



technical memorandum

TO William Dorset FROM Katy Grant
Pukerua Property Group LP DATE 6 August 2026
RE Mount Welcome Fast Track – Response to reviewer comments

1.0 Introduction

Classic Developments Limited on behalf of Pukerua Property Group LP (the Applicant) are seeking to obtain fast-track consent for the development of a residential subdivision near Pukerua Bay in an area known as Mount Welcome. The fast-track panel has provided reviewer comments on the application. This memorandum responds to Greater Wellington Regional Council (GWRC), Porirua City Council (PCC) and Ngāti Toa Rangatira comments relevant to the assessments provided by PDP including wetland and stream hydrology, water quality and contaminated land.

2.0 Greater Wellington Regional Council comments

GWRC provided comments in the following document and associated appendices:

- ✧ Comments on a substantive application under section 53 of the Fast-track Approvals Act 2024 - Mt Welcome, Pukerua Bay, Porirua (GWRC, 28 July 2026)

This included 18 substantive issues where additional information was requested. Of relevance to PDPs assessments were:

- ✧ Issue 2: Proposed retention wetlands
- ✧ Issue 13: Water quality monitoring and discharge quality conditions
- ✧ Appendix 3: Technical Comments Hydrology

2.1 Issue 2/Appendix 3 – Technical Comments Hydrology

GWRC commissioned James Blyth (Collaborations) to undertake the review of the hydrology aspects of the application and his review has been attached as Appendix 3 of their review. This response addresses each comment (where relevant).

2.1.1 Agreement with applicant – comments 1 to 7

No response required

2.1.2 Monitoring data and calibration – comments 8 to 15

It is acknowledged that the assessment was based on limited available site-specific data at the time of submission, which does introduce an element of uncertainty into the assessment. Since the assessment was completed, approximately 8 months of monitoring data has been collected. The results are presented in the Mount Welcome Hydrological Baseline Monitoring Report 2025-2026 and indicate broad agreement

with the assumptions used to develop the model. However, as noted by the reviewer, the flows within the model are higher and have more peaks than the monitoring results indicate.

The model has therefore been recalibrated to the baseline data, and the results of this recalibration are presented here. Local rainfall and evapotranspiration data was run through the 5-minute timestep model for the period 1 June 2025 to 15 May 2026 and compared to the measured data. The 5-minute timestep was used to recalibrate to the flows estimated from the baseline data. It was necessary to slightly alter the run-off lag and downstream hydraulic conductivity values to better fit the data, see results in Figures 1 to 5 below.

The results indicate a good fit to flow in all three monitored catchments, although the model does underestimate the groundwater baseflow into the streams during winter periods in the Taupō Catchments and year-round in the Kakaho Catchment. The modelled wetland water levels exhibit less variability than the observed water levels, reflecting the model structure, which represent each wetland as a storage bucket with inflows and outflows, rather than a dynamic system with internal flow processes. This difference is particularly apparent in the T3 catchment, where the baseline monitoring results indicate that the wetlands can accommodate substantial water level fluctuations without adverse effects.

Furthermore, the monitoring points were not located within the centre of the wetland (to allow for long-term monitoring during and post development) so are likely to show more variation than would be measured centrally. Whilst the fit is not perfect, it is considered that the model provides a reasonable approximation of changes to the entire wetland, albeit not exactly matching localised variations.

