by gravels, cobbles and boulders, although occasional patches of soft sediment are present. When disturbed, sediment plumes were present within the upper portion, above the Taylorville Road culvert. Hydrological heterogeneity throughout the reach was good, and consisted of fast and slow runs, riffles and pools. No natural inland wetlands were associated with Noname Creek.

Riparian vegetation was variable, with the upper Noname Creek consisting of predominantly exotic vegetation and pasture. The lower portion of Noname Creek, below the culvert was largely native with patē, pigeon wood (*Hedycarya arborea*), kanono (*Coprosma grandifolia*), kiokio (*Parablechnum novae-zelandiae*), blackberry, and kōtukutuku (*Fuchsia excorticata*). With the exception of the upper 150 m of Noname Creek, the waterway was well vegetated with good shading and bank stability. The upper portion of Noname Creek, present along the site boundary, was less vegetation and predominantly contained gorse, blackberry, and willow (*Salix* sp) within the riparian yard. Despite this, bank stability appeared to be good and riparian yard functions such as overhanging vegetation and organic matter inputs were abundant.

Photo 1. Noname Upper

Photo 2. Noname Upper

Photo 3. Noname Lower

Photo 4. Noname Lower

Aquatic habitat abundance and diversity in Noname Creek was good, with riffles, pools, runs and overhanging vegetation present throughout. It is likely the elevation and culvert separating the upper and lower reaches, which may act as a partial barrier to fish passage. In the absence of fish barriers, it is expected bully species (*Gobiomorphus* sp) and eels could be present.

Table 1. Ecological value and justification of Noname Creek under assessment matters of the EIANZ guidelines.

Matters	Value and Justification
Representativeness	**Low** Modified water body on the upper reaches through agricultural land use. More naturalised downstream reach. Water flow shallow with a run-riffle-run sequences over cobbles and gravels.
Rarity/distinctiveness	**Low** May support threatened species on the lower extent, low likelihood of fish species colonising upper reach. Typical for stream within the West Coast region.
Diversity and pattern	**Low** Good variety of in-stream habitats, however shallow in depth. Available habitat is not complex and limited, and is likely to only provide habitat for pollutant tolerant macroinvertebrates. culvert creates at least a partial barrier to fish passage, limiting is

Ecological context	**Moderate** First order stream with permanent hard substrates throughout and loading of fine sediments from surrounding agricultural land use. Lower riparian yard indigenous, upper riparian yard exotic.
Overall Ecological Value	**Low**

Grey Tributary

The Grey Tributary was considered to be of **low** ecological value.

The Grey Tributary is located south of the site and classified as a permanent stream. The proposed discharge will eventually enter the Grey Tributary via a roadside drain that collects water from the site and adjoining roadside drains. From this drain connection point, water flows for an additional 615 m in the tributary before entering the Grey River.

The Grey Tributary consisted of a wide (8 m – 13 m) flow path which was relatively shallow throughout, with depth ranging between 0.4 m to 0.7 m, excluding deep pools. The flow path was predominantly soft bottomed, with a layer of thick, but firm mud covering the stream bed. This substrate was not considered to be excessively silty or subject to high sediment loading, with the boot depressions in the substrate approximately 0.06 m in depth. Flow through the tributary was slow with a low variation in hydrology, only consisting of slow runs and deep pools. Approximately 300 m downstream of the drain connection to the tributary, the stream channel narrows (<1 m), with flows becoming swifter and the prevalence of stony substrates increased. The channel morphology of the Grey Tributary was variable. The true right bank was relatively steep sloping, and vegetated with a mix of exotic and native vegetation. The true left bank of the stream was flat sloping with high connectivity to the floodplain.

The riparian vegetation on the true right bank was exotic and native, consisting of species such as of willow (*Salix* sp.), kamāhi (*Pterophylla racemosa*), wild broom (*Cytisus scoparius*), karamū (*Coprosma lucida*), round-leaved coprosma (*Coprosma rotundifolia*), kahikatea (*Dacrycarpus dacrydioides*), gorse (*Ulex europaeus*), patē (*Schefflera digita*), blackberry (*Rubus fruticosus*), and pōhuehue (*Muehlenbeckia complexa*). The true left bank supported a riverine wetland is supported on the immediate floodplain, extending 1 m – 2 m upslope, with the hydric vegetation predominantly exotic; soft rush (*Juncus effusus*), buttercup (*Ranunculus* sp.), wet-tolerant grasses, and fan flowered rush (*Juncus sarophorus*). The base of the Grey River supported macrophyte growth with pond weed (*Potamogeton* sp.).

Photo 5. Grey Tributary Upper

Photo 6. Grey Tributary Upper

Photo 7. Grey Tributary Lower

Photo 8. Grey Tributary Lower

Aquatic habitat within the Grey River was limited to slow runs, pools, macrophytes, woody debris, overhanging vegetation and floodplain vegetation. The macroinvertebrate and fish communities within the Grey Tributary would likely reflect this. Fish passage from the Grey River to the Grey Tributary is limited due to the topography of the two waterways, limiting the potential diversity of fish species capable of accessing the Grey Tributary, and therefore Noname Creek, to species with climbing abilities.

Table 2. Ecological value and justification of the Grey Tributary under assessment matters of the EIANZ guidelines.

Matters	Value and Justification
Representativeness	**Low** Permanent stream with wetland habitats on margins. Water slow flowing and predominantly soft bottomed, lacking diverse habitats, and hydrological variation.
Rarity/distinctiveness	**Moderate** Likely to support at risk species, such as longfin eel. Soft bottomed and silty substrates reduce the quality and complexity of aquatic habitats. Exotic wetland present on the margins and floodplain.
Diversity and pattern	**Low** Likely low diversity of macroinvertebrate and fish communities due to low diversity and complexity of aquatic habitats. Low diversity and complexity of aquatic habitats

Ecological context	**Low** Second order stream with low diversity and abundance on in-stream habitats, predominantly being macrophytes, rushes and woody debris. Indigenous and exotic, pasture riparian yard limiting functions such as filtration and shade.
Overall Ecological Value	**Low**

Roadside Drain

The roadside drain was considered to be of **negligible** ecological value

The roadside drain meets the definition of a 'drain' under the Regional Land and Water Plan (2014), as it is an artificial channel, likely constructed to collect and transport water from the roading. The drain is absent in historic aerial images, and does not incorporate any natural bed, as no river or creek is present in the location of the roadside drain in historic aerials.

The drain, at the point of TCD1 discharge (Section 1), consists of a narrow, shallow drain within 2 m of the gravel road. The base of the drain appears to be bedrock with areas of filamentous algae and water cress (*Nasturtium officinale*) within the channel. Further downstream, where the drain runs eastwards (Section 2) adjacent to Taylorville Road, patches of budding-club rush (*Isolepis prolifera*) and duckweed (*Lemna minor*) was observed. As with Section 1, water depth was overtly shallow, and the channel is located within 2 m of the road and narrow. Section 3 of the drain, which runs westwards from the spring, is also situated close to the road, has very shallow water depth and the bed is covered in fine silts and soft sediments. Overall, the drain (Section 1, Section 2 and Section 3), contains very little hydrological heterogeneity, with shallow depth, and very little to stagnant flow.

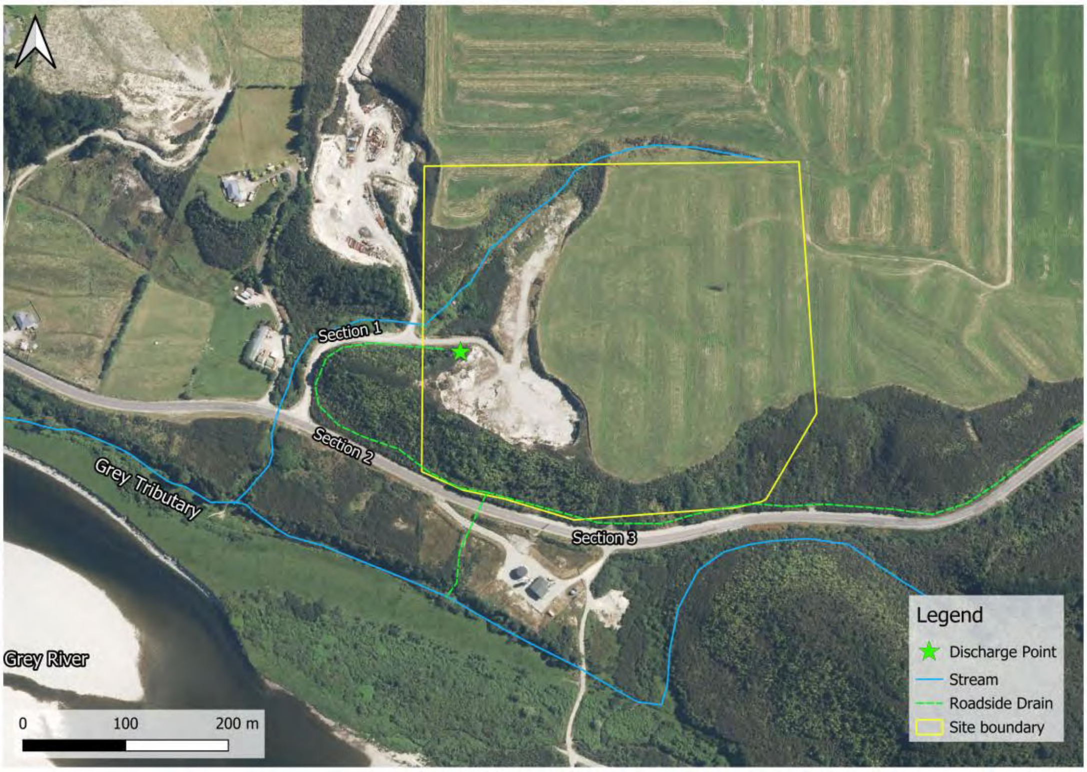


Figure 2. Map of the roadside drain and descriptive sections.

The roadside drain receives water from multiple sources, including daylighted groundwater, overland flow paths, and surface water run-off from the surrounding landscape and roading. Water quality analysis undertaken by Engeo[2] show elevated levels of nitrate-N and conductivity throughout the drain, independent of the site operations.

The drain lacks complex habitats, such as woody debris, cobbles/gravels and interstitial spaces, overhanging vegetation and due to the poor water quality, the macroinvertebrate populations are expected to be of low diversity and abundance, and would consist of pollutant tolerant taxa throughout both Drain 1 and Drain 2. Barriers to fish passage are present where the drain discharges into the Grey Tributary. Native fish populations are not expected to be present in the drain.

Photo 9. Section 1

Photo 10. Section 2

Photo 11. Section 3

Photo 12. Discharge point and polishing area

Table 3. Ecological value and justification of the roadside drain under assessment matters of the EIANZ guidelines.

Matters	Value and Justification
Representativeness	**Very Low** Waterbody is an artificial drain constructed to receive water run-off from surrounding roading. Water still standing or hosts trickle flow, with macrophytes and long filamentous periphyton growing in channel. Minimal aquatic habitat.

[2] Engeo (2024). Review of PDP (11-Oct-24) "Impacts of Taylorville Resource Park Limited Landfill on Grey District Council Coal Creek Water Supply Intake". Memo date: 6 November 2024.

Rarity/distinctiveness	**Very Low** Roadside drain is highly unlikely to support threatened fauna as it is not a natural waterway and has very limited connectivity to the wider catchment.
Diversity and pattern	**Very Low** Drain channel is not a natural waterway and consists of a uniform channel width and depth. Available habitat is not complex and limited, and is likely to only provide habitat for pollutant tolerant macroinvertebrates.
Ecological context	**Very Low** Channel is an artificial roadside drain, lacking aquatic habitat and diversity with the exception of macrophyte growth. Receives water from multiple sources, including containments from agricultural and roading, reducing water quality.
Overall Ecological Value	**Negligible**

Ecological Impact Assessment

The discharge of water from the site (both temporary to land (RC-2024-0122) and via the hummus filter (RC2021.0097)), has the potential to alter the water quality and chemistry within the roadside drain. PDP has acknowledged leachate concentrations are significantly diluted as water moves away from the landfill, and will be below the Drinking Water Standards health-based MAV criteria, therefore no changes in water quality to the Grey Tributary should occur as a result of the discharge to land.

The discharge of water via the roadside drain, which will enter the Grey Tributary ~100 m downstream of the discharge. Water discharged from the TRP is captured via a roadside drain and diverted away from Noname Creek. As such, no future treated leachate or contaminant originating from TRP should enter Noname Creek.

In regards to the roadside drain, hydraulic modelling undertaken by Engeo[3] indicates any contaminants will be generally diluted and dispersed through an aquifer to negligible concentrations prior to discharge and interception within the roadside drain. As such, the discharge of water is unlikely to result in significant, or noticeable changes to the ecological values of the drain as a result of altered water quality and water chemistry. Considering the dilution factor within the drain, no excess in contaminants as a result of the TRP discharge should enter the Grey Tributary.

Whilst site operations may have a minor influence on the water quality within the roadside drains, multiple sources of water enter the channel which are heavily influenced by surrounding land use, independent of TRP. Existing land-use includes agricultural/rural, including aerial spraying of fertiliser, and vehicle use and the associated roading run-off from Taylorville Road. As such, influences to water quality in the roadside cannot be solely attributed to the operations within the site.

The discharge of water to land, which will then enter the roadside drain will not result in the displacement of indigenous fauna (macroinvertebrates and fish), as any organisms, if present, in the drain will be pollutant tolerant macroinvertebrate taxa.

[3] Engeo (2024). Preliminary Hydrogeological Assessment: 287 Taylorville Road, Coal Creek, Greymouth.

The discharge to the roadside drain was considered to be of **low** magnitude and overall **very low** level of effect to the roadside drain and Grey Tributary as it will have a very slight shift from the existing baseline conditions, and negligible impact on ecological values and communities of the drain. There should be no effect to Noname Creek as discharged water should not enter this system.

Regards,

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Bioresearches
A Babbage Company
Babbage Consultants Limited

Appendix A. Ecological Impact Assessment Methodology

Table 4. Criteria for assigning value to habitat/species for assessment.

Value	Determining Factors
Very High	Nationally Threatened species found in the 'zone of influence' (ZOI) either permanently or seasonally. Area rates 'High' for at least three of the assessment matters of Representativeness, Rarity/distinctiveness, Diversity and Pattern, and Ecological Context. Likely to be nationally important and recognised as such.
High	Species listed as At Risk – Declining found in the ZOI either permanently or seasonally. Area rates 'High' for two of the assessment matters, and 'Moderate' and 'Low' for the remainder OR area rates 'High' for one of the assessment matters and 'Moderate' for the remainder. Likely to be regionally significant and recognised as such.
Moderate	Species listed as At Risk – Relict, Naturally Uncommon, Recovering found in the ZOI either permanently or seasonally. Locally uncommon or distinctive species. Area rates 'High' for one of the assessment matters, 'Moderate' or 'Low' for the remainder OR area rates as 'Moderate' for at least two of the assessment matters and 'Low' or 'Very Low' for the remainder. Likely to be important at the level of the Ecological District.
Low	Nationally and locally common indigenous species. Area rates 'Low' or 'Very Low' for majority of assessment matters, and 'Moderate' for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Exotic species including pests, species having recreational value. Area rates 'Very Low' for three assessment matters and 'Moderate', 'Low' or 'Very Low' for the remainder.

Table 5. Criteria for describing the magnitude of effects (EIANZ 2018)

Magnitude	Description
Very High	Total loss of, or a very major alteration to, key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss of major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.

Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances and patterns; AND/OR Having minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Table 6. Criteria for describing the level of effects (EIANZ 2018). Where text is italicised it indicates 'significant effects' where mitigation is required.

Magnitude of Effect	**Ecological Value**				
	Very High	**High**	**Moderate**	**Low**	**Negligible**
Very High	*Very High*	*Very High*	*High*	*Moderate*	Low
High	*Very High*	*Very High*	*Moderate*	Low	Very Low
Moderate	*High*	*High*	*Moderate*	Low	Very Low
Low	*Moderate*	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain

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memorandum

TO	Michael Durand	FROM	Carl Steffens
	Planz Consultants	DATE	24 February 2025
RE	Technical Review – TRPL short-term consent application to discharge contaminants to ground – RFI Response		

West Coast Regional Council (WCRC) sent Taylorville Regional Park Limited (TRPL) a Request for Further Information (RFI) dated 19 December 2024 relating to the TRPL short-term consent application to discharge contaminants to ground at Taylorville Regional Park (TRP) landfill. On behalf of TRPL, ENGEO has provided a response to the RFI via a memo dated 30 January 2025. The response provided includes an additional separate memo prepared by Bioresearches that describes an ecological impact assessment (a request made in the WCRC RFI). Pattle Delamore Partners Limited (PDP) has been engaged by WCRC to carry out a technical review of the RFI response documents. Our review is detailed in this memo.

There are seven individual questions in the WCRC RFI. Each of these is set out below (in bold) followed by comment on whether we consider the additional information provided by ENGEO or Bioresearches sufficiently addresses the question posed.

1. **Hydraulic conductivity estimates from onsite testing (pump testing and/or slug testing). If slug testing is used, then please provide testing data from at least 3 bore locations on the upper terrace surface.**

   ENGEO report they have carried out slug testing at three onsite groundwater monitoring bores (MB13, MB14 and MB19d). Based on analysis of the slug testing using the methodology of Bouwer and Rice (1976), ENGEO report hydraulic conductivity (K) values for the Pleistocene gravels ranging from 1.3×10^{-6} to 1.11×10^{-5} m/s (0.11 to 0.96 m/d).

   We note the use of bore MB19d for the testing is not considered ideal given the small screen interval and the location of much of the screen over the deep mudstone (although the filter pack around the screen extends into the gravelly strata). In addition, this bore is significantly upgradient of the proposed discharge location and we consider downgradient bores are more relevant to the proposal. We also note it is somewhat surprising that the analysis results from MB19d gave the highest values of K given the screen location in the mudstone.

   Despite the comments above, overall it is considered that the information provided has sufficiently addressed the first request of the RFI.

2. **Updated mounding and contaminant modelling simulations using the hydraulic conductivity estimates derived from the requested testing. Based on the testing results, please take into account that the results from testing (particularly slug testing) may provide local values for hydraulic conductivity but not necessarily be representative of the average hydraulic**

conductivity over the area of the landfill. Therefore, please provide multiple modelling simulations informed by the testing results using a realistic range of potential hydraulic conductivity values for the strata beneath the upper terrace surface (i.e. a sensitivity assessment based on varying the hydraulic conductivity that is informed by the testing results).

Mounding

ENGEO has carried out additional mounding calculations using a K value of 0.86 m/day. However, we note this value is at the higher range of values estimated from their slug testing analysis and is also significantly higher than the values derived from bore MB13 (values of 0.13 to 0.16 m/day), which is in close proximity of the proposed discharge location. Lower values of K will result in larger mounding and therefore the values estimated from testing in MB13 would result in higher mounding predictions. Given the location of the proposed discharge the K values from this bore are potentially more relevant. We also note the updated mounding assessment is based on a significantly larger infiltration area (20 m x 20 m instead of 10 m x 10 m in the original application) which will result in a very large excavation onsite.

ENGEO has not reduced the discharge volume for the new assessment (still 800 m^3/day), although in their response they state the anticipated infiltration capacity is on the order of 200 to 300 m^3/day. Therefore, the updated assessment appears to be inconsistent with the expected infiltration rate. The updated assessment predicts maximum mounding of over 8 m after a day of discharge, compared to the much lower mounding prediction of around 0.6 m in the original application. In addition, we note that our own calculations show the predicted mounding will continue to increase significantly for prolonged infiltration periods.

In late 2024, ENGEO indicated that an initial volume of 5,500 m^3 of water needs to be removed from the onsite retention pond, although we assume that volume may have increased since that time. Assuming this volume is still valid, then 6.9 days of continuous discharge would be required at a rate of 800 m^3/day to remove 5,500 m^3 from storage. Our calculations indicate this situation would result in over 20 m of mounding at the end of the discharge period. If the discharge rate is reduced to 200 m^3/day (in line with the infiltration capacity suggested by ENGEO) the mounding after 1 day reduces to around 4.5 m. However, to discharge 5,500 m^3 would require 27.5 days and result in around 12 m of mounding. Furthermore, if K is reduced to 0.13 m/day (as per the slug testing results from MB13), mounding based on discharging 200 m^3 in a day is over 9 m, while discharging that volume of water for 27.5 days results in predicted mounding of over 50 m.

Based on the low values of K estimated from the ENGEO slug testing, we have concerns that discharging the proposed quantities of water to ground will not be feasible, because the calculated mound heights are similar (some short-term dishcarge scenarios) or significantly greater (prolonged discharge scenarios) than the reported depth to water, which was measured at 7.9 m below ground level in monitoring bore MB13 (located closest to the proposed infiltration basin) at the time of the slug testing. Even for the situation where the proposed discharge rate is significantly reduced, it appears mounding could still be prohibitive, accentuated by the prolonged discharges that will be required. Further to the potential difficulties with disposing of the proposed quantities of groundwater to ground at the site, we assume that mounding of the scale predicted could potentially cause stability concerns (including within the landfill) on the terrace.

While ENGEO has addressed the request for additional mounding assessment, the results indicate that the discharge to ground may not be feasible.

Contaminant Modelling

ENGEO has provided updated RISC5 contaminant modelling using high and low K values estimated from their recent slug testing. Based on the information provided with the original short-term consent application, we understand the RISC5 modelling is based on a continuous discharge for 6 months. It isn't clear what discharge rate is used for the modelling, but we assume it is 800 m^3/day, as per the mounding assessments that have been provided. A groundwater gradient of 0.0018 m/m was assumed for the original modelling along with a K value of 84 m/day.

The updated modelling uses much lower values of K (0.11 m/day and 0.86 m/day) based on the slug testing results. We assumed the most recent modelling is also based on a volume of 800 m^3/day discharged continuously for 6 months. We note the outputs from the updated modelling show an assumed gradient of 0.018 m/m compared to 0.0018 m/m, but no reasoning is provided for this change.

The modelling results reported show that only aluminium and Nitrate-N have detectable concentrations at the inferred point of measurement, 310 m from the discharge location. However, for both parameters, the modelled concentrations have significantly reduced by around 3 to 4 orders of magnitude compared to the modelled source water at the point of discharge. The high hydraulic conductivity scenario indicates that peak concentrations at 310 m from the discharge occur around 13 years from the time of discharge, while the low hydraulic conductivity scenario takes around 100 years, or longer, for peak concentrations to occur. We note that the modelled peak concentrations are around an order of magnitude higher for the high hydraulic conductivity scenario compared to the low hydraulic conductivity scenario. This is generally at odds with what we would expect, as more dilution and dispersion would typically be expected to occur under a higher conductivity scenario.

We have concerns regarding the validity of the modelling results. It is stated by ENGEO that the modelling assumes no degradation along the flowpath and that contaminants will generally be attenuated through dilution and dispersion in the unconfined aquifer. However, we note that based on the range of K values estimated from the slug testing, the throughflow of groundwater beneath the terrace is very low. Assuming that groundwater flow occurs along a width of around 100 m (in reality we expect the width of aquifer impacting on the flow of contaminants is likely to be less) and the average thickness of groundwater in the gravel strata above the mudstone is 10 m, the cross-sectional area of groundwater flow beneath the terrace is only 1,000 m^2. Based on the highest modelled K value of 0.86 m/day and hydraulic gradient of 0.0018 m/m, the aquifer throughflow is only 1.55 m^3/day. For the lowest derived slug testing K value of 0.11 m/day, the throughflow is only 0.2 m^3/day. For a discharge of 800 m^3/day (considered unlikely to be feasible based on the mounding results), the potential for dilution of contaminant concentrations is negligible which seems inconsistent with the modelling results.

We also note that the modelling results predict much higher concentrations of Nitrate N in the output compared to Ammonia N (no concentration provided). This is despite the source concentration of Ammonia N (98 mg/L) being much greater than the source concentration of Nitrate N (6.5 mg/L) and the statement by ENGEO that the modelling assumes no degradation of contaminants.

Based on the low potential for dilution (but noting we have not carried out our own detailed modelling), we consider the modelling provided may not be reliable. To address these concerns, we would need either further explanation from ENGEO, or to carry out our own modelling to justify/confirm the large decrease in contaminant concentrations shown by the ENGEO modelling.

In addition to our concerns around the modelling, we consider it is possible these results may not represent the actual discharge that could occur, as the results of the mounding assessments indicate discharging large quantities of water to ground at the site may not be achievable.

3. **Updated contaminant modelling simulations using input parameters more consistent with high parameter concentrations that have been measured in leachate and wastewater.**

   As per the previous section, we have concerns around the validity of the modelling results and further information from ENGEO or additional modelling by PDP would be required to address our concerns.

4. **An ecological survey of the surface water features and aquatic habitat surrounding the site, including Noname Creek, the drain along Taylorville Road, including that part of the drain that begins at spring seep TCD1 and the streams on the southern side of Taylorville Road (excluding the Grey River) and an impact assessment on surface water quality and ecological values resulting from the proposed discharge.**

   An ecological impact assessment has been carried out by Bioresearches and summarised in a memo dated 7 February 2025. Bioresearches consider the ecological value of NoName Creek, the roadside drain originating at TCD1 and the Grey Tributary on the lower terrace surface below Taylorville Road is low based on the Ecological Impact Assessment (EcIA) Guidelines for use in New Zealand (Roper-Linkday et al., 2017).

   A review by PDP's ecology team would be required to confirm the results of the ecological assessment, however at this stage we have not carried out that review because we consider other effects assessments have not been adequately addressed. Our current view is that discharge to ground is unlikely to be feasible due to the low K soils underlying the terrace and the associated large mounding effects that are predicted to occur. In addition, we don't consider we have sufficient information to confirm the potential contaminant concentrations that may reach the surface water bodies in the area. We consider these two issues should be resolved before we review the ecological assessment, however our view is that the currently available information, presented in response to question 1, indicates that the proposed discharge to ground is unlikely to be feasible.

   Regarding contaminant concentrations, if it could be confirmed that ecological receiving water standards wouldn't be breached during discharge of the contaminants to ground, then the results of the ecological assessment are less critical. We do not think that the current information is sufficient to reach that conclusion, but if further work shows that to be the case, then the ecological work that has been carried out may be sufficient.

5. **A water quality comparison between water samples collected from the GDC water supply, the Grey River, groundwater upgradient of the landfill north of Taylorville Road and surface water samples collected at TRD2 and TRD4. The samples should include analysis for anions and cations and nitrogen species, in addition to other parameters sampled to date by TRPL. The purpose of the sampling is to inform whether the GDC water supply source is dominantly Grey River water and there is minimal input to the supply bores from upgradient groundwater and surface drainage.**

   ENGEO collected a water quality sample from the raw (untreated) water at the GDC treatment plant (sample PWT01), in addition to a sample from the Grey River upstream of the treatment plant and GDC supply bores (sample GR-01). The samples were analysed for a number of chemical parameters, including general water quality parameters, nitrogen species, dissolved metals and ions in solution.

The results for ions were compared to October 2024 results from samples collected from monitoring bores MB2s, MB2d, MB3, MB4d, MB14 and MB18 and plotted on an extended Durov diagram (Figures A5.2 and A5.3 of the RFI response). These figures are shown below. ENGEO notes that bores MB2s, MB2d and MB3 are cross gradient bores, while MB4d, MB14 and MB18 are downgradient bores with respect to the waste storage areas.