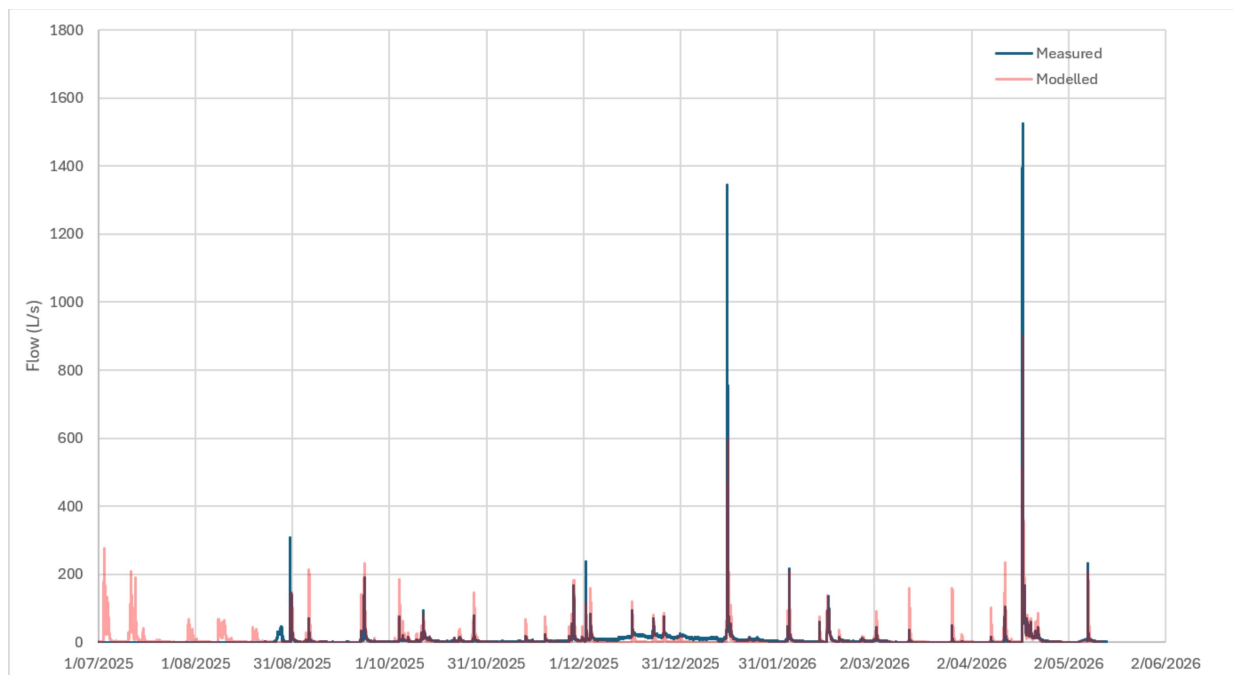


Figure 1: Flow from T1 catchment (SW02)

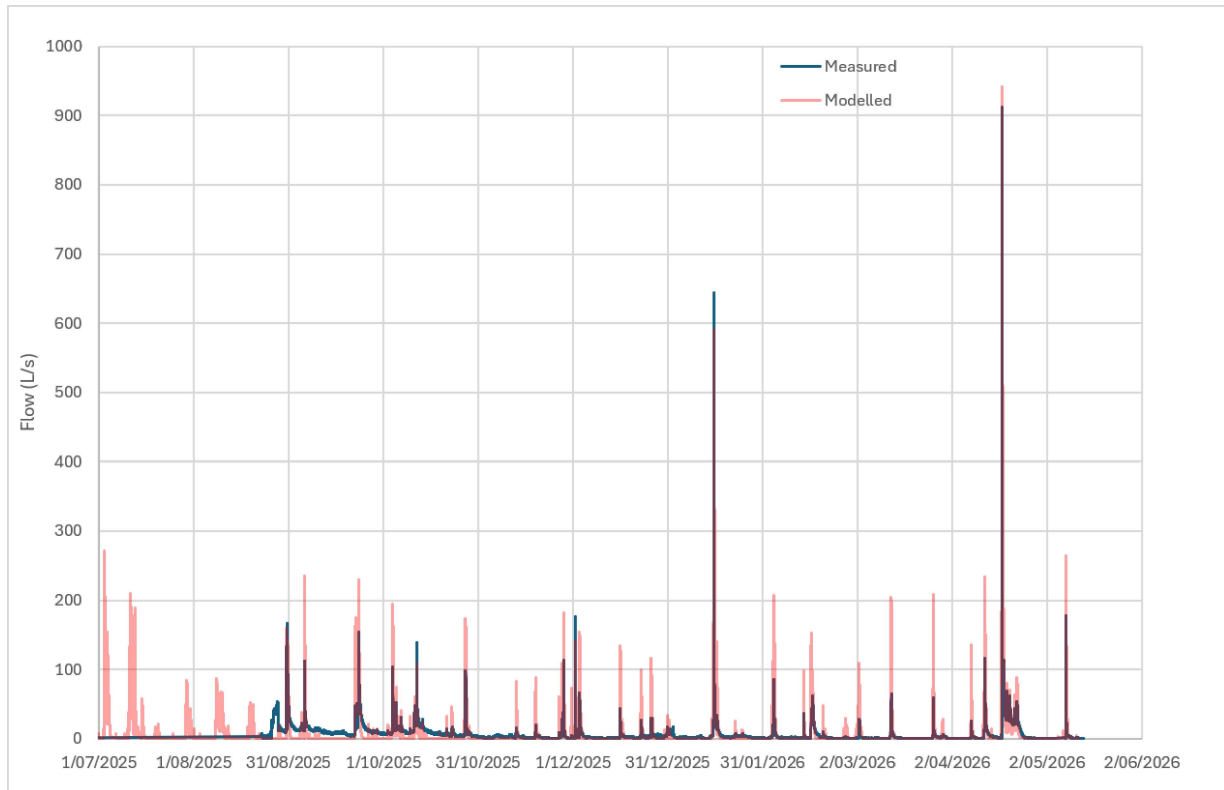


Figure 2: Flow from T3 catchment (SW01)

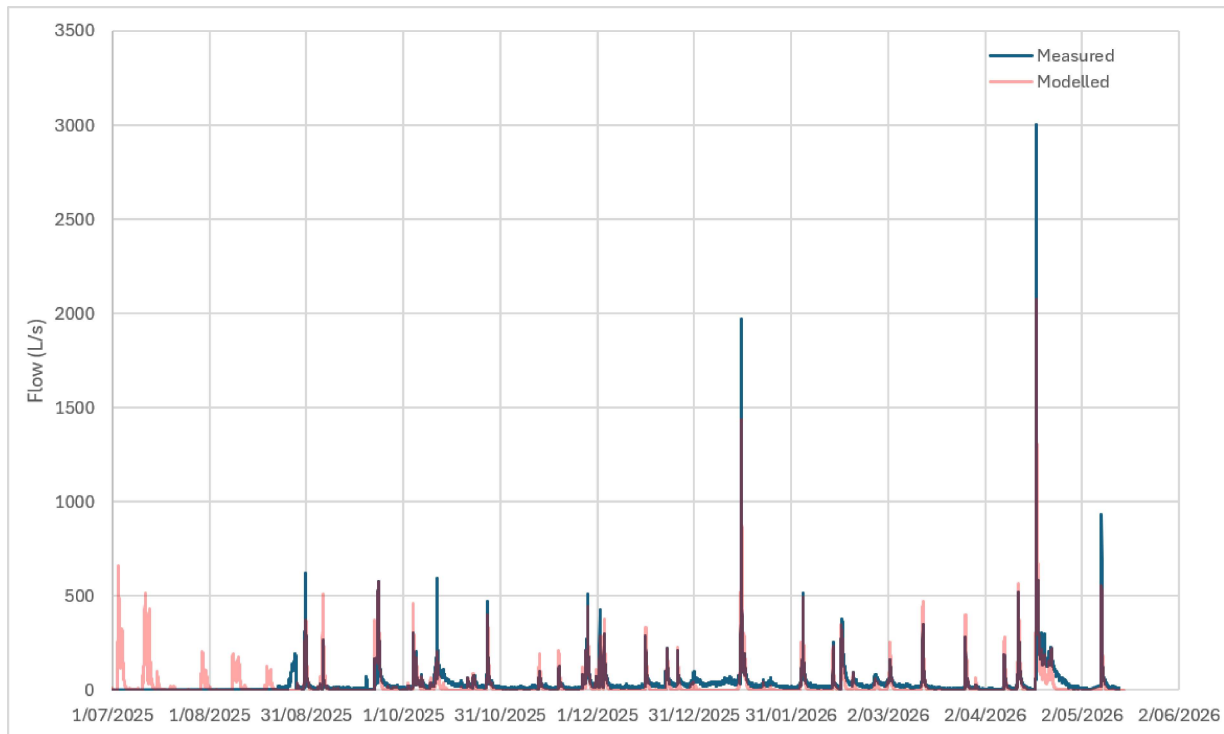


Figure 3: Flow from Kakaho West catchment (SW03)