Figure A5.2 Extended Durov Class Scatter

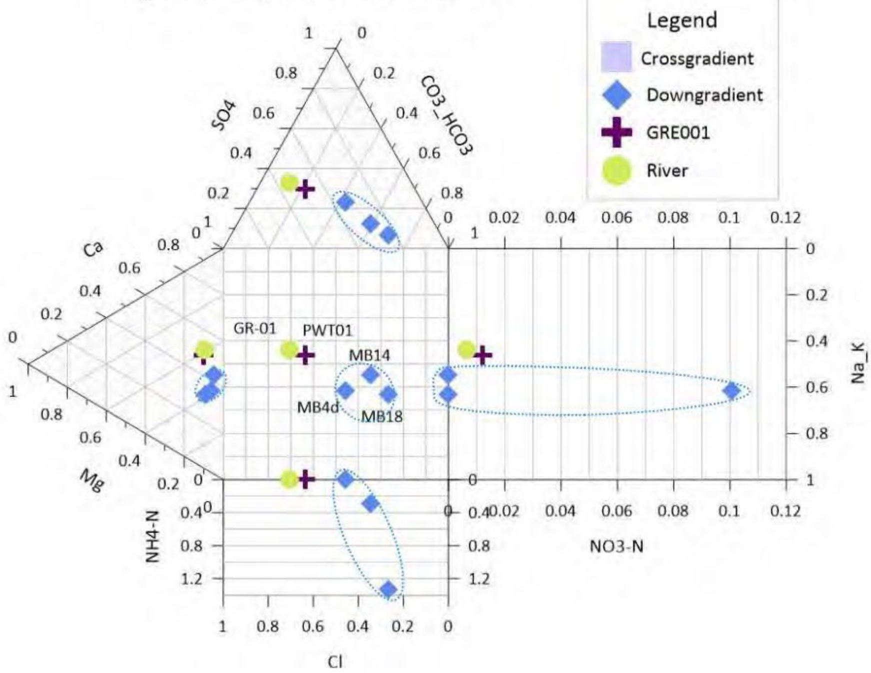
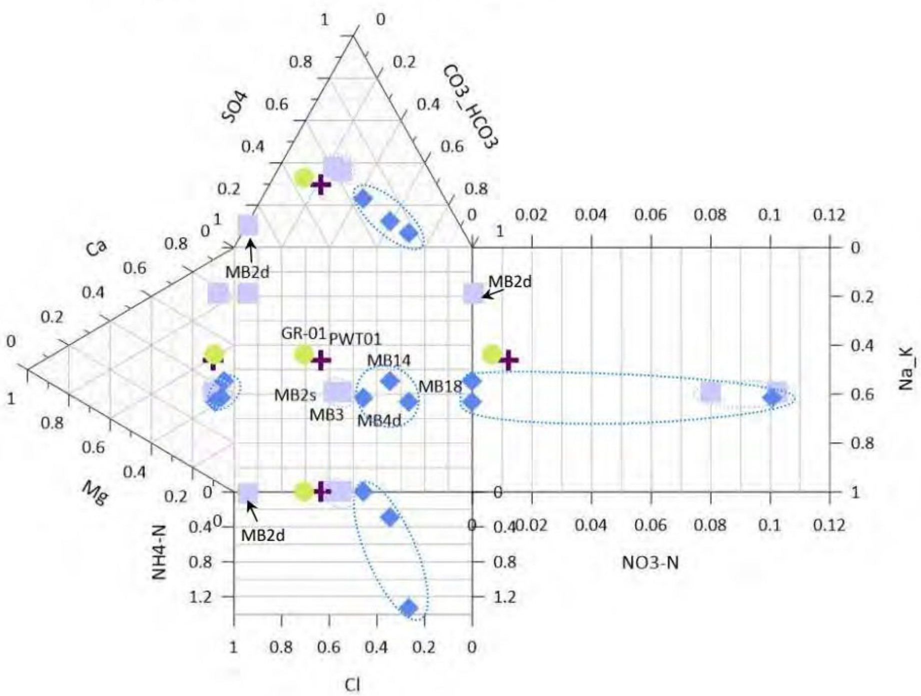


Figure A5.3 Extended Durov Class Scatter



As reported by ENGEO, samples PWT01 and GR-01 plot relatively closely together. This indicates similar water composition between Grey River water and the water in the GDC treatment plant, although they are not exactly the same. The Durov diagrams indicate some deviation in ion chemistry between downgradient groundwater samples and those collected from the Grey River and GDC treatment plant, however the treatment plant sample plots very slightly closer to the downgradient bores compared to the Grey River sample. There is more similarity between samples PWT01 and GR-01 and the cross-gradient bore samples compared with those from down-gradient locations, with the exception of sample MB2d, although the results from this bore may be affected by the screen being in the underlying mudstone beneath the terrace. Overall, based on the ion information provided by ENGEO, there is a relatively good match between raw GDC treatment plant water and Grey River water, although the GDC raw water does suggest some influence from the water chemistry in the groundwater monitoring bores on the terrace above Taylorville Road.

With regard to the results for other parameters, we note the sampling did not include analysis for all parameters previously sampled by TRPL as requested in the RFI. For example, samples PWT01 and GR-01 did not include analysis for dissolved aluminium, iron, manganese or DRP. Ideally, the samples at PWT01 and GR-01 would have been compared with new groundwater samples collected at the same time (rather than comparison with older samples) and we also note that comparison has not been provided with TRD2 and TRD4 as requested.

Furthermore, we note that concentrations of copper, lead and zinc in treatment plant sample PWT01 are unexpectedly high and exceed ecological guideline criteria, whereas Grey River sample GR-01 recorded all dissolved metals at concentrations below the laboratory detection level. Together with the slight deviation of sample PWT01 towards the groundwater bore samples, this potentially suggests an influence on water chemistry in the supply bores from the groundwater north of the river.

With regard to copper (0.193 mg/L) and lead (0.006 mg/L), the concentrations measured in PWT01 are particularly high compared to all other water samples presented in the applicant's information. Both of these parameters were measured in PWT01 at concentrations well above those measured by TRPL in upgradient groundwater and surface water. Furthermore, the dissolved copper and lead concentrations in PWT01 are also higher than those measured in any of the samples collected from wastewater or leachate to date at the landfill (highest concentration in leachate or wastewater of 0.058 mg/L for copper and 0.0024 mg/L for lead), although presumably these concentrations will vary depending on the different wastes that are being received at any particular time. While nickel and zinc were also detected/elevated in PWT01, higher (nickel) or very similar (zinc) concentrations have been measured previously by TRPL in upgradient groundwater bores.

The groundwater quality results from PWT01 and GR-01 potentially indicate that groundwater north of the Grey River may influence the chemistry of water taken for the GDC community water supply. This is despite the supply bores being situated immediately adjacent to the Grey River. We consider this is a significant finding and assuming these results are not due to some other factor (such as potential contamination within the treatment plant), this finding may potentially alter our previous assessment that there is a low risk to the water supply from the operation of the landfill. It would be helpful (and important) for the applicant to provide comment on the potential cause of the elevated concentrations of copper, lead, nickel and zinc in the water treatment plant sample.

6. Yield versus drawdown data from the GDC supply bores to confirm the gravel deposits immediately adjacent to the Grey River are of high permeability with a high hydraulic connection to the Grey River.

ENGEO has provided driller's logs for GDC bores BH01 and BH02 (two of the three GDC community drinking-water supply bores) and data from step-drawdown and constant rate pump testing in BH02. We note the McMillan Drilling report provided indicates that BH01 has been decommissioned and therefore we assume that the drilling and testing in BH02 was carried out to replace BH01.

The driller's log for BH02 describes 0.2 m of fill underlain by sand to 1.3 m below ground level (bgl) and gravel dominated strata (sandy gravel and gravel) thereafter to 8.8 m bgl. Silty clay hard mudstone was observed from 8.8 m to the base of the borehole at 10.5 m bgl. BH02 is screened between approximately 6 and 8.5 m bgl and the static water level in the bore following drilling was measured at 4.23 m bgl. In contrast, the driller's log for BH01 describes fill to 0.4 m bgl, clay to 0.8 m bgl, underlain by sandy gravel to 2.9 m bgl. A thick deposit of coarse sand (with gravels and cobbles) was encountered between 2.9 m and 8 m bgl, underlain by sandy gravel to 8.6 m and clayey gravel to 8.7 m bgl. Silty clay mudstone was encountered thereafter to the base of the borehole at around 10.8 m bgl. No bore construction details are provided for BH01, however based on the logs provided it is clear that large thicknesses of relatively fine-grained strata (sand and clay) was observed during drilling of this bore, which is likely to have negatively impacted on the potential yield that could be achieved.

Raw water level observations are also provided from BH02 during step-drawdown testing and constant rate testing in the bore, as well as pumping rate and sand ingress measurements. In addition, plots of these measurements are also provided, along with analyses of the step-drawdown testing data with associated estimates of K and transmissivity (T)) (provided by McMillan Drilling). Based on those analyses, ENGEO report that values for K of 3.42 x 10^{-2} m/s (2,955 m/day) and 1.58 x 10^{-2} m/s (1,365 m/day) were obtained. We have reviewed the analyses and consider these are not accurate estimates. However, it is clear that pumping from BH02 induces only low levels of drawdown in the bore. Measured drawdown of up to 1 m was measured in the bore at a flow rate of up to approximately 70 L/s.

It would be possible to carry out a more accurate analysis of the pumping test data provided to better estimate K and T, however we don't consider this is necessary as it is clear that operation of BH02 induces very little drawdown in the bore. Drawdown outside the bore casing can be expected to be less than that measured during the testing as additional well losses from turbulent head losses will occur within the bore casing. This information would typically suggest that operation of the GDC bores draws very large volumes of water directly from the Grey River. However, the elevated metals concentrations in sample PWT01 suggests there is still some other significant influence on the chemistry of water abstracted for the GDC water supply. As indicated in the previous section, we consider it will be important for the applicant to provide comment on the potential cause of the elevated concentrations of copper, lead, nickel and zinc in the water treatment plant sample.

7. XRD sample analysis from the Kaiata mudstone underlying the landfill to confirm clay mineralogy in the mudstone and confirm ENGEO comments that swelling within any fractures that may be present in the mudstone will block the transmission of groundwater via a facture network.

ENGEO has quoted previous XRD analysis (Leaver, 1999) from two Kaiata Mudstone outcrops on the west coast. Based on that data, they state the mineralogy of the Kaiata mudstone comprises a mixture of kaolinite, illite and vermiculite. They consider this minerology comprises a mixture of swelling and non-swelling clay minerals and therefore it is inferred there is negligible flow through defects due to clay swelling. ENGEO do consider there is the potential for preferential pathways through interbedded layers of non-clay materials (silts and sands), but that groundwater that intersects these layers will most likely be transported west-southwest, along the dip of the mudstone bedding planes and away from the GDC water supply.

A review of clay swelling behaviour indicates that kaolinite and illite don't appear to have high swelling ability. The swelling ability of vermiculite may be higher (but still not high), although is also highly dependent on temperature. In addition, there are other properties that affect the swelling ability of these clay minerals (for example pH, salinity and presence of cations) which haven't been discussed by ENGEO. We also note the sample results are from sites distant from the landfill and therefore may not be relevant to local conditions. Furthermore, ENGEO indicate there are layers within the mudstone that may not contain clay minerals, but in those cases groundwater flow will occur along the direction of bedding away from the GDC water supply bores. However, ENGEO has not provided any information to confirm there is no potential for fracture networks at other angles to the dip of the bedding. Based on the information provided, we are currently not satisfied there is no potential for groundwater flow in the direction of the GDC supply bores within fractures within the mudstone.

Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by West Coast Regional Council and others (not directly contracted by PDP for the work), including Planz, ENGEO and Biorearches. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of West Coast Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Prepared by

Carl Steffens

Technical Director – Water Resources

Site Memorandum

Project Name	Taylorville Resource Park		
Memo Topic	RC-2024-0122 and RC-2021-0097-V10 - RFI Response		
Memo Date	5 March 2025	**Date of Site Visit**	N/A
ENGEO Memo No.	09	**ENGEO Project No.**	26200.000.001
To	Taylorville Resource Park Ltd	**Copy**	Barker and Associates
Author	Lyn Nugent	**Reviewers**	Dave Robotham, James Thurber, Richard Justice

ENGEO has reviewed the memo prepared by PDP (Steffens, C [24 February 2025] to Michael Durand "*RE Technical Review – TRPL short-term consent to discharge contaminants to ground – RFI Response"*). The original queries (in grey) and ENGEO responses (in blue), reflecting comments by PDP, are provided below.

1. Hydraulic conductivity estimates from onsite testing (pump testing and/or slug testing). If slug testing is used, then please provide testing data from at least 3 bore locations on the upper terrace surface

PDP considers that the information provided by ENGEO sufficiently addresses this item of the RFI, with commentary regarding the results. We do note that the range of hydraulic conductivity values (1.05 x 10^{-5} m/s – 1.3 x 10^{-6} m/s) generally fall within one standard deviation of the mean, which suggests a small variance (good reproducibility) in the dataset. We further note the hydraulic conductivity values should not be interpreted as a precise measurement; rather, they represent a likely range of conductivity values, of which the most conservative should be applied (refer next item).

2. Updated mounding and contaminant modelling simulations using the hydraulic conductivity estimates derived from the requested testing. Based on the testing results, please take into account that the results from testing (particularly slug testing) may provide local values for hydraulic conductivity but not necessarily be representative of the average hydraulic conductivity over the area of the landfill. Therefore, please provide multiple modelling simulations informed by the testing results using a realistic range of potential hydraulic conductivity values for the strata beneath the upper terrace surface (i.e. a sensitivity assessment based on varying the hydraulic conductivity that is informed by the testing results).

PDP provided a lengthy response to the ENGEO assessment for this item. For brevity, we have consolidated their queries in our response.

Groundwater

PDP indicates that ENGEO applied a discharge rate of 800 m^3/d in the RISC model. To be conservative, we did not consider vadose (unsaturated zone) transport in our RISC model; as such, the discharge rate is not an input parameter (we refer to the model input summary in Appendix 3 of the ENGEO memo dated 30 January 2025).

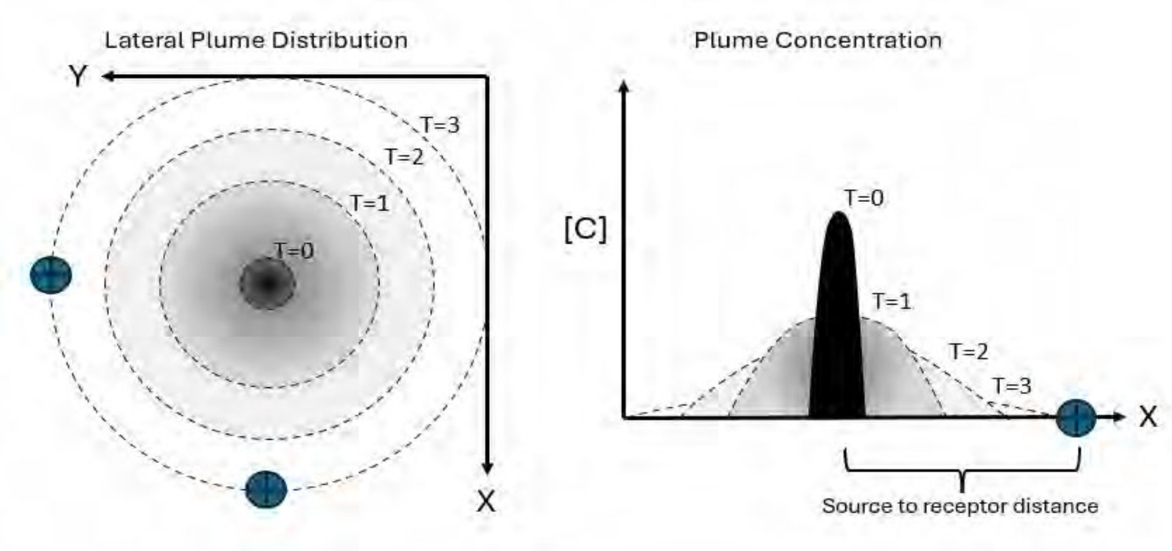
In our model we considered a saturated source with cross-sectional area measuring 80 m^2 (8 m thickness and 10 m width) and a length of 10 m.

PDP queried the change in inferred hydraulic gradient between the original modelling works (0.0018 m/m; ENGEO, 2024) and the updated modelling (0.018 m/m; January 2025). The hydraulic gradient was revised following the installation of additional monitoring wells in October 2024. This update was provided to WCRC in a memorandum prepared by ENGEO dated 6 November 2024.

PDP notes that they have not undertaken their own modelling but questions the validity of the ENGEO modelling results based on their expectation that the modelled peak concentrations should be inversely proportional to hydraulic conductivity (i.e., lower peak concentrations with higher hydraulic conductivity).

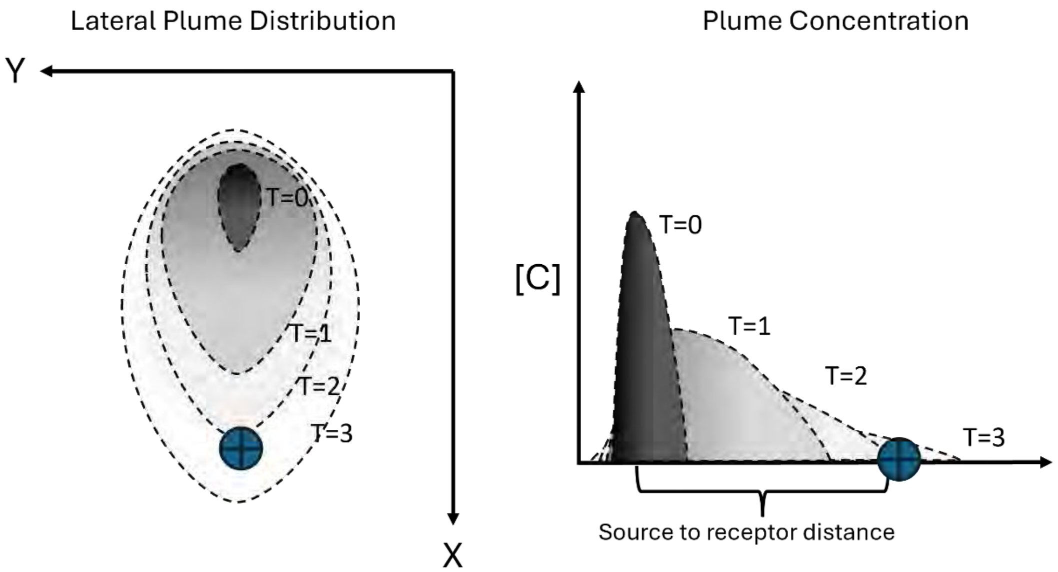
The movement of a contaminant plume is governed by groundwater flow (i.e., advection and dispersion) and short-range interactions between water molecules (e.g., concentration-dependent diffusion, Brownian motion) (Fetter, 2021). In a scenario with no water flow (K=0), a contaminant plume would uniformly migrate away from the source outward as the concentrations equilibrate due to short-range interactions. As such, the concentration (C) will be the same in all directions at a given radius. Figure 1 shown the migration of a plume with K=0 at multiple time steps (T=0, T=1, T=2, T=3).

Figure 1: Plume Migration at K=0



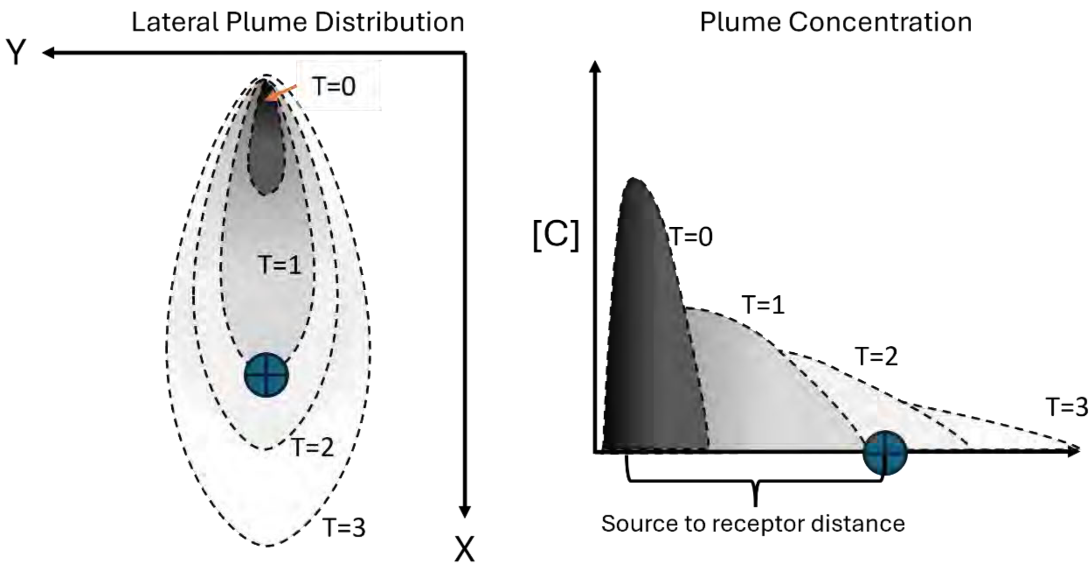
If groundwater flow is introduced and hydraulic conductivity is greater than zero (K_1), the plume will still diffuse due to short-range interactions; however, it will also elongate in the direction of flow (X) due to advection and spread laterally and vertically due to dispersion (refer Figure 2).

Figure 2: Plume Migration at K_1



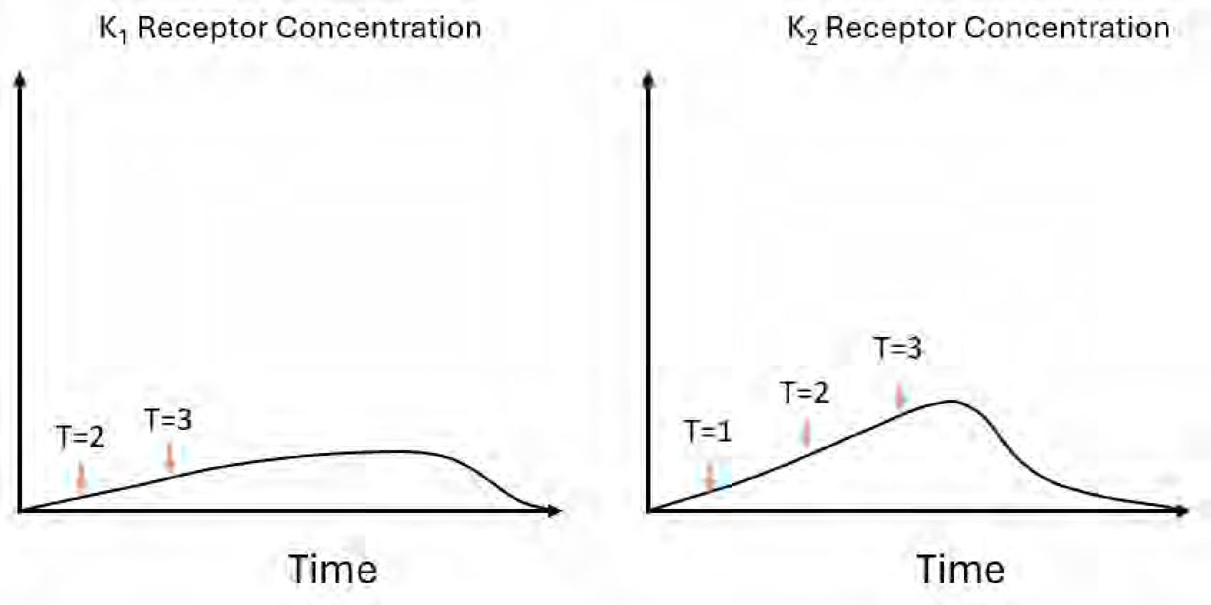
If the hydraulic conductivity is increased (K_2>K_1), the plume will further elongate in the direction of flow (X) and short-range interactions will become less significant (Figure 3).

Figure 3: Plume Migration at k_2



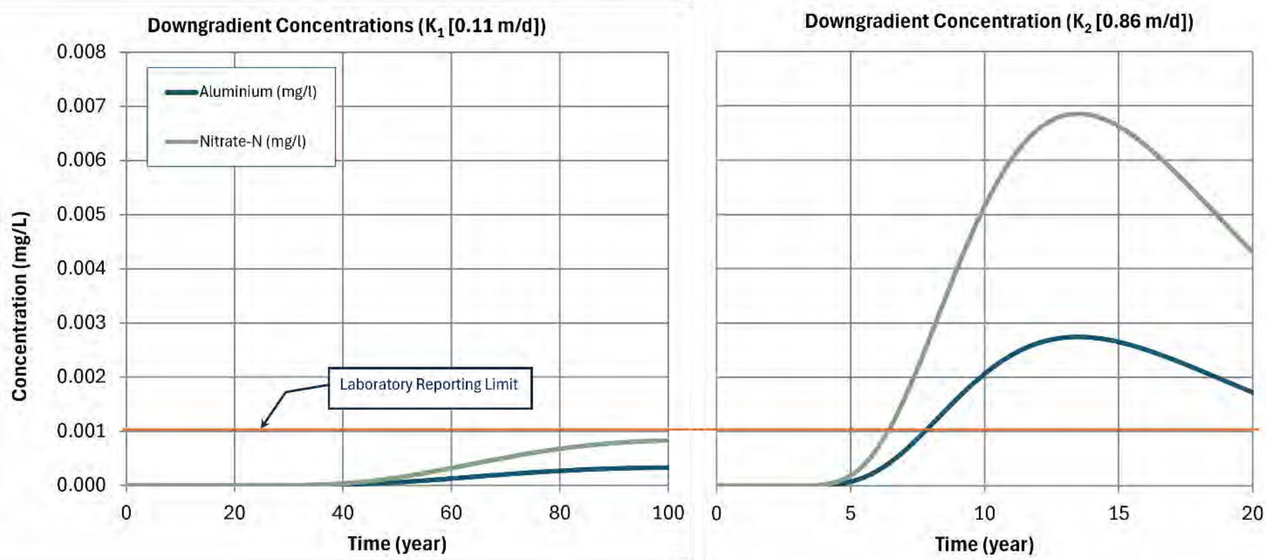
Note that in all scenarios, the mass of the contaminant in the plume at any time interval is constant. As such, with greater elongation the mass of contaminants in the plume will be more constrained in the lateral (Y) direction and concentrations will be higher along the flow axis. As shown in Figure 4, the downgradient effect will be that, as the hydraulic conductivity increases, the plume will reach the receptor sooner, the maximum concentration will be higher, and the plume will pass more quickly (noting that the source is a 6-month pulse so concentrations will not reach steady state).

Figure 4: Receptor Concentration with Time, where $K_1 < K_2$



This corresponds with the results provided in the ENGEO memo dated 30 January 2025 (Figure 5), which showed the concentrations at a point located directly 310 m downgradient of the soakage area.

Figure 5: RISC Modelled Downgradient Concentration at K_1 and K_2



Note: Concentration graphs have been excerpted and modified for relevance.

As demonstrated, when all other inputs (e.g., porosity) are held constant and there is no retardation, modelled peak concentrations should be proportional to hydraulic conductivity (i.e., lower peak concentrations with lower hydraulic conductivity).

Furthermore, we reiterate that the modelled concentrations in both scenarios (0.11 m/d and 0.86 m/d) are at least two orders of magnitude below the most conservative human or ecological health-based criteria (0.055 mg/L, aluminium [NZWQS 95%]; 11.3 mg/L, nitrate-N [NZDWS]).

The effect of dilution by upgradient groundwater will not be significant (i.e., relative to advection / dispersion) where there is no retardation. There will likely be some dilution from surface infiltration along the flow path, which will *reduce* concentrations; however, this was not considered in the model. The cross-sectional area of the aquifer is not germane.

In summary, the findings reported in the ENGEO memo dated 30 January 2025 are valid and consistent with anticipated results related to a change in hydraulic conductivity. Furthermore, the hydraulic conductivity applied in the ENGEO model (0.86 m/d) is a conservative estimate from the slug testing and, even under this scenario, the maximum modelled contractions at the boundary are either not detectable or orders of magnitude below the human or ecological-health based criteria.

Mounding

The predicted maximum mounding is based on a conservative scenario whereby the mound extends from the water table up to the base of the soakage area (saturated conditions below the soakage area). As stated in the ENGEO memo dated 21 November 2024, the anticipated infiltration of the soakage is on the order of 200 m^3/d – 300 m^3/d. We acknowledge that the length and width of the basin bottom (10 m x 10 m) were not halved when the dimensions were input into the model. The corrected Hantush model (Hantush, 1967) is included in Appendix 1. As shown, correcting the dimensions of the soakage area resulted in a 58% *reduction* to the mounding height while still allowing for a daily discharge of 200 m^3/day.

As noted in our letter dated 30 October 2024, the actual discharge volumes will vary and depend on the infiltration capacity in the soakage area, rainfall, and evaporation rates. Uncertainties related to the infiltration rate do not present a potential risk to off-site receptors, as they can be managed through conditions of consent. WCRC has been provided with proposed conditions of consent (Cook, K [25/11/24] email to Michael Durand *"RE: RC-2024-0122 – s92 response"*) to address uncertainties relating to the infiltration rate, specifically:

12	Discharging shall be undertaken at a rate that is no greater than the infiltration capacity of the soakage area, with a *maximum* discharge rate of 800 m^3/day.
14	The soakage area shall maintain a freeboard of *at least* 0.5 m. If the rate of discharge is such that a 0.5 m freeboard cannot be maintained, the flowrate shall be reduced to a rate that maintains a *minimum* 0.5 m freeboard.

In summary, we do not agree with the PDP statement that the results of the mound modelling indicate that discharge to ground may not be feasible. While ENGEO concurs that the soakage area may not be able to accommodate the maximum discharge of 800 m^3/d, it will still be able to receive discharges to achieve the application objectives without causing a *greater than minor* offsite effect.

3. Updated contaminant modelling simulations using input parameters more consistent with high parameter concentrations that have been measured in leachate and wastewater.

PDP considers that additional information is required to assess the validity of the modelling results. The above section addresses PDP queries.

4. An ecological survey of the surface water features and aquatic habitat surrounding the site, including Noname Creek, the drain along Taylorville Road, including that part of the drain that begins at spring seep TCD1 and the streams on the southern side of Taylorville Road (excluding the Grey River) and an impact assessment on surface water quality and ecological values resulting from the proposed discharge.

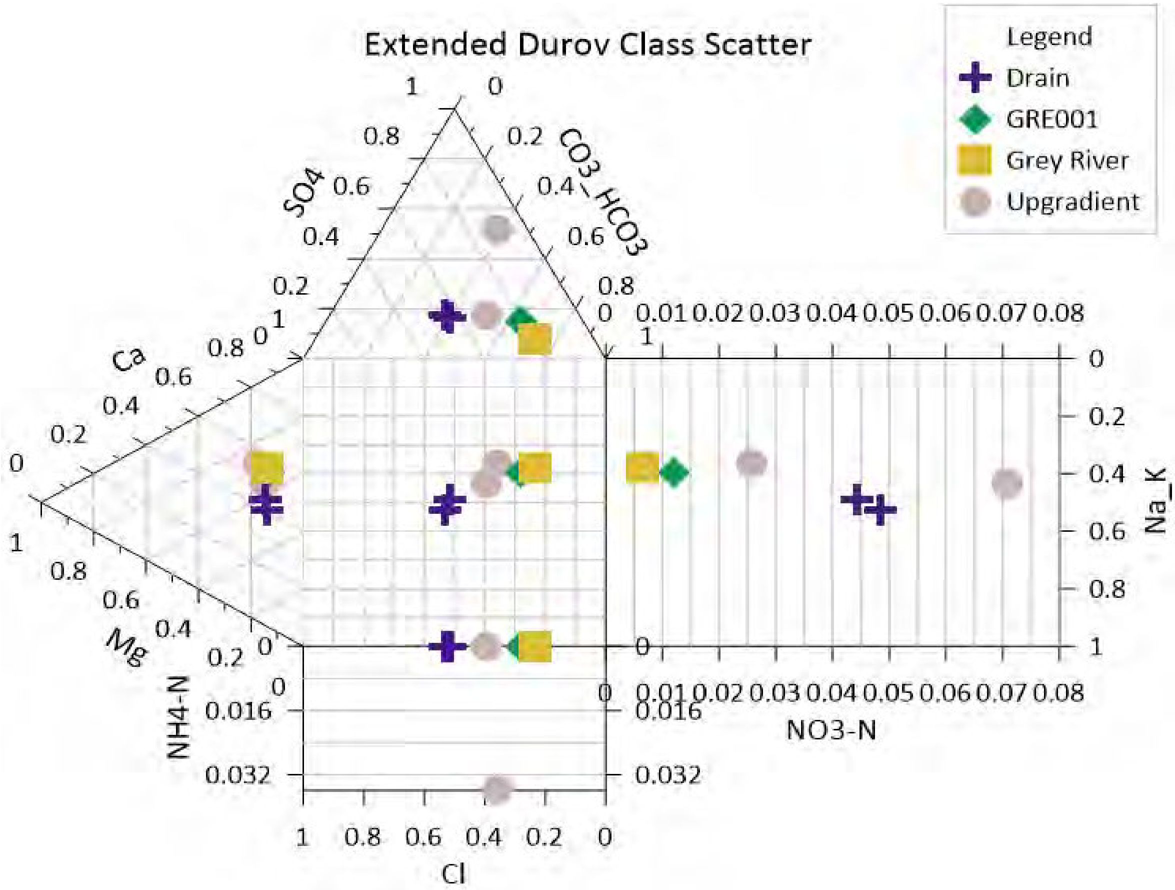
PDP has not reviewed the ecological impact assessment prepared by Bio-researchers.

5. A water quality comparison between water samples collected from the GDC water supply, the Grey River, groundwater upgradient of the landfill north of Taylorville Road and surface water samples collected at TRD2 and TRD4. The samples should include analysis for anions and cations and nitrogen species, in addition to other parameters sampled to date by TRPL. The purpose of the sampling is to inform whether the GDC water supply source is dominantly Grey River water and that there is minimal input to the supply bores from upgradient groundwater and surface drainage.

PDP notes that samples collected from TRD2 and TRD4 were not included in the comparison. We have revised our plot (Figure 6) to include only upgradient bores (MB1, MB19s), the Grey River (GR-01), untreated water for the GRE001 supply (PWT01), and the requested drain locations (TRD2 and TRD4). The drain locations were excluded from the original assessment due to the influence of other inputs along Taylorville Road and because water quality in samples collected from monitoring bores MB4, MB14, and MB18 are more relevant to assess inputs from the operations.

We refer to Figure A5.1 of the 30 January 2025 memo for sample locations.

Figure 6: Durov Plot of GRE001 Water and Upgradient Locations



As shown, the water sample from untreated water from the GRE100 supply (◆) plots most closely with the sample collected from the Grey River (■) with some similarity to upgradient groundwater (●).

We note that there is another deposit of the Pleistocene gravels (on the south side of Taylorville Road) that is not hydraulically connected to the subject site (ENGEO, 2024). Considering that ambient groundwater quality is likely similar in both deposits and the abstraction area is located approximately

100 m due south of the deposits on the south side of Taylorville Road, it is inferred that groundwater discharges from these deposits may be influencing water quality in the abstraction gallery, rather than waters from upgradient of the site.

The sample collected from the untreated water at the GRE001 water supply was most dissimilar to the samples collected from the drain adjacent to the site (✚).

PDP notes that, compared to water samples collected from downgradient of the operations, there is more similarity between the water sample collected from the raw (untreated) water at GRE001 (PWT01), the Grey River approximately 300 – 400 m upstream of GRE001 (GR-01), and water samples collected upgradient of the operations. As stated in the ENGEO memo date 30 January 2025, this is to be expected as all samples were collected from the same catchment.

In the ENGEO memo dated 30 January 25, it was noted that concentrations of dissolved metals (copper, lead, nickel, zinc) in the sample collected from the GRE100 supply (PWT01) differed significantly from the sample collected from the Grey River (GR-01) and samples collected along the southern site boundary. PDP states that, unless the applicant can identify another potential cause of the elevated metals, it may be interpreted that these concentrations are due to landfill operations.

We note that the concentrations detected in PWT01 are higher—by several orders of magnitude—than *any concentrations recorded* in water samples collected from Taylorville Road Drain, locations in the water treatment system, or monitoring bores located downgradient of the operations (ENGEO, 2024) (ENGEO, 2025). As such, there is no basis to suggest that the concentrations of dissolved metals in PWT01 are related to the operations.

It is beyond the scope of the proposed works to require the applicant to undertake a detailed investigation of all potential inputs to the GDC abstraction gallery which, as has been noted (ibid), is upgradient of the operations.

As stated in the memo dated 30 January 2025, it is inferred that concentrations in PWT-01 are naturally occurring (e.g., concentrations in the Holocene gravels) or due to the influence of waters originating at another (offsite) source area.

6. Yield versus drawdown data from the GDC supply bores to confirm the gravel deposits immediately adjacent to the Grey River are of high permeability with a high hydraulic connection to the Grey River.

ENGEO analysed pumping test data provided by GDC using published and industry accepted methods (Boulton [1963], Neuman [1975]) and hydrogeological software (Aquifer Test 11.0) to estimate hydraulic conductivity in the Holocene gravels.

PDP states, without details, they do not consider that these are accurate estimates; however, they do not consider further analysis necessary as there was very little drawdown in the bore.

ENGEO notes only that these estimates are consistent with a variety of published estimates for unconsolidated gravels (Fetter, 2021).

7. XRD sample analysis from the Kaiata mudstone underlying the landfill to confirm clay mineralogy in the mudstone and confirm ENGEO comments that swelling within any fractures that may be present in the mudstone will block the transmission of groundwater via a fracture network.

As stated in the memo dated 30 January 2025, XRD analysis of two mudstone outcrops show that it is comprised of a mixture of swelling and non-swelling clay minerals. PDP maintains that there is still potential from migration from the site to the GRE100 supply bores through fracture flow in the mudstone.

There is no confining pressure at the site or natural force that will cause significant quantities of groundwater to migrate vertically from the Pleistocene gravels into the mudstone—which has a hydraulic conductivity that is lower by orders of magnitude—much less induce it to migrate hydraulically upgradient via fracture flow.

Regardless of the extent of investigations, due to natural heterogeneity and uneven stress / strain placed on rock formations, it is not feasible to disprove the *possibility* of fractures that trend in the direction from the site to the GRE001 abstraction bores and that fractures (if any) could *possibly* transmit minute quantities of water along a 300–400 m flowpath. However, based on the presence of swelling clays and absence of observable fracturing, we consider this a *highly unlikely* migration pathway.

We note that the threshold for the purpose of processing the application is not to prove a null hypothesis; it is to assess the likelihood of a *greater than minor* deleterious effect, and that the applicant is being asked to provide evidence that far exceeds the scale and significance of the proposed activity.

To consider potential effects, we used Darcy's Equation (Q=KiA) to calculate an estimated daily flow (Q) of groundwater from upgradient onto the site that is on the order of 50 m^3/day[1]. In correspondences from GDC to the West Coast Regional Council (Lane, L [19 January 2024] to Chris Barnes, *"RE: Flow Rate Compliance Report"*), GDC reports an average flow rate from the GRE001 abstraction bores (8,513 m^3/day) that is 170 times higher than the *total flow* of groundwater across the site.

In summary, it is considered *highly unlikely* that groundwater from the site will migrate through the mudstone from the site to the abstraction bores and, noting the relative flow rates, it is *highly unlikely* that any incidental migration would be detectable or have a *greater than minor* effect.

Based on our assessment works to date and in conjunction with the proposed conditions of consent, it is deemed ***highly unlikely*** that the proposed discharges will have a deleterious effect on human or ecological health.

[1] Estimated using the hydraulic conductivity (K=1 x 10^{-5} m/s), the hydraulic gradient (i=0.018), and the approximate cross-sectional area of the saturated aquifer perpendicular to flow between the head of Noname Creek and the extent of the Pleistocene gravels (A=3,000 m^2–3,600 m^2; refer Figure 6.)

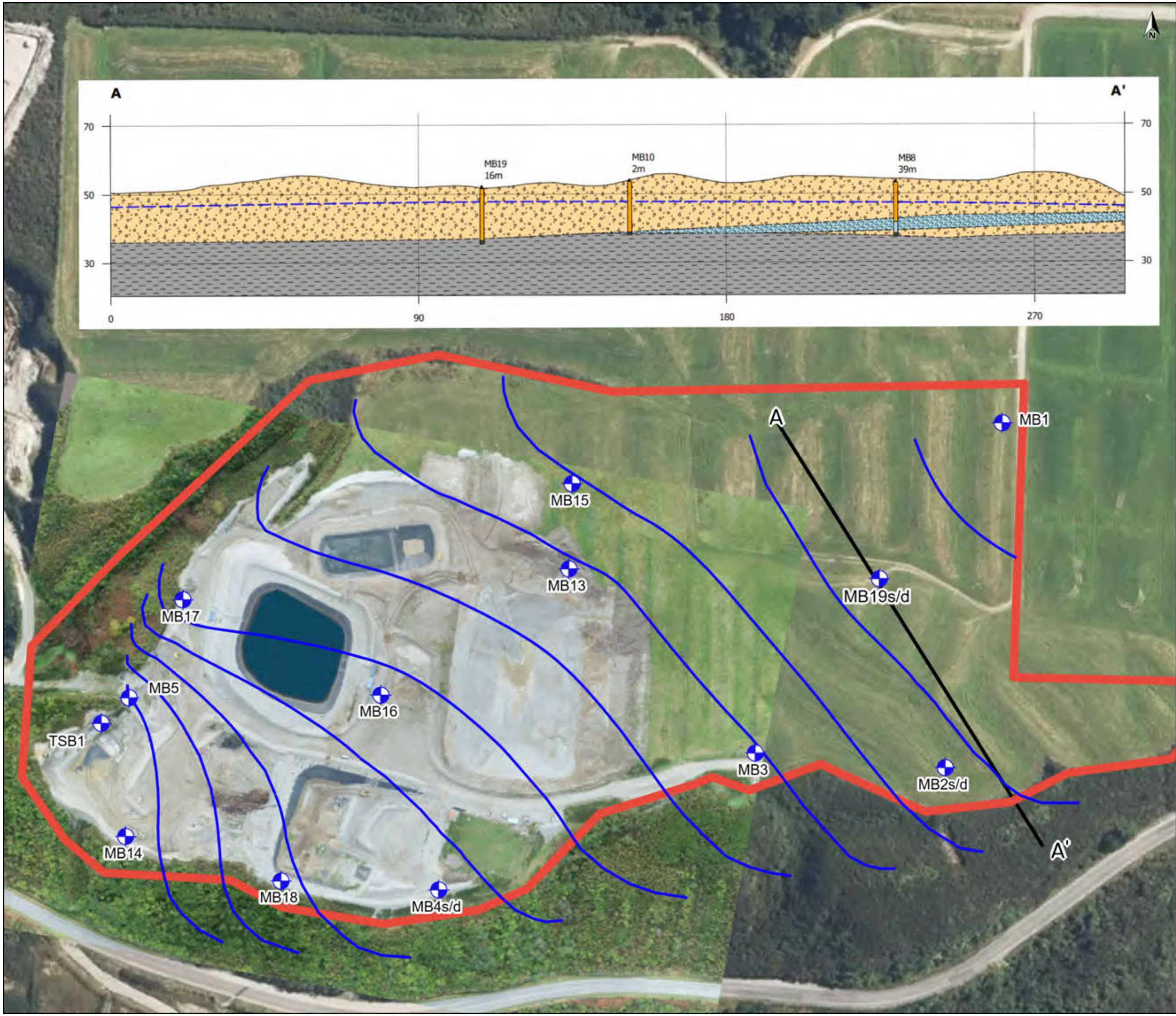
References

ENGEO. (2024). *Preliminary Hydrogeological Assessment.* Job No. 26200.000.001: Prepared for TRPL.

ENGEO. (2025). *2024 Annual Report.* Job No. 26200.000.001: Prepared for TRPL.

Fetter, C. (2021). *Applied Hydrogeology.* Upper Saddle River, NJ: Prentice-Hall, Inc.

Hantush, M. (1967). Growth and Decay of Groundwater Mounds in Response to Uniform Percolation. *Water Resources Journal (3)*, 227-234.



Legend

- A-A' Cross Section (2x scale)
- Monitoring Well Locations
- Inferred Groundwater Contour Lines
- Approximate Site Boundary
- Line of Cross Section

0 50 m 100 m

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ENGEO

Produced by **Datanest.earth**

Title: Pleistocene Aquifer Cross Section		
Client: Taylorville Resource Park Ltd		Size: A4
Project: Taylorville Resource Park	Drawn: LN	Figure No.: 6
Date: 21-01-2025	Checked: DR	
Proj No: 26200.000.001	Scale: 1:3068	Version: 1.0

APPENDIX 1

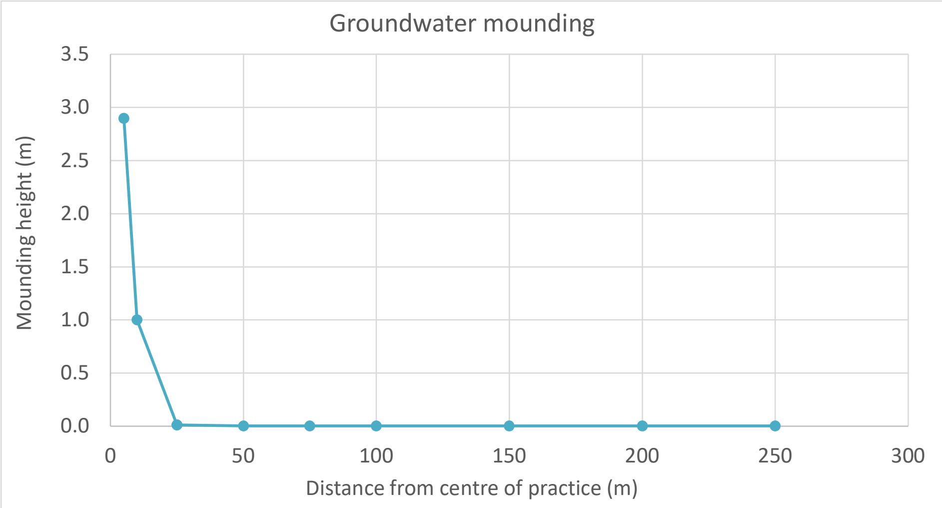
Corrected Hantush Model

This spreadsheet will calculate the height of a groundwater mound beneath an stormwater infiltration BMP.
More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102
"Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

Go to the USGS report

	Input Values	
Recharge (infiltration) rate (m/day)	*2.000*	*R*
Specific yield, S_y (dimensionless)	*0.190*	Sy
Horizontal hydraulic conductivity, K_h (m/day)	0.860000	K
1/2 length of basin (x direction, in m)	5.0	x
1/2 width of basin (y direction, in m)	5.0	y
Duration of infiltration period (days)	1	t
Initial thickness of saturated zone (m)	8.0	hi(0)

CALCULATE



Distance from center of infiltration BMP (m)	Ground-water mounding (m)
5	2.90
10	1.00
25	0.01
25	0.01
50	0.00
75	0.00
100	0.00
150	0.00
200	0.00
250	0.00

IF YOU CHANGE THE SCALE OF THE DISTANCE MEASUREMENTS (OR ANY OTHER PARAMETER), YOU MUST RECALCULATE!!

Site Memorandum

Project Name	Taylorville Resource Park		
Memo Topic	RC-2024-0122 and RC-2021-0097-V10 - RFI Response		
Memo Date	17 March 2025	**Date of Site Visit**	N/A
ENGEO Memo No.	10	**ENGEO Project No.**	26200.000.001
To	Taylorville Resource Park Ltd	**Copy**	Barker and Associates
Author	Lyn Nugent	**Reviewers**	Richard Griffiths Neil Charters

ENGEO attended discussions with the West Coast Regional Council (WCRC) on 7 March 2025, to discuss further information requested by WCRC in relation to resource consent application RC-2024-0012. WCRC has requested additional information related to the further information request issued by WCRC (dated 21-Oct-24) under Section 92(1) of the Resource Management Act 1991. WCRC queries are shown in grey, with ENGEO responses are shown in blue.

1. Will mounding beneath the soakage area affect slope stability?

Infiltrating water beneath the soakage area may mound to an elevation that intersects with the base of the soakage area, which will be approximately 8 m above the current water table. The rate of infiltration will be limited by the vertical hydraulic conductivity in the Pleistocene gravels. As the gravels are not bedded, we assume a relatively isotropic formation, meaning that the horizontal conductivity is likely very similar to the vertical and the extent of mounding will be proportionally limited (i.e., the formation will not accept more water than it can disperse).

Our conservative mounding estimate (Appendix 1) shows the lateral extent of any mounding will be limited to a radius of ~20 m beyond the infiltration basin. Beyond that distance, the mounding effect will be significantly less than the inferred seasonal variability of the water table (< 4 cm).

The proposed soakage area is located approximately 100 m away from the head of Noname Creek and approximately 150 m away from the extents of the Pleistocene gravels, which demarcate the nearest sloping ground. This negligible groundwater response from mounding will not increase the risk of slope instability.

As noted in our letter dated 30 October 2024, the actual discharge volumes will vary and depend on the infiltration capacity in the soakage area, rainfall, and evaporation rates. Uncertainties related to the infiltration rate do not present a potential risk to offsite receptors, as they can be managed through conditions of consent. WCRC has been provided with proposed conditions of consent (Cook, K [25/11/24] email to Michael Durand *"RE: RC-2024-0122 – s92 response"*) to address uncertainties relating to the infiltration rate, specifically:

12	Discharging shall be undertaken at a rate that is no greater than the infiltration capacity of the soakage area, with a maximum discharge rate of 800 m3/day.
14	The soakage area shall maintain a freeboard of at least 0.5 m. If the rate of discharge is such that a 0.5 m freeboard cannot be maintained, the flowrate shall be reduced to a rate that maintains a minimum 0.5 m freeboard.

2. Provide updated contaminant modelling showing a scenario with no retardation.

Updated modelling is attached in Appendix 2. As shown, even in a high hydraulic conductivity (K=0.86 m/d) scenario with no attenuation / degradation and no retardation (K_d/K_{oc}=0), and using the maximum concentrations detected at the site, concentrations at the downgradient boundary will not exceed the Drinking Water Standards for New Zealand (DWSNZ) or the Australian and New Zealand Guidelines for Fresh and Marine Water Quality default guideline values (DGVs) for 90% protection of freshwater species. This modelling is based on several conservative assumptions:

- The concentrations of the discharges will be equivalent to the highest concentrations ever recorded at the site (e.g., undiluted leachate from Cell C in July 2023);
- There will be no interactions between contaminants and aquifer materials (e.g., inert aquifer media);
- There will be no interactions with organic matter in the Pleistocene gravels; and
- There will be no nitrification / oxidation along the flow path.

These assumptions overestimate the actual anticipated, detectable concentrations at the boundary for several reasons:

- The modelled concentrations were undiluted and have not been detected in over a year. They were likely related to the discharge of greenwaste (i.e., tomato plants) in Cell C (January 2023). Waters in the retention pond (waters proposed for discharge) are significantly lower due to treatment (flocculation), aeration, and dilution with stormwater.
- Site-specific Kd values have been developed for heavy metals (Table 1); as shown, the mobility is generally classified as slightly mobile to immobile.
- We have not quantified partition coefficients for nitrogen compounds; however, there may be some adsorption to the substrate media. Based on field measurements (e.g., redox, dissolved oxygen) and laboratory results (Appendix 3), the subsurface conditions are suboxic near the proposed soakage area and become oxic as water moves downgradient towards the Pleistocene gravels, indicating that conditions are favourable to nitrification, which would reduce the concentration of ammoniacal-N.

This demonstrates it is *highly unlikely* that discharges will have a *greater than minor effect* at the downgradient property boundary.

WCRC has been provided with proposed conditions of consent (Cook, K [25/11/24] email to Michael Durand *"RE: RC-2024-0122 – s92 response"*) to address uncertainties relating to concentrations in discharges and the fate and transport of determinands in discharge waters, specifically:

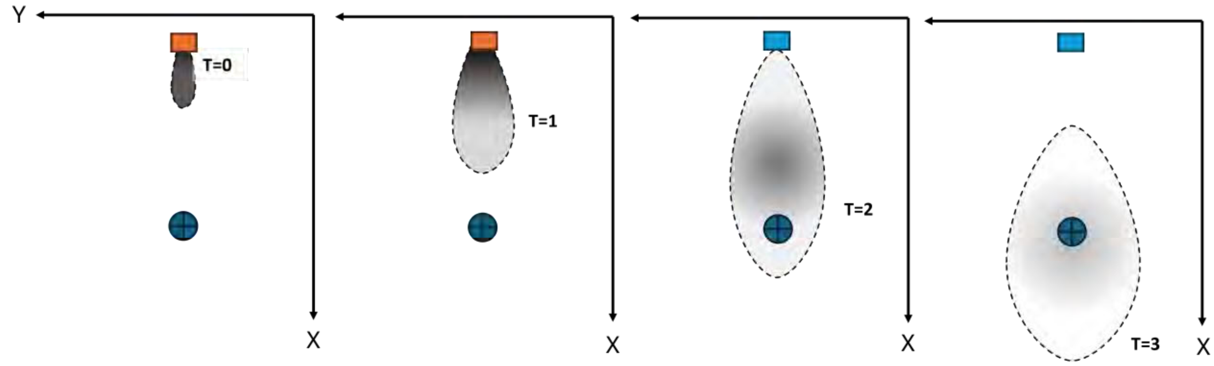
17	Prior to the commencement of discharges, baseline groundwater samples shall be collected from monitoring bores MB13 and MB15 and analysed for the following determinands: • Sum of Anions • Sum of Cations • An/Cat balance (%) • pH • Total Alkalinity • Bicarbonate. CO3, CO2 • Total Hardness • Electrical conductivity (mS/m) • Dissolved aluminium • Total aluminium • Dissolved calcium • Dissolved iron • Total iron • Dissolved magnesium • Total magnesium • Dissolved manganese • Total manganese • Dissolved potassium • Dissolved sodium • Chloride • Total Ammoniacal-N • Nitrite-N • Nitrate-N • TKN • Total-N • Total-P • DRP • Sulphate • cBOD5 • Total and dissolved heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc)
18	For six weeks following the commencement of discharges, groundwater samples shall be collected at 2-week intervals from monitoring bores MB13 and MB15 and analysed for the determinands in Condition 17.
19	Following the two-weekly groundwater monitoring described in Condition 16 groundwater samples shall be collected at monthly intervals for the duration of discharges from monitoring bores MB13 and MB15 and analysed for the determinands in Condition 17.
20	Following each monitoring round described in Conditions 18–19, groundwater analytical results shall be compared to the baseline concentrations (refer Condition 17). If the *change* in groundwater quality exceeds 50% of the New Zealand Drinking Water Standard (NZDWS), discharges shall cease and the actions in Condition 21 shall be implemented.
21	If the *change* in groundwater quality at monitoring bores MB13 or MB15 exceeds 50% of the NZDWS, the Applicant shall: Cease discharges to the soakage area; Notify the WCRC Group Manager – Regulatory & Policy; Engage a Suitably Qualified and Experienced Practitioner (SQEP) to Assess if the change in groundwater quality at MB13 and MB15 is due to discharges or other (e.g., upgradient water quality) factors; Characterise the potential offsite effect of changes due to changes in water quality on likely human and ecological receptors; If necessary, develop a revised monitoring programme at downgradient monitoring bores and develop mitigation measures; and Prepare a Response Plan for submission to the WCRC.

22	All groundwater quality monitoring results shall be provided to the WCRC Group Manager – Regulatory & Policy within one week of them being received in an electronic format, suitable for automatic upload to a water quality database. At the conclusion of discharges, a summary email will be prepared for the WCRC that includes: Estimated total volume of discharges Tabulated analytical results and a trend analysis Exceedances of Condition 20 criteria and any mitigation actions

3. How will a pulse source (six-month discharge) affect the mass flux of contaminants or concentrations at the receptor?

The plume maximum will extend downgradient from the source area, with a stable source area for the duration of discharges (Figure 1). However, the concentrations will not achieve steady-state conditions and, once the discharges cease, the maximum concentration will be transported downgradient and reduced due to minute differences in flow velocity (Hemond, 2000). The total mass of contaminants in the plume will be the same as the mass of contaminants discharged (excluding degradation / attenuation / decay). Concentrations at the receptor are provided in Appendix 2.

Figure 1: Plume Migration with a Pulse Source at Different Time Intervals



Note: Source area discharging at T=0 and T=1 (orange rectangle), no discharges from the source area at T=2 and T=3 (blue rectangle). Downgradient receptor shown as a blue circle.

4. Provide additional comparison between water collected at the GRE001 supply (PWT01), the Grey River (GR-01), Taylorville Road drain locations (TRD1—TRD5), upgradient groundwater monitoring bores (MB1, MB19s/d) and locations downgradient of the operations.

As discussed in our memos dated 30 January and 5 March 2025, concentrations of heavy metals in the sample collected from PWT-01 are higher—by several orders of magnitude—than any concentrations recorded in water samples collected from:

- Taylorville Road drain
- The water treatment system, or
- Monitoring bores located downgradient of the operations.

To further assess for any potential contributions from the site to the sample collected at the GRE001 supply, we compared the analytical results for copper, nickel, lead, and zinc in all samples collected during the January 2025 monitoring round (Table 2). While dissolved metals concentrations are more applicable for this migration pathway, we have considered concentrations of both total and dissolved metals.

The ternary diagrams in Appendix 3 show that the proportions of metals in the sample collected at PWT-01 are significantly different from any groundwater samples collected at the site (upgradient and downgradient), Taylorville Road drain, the Grey River and the river tributaries.

The solubility of heavy metals is dependent on the pH and presence of anionic species (e.g., hydroxide, sulphate); however, in general, at a neutral pH (7), the copper will be relatively insoluble followed by zinc, lead, and nickel (most soluble) (Karimi, 2017) (Lewis, 2010) (MacBerthouex, 2019) (Brezonik, 2011). If the concentrations at PWT-01 originated from any of the other sample locations, the proportion of soluble metals (e.g., nickel) would be higher than insoluble (e.g., copper) relative to the source; however, the inverse condition exists.

We also compared the concentrations of the target heavy metal determinands (Appendix 3). As shown, the absolute and relative concentrations of heavy metals in the sample collected from PWT-01 do not resemble those in *any other sample collected*. This is additional to the fact that there is no mechanism that would cause metals concentrations from the site to concentrate by orders of magnitude on the flow path from the site to the abstraction bores.

This demonstrates that there is no basis to suggest that the concentrations of total and dissolved metals in PWT-01 are related to the operations and it is beyond the scale and significance of the proposed works to require the applicant to undertake additional sampling or investigation works.

WCRC requested a review of the Durov scatter plots to explain differences in the plot provided on 30 January and the plot provided on 5 March 2025. Both plots were based on the sample dataset; however, the plotted samples differed between the two memoranda. The original plot did not include samples from the upgradient bores and Taylorville Road drain locations, but did include downgradient / cross gradient bores. In accordance with WCRC's request of 25 February 2025, the plot was updated to include only upgradient bores (MB1, MB19s), the Grey River (GR-01), untreated water for the GRE001 supply (PWT01), and the requested drain locations (TRD2 and TRD4). We do note that the axis titles for the anions were incorrectly placed in the figures provided on 30 January; this was corrected in the 5 March memorandum.

5. WCRC/PDP is not satisfied that swelling within any fractures that may be present in the mudstone will block the transmission of groundwater via a fracture network.