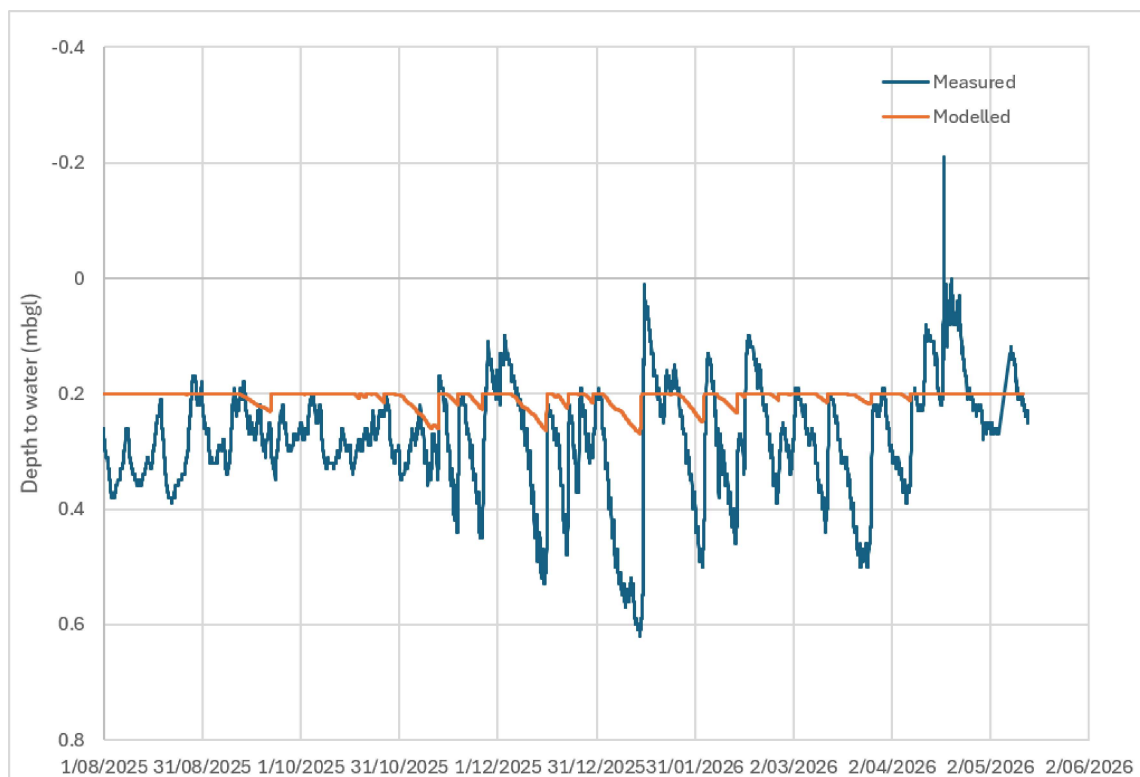


Figure 4: Water levels in T3W1 (BH01)

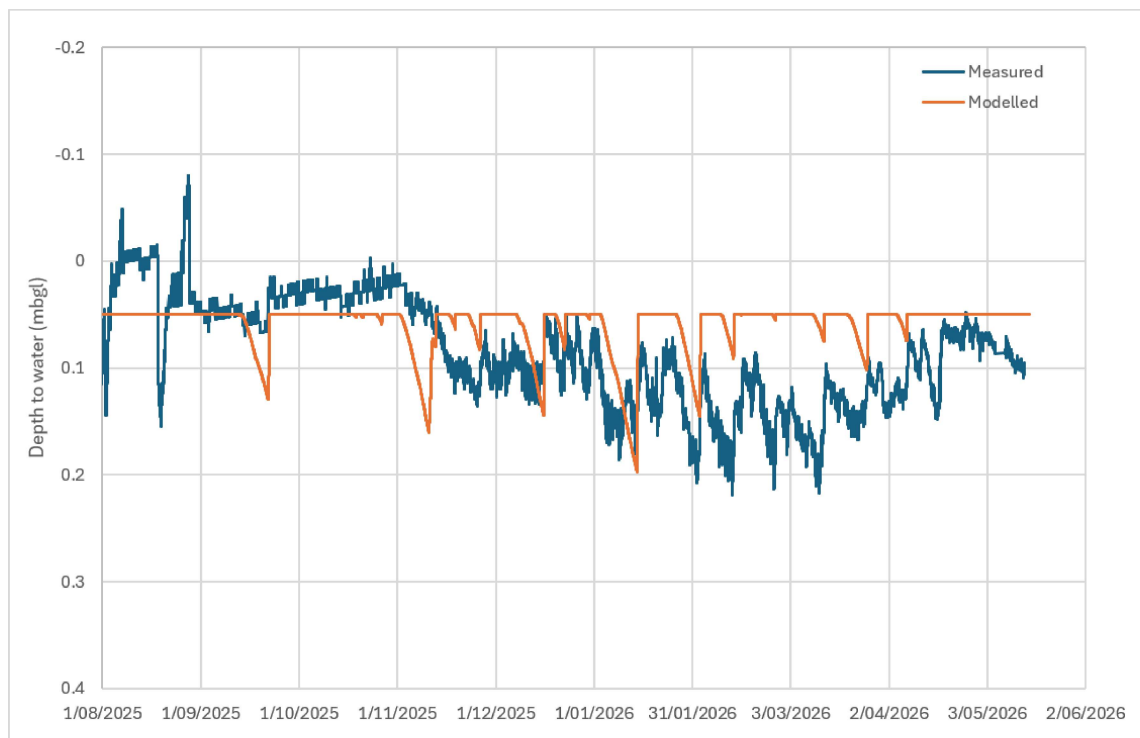


Figure 5: Water levels in K1W4 (BH01)

The updated calibration parameters were used in the 25 year 1-day timestep models to check the original assessment of effects remained representative. The results are presented below.

There are some relatively minor differences in the modelled wetland water levels from the original assessment. However, for the majority of the wetlands the effects of the development are the same. The wetlands will have water levels that are either consistent or wetter than baseline conditions in the Taupō catchment.