We understand this question is essentially in relation to a concern that contaminated groundwater may be able to travel below / downgradient of the soakage area to the GDC supply bores through fractures in the mudstone.

We have drawn up a cross section from the supply bores to the landfill (Figure 2). We consider it *highly unlikely* that fracture flow of potentially contaminated groundwater (if any) will have a *greater than minor effect* on users of the GRE001 water supply based on the following rationale:

- Previous investigations (Golder and Associates, 2005) (Bishop, 2004) estimated the horizontal hydraulic conductivity of the Kaiata Mudstone (1×10^{-8} m/s), with an inferred ratio of horizontal to vertical conductivity of at least 10:1 (Domenico, 1990). Based on field observations made by ENGEO along exposures of the Kaiata Mudstone, the formation is massive with little evidence of fracturing.

- The measured hydraulic conductivity in the overlying Pleistocene gravels is higher by 2–3 orders of magnitude (1×10^{-5} m/s–1×10^{-6} m/s). There is no confining pressure at the site or natural force that would cause significant quantities of groundwater to migrate vertically from the much higher permeability Pleistocene gravels into the lower permeability mudstone.

- Flow from the discharge area to the abstraction bores would require a *highly unlikely* scenario which would need to involve:
  - Discharges from the soakage area migrating vertically (perpendicular to the flow of groundwater) to the mudstone, **and**
  - The discharges encounter a fracture(s) that runs perpendicular to the regional orientation of mapped faults (northeast–southwest) and are connected along the 300–400 m flow path to the abstraction wells, **and**
  - The fractures do not intersect with any preferential pathways in the bedding planes in the mudstone and travel west-southwest along the dip direction, **and**
  - The fractures have an angle(s) that will cause them to daylight near the abstraction bores (i.e., and not in the road cut or the banks of the Grey River channel), **and**
  - The mudstone does not contain swelling clays at an adequate proportion to hinder the flow of groundwater, **and**
  - The discharges are not diluted by any other groundwater flowing through the mudstone; **and**
  - The discharges are not captured or diluted by groundwater flow in the Holocene gravels, **and**
  - The discharges intersect with the radius of influence of the abstraction wells (noting that there is very little measured drawdown).

  Even assuming a *highly conservative* scenario whereby 1% of the maximum daily discharges (8 m^3/d) are transported via the *highly unlikely* scenario outlined above, the discharges would still comprise *less than 0.1%* of the average flow rate from the abstraction bores (8,513 m^3/d) and the resulting concentrations would be orders of magnitude below any of the human health-based criteria.

PDP has recommended a Lugeon test to assess for the *possibility* of fracture flow. Noting again that the threshold for notification is based on the likelihood and magnitude of potential effect(s), rather than possibility, a Lugeon test has several limitations that make it unsuitable to address this query:

- It will not differentiate different flow pathways (e.g., bedding vs. fracture),
- It will not determine the orientation and angle of any fractures,and
- It will not determine the connectedness of any flow paths between the site and the abstraction wells.

As such, this issue is most appropriately addressed through a logic test and, as described above, it is considered *highly unlikely* that groundwater from the site will migrate through the mudstone from the site to the abstraction bores and, noting the relative flow rates, it is *highly unlikely* that any incidental migration would be detectable or have a *greater than minor* effect.

If there are additional queries regarding fracture flow transport through the mudstone, we recommend a meeting between one of the Principal Engineering Geologists at ENGEO and their PDP counterpart(s).

Based on our assessment works to date and in conjunction with the proposed conditions of consent, it is deemed ***highly unlikely*** that the proposed discharges will have an adverse effect on human or ecological health.

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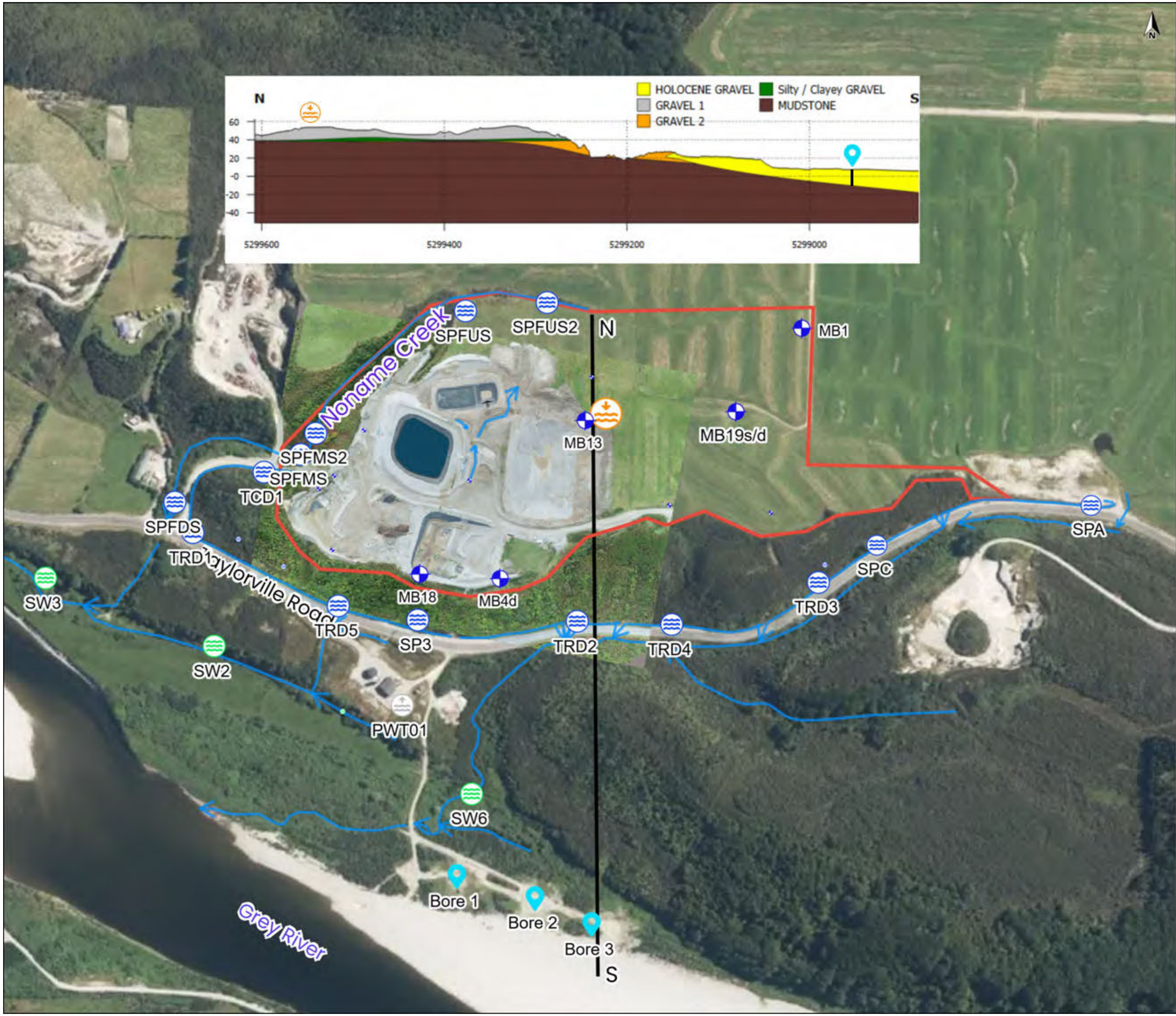

Legend

- Surface Water Sampling Locations
- Coal Creek WTP
- Grey River Sample Location
- Monitoring Well Locations
- Tributary Surface Water Sample Locations
- GRE001 Abstraction Wells
- Proposed Discharge Location
- Approximate Site Boundary
- Line of Cross Section

0 100 m 200 m

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ENGEO

Produced by **Datanest.earth**

Title: Sampling Locations and Cross Section (soakage area to abstraction wells)		
Client: Taylorville Resource Park Ltd		Size: A4
Project: Taylorville Resource Park	Drawn: PS	Figure No.: 2
Date: 12-03-2025	Checked: DW	
Proj No: 26200.000.001	Scale: 1:5730	Version: 1.0

Table 1: Gravel Analytical Results and Calculated Partition Coefficients

Analyte	BH13 0m - 1.5m	BH13 9m - 10m	BH13 17m - 18m	BH15 0m - 1.5m	BH15 13m - 15m	BH15 16m - 18m	BH19 0m - 1.5m	BH19 7m - 8m	BH19 15.6m - 16.5m
	18-10-2024	18-10-2024	18-10-2024	18-10-2024	18-10-2024	18-10-2024	18-10-2024	18-10-2024	18-10-2024
Total Metals (mg/kg)									
Arsenic	3	5	13	3	7	13	3	3	15
Chromium (III+VI)	20	13	34	14	23	31	10	13	29
Copper	9	11	17	8	12	16	7	9	15
Lead	11	18.7	11.6	9.3	19.5	11.7	8.5	16	12.8
Nickel	14	13	36	11	15	36	9	13	40
Zinc	38	50	81	31	52	76	26	42	73
SPLP Metals (mg/L)									
Arsenic	*0.0011*	0.0013	0.0022	*0.0011*	0.0028	*0.0011*	*0.0011*	0.002	*0.0011*
Chromium (III+VI)	0.003	0.0023	0.0057	*0.00053*	0.0086	0.0007	*0.00053*	0.0049	*0.00053*
Copper	0.00191	0.0032	*0.00053*	*0.00053*	0.0061	0.00054	*0.00053*	0.0047	*0.00053*
Lead	0.002	0.0044	0.00021	*0.00011*	0.0086	0.00012	*0.00011*	0.0082	*0.00011*
Nickel	0.00172	0.0027	0.0049	*0.00053*	0.006	0.00132	*0.00053*	0.0039	0.0013
Zinc	0.0055	0.0122	*0.0011*	*0.0011*	0.023	*0.0011*	*0.0011*	0.0158	*0.0011*
Soil-Water Partition Coefficient (L/kg)									
Arsenic	2707	3826	5889	2707	2480	11798	2707	1480	13616
Chromium (III+VI)	6647	5632	5945	26395	2654	44266	18848	2633	54697
Copper	4692	3418	32055	15074	1947	29610	13188	1895	28282
Lead	5480	4230	55218	84525	2247	97480	77253	1931	116344
Nickel	8120	4795	7327	20735	2480	27253	16961	3313	30749
Zinc	6889	4078	73616	28162	2241	69071	23616	2638	66344

Notes:

All values provided in units of miligrams per kilogram (mg/kg).

Values in *italics* were detected below the laboratory reporting limit (RL shown)

McCall's Soil Mobility Classification Scheme Colour Key:

Mobility class	Range of Kd
Very high	0 - 50
High	50 - 150
Medium	150 - 500
Low	500 - 2000
Slightly	2000 - 5000
Immobile	> 5000

Table 2: January 2025 TRP Sample Results

Analyte	NZDWS [1]	NZWQS (95%) [2]	NZWQS (90%) [2]	NZWQS (80%) [2]	Groundwater						Taylorville Road Drain					Downgradient Springs / Seeps			
					MB1	MB4d	MB13	MB18	MP19s	MB19	TRD1	TRD2	TRD3	TRD4	TRD5	TCD1	SPA	SPC	SP3
					20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25
Sum of Anions					0.76	1.12	2.2	7.6	0.9	6.4	5.1	0.45	0.73	0.54	8.1	6.3	0.77	0.72	4.6
Sum of Cations					0.75	1.11	2.3	7.7	0.87	6.7	5.2	0.45	0.73	0.55	7.2	6.4	0.73	0.73	4.6
An/Cat balance (%)																			
pH					6.2	6.1	6.6	7.1	5.9	7.5	7.8	6.2	6.7	6.9	4.8	6.4	7.1	7.1	5.2
Total Alkalinity					17.9	30	94	210	23	290	82	6.7	18.9	9.2	1.5	100	18.8	19.9	2.4
Bicarbonate					22	36	115	250	28	360	99	8.1	23	11.2	1.9	122	23	24	2.9
Total Hardness					25	38	73	250	28	220	220	9.6	24	13.7	280	270	27	25	176
Electrical conductivity (mS/m)					8.4	12.4	22.1	74.7	10.2	57.6	52.4	5.2	7.9	6	80.1	63.1	8.3	7.7	48.3
Dissolved aluminium	1	0.055	0.08	0.15	*0.08*	0.017	0.006	0.013	0.028	0.038	0.05	***0.142***	0.051	*0.118*	*0.097*	0.005	0.005	*0.071*	***0.2***
Total aluminium		0.055	0.08	0.15	***0.119***	***0.84***	0.02	***6.8***	***1.51***	0.029	***0.088***	***1.36***	***0.095***	***0.17***	***0.97***	0.0098	0.0138	***0.25***	***3.4***
Dissolved calcium					7.7	13.7	17.5	90	9	66	77	2.6	7.4	3.9	91	96	9.3	8.3	57
Dissolved iron					< 0.02	0.04	2.7	0.85	< 0.02	4.3	0.06	0.27	0.08	0.3	0.03	0.02	0.13	0.24	0.03
Total iron					0.024	0.55	3.1	8.3	2.6	7.7	0.142	4.4	0.29	0.6	0.4	0.083	0.57	2.8	4.2
Dissolved magnesium					1.37	1.01	7	7.1	1.34	12.4	6.4	0.73	1.34	0.93	13.5	7.5	0.9	0.94	8.4
Total magnesium					1.28	1.05	6.6	8.7	1.79	10.1	5.9	0.83	1.33	0.99	14.5	7.7	0.9	0.91	8.1
Dissolved manganese	0.4	1.9	2.5	3.6	0.009	0.028	0.89	*2.3*	0.186	1.18	0.0018	0.02	0.0099	0.0106	0.139	*2*	0.23	0.024	0.067
Total manganese		1.9	2.5	3.6	0.0081	0.042	0.9	*2.3*	0.21	1.35	0.03	0.04	0.0177	0.0148	0.173	*2.1*	0.27	0.39	0.096
Dissolved potassium					0.62	1.29	1.25	18.1	0.79	3.6	5.8	0.24	0.62	0.28	1.66	5.2	0.88	0.93	0.4
Dissolved sodium					5.2	6.9	16.3	20	6.3	48	15.3	5.1	5.1	5.6	34	17.4	3.7	4.5	24
Chloride					7.9	6.7	9.8	10.2	7.8	11.4	12.9	9	8.1	8.4	26	11.4	8.2	7.6	18.4
Total-N					0.96	1.14	0.17	17.9	0.8	2.1	0.88	0.47	0.27	0.28	1.82	3	0.15	0.23	0.83
Total Ammoniacal-N		0.9	1.43	2.3	< 0.010	< 0.010	0.011	***17***	0.069	0.7	0.012	< 0.010	< 0.010	< 0.010	*0.93*	0.041	0.019	0.016	< 0.010
Nitrite-N	0.912				< 0.002	< 0.002	0.004	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002	< 0.002	< 0.002	0.021	< 0.002	< 0.002	< 0.002
Nitrate-N	11.3				0.91	1.05	0.064	< 0.002	0.65	< 0.002	0.41	0.065	0.191	0.087	0.57	2.4	0.015	0.027	0.021
Nitrite+Nitrate-N					0.91	1.05	0.068	0.003	0.65	< 0.002	0.41	0.065	0.191	0.089	0.57	2.4	0.015	0.028	0.021
TKN					< 0.10	< 0.10	0.11	17.9	0.15	2.1	0.47	0.4	< 0.10	0.19	1.26	0.63	0.14	0.21	0.81
DRP					< 0.004	0.004	< 0.004	< 0.004	0.006	0.043	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Total-P					0.009	0.22	0.044	0.35	0.077	0.13	0.026	0.12	0.003	0.011	0.007	0.007	0.004	0.011	0.182
Sulphate					5.5	12.3	2.8	155	8.5	10.3	147	2.8	5.5	5.5	350	183	7.7	4.9	196
cBOD5					< 2	< 2	< 2	3	< 2	11	< 2	2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
COD					-	-	-	-	-	-	28	38	17	10	36	36	< 6	18	75
Dissolved arsenic	0.01	0.013	0.42	1.4	< 0.0010	< 0.0010	0.0023	*0.044*	< 0.0010	0.003	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0014	0.0013	< 0.0010	< 0.0010	< 0.0010
Dissolved cadmium	0.004	0.0002	0.0004	0.0008	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005	< 0.00005	< 0.00005	< 0.00005	0.00006
Dissolved chromium	0.05	0.0033	0.006	0.04	< 0.0005	< 0.0005	< 0.0005	0.0017	< 0.0005	0.0017	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0008	0.0009	< 0.0005	< 0.0005	0.0005
Dissolved copper	2	0.0014	0.0018	0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0008	0.0007	< 0.0005	< 0.0005	< 0.0005	0.0009	< 0.0005	< 0.0005	0.0005
Dissolved lead	0.01	0.0034	0.0056	0.0094	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00011	< 0.00010	< 0.00010	< 0.00010	0.00014
Dissolved nickel	0.08	0.011	0.013	0.017	< 0.0005	< 0.0005	0.0007	0.0013	0.0007	< 0.0005	0.0007	< 0.0005	< 0.0005	< 0.0005	0.0017	0.0016	< 0.0005	< 0.0005	0.0011
Dissolved zinc		0.008	0.015	0.031	0.0059	0.0025	0.0016	0.0065	0.0019	0.0011	< 0.0010	0.002	< 0.0010	< 0.0010	0.0072	0.0039	0.0012	< 0.0010	0.0054
Total arsenic		0.013	0.42	1.4	< 0.0011	< 0.0011	0.0024	*0.047*	0.0015	0.0022	< 0.0011	0.0013	< 0.0011	< 0.0011	0.0019	0.0013	< 0.0011	< 0.0011	0.0012
Total cadmium		0.0002	0.0004	0.0008	< 0.000053	< 0.000053	< 0.000053	< 0.00053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	0.000060	< 0.000053	< 0.000053	< 0.000053	0.000069
Total chromium (IV)		0.0033	0.006	0.04	< 0.00053	0.00108	< 0.00053	***0.02***	*0.0042*	0.00124	0.00103	0.00099	< 0.00053	< 0.00053	0.00161	0.00131	< 0.00053	0.00057	0.0029
Total copper		0.0014	0.0018	0.0025	< 0.00053	*0.00168*	< 0.00053	***0.0133***	***0.0023***	< 0.00053	0.00079	*0.00163*	< 0.00053	< 0.00053	0.00058	0.00085	< 0.00053	< 0.00053	***0.0049***
Total lead		0.0034	0.0056	0.0094	< 0.00011	0.0026	< 0.00011	***0.0118***	0.0031	0.00016	0.00013	0.00151	< 0.00011	0.00018	0.00059	< 0.00011	< 0.00011	0.00056	*0.0046*
Total nickel		0.011	0.013	0.017	< 0.00053	0.00072	0.00066	0.0087	0.0031	< 0.00053	0.00074	0.00062	< 0.00053	< 0.00053	0.00194	0.00141	< 0.00053	< 0.00053	0.0024
Total zinc		0.008	0.015	0.031	0.0057	0.0051	0.0013	***0.036***	0.0079	0.0012	0.0018	0.007	< 0.0011	0.0012	*0.0093*	0.0043	0.0015	0.0021	*0.0128*
Benzo(a)Pyrene					-	<0.00010	-	<0.00010	-	-	-	-	-	-	-	-	-	-	-

Notes:

All values provided in units of miligrams per liter (mg/L) unless otherwise specified.

[1] Drinking-water Standards for New Zealand 2022. Table 2 (maximum acceptable values for inorganic determinands)

[2] Australia and New Zealand Guidelines from Fresh & Marine Water Quality. Default Guideline Values, level of protection specified.

Bordered values exceed the NZDWS MAV

Values in *italics* exceed the NZWQS, 95% level of protection

Values in **bold** exceed the NZWQS, 90% level of protection

Gray highlighted values exceed the NZWQS, 80% level of protection

Table 2: January 2025 TRP Sample Results

Analyte	NZDWS [1]	NZWQS (95%) [2]	NZWQS (90%) [2]	NZWQS (80%) [2]	Grey River Tributaries			Grey Rvr	GRE001	Noname Creek				
					SW2	SW3	SW6	GR-01	PWT01	SPFUS	SPFMS	SPFDS	SPFUS2	SPFMS2
					20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25	20/01/25
Sum of Anions					5.2	2.9	0.78	0.58	0.68	0.87	1.95	1.86	1.12	0.84
Sum of Cations					4.8	2.9	0.81	0.56	0.65	0.86	2	1.89	1.19	0.87
An/Cat balance (%)														
pH					7.2	7.4	7.3	7.5	7	6.8	7.6	7.9	6.6	6.7
Total Alkalinity					27	70	12.9	21	22	12.3	63	57	11	11.9
Bicarbonate					33	85	15.7	25	27	15	77	69	13.4	14.5
Total Hardness					188	118	25	19.3	21	29	79	73	32	30
Electrical conductivity (mS/m)					51.6	30.3	8.8	5.7	6.9	10.2	20.5	19.7	13.8	9.9
Dissolved aluminium	1	0.055	0.08	0.15	*0.061*	0.006	*0.125*	0.035	0.012	*0.07*	0.015	0.023	***0.21***	*0.065*
Total aluminium		0.055	0.08	0.15	***0.19***	0.039	***0.22***	***0.159***	0.0183	***0.084***	*0.074*	0.044	***0.28***	***0.117***
Dissolved calcium					61	42	7.7	6.2	6.8	9.7	28	26	10.4	9.9
Dissolved iron					0.03	< 0.02	0.16	0.05	< 0.02	0.07	0.08	0.06	0.23	0.11
Total iron					0.171	0.29	0.28	0.26	< 0.021	0.132	0.55	0.128	0.43	0.5
Dissolved magnesium					8.5	3.2	1.3	0.9	1.0	1.2	2.2	2.1	1.34	1.19
Total magnesium					8.9	3.2	1.2	1.0	1.0	1.2	2.1	2.1	1.36	1.22
Dissolved manganese	0.4	1.9	2.5	3.6	0.0065	0.0034	0.0062	0.0009	< 0.0005	0.0151	0.096	0.0048	0.059	0.022
Total manganese		1.9	2.5	3.6	0.084	0.147	0.0125	0.0141	0.00059	0.021	0.162	0.0127	0.067	0.051
Dissolved potassium					3.4	3.8	0.8	0.71	0.94	1.48	3.3	3	6.8	1.26
Dissolved sodium					21	10.7	6.4	3.5	4.6	5.3	8.1	8	7.9	5.3
Chloride					17.6	10.5	8.7	3.7	5.2	13.2	10.2	9.9	27	13
Total-N					0.86	0.42	0.29	-	-	0.67	0.67	0.47	1.58	0.57
Total Ammoniacal-N		0.9	1.43	2.3	0.055	0.01	< 0.010	-	-	< 0.010	0.02	< 0.010	0.08	< 0.010
Nitrite-N	0.912				0.013	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.008	< 0.002	0.013	< 0.002
Nitrate-N	11.3				0.23	< 0.002	0.125	0.079	0.26	0.35	0.3	0.25	0.34	0.3
Nitrite+Nitrate-N					0.24	< 0.002	0.126	0.08	0.26	0.35	0.31	0.25	0.35	0.3
TKN					0.62	0.42	0.16	-	-	0.32	0.36	0.21	1.23	0.26
DRP					< 0.004	< 0.004	< 0.004	-	-	0.005	< 0.004	< 0.004	0.035	< 0.004
Total-P					0.025	0.021	0.021	-	-	0.017	0.027	0.007	0.172	0.015
Sulphate					197	58	12.7	2.3	3.3	10.9	18.1	20	4.6	10.5
cBOD5					< 2	< 2	< 2	-	-	< 2	< 2	< 2	< 2	< 2
COD					32	28	12	-	-	9	11	11	63	7
Dissolved arsenic	0.01	0.013	0.42	1.4	0.0013	0.0011	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0015	< 0.0010
Dissolved cadmium	0.004	0.0002	0.0004	0.0008	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved chromium	0.05	0.0033	0.006	0.04	0.0006	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved copper	2	0.0014	0.0018	0.0025	< 0.0005	< 0.0005	< 0.0005	< 0.0005	***0.0115***	0.0006	0.0006	0.0008	***0.0024***	0.0005
Dissolved lead	0.01	0.0034	0.0056	0.0094	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.00061	< 0.00010	< 0.00010	< 0.00010	0.00012	< 0.00010
Dissolved nickel	0.08	0.011	0.013	0.017	0.0008	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved zinc		0.008	0.015	0.031	0.001	< 0.0010	< 0.0010	< 0.0010	*0.0113*	< 0.0010	0.0017	< 0.0010	0.0057	0.0014
Total arsenic		0.013	0.42	1.4	0.0016	0.0014	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.0018	< 0.0011
Total cadmium		0.0002	0.0004	0.0008	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053
Total chromium (IV)		0.0033	0.006	0.04	0.00113	0.00084	< 0.00053	< 0.00053	< 0.00053	< 0.00053	0.00059	0.0006	0.0006	< 0.00053
Total copper		0.0014	0.0018	0.0025	0.00102	< 0.00053	0.00054	< 0.00053	***0.053***	0.00061	0.00074	0.00088	***0.0027***	0.00058
Total lead		0.0034	0.0056	0.0094	0.00025	0.0002	0.00014	0.00025	0.0023	< 0.00011	0.00071	0.00012	0.00031	< 0.00011
Total nickel		0.011	0.013	0.017	0.00083	< 0.00053	< 0.00053	< 0.00053	< 0.00053	< 0.00053	< 0.00053	< 0.00053	< 0.00053	< 0.00053
Total zinc		0.008	0.015	0.031	0.0047	0.0013	< 0.0011	< 0.0011	***0.043***	0.0014	0.003	0.0024	0.0059	0.0016
Benzo(a)Pyrene					-	-	-	-	-	-	-	-	-	-

Notes:

All values provided in units of miligrams per liter (mg/L) unless otherwise specified.

[1] Drinking-water Standards for New Zealand 2022. Table 2 (maximum acceptable values

[2] Australia and New Zealand Guidelines from Fresh & Marine Water Quality. Default Gui

Bordered values exceed the NZDWS MAV

Values in *italics* exceed the NZWQS, 95% level of protection

Values in **bold** exceed the NZWQS, 90% level of protection

Gray highlighted values exceed the NZWQS, 80% level of protection

APPENDIX 1

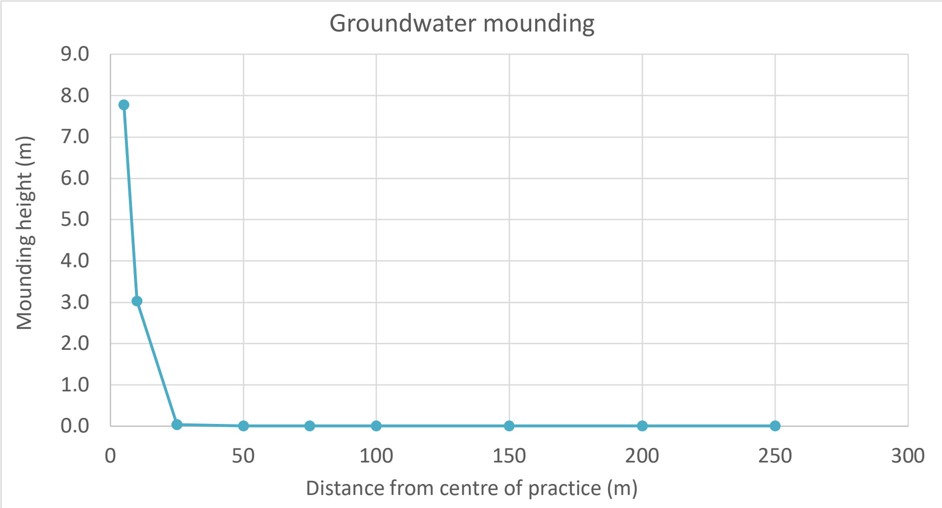
Hantush Model

This spreadsheet will calculate the height of a groundwater mound beneath an stormwater infiltration BMP.
More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102
"Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

[Go to the USGS report]

	Input Values	
Recharge (infiltration) rate (m/day)	*6.000*	R
Specific yield, S_y (dimensionless)	*0.190*	Sy
Horizontal hydraulic conductivity, K_h (m/day)	0.860000	K
1/2 length of basin (x direction, in m)	5.0	x
1/2 width of basin (y direction, in m)	5.0	y
Duration of infiltration period (days)	1	t
Initial thickness of saturated zone (m)	8.0	hi(0)

CALCULATE



Distance from center of infiltration BMP (m)	Ground-water mounding (m)
5	7.78
10	3.03
25	0.04
25	0.04
50	0.01
75	0.01
100	0.01
150	0.01
200	0.01
250	0.01

IF YOU CHANGE THE SCALE OF THE DISTANCE MEASUREMENTS (OR ANY OTHER PARAMETER), YOU MUST RECALCULATE!!

APPENDIX 2

RISC Model

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

Aquifer Properties		
Effective porosity	cm3/cm3	3.0E-01
Fraction organic carbon	g oc/g soil	1.0E-03
Hydraulic conductivity	m/d	8.6E-01
Soil bulk density	g/cm3	1.6E+00
Hydraulic gradient	m/m	1.8E-02

Groundwater Source Geometry		
*****Pulse Source. Length of pulse:**	**yr**	**5.0E-01**
Total thickness of source	m	8.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Receptor Well Location		
Distance downgradient	m	3.1E+02
Distance cross-gradient	m	0.0E+00
Depth to top of well screen	m	0.0E+00
Depth to bottom of well screen	m	5.0E+00
Number of vertical points used to calculate conc.	-	5.0E+00
Longitudinal dispersivity code calculated. See output file.		
Transverse dispersivity code calculated. See output file.		
Vertical dispersivity code calculated. See output file.		

Dissolved Source for Groundwater Model [mg/l]		
Aluminium	mg/l	2.6E+00
Ammonium-N	mg/l	9.8E+01
Arsenic	mg/l	9.8E-01
Chromium (VI)	mg/l	2.2E-01
Copper	mg/l	1.9E-01
Lead	mg/l	1.3E-02
Manganese	mg/l	6.7E+00
Nickel (soluble salts)	mg/l	1.6E-01
Nitrate-N	mg/l	6.5E+00

Chemical Properties	**Units**	**Aluminium**	**Ammonium-N**	**Arsenic**	**Chromium (VI)**	**Copper**	**Lead**	**Manganese**	**Nickel (soluble salts)**	**Nitrate-N**
Diffusion coefficient in air	cm2/s	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diffusion coefficient in water	cm2/s	ND	1.9E-05	ND	ND	ND	ND	ND	ND	ND
Solubility	mg/l	1.3E+03	1.0E+04	1.8E+04	1.7E+06	0.0E+00	0.0E+00	0.0E+00	ND	1.0E+04
Kd (total soil partition coefficient)	L/kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
KOC (organiChem carbon partition coefficient	L/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND
Henry's Law coefficient	m3-H2O)/(m3-air	0.0E+00	6.0E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	ND	ND
Molecular weight	g/mol	ND	1.8E+01	7.8E+01	5.2E+01	6.4E+01	8.2E+01	2.5E+01	5.9E+01	6.5E+01
Degradation rate, saturated zone	1/d	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

Aquifer Properties		
Effective porosity	cm3/cm3	3.0E-01
Fraction organic carbon	g oc/g soil	1.0E-03
Hydraulic conductivity	m/d	8.6E-01
Soil bulk density	g/cm3	1.6E+00
Hydraulic gradient	m/m	1.8E-02

Groundwater Source Geometry		
*****Pulse Source. Length of pulse:**	**yr**	**5.0E-01**
Total thickness of source	m	8.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Receptor Well Location		
Distance downgradient	m	3.1E+02
Distance cross-gradient	m	0.0E+00
Depth to top of well screen	m	0.0E+00
Depth to bottom of well screen	m	5.0E+00
Number of vertical points used to calculate conc.	-	5.0E+00
Longitudinal dispersivity code calculated. See output file.		
Transverse dispersivity code calculated. See output file.		
Vertical dispersivity code calculated. See output file.		

Dissolved Source for Groundwater Model [mg/l]		
Aluminium	mg/l	2.6E+00
Ammonium-N	mg/l	9.8E+01
Arsenic	mg/l	9.8E-01
Chromium (VI)	mg/l	2.2E-01
Copper	mg/l	1.9E-01
Lead	mg/l	1.3E-02
Manganese	mg/l	6.7E+00
Nickel (soluble salts)	mg/l	1.6E-01
Nitrate-N	mg/l	6.5E+00

Chemical Properties	**Units**	**Aluminium**	**Ammonium-N**	**Arsenic**	**Chromium (VI)**	**Copper**	**Lead**	**Manganese**	**Nickel (soluble salts)**	**Nitrate-N**
Diffusion coefficient in air	cm2/s	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diffusion coefficient in water	cm2/s	ND	1.9E-05	ND	ND	ND	ND	ND	ND	ND
Solubility	mg/l	1.3E+03	1.0E+04	1.8E+04	1.7E+06	0.0E+00	0.0E+00	0.0E+00	ND	1.0E+04
Kd (total soil partition coefficient)	L/kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
KOC (organiChem carbon partition coefficient	L/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND
Henry's Law coefficient	m3-H2O)/(m3-air	0.0E+00	6.0E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	ND	ND
Molecular weight	g/mol	ND	1.8E+01	7.8E+01	5.2E+01	6.4E+01	8.2E+01	2.5E+01	5.9E+01	6.5E+01
Degradation rate, saturated zone	1/d	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Time (year)	Aluminium (mg/l)	Ammonium-N (mg/l)	Arsenic (mg/l)	Chromium (VI) (mg/l)	Copper (mg/l)	Lead (mg/l)	Manganese (mg/l)	Nickel (soluble salts) (mg/l)	Nitrate-N (mg/l)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
1	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
2	6.5E-11	2.5E-09	2.5E-11	5.5E-12	4.8E-12	3.3E-13	1.7E-10	3.9E-12	1.6E-10
3	1.8E-07	6.7E-06	6.7E-08	1.5E-08	1.3E-08	8.8E-10	4.6E-07	1.1E-08	4.4E-07
4	8.1E-06	3.0E-04	3.0E-06	6.8E-07	6.0E-07	4.0E-08	2.1E-05	4.8E-07	2.0E-05
5	6.9E-05	2.6E-03	2.6E-05	5.8E-06	5.1E-06	3.4E-07	1.8E-04	4.1E-06	1.7E-04
6	2.5E-04	9.6E-03	9.6E-05	2.2E-05	1.9E-05	1.3E-06	6.6E-04	1.5E-05	6.4E-04
7	5.9E-04	2.2E-02	2.2E-04	5.0E-05	4.4E-05	3.0E-06	1.5E-03	3.6E-05	1.5E-03
8	1.0E-03	3.9E-02	3.9E-04	8.8E-05	7.7E-05	5.2E-06	2.7E-03	6.2E-05	2.6E-03
9	1.5E-03	5.7E-02	5.7E-04	1.3E-04	1.1E-04	7.5E-06	3.9E-03	9.0E-05	3.8E-03
10	1.9E-03	7.3E-02	7.3E-04	1.6E-04	1.4E-04	9.6E-06	5.0E-03	1.2E-04	4.8E-03
11	2.3E-03	8.5E-02	8.5E-04	1.9E-04	1.7E-04	1.1E-05	5.8E-03	1.4E-04	5.6E-03
12	2.5E-03	9.3E-02	9.3E-04	2.1E-04	1.8E-04	1.2E-05	6.4E-03	1.5E-04	6.2E-03
13	2.6E-03	9.7E-02	9.7E-04	2.2E-04	1.9E-04	1.3E-05	6.6E-03	1.5E-04	6.4E-03
14	2.6E-03	9.7E-02	9.7E-04	2.2E-04	1.9E-04	1.3E-05	6.6E-03	1.5E-04	6.4E-03
15	2.5E-03	9.4E-02	9.4E-04	2.1E-04	1.9E-04	1.3E-05	6.5E-03	1.5E-04	6.3E-03
16	2.4E-03	9.0E-02	9.0E-04	2.0E-04	1.8E-04	1.2E-05	6.1E-03	1.4E-04	5.9E-03
17	2.2E-03	8.3E-02	8.3E-04	1.9E-04	1.6E-04	1.1E-05	5.7E-03	1.3E-04	5.5E-03
18	2.0E-03	7.6E-02	7.6E-04	1.7E-04	1.5E-04	1.0E-05	5.2E-03	1.2E-04	5.1E-03
19	1.8E-03	6.9E-02	6.9E-04	1.5E-04	1.4E-04	9.2E-06	4.7E-03	1.1E-04	4.6E-03
20	1.6E-03	6.2E-02	6.2E-04	1.4E-04	1.2E-04	8.2E-06	4.2E-03	9.8E-05	4.1E-03
21	1.5E-03	5.5E-02	5.5E-04	1.2E-04	1.1E-04	7.3E-06	3.7E-03	8.7E-05	3.6E-03
22	1.3E-03	4.8E-02	4.8E-04	1.1E-04	9.5E-05	6.4E-06	3.3E-03	7.7E-05	3.2E-03
23	1.1E-03	4.2E-02	4.2E-04	9.4E-05	8.3E-05	5.6E-06	2.9E-03	6.7E-05	2.8E-03
24	9.7E-04	3.7E-02	3.7E-04	8.2E-05	7.2E-05	4.8E-06	2.5E-03	5.8E-05	2.4E-03
25	8.4E-04	3.2E-02	3.2E-04	7.1E-05	6.2E-05	4.2E-06	2.2E-03	5.0E-05	2.1E-03
26	7.2E-04	2.7E-02	2.7E-04	6.1E-05	5.4E-05	3.6E-06	1.9E-03	4.3E-05	1.8E-03
27	6.2E-04	2.3E-02	2.3E-04	5.2E-05	4.6E-05	3.1E-06	1.6E-03	3.7E-05	1.5E-03
28	5.3E-04	2.0E-02	2.0E-04	4.5E-05	3.9E-05	2.6E-06	1.4E-03	3.2E-05	1.3E-03
29	4.5E-04	1.7E-02	1.7E-04	3.8E-05	3.4E-05	2.3E-06	1.2E-03	2.7E-05	1.1E-03
30	3.8E-04	1.4E-02	1.4E-04	3.3E-05	2.9E-05	1.9E-06	9.9E-04	2.3E-05	9.6E-04
31	3.3E-04	1.2E-02	1.2E-04	2.8E-05	2.4E-05	1.6E-06	8.4E-04	2.0E-05	8.2E-04
32	2.8E-04	1.0E-02	1.0E-04	2.3E-05	2.1E-05	1.4E-06	7.1E-04	1.7E-05	6.9E-04
33	2.3E-04	8.8E-03	8.8E-05	2.0E-05	1.7E-05	1.2E-06	6.0E-04	1.4E-05	5.8E-04
34	2.0E-04	7.5E-03	7.5E-05	1.7E-05	1.5E-05	9.9E-07	5.1E-04	1.2E-05	4.9E-04
35	1.7E-04	6.3E-03	6.3E-05	1.4E-05	1.2E-05	8.3E-07	4.3E-04	1.0E-05	4.2E-04
36	1.4E-04	5.3E-03	5.3E-05	1.2E-05	1.0E-05	7.0E-07	3.6E-04	8.4E-06	3.5E-04
37	1.2E-04	4.5E-03	4.5E-05	1.0E-05	8.8E-06	5.9E-07	3.0E-04	7.1E-06	3.0E-04

38	1.0E-04	3.8E-03	3.8E-05	8.4E-06	7.4E-06	5.0E-07	2.6E-04	6.0E-06	2.5E-04
39	8.4E-05	3.2E-03	3.2E-05	7.1E-06	6.2E-06	4.2E-07	2.2E-04	5.0E-06	2.1E-04
40	7.0E-05	2.6E-03	2.6E-05	5.9E-06	5.2E-06	3.5E-07	1.8E-04	4.2E-06	1.8E-04
41	5.9E-05	2.2E-03	2.2E-05	5.0E-06	4.4E-06	2.9E-07	1.5E-04	3.5E-06	1.5E-04
42	4.9E-05	1.9E-03	1.9E-05	4.2E-06	3.7E-06	2.5E-07	1.3E-04	3.0E-06	1.2E-04
43	4.1E-05	1.6E-03	1.6E-05	3.5E-06	3.1E-06	2.1E-07	1.1E-04	2.5E-06	1.0E-04
44	3.5E-05	1.3E-03	1.3E-05	2.9E-06	2.6E-06	1.7E-07	9.0E-05	2.1E-06	8.7E-05
45	2.9E-05	1.1E-03	1.1E-05	2.5E-06	2.2E-06	1.5E-07	7.5E-05	1.7E-06	7.3E-05
46	2.4E-05	9.2E-04	9.2E-06	2.1E-06	1.8E-06	1.2E-07	6.3E-05	1.5E-06	6.1E-05
47	2.0E-05	7.7E-04	7.7E-06	1.7E-06	1.5E-06	1.0E-07	5.3E-05	1.2E-06	5.1E-05
48	1.7E-05	6.4E-04	6.4E-06	1.4E-06	1.3E-06	8.5E-08	4.4E-05	1.0E-06	4.3E-05
49	1.4E-05	5.4E-04	5.4E-06	1.2E-06	1.1E-06	7.1E-08	3.7E-05	8.6E-07	3.6E-05
50	1.2E-05	4.5E-04	4.5E-06	1.0E-06	8.9E-07	6.0E-08	3.1E-05	7.2E-07	3.0E-05
51	1.0E-05	3.8E-04	3.8E-06	8.4E-07	7.4E-07	5.0E-08	2.6E-05	6.0E-07	2.5E-05
52	8.3E-06	3.1E-04	3.1E-06	7.1E-07	6.2E-07	4.2E-08	2.2E-05	5.0E-07	2.1E-05
53	7.0E-06	2.6E-04	2.6E-06	5.9E-07	5.2E-07	3.5E-08	1.8E-05	4.2E-07	1.7E-05
54	5.8E-06	2.2E-04	2.2E-06	4.9E-07	4.3E-07	2.9E-08	1.5E-05	3.5E-07	1.5E-05
55	4.9E-06	1.8E-04	1.8E-06	4.1E-07	3.6E-07	2.4E-08	1.3E-05	2.9E-07	1.2E-05
56	4.1E-06	1.5E-04	1.5E-06	3.4E-07	3.0E-07	2.0E-08	1.0E-05	2.4E-07	1.0E-05
57	3.4E-06	1.3E-04	1.3E-06	2.9E-07	2.5E-07	1.7E-08	8.8E-06	2.0E-07	8.5E-06
58	2.8E-06	1.1E-04	1.1E-06	2.4E-07	2.1E-07	1.4E-08	7.3E-06	1.7E-07	7.1E-06
59	2.4E-06	8.9E-05	8.9E-07	2.0E-07	1.8E-07	1.2E-08	6.1E-06	1.4E-07	5.9E-06
60	2.0E-06	7.5E-05	7.5E-07	1.7E-07	1.5E-07	9.9E-09	5.1E-06	1.2E-07	5.0E-06
61	1.7E-06	6.2E-05	6.2E-07	1.4E-07	1.2E-07	8.3E-09	4.3E-06	9.9E-08	4.1E-06
62	1.4E-06	5.2E-05	5.2E-07	1.2E-07	1.0E-07	6.9E-09	3.6E-06	8.3E-08	3.5E-06
63	1.2E-06	4.3E-05	4.3E-07	9.8E-08	8.6E-08	5.8E-09	3.0E-06	6.9E-08	2.9E-06
64	9.6E-07	3.6E-05	3.6E-07	8.2E-08	7.2E-08	4.8E-09	2.5E-06	5.8E-08	2.4E-06
65	8.0E-07	3.0E-05	3.0E-07	6.8E-08	6.0E-08	4.0E-09	2.1E-06	4.8E-08	2.0E-06
66	6.7E-07	2.5E-05	2.5E-07	5.7E-08	5.0E-08	3.4E-09	1.7E-06	4.0E-08	1.7E-06
67	5.6E-07	2.1E-05	2.1E-07	4.7E-08	4.2E-08	2.8E-09	1.4E-06	3.4E-08	1.4E-06
68	4.7E-07	1.8E-05	1.8E-07	4.0E-08	3.5E-08	2.3E-09	1.2E-06	2.8E-08	1.2E-06
69	3.9E-07	1.5E-05	1.5E-07	3.3E-08	2.9E-08	2.0E-09	1.0E-06	2.3E-08	9.8E-07
70	3.3E-07	1.2E-05	1.2E-07	2.8E-08	2.4E-08	1.6E-09	8.4E-07	2.0E-08	8.2E-07
71	2.7E-07	1.0E-05	1.0E-07	2.3E-08	2.0E-08	1.4E-09	7.0E-07	1.6E-08	6.8E-07
72	2.3E-07	8.6E-06	8.6E-08	1.9E-08	1.7E-08	1.1E-09	5.9E-07	1.4E-08	5.7E-07
73	1.9E-07	7.2E-06	7.2E-08	1.6E-08	1.4E-08	9.5E-10	4.9E-07	1.1E-08	4.8E-07
74	1.6E-07	6.0E-06	6.0E-08	1.3E-08	1.2E-08	7.9E-10	4.1E-07	9.5E-09	4.0E-07
75	1.3E-07	5.0E-06	5.0E-08	1.1E-08	9.9E-09	6.6E-10	3.4E-07	8.0E-09	3.3E-07
76	1.1E-07	4.2E-06	4.2E-08	9.4E-09	8.2E-09	5.5E-10	2.9E-07	6.6E-09	2.8E-07
77	9.3E-08	3.5E-06	3.5E-08	7.8E-09	6.9E-09	4.6E-10	2.4E-07	5.6E-09	2.3E-07
78	7.7E-08	2.9E-06	2.9E-08	6.5E-09	5.7E-09	3.9E-10	2.0E-07	4.6E-09	1.9E-07
79	6.5E-08	2.4E-06	2.4E-08	5.5E-09	4.8E-09	3.2E-10	1.7E-07	3.9E-09	1.6E-07

80	5.4E-08	2.0E-06	2.0E-08	4.6E-09	4.0E-09	2.7E-10	1.4E-07	3.2E-09	1.3E-07
81	4.5E-08	1.7E-06	1.7E-08	3.8E-09	3.3E-09	2.3E-10	1.2E-07	2.7E-09	1.1E-07
82	3.8E-08	1.4E-06	1.4E-08	3.2E-09	2.8E-09	1.9E-10	9.7E-08	2.3E-09	9.4E-08
83	3.1E-08	1.2E-06	1.2E-08	2.7E-09	2.3E-09	1.6E-10	8.1E-08	1.9E-09	7.9E-08
84	2.6E-08	9.9E-07	9.9E-09	2.2E-09	2.0E-09	1.3E-10	6.8E-08	1.6E-09	6.6E-08
85	2.2E-08	8.3E-07	8.3E-09	1.9E-09	1.6E-09	1.1E-10	5.6E-08	1.3E-09	5.5E-08
86	1.8E-08	6.9E-07	6.9E-09	1.5E-09	1.4E-09	9.2E-11	4.7E-08	1.1E-09	4.6E-08
87	1.5E-08	5.8E-07	5.8E-09	1.3E-09	1.1E-09	7.7E-11	3.9E-08	9.2E-10	3.8E-08
88	1.3E-08	4.8E-07	4.8E-09	1.1E-09	9.5E-10	6.4E-11	3.3E-08	7.7E-10	3.2E-08
89	1.1E-08	4.0E-07	4.0E-09	9.0E-10	7.9E-10	5.3E-11	2.8E-08	6.4E-10	2.7E-08
90	8.9E-09	3.4E-07	3.4E-09	7.6E-10	6.6E-10	4.5E-11	2.3E-08	5.4E-10	2.2E-08
91	7.5E-09	2.8E-07	2.8E-09	6.3E-10	5.5E-10	3.7E-11	1.9E-08	4.5E-10	1.9E-08
92	6.2E-09	2.3E-07	2.3E-09	5.3E-10	4.6E-10	3.1E-11	1.6E-08	3.7E-10	1.6E-08
93	5.2E-09	2.0E-07	2.0E-09	4.4E-10	3.9E-10	2.6E-11	1.3E-08	3.1E-10	1.3E-08
94	4.4E-09	1.6E-07	1.6E-09	3.7E-10	3.2E-10	2.2E-11	1.1E-08	2.6E-10	1.1E-08
95	3.6E-09	1.4E-07	1.4E-09	3.1E-10	2.7E-10	1.8E-11	9.4E-09	2.2E-10	9.1E-09
96	3.0E-09	1.1E-07	1.1E-09	2.6E-10	2.3E-10	1.5E-11	7.8E-09	1.8E-10	7.6E-09
97	2.5E-09	9.6E-08	9.6E-10	2.2E-10	1.9E-10	1.3E-11	6.5E-09	1.5E-10	6.4E-09
98	2.1E-09	8.0E-08	8.0E-10	1.8E-10	1.6E-10	1.1E-11	5.5E-09	1.3E-10	5.3E-09
99	1.8E-09	6.7E-08	6.7E-10	1.5E-10	1.3E-10	8.9E-12	4.6E-09	1.1E-10	4.4E-09
100	1.5E-09	5.6E-08	5.6E-10	1.3E-10	1.1E-10	7.4E-12	3.8E-09	8.9E-11	3.7E-09

APPENDIX 3

Redox Model

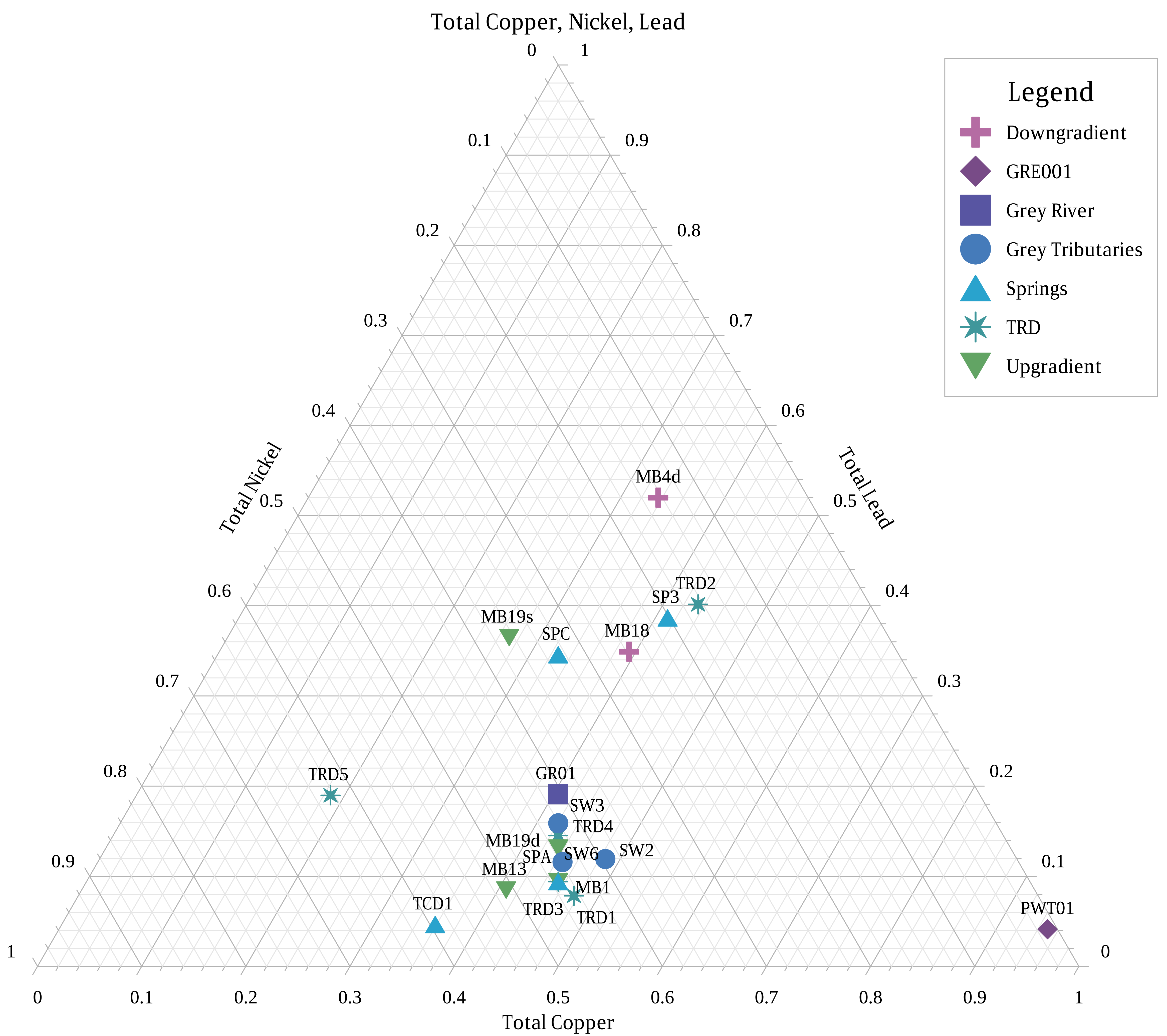
Redox Assignment

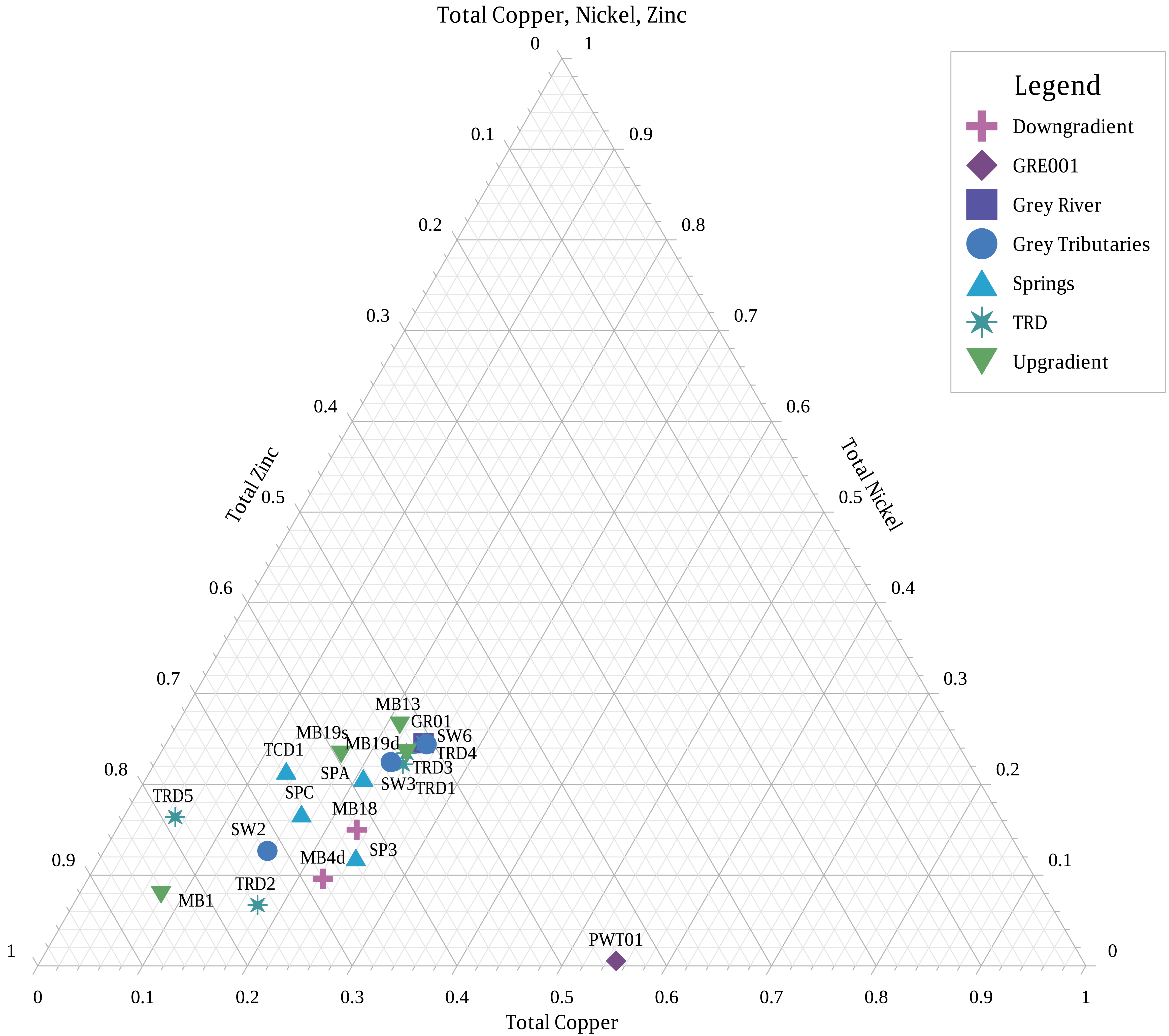
Sample ID	Redox	Redox Variables	Dissolved O_2	NO_3^- (as Nitrogen)	Mn^{2+}	Fe^{2+}	SO_4^{2-}		
	mV	Units	millig/L	millig/L	microg/L	microg/L	millig/L	millig/L	
		Threshold values	**0.5**	**0.5**	**50**	**100**	**0.5**	Num of Params	General Redox Category	Redox Process
MB4d	144		2.96	1.05	0.028	0.04	12.3	5	Oxic	O2
MB13	-17		0.23	0.064	0.89	2.7	2.8	5	Suboxic	Suboxic
MB18	6		0.76	0.002	2.3	0.85	155	5	Oxic	O2

Modified from Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel® workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.