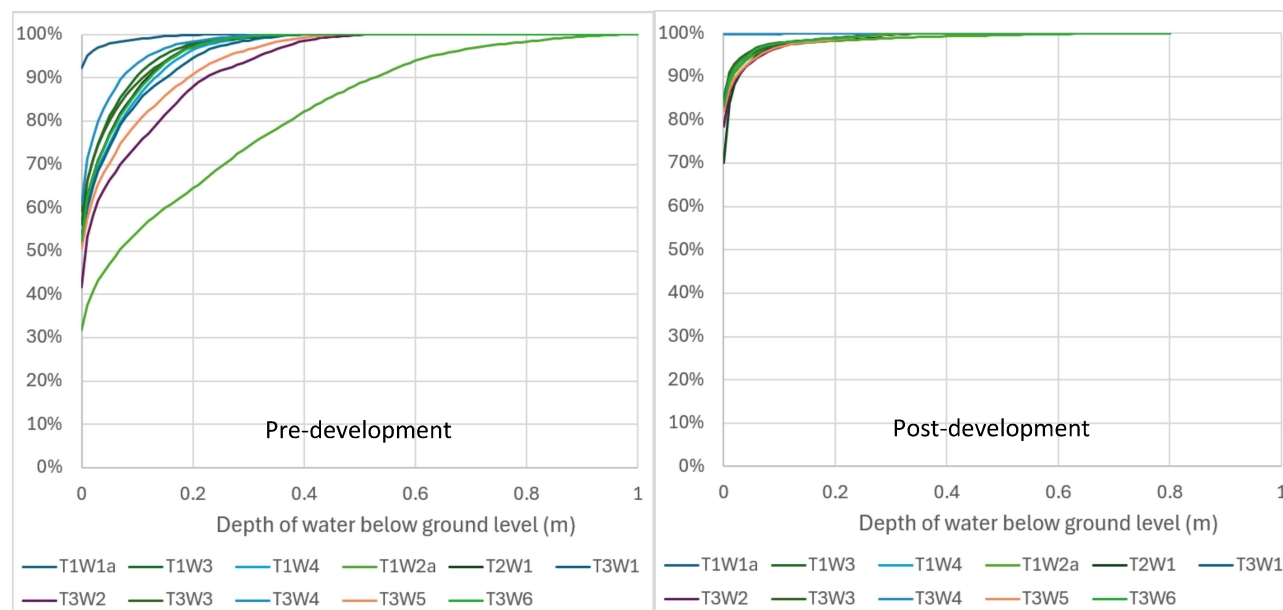


Figure 6: Modelled Water Level Duration Curves for Taupō Catchment

Table 1: Changes to wetland water levels under post development conditions – Taupō

	T1W1	T1W2	T1W3	T1W4	T2W1	T3W1	T3W2	T3W3	T3W4	T3W5	T3W6
Wetter (%)	2.1	52.8	13.8	21.6	17.6	25.9	30.5	15.8	14.5	24.7	19.1
Drier (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Same (%)	97.9	47.2	86.2	78.4	82.4	74.1	69.5	84.2	85.5	75.3	80.9

Notes:

1. Only considered variations greater than 0.05 m from the baseline as significant.
2. All data used, but summer results were very similar (<0.1% variation)

The Kakaho West wetlands will mostly be the same or wetter but, as with the previous assessment, there may be short periods where the wetlands are drier than under baseline conditions. These wetlands are used to oscillating water levels and the project ecologist has indicated that they can cope with these variations.

One key difference of note is, the higher aquifer permeability included at K1W4 (retention wetland E) means that there is more water fluctuation here under the updated model. However, as noted the updated calibration, still underestimates the inflow of groundwater into the stream, so the modelling is considered to be a conservative representation of water levels in the wetland post-development. This water level fluctuation is addressed in more detail in the next section.