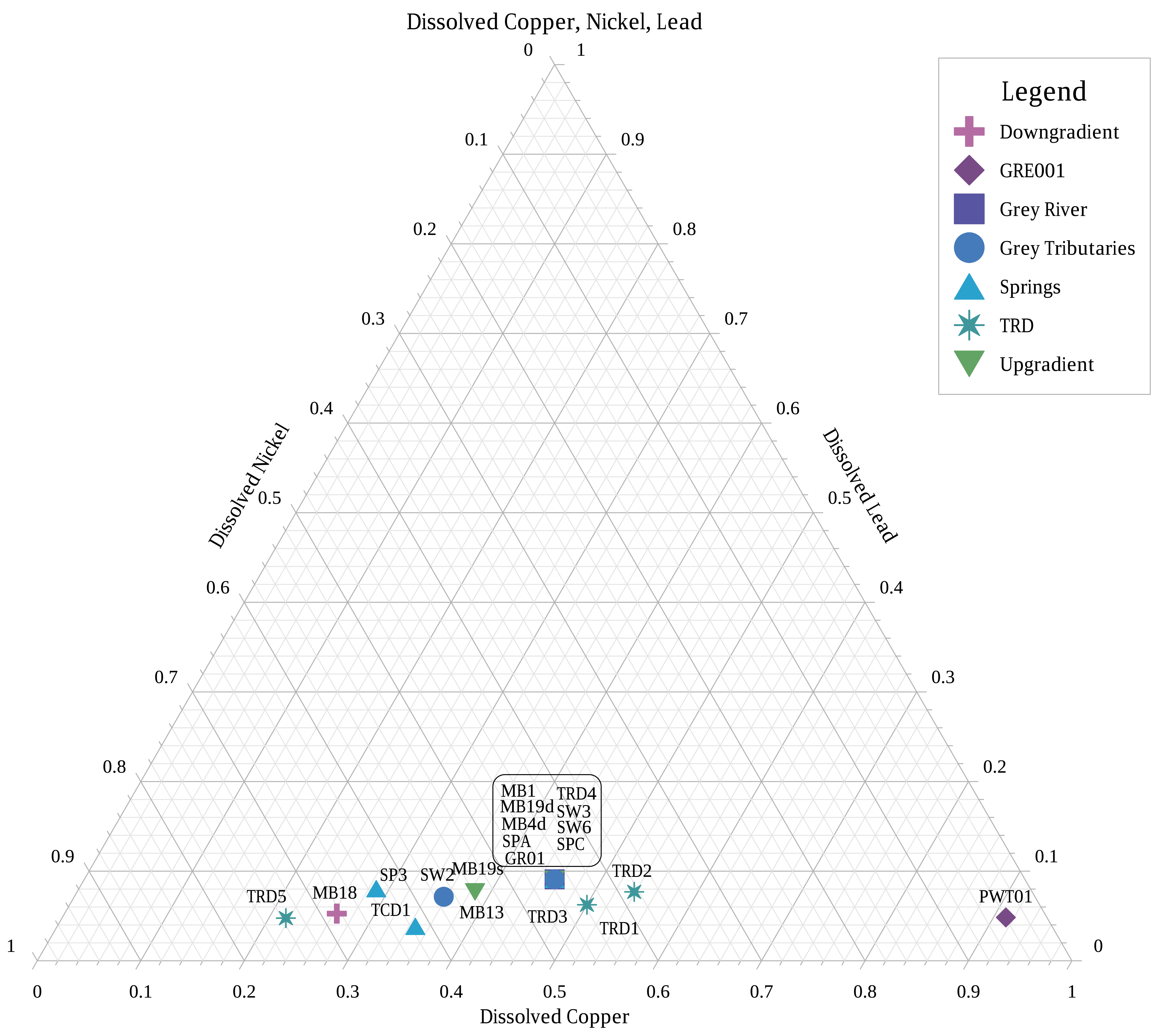
APPENDIX 4

Heavy Metal Concentration Graphs

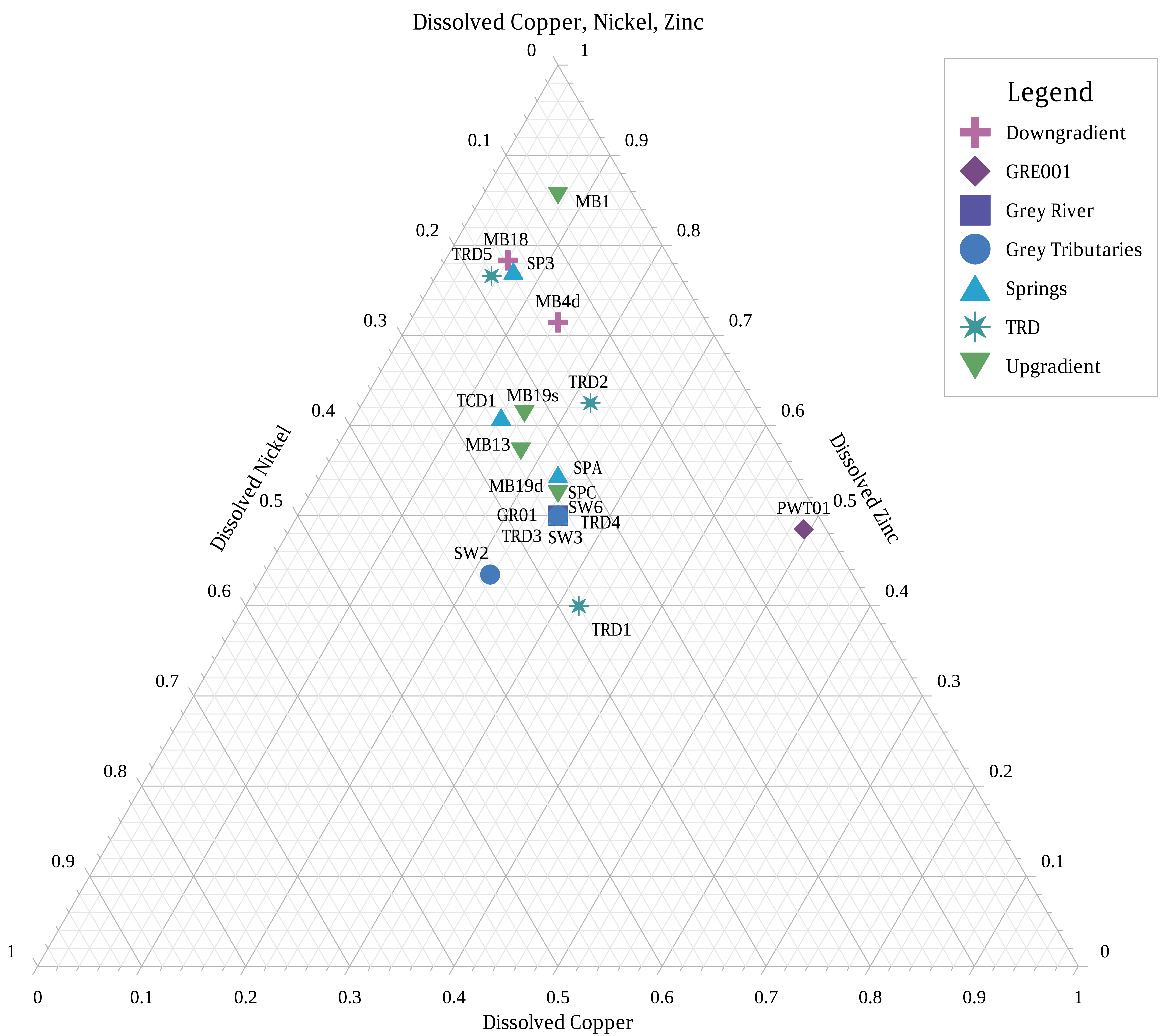

Total Copper, Nickel, Lead
Total Nickel
Total Lead
Total Copper
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
MB4d
TRD2
SP3
MB19s
SPC
MB18
TRD5
GR01
SW3
TRD4
MB19d
SPA
SW6
SW2
MB13
MB1
TRD3
TRD1
TCD1
PWT01



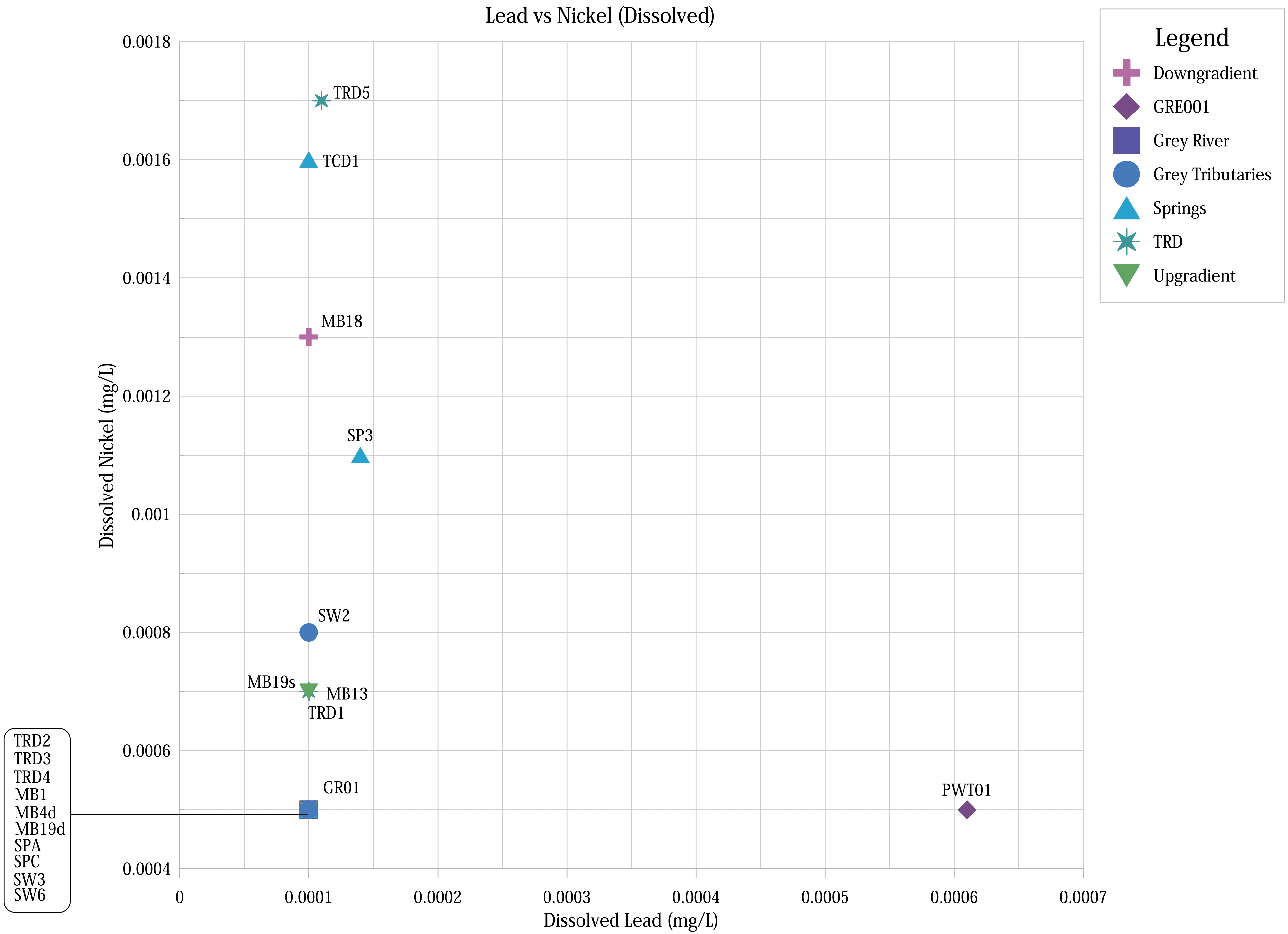
Total Copper, Nickel, Zinc
Total Zinc
Total Nickel
Total Copper
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
MB13
GR01
SW6
TRD4
MB19s
MB19d
TCD1
TRD3
SPA
SW3
TRD1
TRD5
SPC
MB18
SW2
SP3
MB4d
TRD2
MB1
PWT01



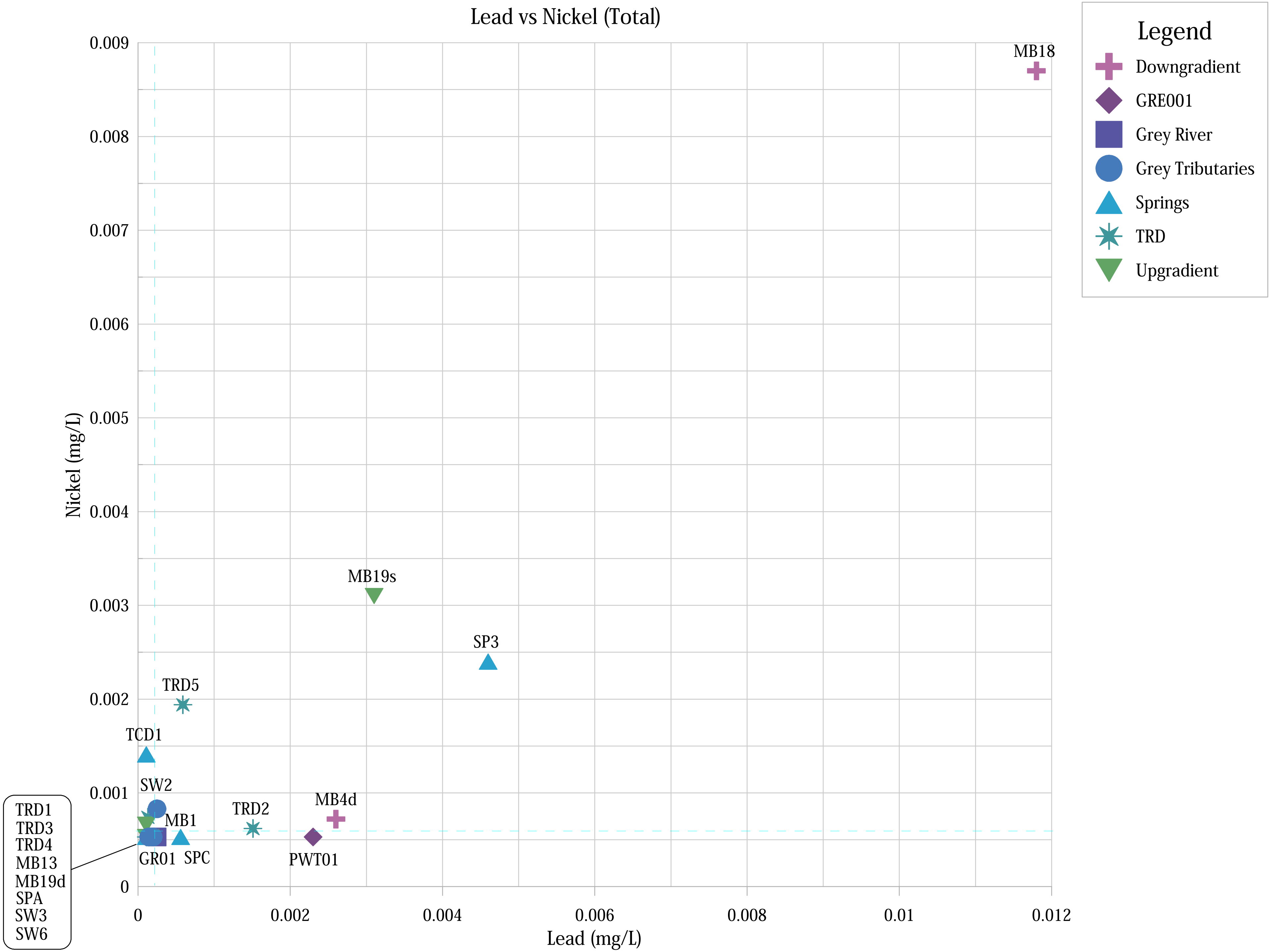
Dissolved Copper, Nickel, Lead
Dissolved Nickel
Dissolved Lead
Dissolved Copper
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
MB1
MB19d
MB4d
SPA
GR01
TRD4
SW3
SW6
SPC
TRD5
MB18
SP3
TCD1
SW2
MB19s
MB13
TRD3
TRD1
TRD2
PWT01



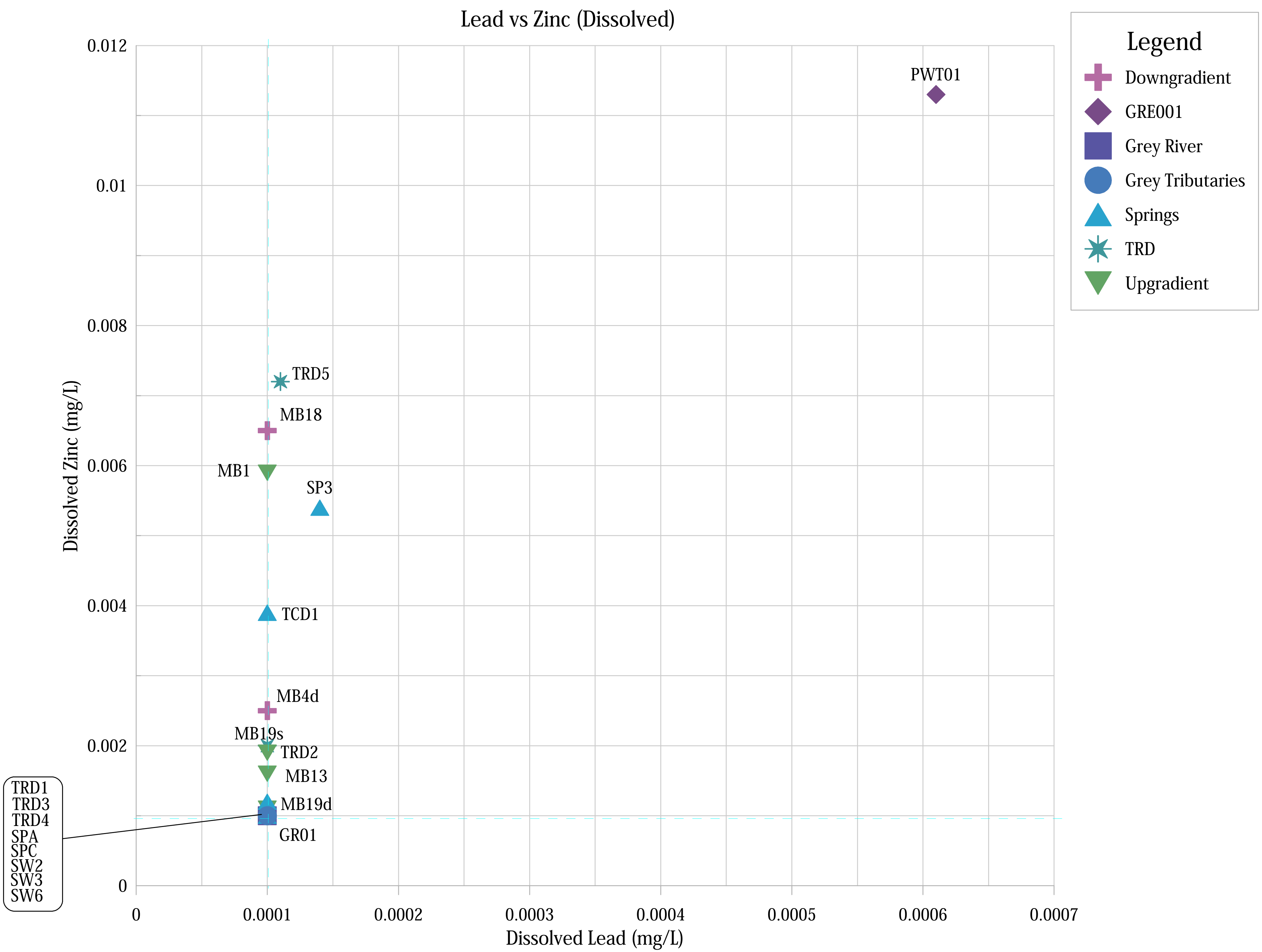
Dissolved Copper, Nickel, Zinc
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
MB1
MB18
TRD5
SP3
MB4d
TRD2
TCD1
MB19s
MB13
SPA
MB19d
SPC
SW6
GR01
TRD4
TRD3
SW3
SW2
PWT01
TRD1
Dissolved Nickel
Dissolved Zinc
Dissolved Copper
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



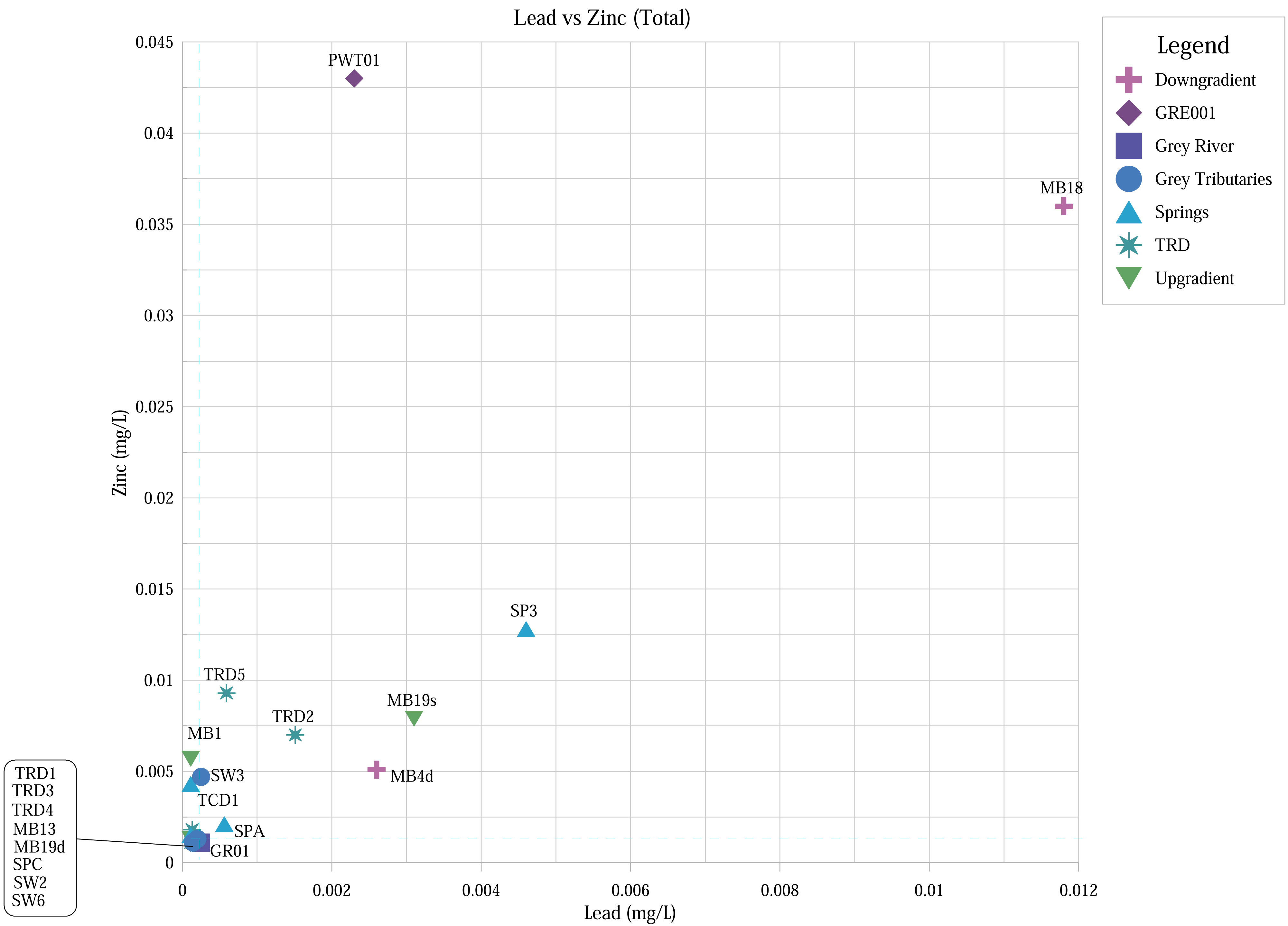
Lead vs Nickel (Dissolved)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
TRD5
TCD1
MB18
SP3
SW2
MB19s
MB13
TRD1
GR01
PWT01
TRD2
TRD3
TRD4
MB1
MB4d
MB19d
SPA
SPC
SW3
SW6
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
Dissolved Nickel (mg/L)
Dissolved Lead (mg/L)



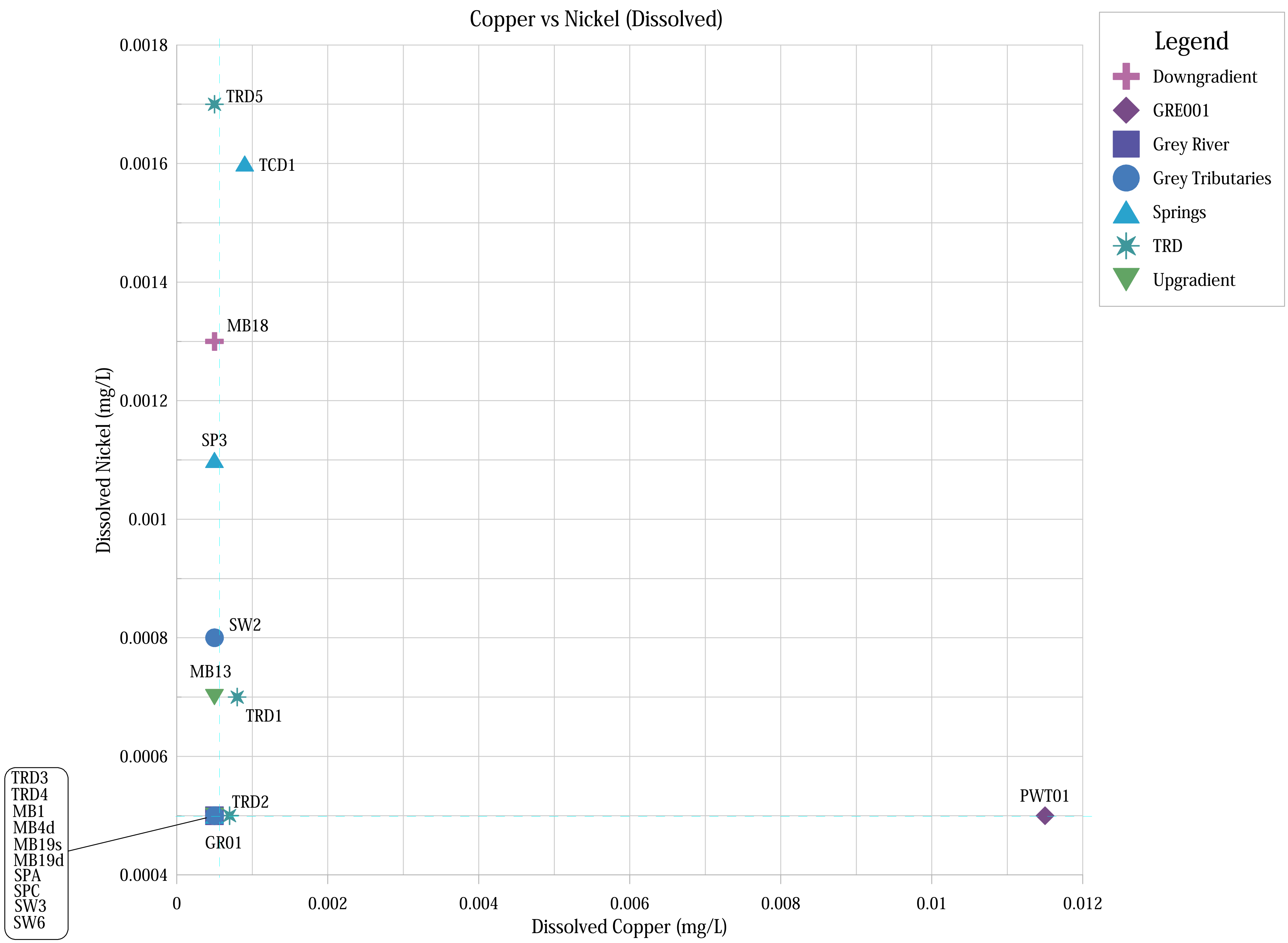
Lead vs Nickel (Total)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
MB18
MB19s
SP3
TRD5
TCD1
SW2
MB1
TRD2
MB4d
GR01
SPC
PWT01
TRD1
TRD3
TRD4
MB13
MB19d
SPA
SW3
SW6
Nickel (mg/L)
Lead (mg/L)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0.002
0.004
0.006
0.008
0.01
0.012

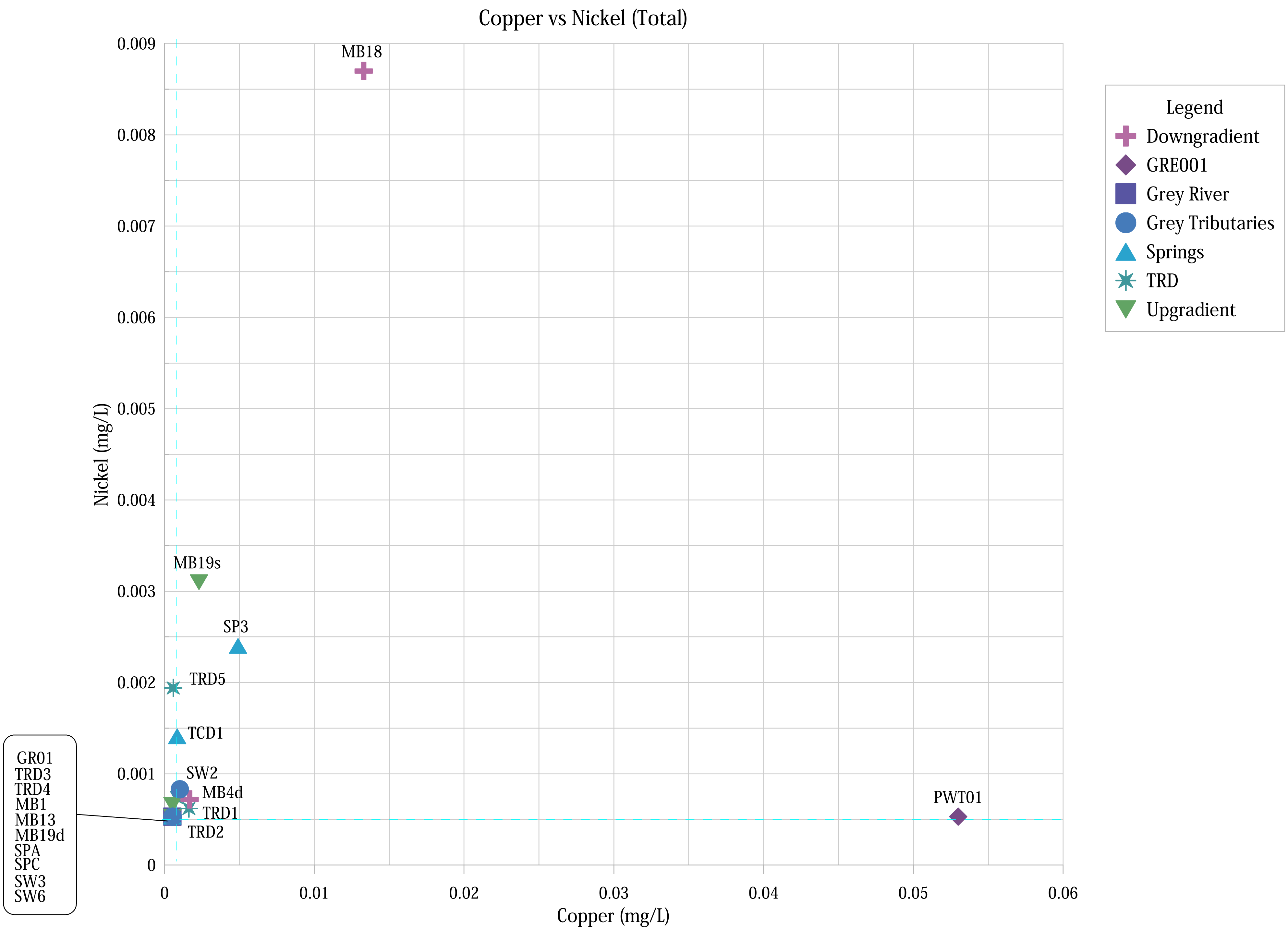


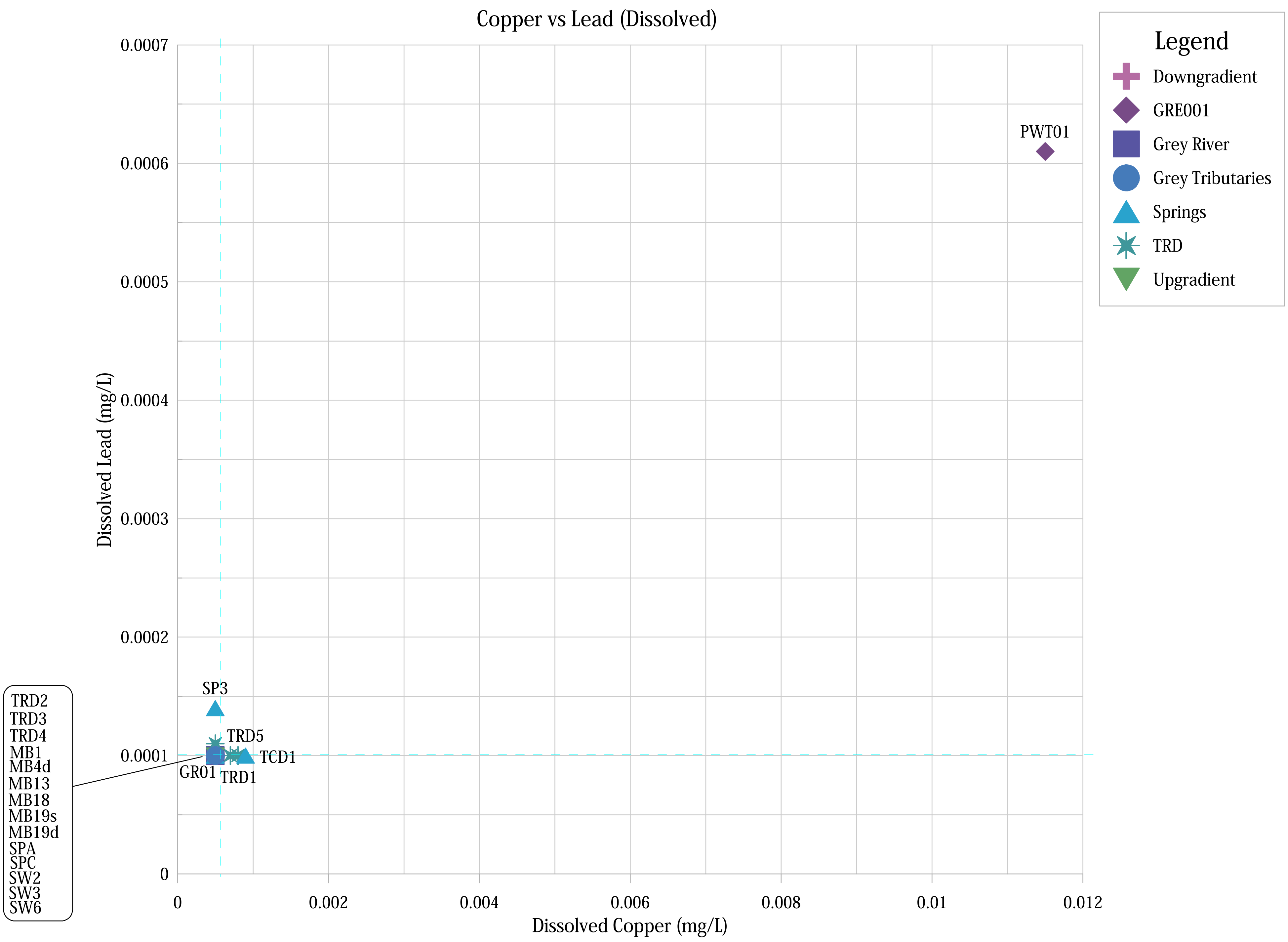
Lead vs Zinc (Dissolved)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
PWT01
TRD5
MB18
MB1
SP3
TCD1
MB4d
MB19s
TRD2
MB13
MB19d
GR01
TRD1
TRD3
TRD4
SPA
SPC
SW2
SW3
SW6
Dissolved Zinc (mg/L)
Dissolved Lead (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007



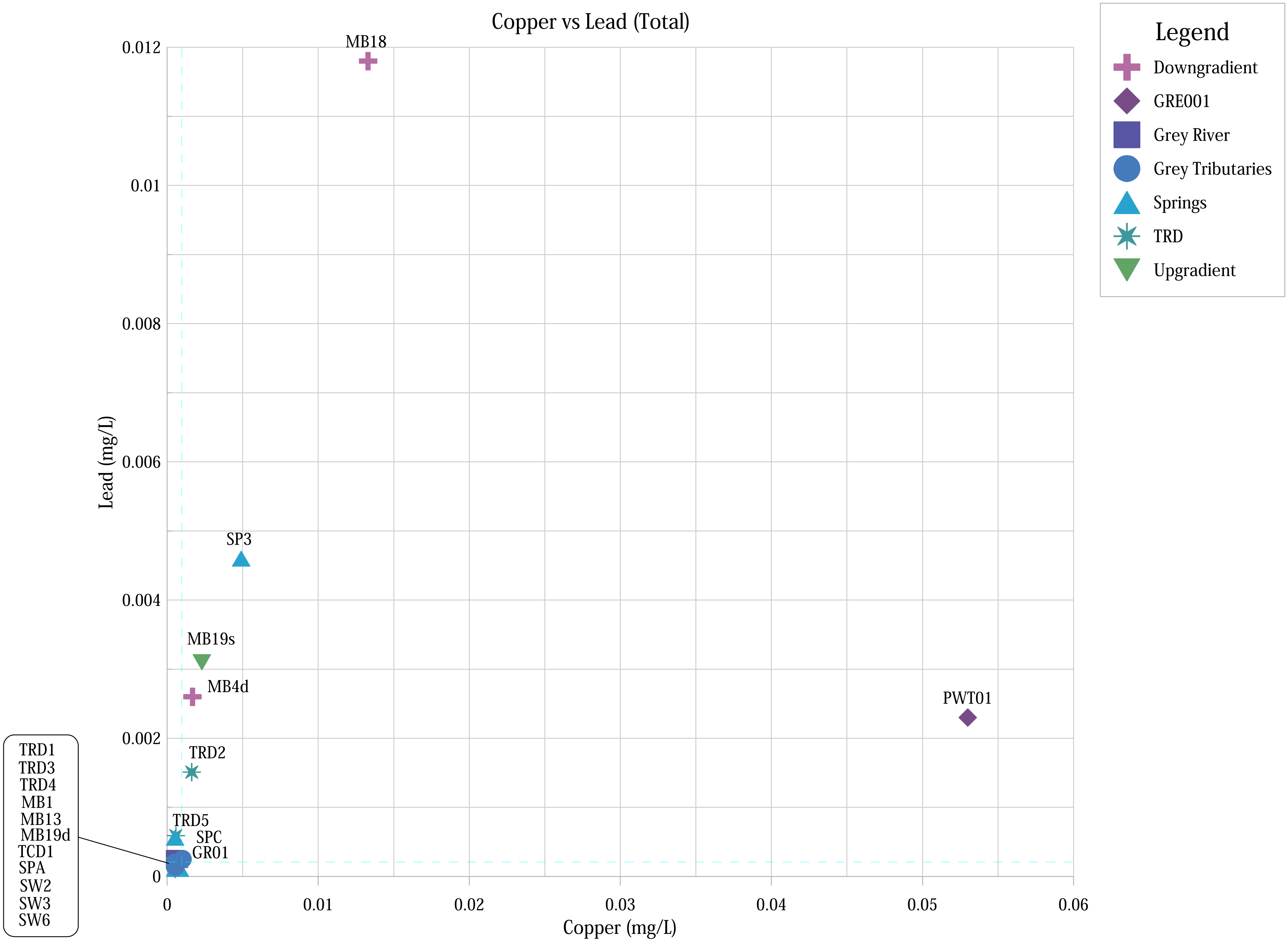
Lead vs Zinc (Total)
Zinc (mg/L)
Lead (mg/L)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.002
0.004
0.006
0.008
0.01
0.012
PWT01
MB18
SP3
TRD5
MB19s
TRD2
MB1
SW3
MB4d
TCD1
SPA
GR01
TRD1
TRD3
TRD4
MB13
MB19d
SPC
SW2
SW6
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient


Copper vs Nickel (Dissolved)
Dissolved Nickel (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0
0.002
0.004
0.006
0.008
0.01
0.012
Dissolved Copper (mg/L)
TRD5
TCD1
MB18
SP3
SW2
MB13
TRD1
TRD2
GR01
PWT01
TRD3
TRD4
MB1
MB4d
MB19s
MB19d
SPA
SPC
SW3
SW6
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient

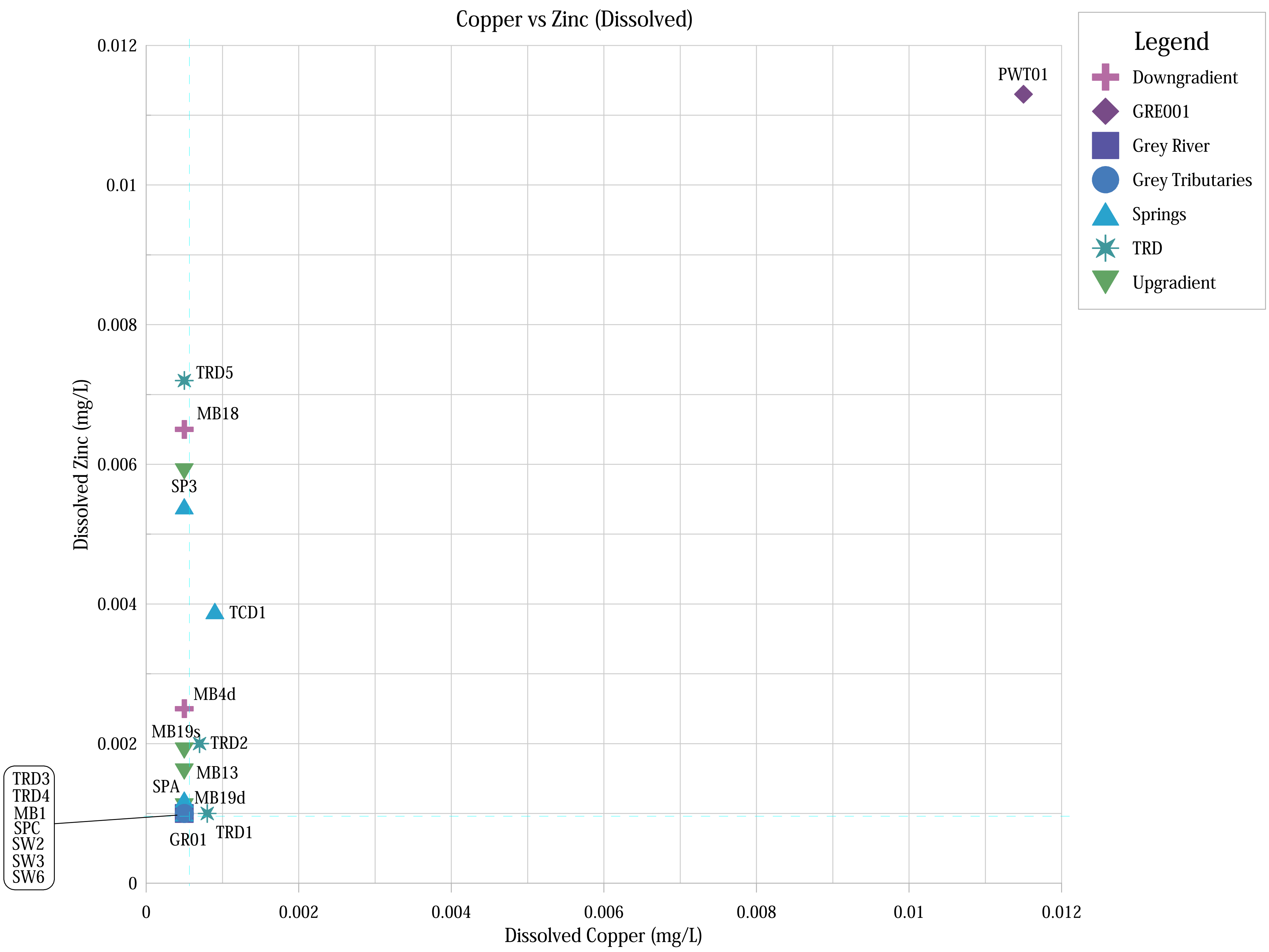

Copper vs Nickel (Total)
Nickel (mg/L)
Copper (mg/L)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0.01
0.02
0.03
0.04
0.05
0.06
MB18
MB19s
SP3
TRD5
TCD1
SW2
MB4d
TRD1
TRD2
PWT01
GR01
TRD3
TRD4
MB1
MB13
MB19d
SPA
SPC
SW3
SW6
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient

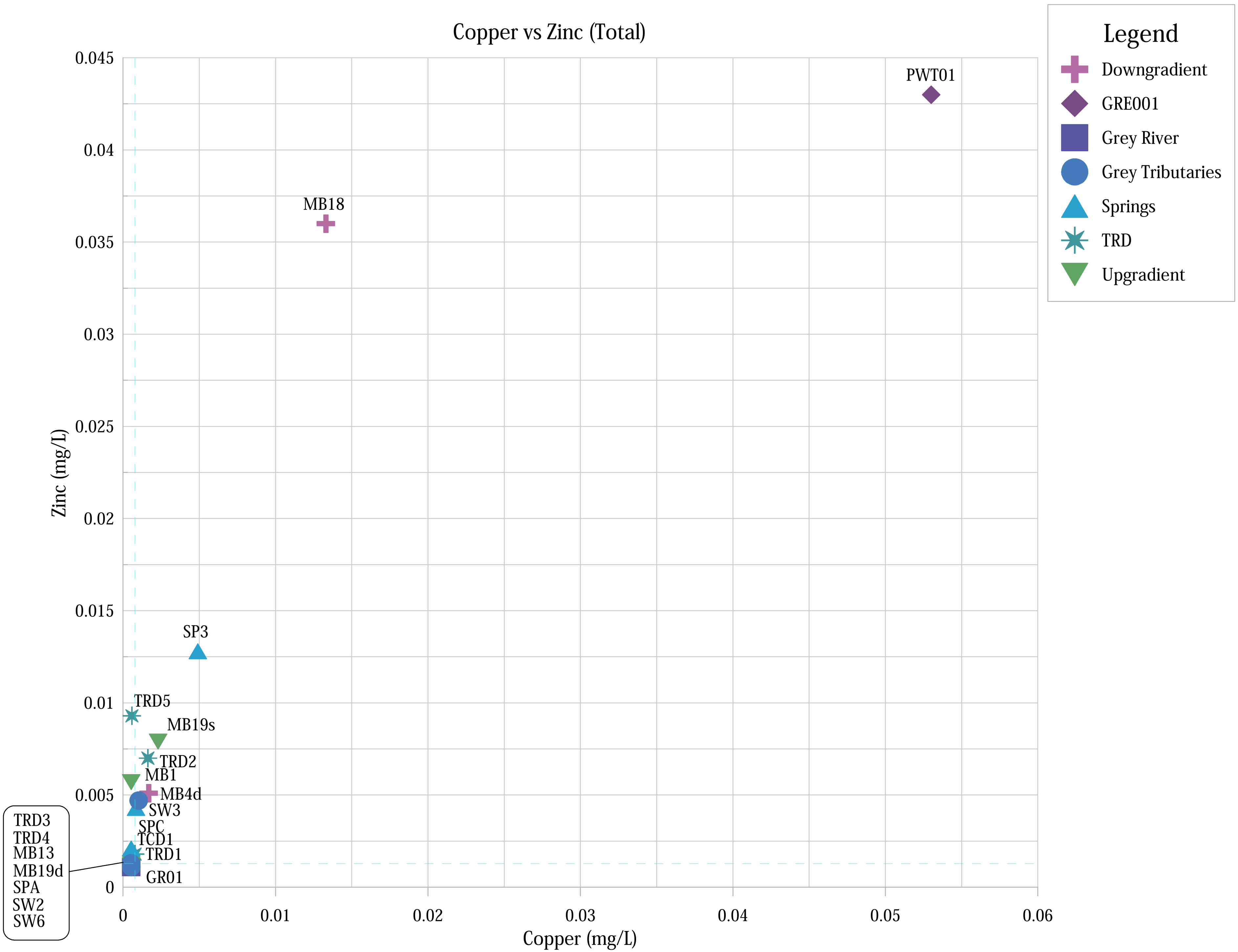


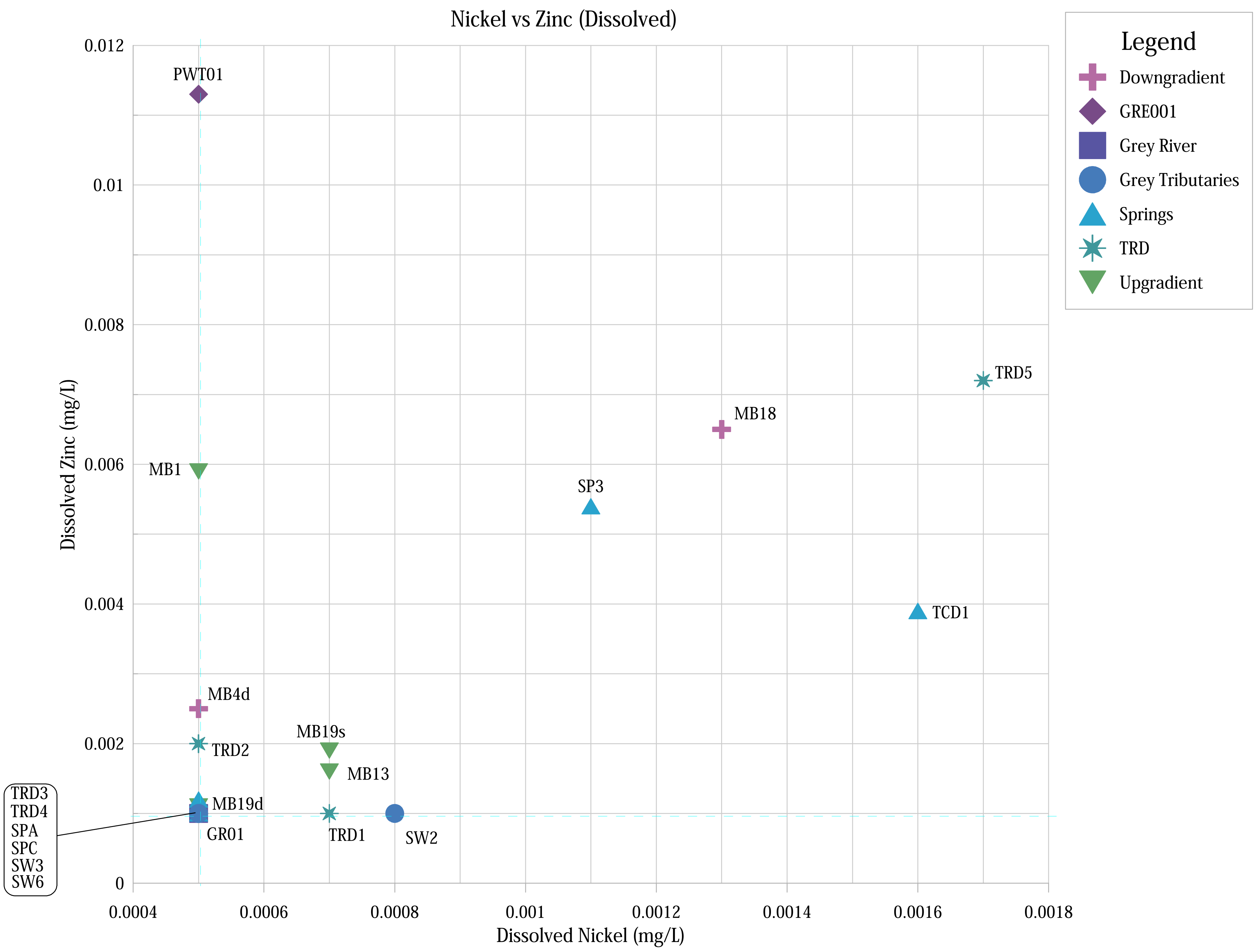
Copper vs Lead (Dissolved)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
PWT01
SP3
TRD5
TCD1
GR01
TRD1
TRD2
TRD3
TRD4
MB1
MB4d
MB13
MB18
MB19s
MB19d
SPA
SPC
SW2
SW3
SW6
Dissolved Lead (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
Dissolved Copper (mg/L)
0
0.002
0.004
0.006
0.008
0.01
0.012



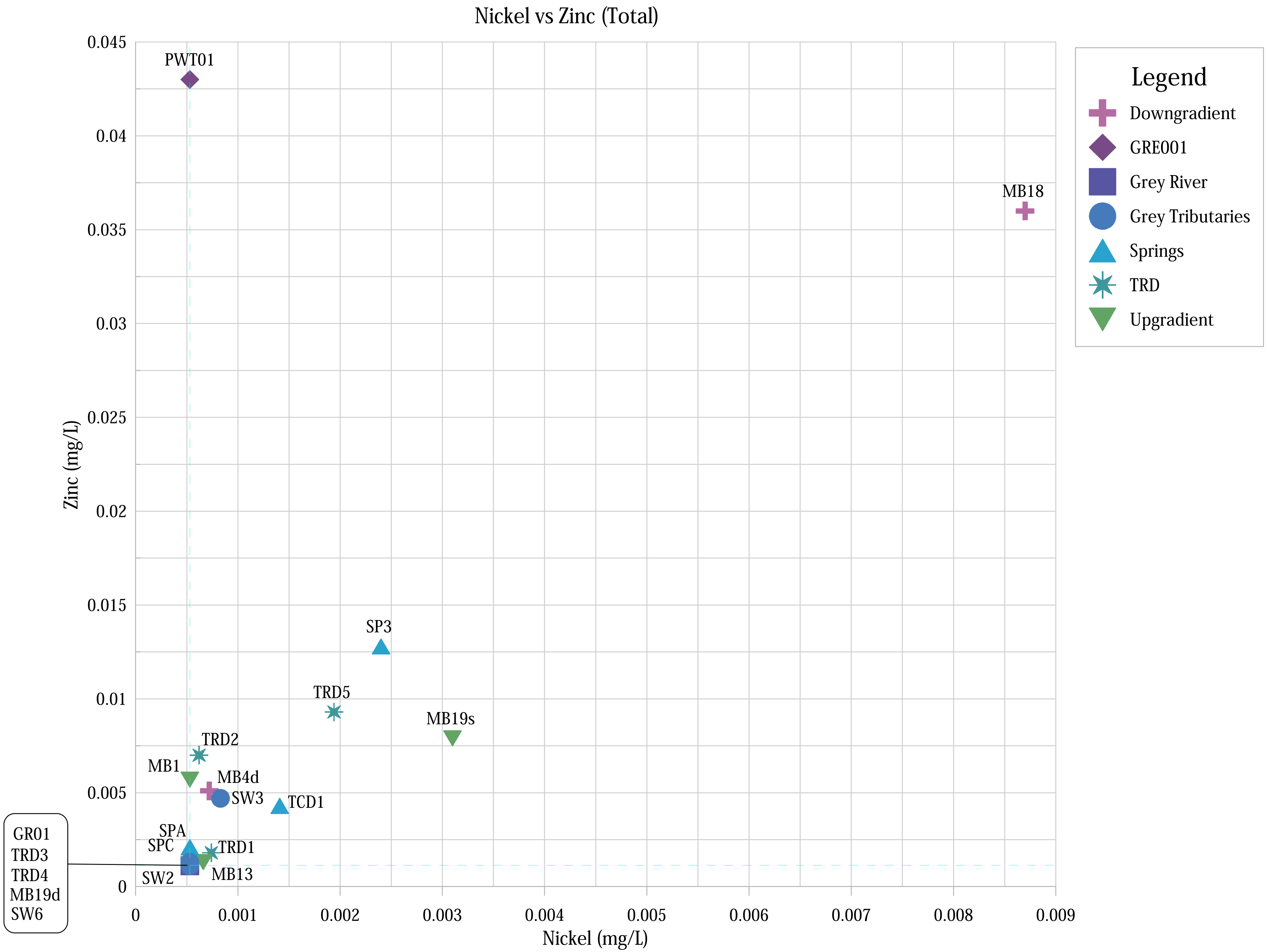
Copper vs Lead (Total)
Lead (mg/L)
Copper (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
0.01
0.02
0.03
0.04
0.05
0.06
MB18
SP3
MB19s
MB4d
PWT01
TRD2
TRD5
SPC
GR01
TRD1
TRD3
TRD4
MB1
MB13
MB19d
TCD1
SPA
SW2
SW3
SW6
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient


Copper vs Zinc (Dissolved)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
Dissolved Zinc (mg/L)
Dissolved Copper (mg/L)
0
0.002
0.004
0.006
0.008
0.01
0.012
PWT01
TRD5
MB18
SP3
TCD1
MB4d
MB19s
TRD2
MB13
SPA
MB19d
TRD1
GR01
TRD3
TRD4
MB1
SPC
SW2
SW3
SW6


Copper vs Zinc (Total)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
PWT01
MB18
SP3
TRD5
MB19s
TRD2
MB1
MB4d
SW3
SPC
TCD1
TRD1
GR01
TRD3
TRD4
MB13
MB19d
SPA
SW2
SW6
Zinc (mg/L)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Copper (mg/L)
0
0.01
0.02
0.03
0.04
0.05
0.06



Nickel vs Zinc (Dissolved)
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient
Dissolved Zinc (mg/L)
Dissolved Nickel (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
0.0004
0.0006
0.0008
0.001
0.0012
0.0014
0.0016
0.0018
PWT01
MB1
MB18
TRD5
SP3
TCD1
MB4d
TRD2
MB19s
MB13
MB19d
GR01
TRD1
SW2
TRD3
TRD4
SPA
SPC
SW3
SW6


Nickel vs Zinc (Total)
Zinc (mg/L)
Nickel (mg/L)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
PWT01
MB18
SP3
TRD5
MB19s
TRD2
MB1
MB4d
SW3
TCD1
SPA
SPC
TRD1
SW2
MB13
GR01
TRD3
TRD4
MB19d
SW6
Legend
Downgradient
GRE001
Grey River
Grey Tributaries
Springs
TRD
Upgradient

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memorandum

TO	Mike Durand	FROM	Duncan Gray
	Planz	DATE	20 May 2025
RE	Taylorville Resource Park Limited Short-term Consent Application – Ecological Review		

1.0 Introduction

1.1 Context

Bioresearches was engaged by ENGEO, on behalf of their client Taylorville Resource Park Limited (TRPL), to undertake an Ecological Impact Assessment (EcIA) for the temporary discharge of leachate contaminated water to land (RC-2024-0122). The Bioresearches assessment is presented in a memo dated 7 February 2025. That ecological assessment was in response to a s92 RMA request sent by the West Coast Regional Council (WCRC) (WCRC letter dated 19 December 2024) to address questions raised during consent processing.