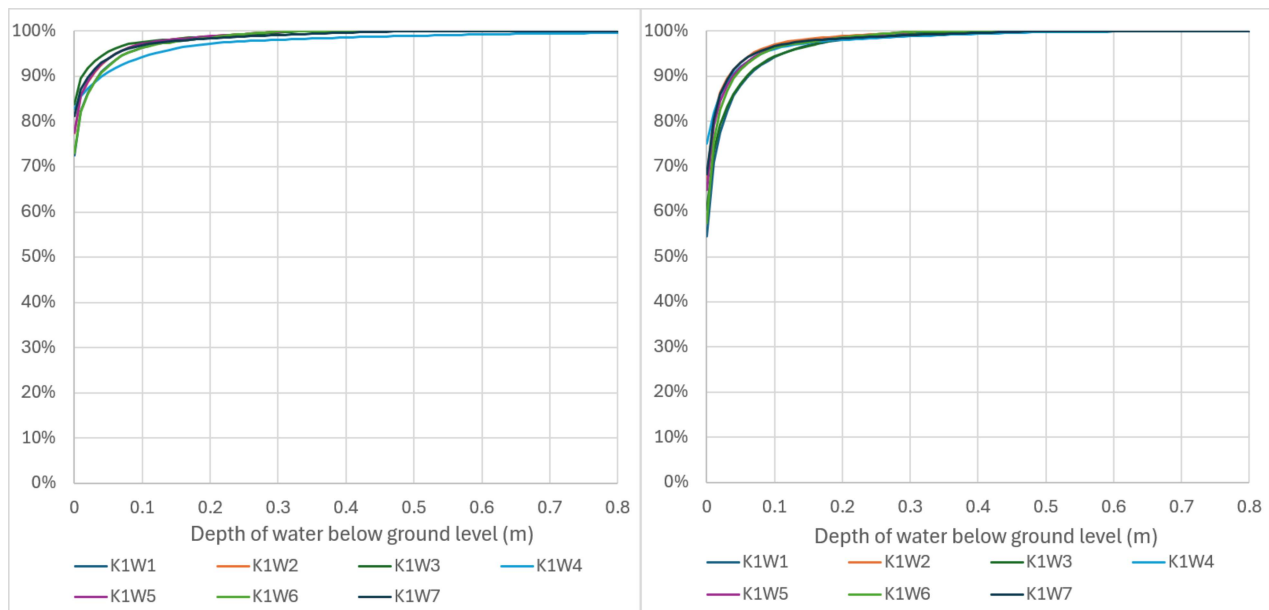


Figure 7: Modelled Water Level Duration Curves for Kakaho West Catchment

Table 2: Changes to wetland water levels under post development conditions – Kakaho West

	K1W1	K1W2	K1W3	K1W4	K1W5	K1W6	K1W7
Wetter (%)	0.0	0.5	0.0	4.8	0.3	0.6	0.7
Drier (%)	2.2	0.4	5.5	0.4	0.8	0.4	0.5
Same (%)	97.8	99.1	94.4	94.8	98.9	99.0	98.8
Notes: 1. Only considered variations greater than 0.05 m from the baseline as significant. 2. All data used, but summer results were very similar (<0.1% variation)							

The flow duration curves for the 1-day model for the surface water outflows from each catchment are presented in Figures 8 and 9. The key difference from the original modelling is the reduction in the number and magnitude of high peak flows, which is more in line with the measured baseline data.

The results support the findings of the original assessment, with higher daily discharges from the Taupō Catchment due to the increase in impervious surfaces and a small reduction from the Kakaho catchment due to the loss of catchment area. It is worth noting that the modelling for both catchments indicates that 95% of the time the average daily flow will be below 10 L/s (both pre and post development). This may be a slight underestimate during periods of higher groundwater, but does indicate that sustained higher intensity flows are not considered likely.