This memorandum is a review of the Bioresearches EcIA and consideration of the potential ecological effects of the TRPL proposal. To inform my review I have considered the information contained within the ENGEO Preliminary Hydrogeological Assessment (the original effects assessment provided with the resource consent application dated 19 September 2024), a later ENGEO memo detailing water quality results from samples collected in January 2025, images created by EHS Support (relevant to previous consent applications for the site) and conversations with Carl Steffens (PDP), whom has undertaken a formal review of hydrogeological issues relevant to the application on behalf of WCRC.

1.2 Assessment Overview

The Bioresearches EcIA is a brief document based on a walk-over or images provided by a third party. It is not apparent that Bioresearches visited the site or what assessments were undertaken. Bioresearches Figure 1 (provided below) indicates that macroinvertebrates and fish were surveyed, but that information is not presented in the document. Throughout there are statements made about values that have little to no basis or supporting material and are counter to my own interpretations of the information provided.

1.3 Site Layout

I note that the alignment of streams shown by Bioresearches (Figure 1) is incorrect and I have included what appears to be a correct interpretation of waterways presented in an EHS Support report from 2024 (this document Figure 2).

Noname Creek drains a gully to the north and north-west of the landfill site, crosses under Taylorville Road and drops down to the Grey River flats. There it is joined by Grey River tributary which appears to arise on the flats at the base of a bank below Taylorville Road. The Taylorville Road roadside drain is the only obvious headwater to the Grey River tributary (via a culvert passing under the road). The stream is assumed to be otherwise groundwater fed along the flats.

The Roadside drain collects water from the western edge of the landfill and along the adjacent access road to the neighbour's property, in addition to receiving groundwater seepage via a spring at the head of the drain (western boundary of the landfill). At the intersection of the neighbour's driveway and Taylorville Road (west of the landfill) the roadside drain also collects water from along the Taylorville Road and flows to the east. However, as shown in Figure 2 below, further east along the road the direction of flow in the roadside drain reverses on two occasions. Drain water flowing in opposite directions converges at culverts shown at the locations of TRD5 and TRD2 in Figure 2. The culvert at TRD5 drains water under the road into the Grey River tributary as described above, while the culvert at TRD2 transfers water to another stream situated on the lower terrace surface below the road and which drains land to the east and south of the Grey District Council (GDC) Coal Creek water treatment plant. For the purpose of this review the stream to the east of the GDC treatment plant is referred to as the Noname Creek 2.

The Noname Creek 2 and associated drains collect water from an eastern catchment but also receive water from the roadside drain directly below the southern flanks of the landfill terrace via the culvert at TRD2. This section of the roadside drain, in addition to roadside drainage further east (that crosses into the Noname Creek 2 via an additional culvert at TRD4 as seen in Figure 2) is also close to the proposed TRPL discharge to land site (Figure 3). The Noname Creek 2 ultimately meanders across the flats on the floodplain of the Grey River in the vicinity of the GDC Coal Creek water supply bores before discharging to the Grey River. I note the ecological value of the Noname Creek 2 has not been assessed despite being in relatively close proximity to potential groundwater and surface water flow paths that could be affected by the proposed discharge to land.

Based on the descriptions provided above, we note that Bioresearches Figure 1 indicates that the Noname Creek 2 and the Grey River tributary are connected and the lower section of the Noname Creek 2 on the Grey River floodplain are also not shown in the Bioresearches figure. In addition, the Bioresearches figure doesn't show the culverts at the locations of TRD2 and TRD4 that provide a pathway for drain water on the northern side of Taylorville Road to enter into the Noname Creek 2.

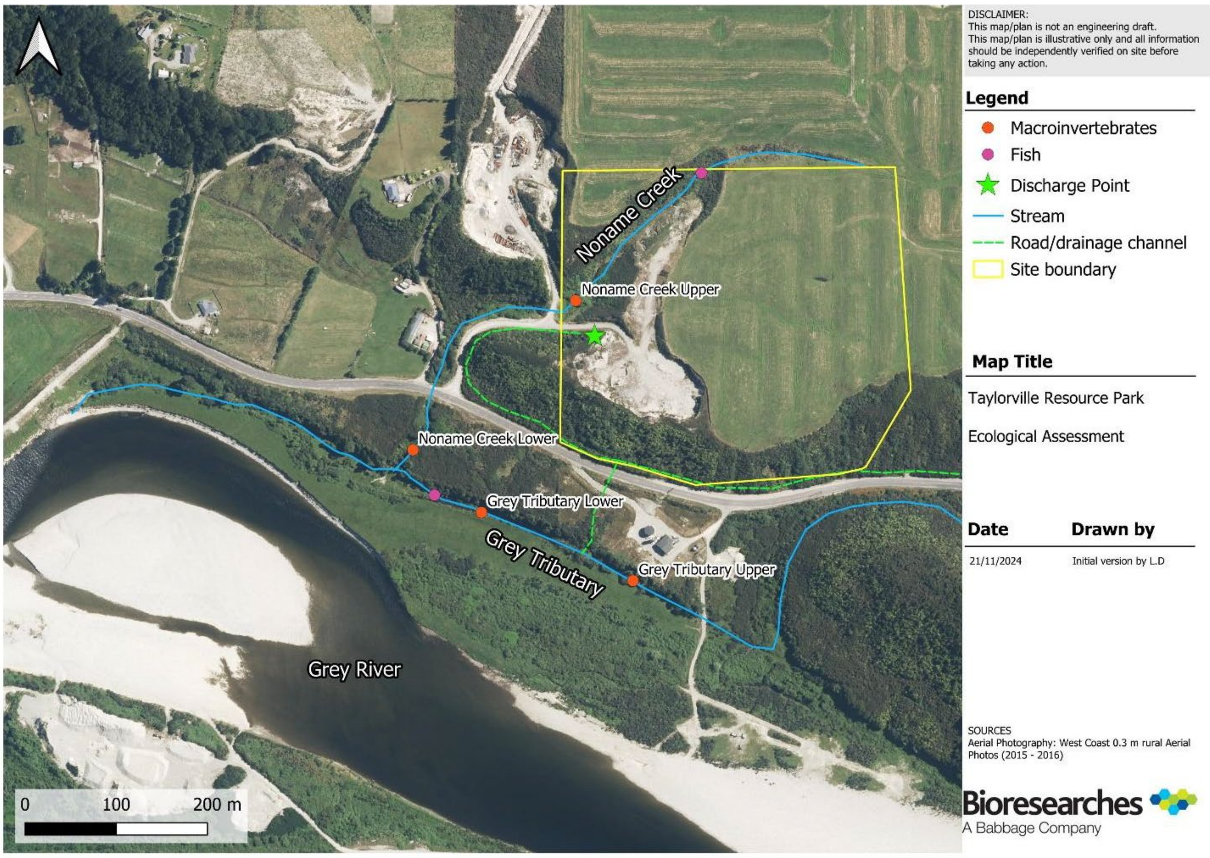

Figure 1. Bioresearchers Figure 1 showing an erroneous interpretation of the stream networks and locations of sampling sites that were not subsequently reported.

Figure 2. Site layout from EHS Support (2004). Facility in red. Surface Drains and streams in orange and blue. Water sampling locations in yellow (surface water) and grey (groundwater)

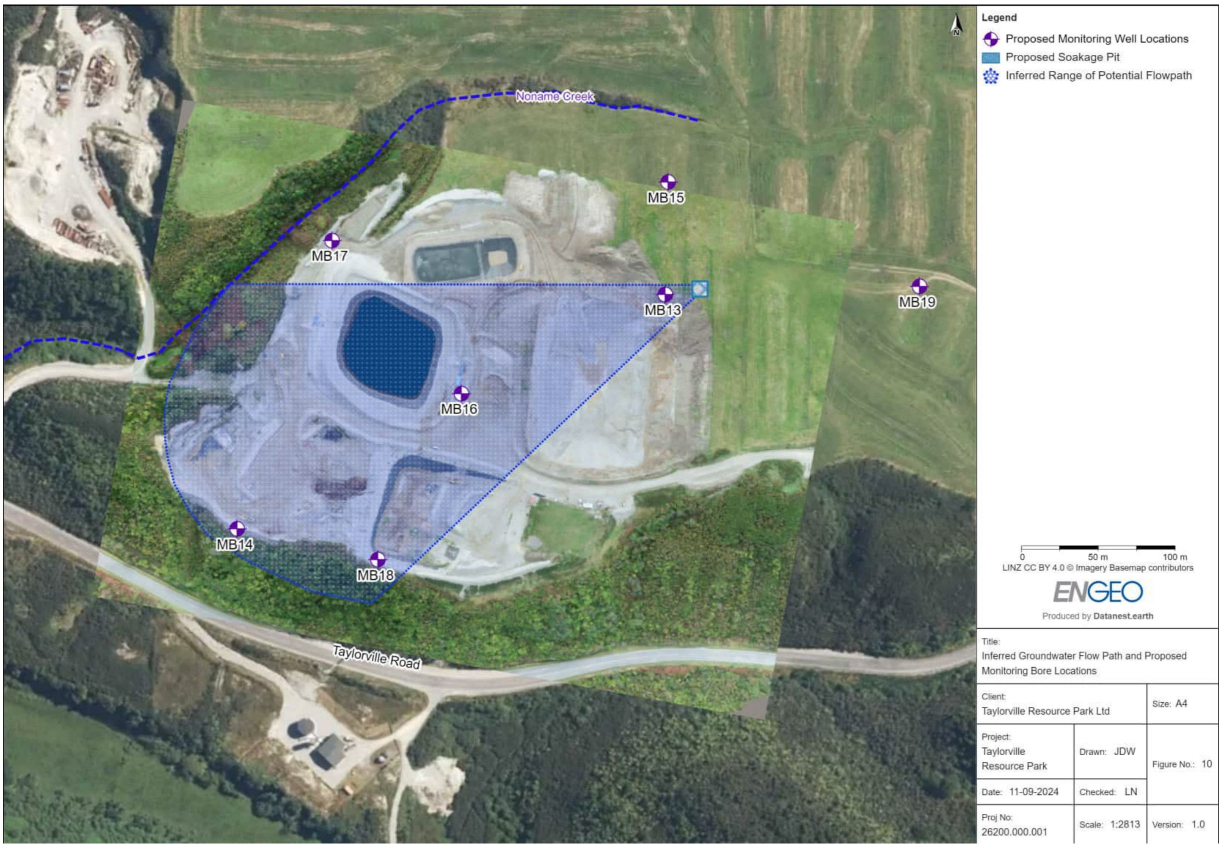

Figure 3. Location of proposed discharge of excess leachate and stormwater to land and inferred range of potential groundwater flowpath (ENGEO preliminary hydrogeological investigation).

2.0 Ecological Values

2.1 Noname Creek

Noname Creek is described by Bioresearches as a small waterway with a generally cobble / gravel bed and dense riparian vegetation that is a mix of native and exotics. Bioresearches describe some fine sediment being present on the bed, but no formal assessment of deposited sediment has been made to determine if that sediment would be likely to impact aquatic ecosystems. Based on the description I consider this stream would offer good habitat to a diversity of fish and macroinvertebrates.

Water quality results taken from Noname Creek are reviewed by ENGEO in their preliminary hydrogeological assessment and presented in Appendix 5 (Table A6.4 and 6.5) of that report. Those results indicated that in general the water in Noname Creek was clean (although the number of parameters sampled from early 2023 to mid-2024 were limited), albeit with consistently elevated Nitrate-N and occasional spikes in aluminium and zinc. The concentrations of Nitrate-N peaked at 1.44 mg/l at the upstream site (sample SPFUS) and such concentrations might contribute to the growth of undesirable algae in the stream where it is less shaded. However, in terms of toxicity the recorded concentrations are suitable for a moderately disturbed system with effects on 5 % of sensitive species (Hickey, 2013; MfE, 2023).

Subsequent information provided in an ENGEO memo dated 17 March 2025 provides updated water quality results for the Noname Creek. January 2025 results for Nitrate-N peaked at 0.25 mg/l in the downstream Noname Creek site. The ENGEO memo (March 2025) describes how elevated parameter concentrations in wastewater peaked during January 2023 and were likely due to the inappropriate deposition of a large volume of organic matter (tomato plants) in Cell C. We note this was the same time that the concentrations of Nitrate-N peaked in Noname Creek. It is possible that the effects of that organic matter may have passed (or have temporarily reduced due to seasonal changes in groundwater and rainfall interaction within Cell C). Based on the above, the elevated nitrate concentrations (1.44 mg/l in January 2023) may not be representative of Noname Creek over the longer term. This indicates that Noname Creek water quality and ecological health, in terms of nitrate, may be better than indicated by the initial data derived from ENGEO in their preliminary hydrogeological assessment and that was used by Bioresearches.

Given the descriptions of water quality and habitat for the Noname Creek I am unable to agree with the description of the stream as having low ecological values or likely a depauperate fish community. The Noname Creek discharges to the Grey River within 5 km of the Tasman Sea. A large proportion of New Zealand native fish are diadromous meaning they must migrate between the ocean and freshwater to complete their lifecycle (McDowall, 1998). Consequently, the number of fish species likely to be found in a stream is strongly regulated by distance to the ocean.

In the absence of barriers to fish passage I would expect Noname Creek to provide habitat to a broader array of fish than described by Bioresearches, including some 'At Risk', 'Threatened' or culturally valuable species. In addition to eels (two species) and any of several bully species, I suggest that migratory and non-migratory galaxiids, lamprey and torrent fish could be present in the stream. The most likely additional inhabitants of the Noname Creek are the galaxiids. The Koaro (*Galaxias beivipinnis*) classified as 'At Risk – declining' (Dunn et al., 2018), banded kokopu (*Galaxias fasciatus*) classified as 'Not Threatened', and the shortjaw kokopu (*Galaxias postvectis*) classified as 'Threatened – nationally vulnerable' are all capable of ascending relatively steep obstacles to access streams. The giant kokopu (*Galaxias argenteus*) classified as 'At Risk – declining' and Inanga (*Galaxias maculatus*) classified as 'At Risk – declining' are less competent climbers although the inanga can jump and these species would be more likely to occur in the Grey River tributary. The dwarf galaxias (*Galaxias divergens*) classified as 'At Risk – declining' is non-migratory meaning it resides permanently in the stream and is typically less affected by barriers to fish passage. The lamprey (*Geotria australis*) classified as Threatened – Nationally Vulnerable, is an accomplished climber, while the torrent fish (Cheimarrichthys fosteri) classified as 'At Risk – declining' is more a fast water specialist with a lesser climbing ability and least likely to reside in Noname Creek.

Bioresearches suggest that a fish barrier may be present where the Noname Creek passes under Taylorville Road but provide no images or assessment. I note that fish passage barrier assessments can be routinely undertaken and uploaded to a national database administrated by NIWA free of charge[1]. A further fish passage barrier may occur where the Grey River tributary flows into the Grey River. Passage at this point has not been assessed but is likely to be partial, in that the Grey River tributary may flow within porous river gravels during periods of low flows, but that elevated flows in either the Grey River or Grey River tributary will allow passage.

In summary, the Noname Creek described by Bioresearches has the potential for a diverse macroinvertebrate and fish community with the caveat that there may be barriers to fish migration. Accordingly, I would consider that in the absence of information to the contrary, the Noname Creek would have the potential for at least moderate ecological values.

[1] https://fishpassage.niwa.co.nz/. The Fish Passage Assessment Tool has been developed to provide an easy to use, practical tool for recording instream structures and assessing their likely impact on fish movements. Data is collected using the Fish Passage Assessment Survey available in the NIWA Citizen Science app. A User Guide for the Fish Passage Assessment Survey is available on NIWA's website. The information collected using the app is automatically uploaded to a national fish passage database.

2.2 Grey River Tributary

The Grey River tributary appears to arise on the Grey River flats, fed by groundwater at the base of terraces and the Noname Creek. Based on the map provided by EHS Support (Figure 2), it does not have an upstream connection to Noname Creek 2. The area where it arises on the flats, appears to be more wetland/pond habitat than a stream, but the waterway is described as subsequently becoming narrow and swift further downstream. The slow flowing wide reaches of the stream are natural deposition areas for fine sediments and so the predominance of sand and silt is not necessarily an indication of degradation. Sand and silts would derive from upstream erosion or potentially inundation from the Grey River during times of high flow and sediment load.

Bioresearches describe the Grey River tributary as having a variety of flow types (run, riffle, pool) and a diversity of riparian vegetation. As such, the stream provides a spectrum of habitats for both fish and macroinvertebrates. In particular, the slow flowing wetland reaches of the tributary would be favoured habitat for giant kokopu, shortfin eel and inanga. Bioresearches describe fish passage into the stream as being limited by topography but provide no other detail or assessment other than to state that only climbing species could gain access. However, Bioresearches decline to list or consider those climbing species at any point in the assessment. In the absence of a meaningful assessment of fish passage or fish communities it is prudent to assume that a more diverse community may be present than described in the Bioresearches assessment.

Water quality in the Grey River tributary during January 2025 shows potential evidence of some contamination from landfill leachate based on Table 2 of the ENGEO March 2025 memo. Noname Creek 2 (sample SW6), here used as a reference site, had low sulphates[2] (12.7 mg/l), whereas the Grey River tributary downstream of the roadside drain discharge at TRD5 (SW2) had much higher concentrations (197 mg/l). Further downstream in the Grey River tributary at site SW3 (slightly downstream of the Noname Creek discharge into the Grey River tributary), sulphate levels had begun to decline (58 mg/l). The same pattern was seen for a number of other parameters, potentially indicating that water quality impacts from the landfill can migrate significant distances along the surrounding surface water features. While these January 2025 results suggest a source of contamination from the landfill to the Grey River tributary, the measured concentrations at that time are unlikely to cause significant negative effects on stream ecology. However, based on earlier water quality results in Noname Creek during 2023, it is possible that contaminant concentrations in the Grey River tributary may have been higher at that time.

The Grey River tributary, based on Bioresearches descriptions, is likely to contain a diversity of fish and macroinvertebrates and there is no basis for determining its ecological value to be low. On the basis of the descriptions available, I suspect the headwaters of the Grey River tributary constitute a natural inland wetland as suggested by the ENGEO report, however a formal assessment would be required to confirm that determination.

2.3 Roadside Drain

The Roadside drain is described as artificial with limited flow or habitat heterogeneity. Being artificial does not automatically mean a waterway has low, very low or negligible ecological values but based on the images and description I agree with that conclusion. The fish passage assessment is un-qualified, merely assertion, but there appears to be very limited habitat available on the day images where taken. The key concern about the roadside drain is the collection of potentially contaminated groundwater and conveyance to natural water bodies such as the Grey River Tributary and Noname Creek 2. Water quality

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[2] Sulphates are considered a useful indicator of leachate from the Taylorville Landfill. WCRC Selva Selvarajah pers. Comm. May 15, 2025.

data collected by the applicant confirms that significantly high concentrations of landfill derived contaminants have been measured in the drain.

3.0 Ecological Impact Assessment

It is not clear from the EcIA undertaken by Bioresearches what their understanding of the potential flow paths of leachate and stormwater to the receiving environment might be. The map included in the assessment shows a discharge point at the head of the roadside drain immediately west of the landfill (corresponding with the known spring location), however ENGEO confirm the location of the proposed discharge to land is east of the landfill as shown above in Figure 3 of this memo.

My understanding based on discussion with Carl Steffens is that contaminated water potentially being discharged to land at the location shown in Figure 3 will likely cause significant mounding of groundwater beneath the point of discharge, potentially causing a local increase in groundwater level by up to 8 m (groundwater may reach near the ground surface at the discharge point). This will affect local groundwater flow directions with potential local groundwater flow from the discharge point occurring radially in all directions. This could cause local migration of contaminants in the discharge in a northerly direction toward the upper reaches of Noname Creek, as well as in the natural direction of groundwater flow (generally from west through to south) and also to the south-east. Therefore, PDP's view is that the inferred contaminant flow path indicated by ENGEO and which is shown in Figure 3 may not be accurate.

PDP considers there is the potential for contaminants from the discharge to reach the headwaters of Noname Creek, the existing landfill cells, spring discharges and drains that occur in and along the roadside cutting on the northern side of Taylorville Road (including as far east as TRD4). As a result, contaminants incorporated in the discharge may potentially reach all the drains and streams described in Section 1.3 of this memo. Carl Steffens has indicated that contaminant concentrations will decrease in groundwater with distance from the discharge point, however he considers that information provided to date by ENGEO has not adequately confirmed the scale of reduction in contaminant concentrations prior to discharge of the contaminant plume to surface water. He considers the surface water bodies where contaminant discharges from the proposal may potentially be highest are Noname Creek (near its headwaters) and the roadside drains in the vicinity of TRD2 and TRD4. At TRD2 and TRD4, any discharges of contaminants from the proposal only need to travel a short distance through the Taylorville Road culverts into Noname Creek 2. The Grey River tributary is expected to be less likely to be impacted from contaminant discharges from the proposed discharge due to dilution, however as discussed previously water quality sampling indicates a potential impact in the Grey River tributary from the general landfill activities. While far field and large water bodies such as the Grey River are unlikely to show any demonstrable effect of relatively small volumes of contaminants, the uncertainty around the pathways and eventual fate and concentrations of contaminants at this site is of general concern.

ENGEO provide indicative estimated concentrations derived from the mixing of the discharge with flow in the Noname Creek. Their estimates are presented in Table 3 of the ENGEO Preliminary Hydrogeological Assessment and we have used those estimates to consider potential outcomes for near field receiving environments at the site. However, I note that ENGEO has carried out more recent RISC5 contaminant modelling to estimate contaminant concentrations at the nearest offsite receptor (310 m away as reported by ENGEO). Based on discussions with Carl Steffens, he has informed me he considers the modelling cannot be relied upon based on the level of detail provided by ENGEO to date. In addition, taking into account the mounding discussed previously, he also considers the nearest receptors may be closer (potentially more akin to 100 m distant from the discharge point). Further to the above, I note that the ENGEO text describes the generation of Table 3 using maximum values of stormwater and leachate (Table 3: column 2), but those values don't match the maximum values in the raw data presented in ENGEO Table A6.1. For example, table 3 uses a maximum value of 16.1 mg/l (total ammoniacal nitrogen) collected in cell B/C, while the actual maximum value from cell B/C is 98 mg/l. The value used by ENGEO for their later RISC5 modelling was 98 mg/l. Therefore, we also have concerns that their estimates presented in Table 3 of their report may not be conservative enough.

Despite the issues described above and significant uncertainty with regard to potential contaminant discharge concentrations, we have used the information provided in Table 3 from ENGEO to make an initial assessment of potential effects. ENGEO Table 3 contaminant concentrations are presented alongside measured maximum values from the downstream site in Noname Creek (Table 1). As discussed above, there is the suggestion that maximum values measured in the Noname Creek may be representative of an inappropriate deposition of organic matter into the landfill and not representative of long-term natural stream conditions. The effects of that organic matter are considered potentially to have passed (although it can't be ruled out that future interactions between rainfall, groundwater and the fill within the landfill cells may result in further periods of significant stream impacts) and therefore water quality results at the downstream Noname Creek site collected in January 2025 have been used in Table 1 to indicate long-term water quality.

It is important to note that none of these concentrations are adjusted for bioavailability (e.g. adjustments based on pH, dissolved organic carbon or hardness) and that the concentrations shown are total metals not the dissolved fraction conventionally used for toxicity assessments. The latter option was chosen because Table 3 ENGEO only provided total concentrations and lacked estimates of any of the toxicant modifying factors.

Measured maximum values in Noname Creek were typically less than the thresholds for protection of 95 % of species and would be considered suitable for a moderately impacted stream. Exceptions were the maximum concentrations of Nitrate-N, total aluminium, total chromium and total zinc. However, it should be noted that the maximum aluminium and zinc concentrations were an order of magnitude greater than the three other samples collected, while the Nitrate -N concentration was not out of character for the creek during 2023-24.

Concentrations recorded in January 2025 were in some cases lower than the maximums by an order of magnitude. A high level of species protection was provided by concentrations of all contaminants other than aluminium, arsenic (V) and total chromium (VI) that provided 95 % protection. These latest results suggest that water quality in the Noname Creek is generally good and would support diverse ecological communities.

Assessment undertaken by ENGEO indicated that many contaminant concentrations could increase relative to the maximum values, including Ammoniacal-N, total manganese, total arsenic, total chromium, total copper, total lead, total nickel and total zinc. In some cases, the extent of the potential increase is that ANZG (2018) would indicate the site is a highly disturbed system and measurably degraded with chronic toxicity effects on more than 80 % of species. The level of impact is greater when the January 2025 Noname Creek water quality data is used which we consider is likely more representative.

Table 1. Comparison of modelled and measured contaminant concentrations in Noname Creek

	Noname Creek maximum (SPFDS)		Noname Creek Jan 2025 (SPFDS)		Table 3	
Contaminant	Max Concentration (mg/l)	ANZG Protection level (and threshold, mg/l)	Concentration (mg/l)	ANZG Protection level (and threshold, mg/l)	Concentration (mg/l)	ANZG Protection level (and upper threshold, mg/l)
Total Ammoniacal N	0.014	>99 %	<0.010	>99 %	5.07	<80 % (2.3)
Nitrate N	1.33	>90 % (1)	0.25	>99 %	0.11	>99 %[3]
Total[4] aluminium	0.26	<80 % (0.15)	0.044	>95 % (0.027)	0.066	>90 % (0.055)
Total manganese	0.039	>99 %	0.0127	>99 %	0.82	>99 %
Total arsenic (AsV)	0.0012	>95 % (0.0008)	<0.0011	>95 % (0.0088)	0.02	>90 % (0.013)
Total chromium (Cr VI)	0.00102	>90 % (0.001)	0.0006	>95 % (0.00001)	0.0052	>90 % (0.001)
Total copper	0.00123	>95 % (0.001)	0.00088	>99 %	0.056	<80 % (0.0025)
Total lead	0.00074	>99 %	0.00012	>99 %	0.0012	>95 % (0.001)
Total nickel	<0.00053	>99 %	<0.00053	>99 %	0.018	<80 % (0.017)
Total zinc	0.0103	>90% (0.008)	0.0024	99 %	0.066	<80 % (0.031)

[3] Note the ANZECC 2000 default guideline for Nitrate was erroneous and ANZG (2018) refer to the grading guidelines in (Hickey, 2013).
[4] Metal toxicity is typically compared against concentrations of the dissolved fraction rather than total. As such this comparison is inherently conservative.

4.0 Summary

There is considerable uncertainty around the ecological values of receiving environments potentially affected by the proposed TRPL discharge. I do not agree that the ecological values of the receiving environments that have been assessed can be determined as low. In contrast, based on the information available I would consider values to be at least moderate. Values in Noname Creek 2 have not been assessed.

There is further uncertainty around the flow paths of contaminant laden groundwater to receiving environments, in particular in the event that groundwater mounding results in leachate and stormwater being discharged to Noname Creek and the Taylorville Road drain in relatively close proximity to the discharge location.

Finally, the concentrations of contaminants that reach receiving environments are uncertain although previous estimates by ENGEO suggest potential effects would result in a degradation of ecological values. We note ENGEO has carried out more recent modelling of contaminant discharges at surface water receptors using RISC5, however we don't consider the outputs from that modelling can be relied upon.

In light of the available information, it seems possible that there is the potential for demonstrable and long lasting effects on the ecological values of Noname Creek (and possibly Noname Creek 2, and potentially the Grey River tributary). Due to the large dilution available, there are highly unlikely to be effects observed in the Grey River. While it is realistic that contaminant concentrations will reduce with distance from the discharge point, we don't consider that ENGEO has reliably demonstrated to date that concentrations will reduce to a level whereby there are no potential effects in nearby surface water bodies. In addition, based on the ENGEO Preliminary Hydrological Assessment, the potential effects in Noname Creek would be significant.

5.0 References

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Hickey, C. W. (2013). *Updating nitrate toxicity effects on freshwater aquatic species* (HAM2013-009; Issues HAM2013-009). Prepared for te Ministry of Building, Innovation and Employment by NIWA.

McDowall, R. M. (1998). Fighting the flow: Downstream-upstream linkages in the ecology of diadromous fish faunas in West Coast New Zealand rivers. *Freshwater Biology*, *40*, 111–122.

MfE. (2023). *National Policy Statement for Freshwater Management 2020, February 2023* (p. 75). Ministry for the Environment.

6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by West Coast Regional Council and others (not directly contracted by PDP for the work), including Planz, EHS Support, Bioresearches and ENGEO. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This memorandum has been prepared by PDP on the specific instructions of West Coast Regional Council for the limited purposes described in the memorandum. PDP accepts no liability if the memorandum is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

Prepared by

Duncan Gray

Technical Director - Ecology