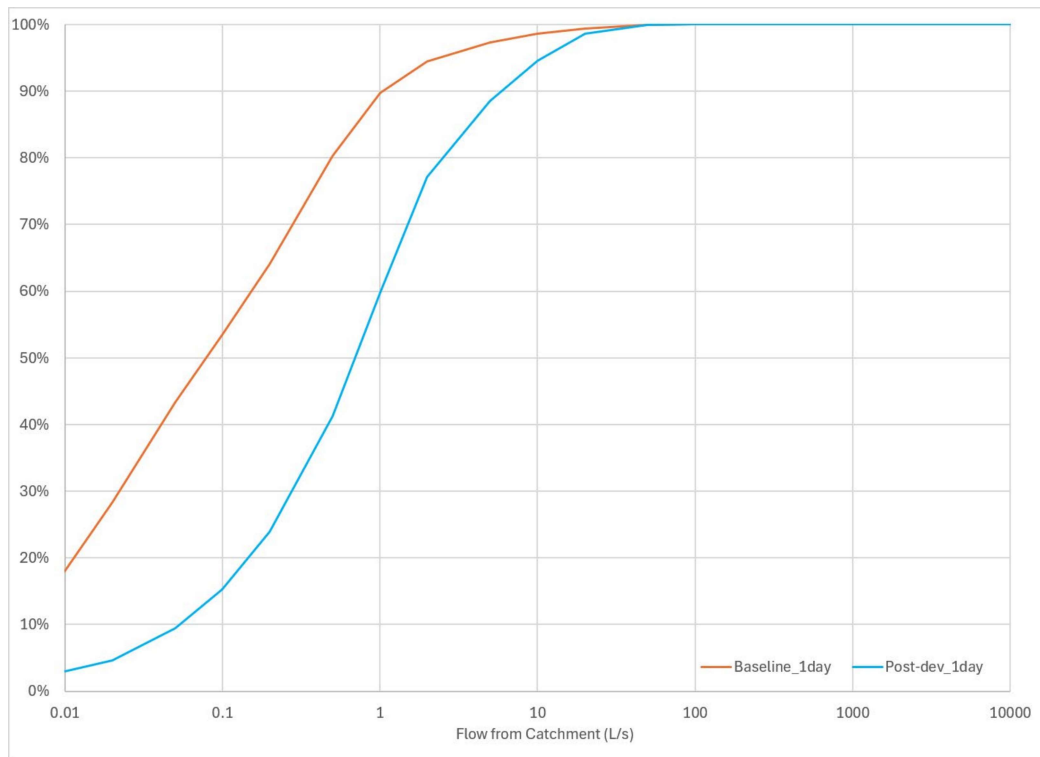


Figure 8: Flow Duration Curve - Taupō Catchment

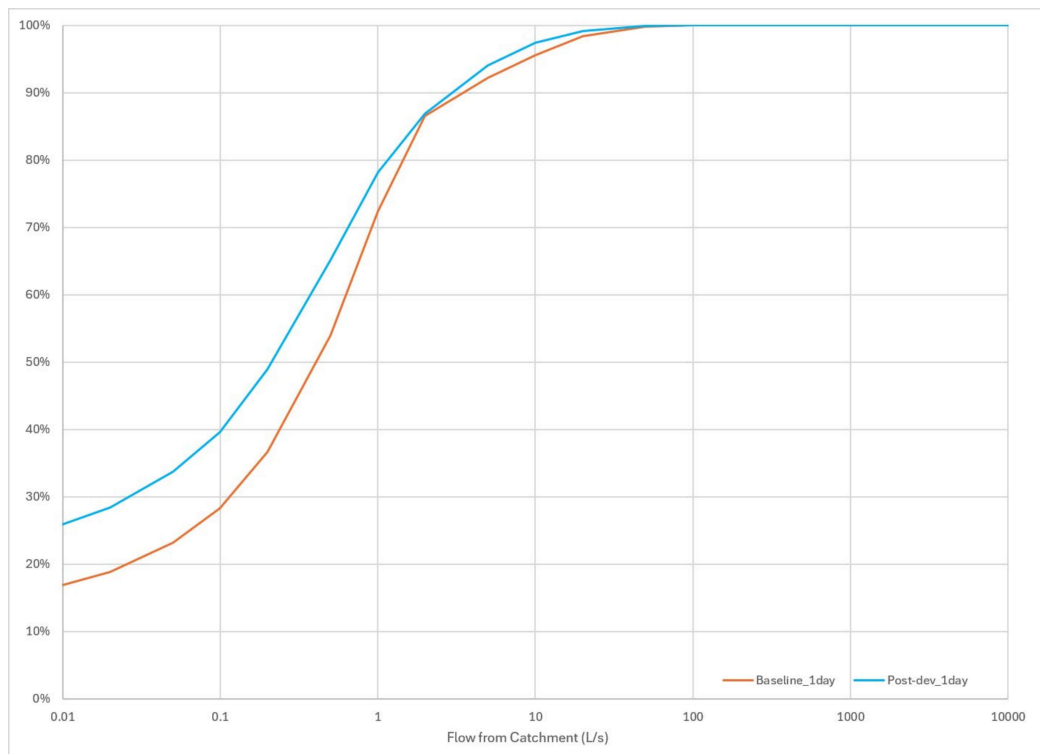


Figure 9: Flow Duration Curve – Kakaho West Catchment

Table 3: Discharge from site (m³/day)

Parameter	Taupō Catchment		Kakaho Catchment	
	Baseline	Post-development	Baseline	Post-development
Minimum	0	0	0	0
Lower quartile	17	216	69	10
Mean	691	2,232	1,732	1,241
Median	80	710	429	215
Upper quartile	361	1,789	1,120	825
Maximum	59,500	80,600	86,830	70,004
Notes: 1. This is based on the 25 year daily model results, rather than the 1 year 5 minute model results for an average year presented in the original assessment, so they are not directly comparable.				

The calibration of the model to baseline data addresses the reviewers concerns regarding the uncertainty within the hydrology assessment. Whilst the calibration has resulted in some changes, the overall conclusions of the original assessment remain unchanged.

2.1.3 Retention wetlands and stormwater management functions – comments 16 to 35

The reviewer has several key concerns relating to use of retention wetlands at the site, including:

- A. Sediment retention in the wetlands and how this will be managed during and post construction.
- B. The duration of time the wetlands and streams may be off-line during construction.
- C. The depth of standing water within these wetlands and whether this will be sustainable from a wetland planting perspective.
- D. Water quality and fish passage issues associated with a standing water body within these wetlands when there are periods of no flow through the culvert outlets.

This response provides supplementary evidence to the ecology and stormwater management responses and should be considered in conjunction with those documents. Points B and C are addressed elsewhere.

Regarding concerns around the periods of no flow through culvert outlets (point D), Figure 10 below indicates that there may be periods when the water level in Retention Wetland E (K1W4) will be lower than the culvert inlet (line marked permanent in figure). This is also true to a lesser extent for the retention wetlands (A, B and C) in the Taupō Catchment. The duration and extent of water level fluctuation is very sensitive to the hydraulic conductivity of soils downstream of the wetland, which are higher in the Kakaho Catchment due to the alluvial deposits present in this area.

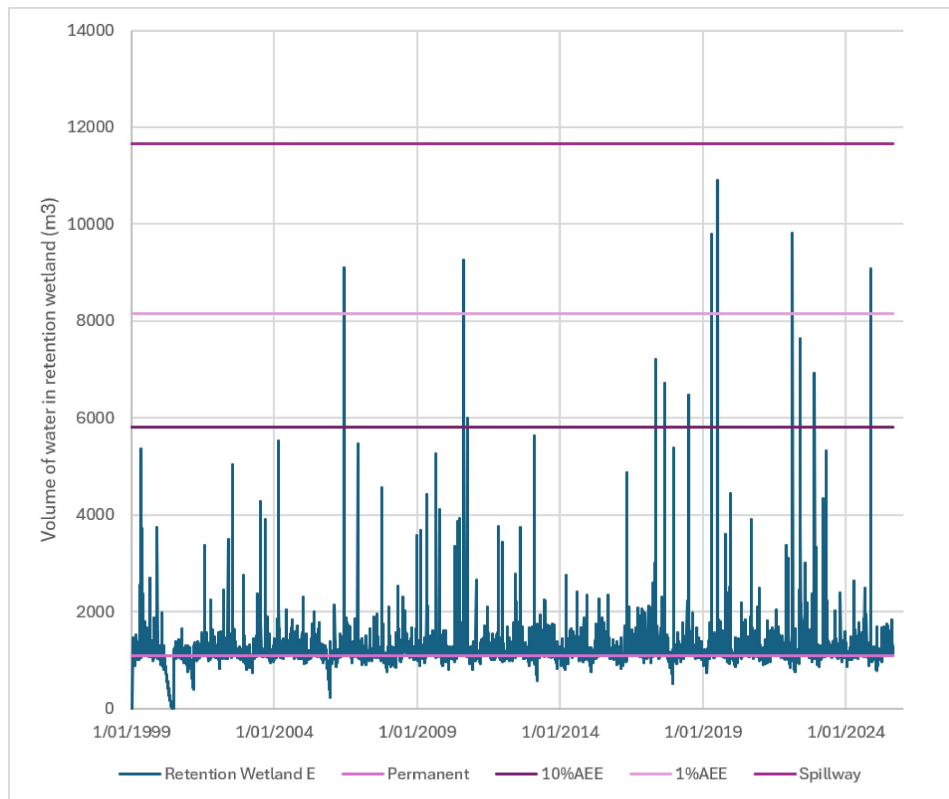


Figure 10: Modelled pond volumes at Retention Wetland E

It should be noted that this assessment is considered to be conservative as it underestimates the inflow of groundwater into the wetland and stream, see baseline calibration above. However, based on the modelling results, there may be periods when water does not flow through the culvert at Retention Wetland E. These periods are mostly concentrated in the summer months when it is understood from the project ecologist that fish passage is less critical. During winter months it is considered likely that higher groundwater levels will mean flow is more consistent, but based on the conservative model results, periods of no fish passage are usually less than 8 consecutive days.

There will potentially be longer periods during the summer where the culvert does not flow. GWRC has raised concerns about the potential impacts on the water quality in the retention wetlands as a result and proposes monitoring of water quality parameters to ensure the ongoing health of the wetland. This is considered reasonable and will be covered in the combined Eco-Hydrological Management, Offsetting, and Monitoring Plan (EHMP) recommended by GWRC. This plan will consolidate the ecology and hydrology monitoring requirements to ensure wetland and stream health for up to three years post-construction.

It is reiterated that the model underestimates the baseflow from regional groundwater into the stream, so the assessment of effects is considered to be highly conservative and flow is considered likely to occur for the majority of the year.

Regarding the sediment retention in the wetlands (Point A), the effects during construction will be addressed elsewhere. Post-construction, the retention wetlands are designed with initial permanent pond volumes of between 480 and 1,090 m³, which allows significant capacity for natural sedimentation before the functioning of the wetlands or stormwater detention would be impacted.

PDP has undertaken a broad assessment of sediment loads entering the wetlands based on the erosion rates described in Donovan (2022)¹. The assessment concluded that, for the Kakaho West catchment, the proposed land use change is expected to reduce sediment loads by approximately 35-40%, with a greater reduction for the Taupō Catchment (70-80%). Whilst these values are indicative only, they do suggest a significant reduction in sediment inflow post development primarily due to the removal of stock from large parts of the catchment and associated revegetation of slopes.

To assess the potential infilling rates of the retention wetlands, PDP undertook a high-level literature review of sediment accumulation rates in natural and constructed wetlands. It is acknowledged that sediment loading and deposition are influenced by numerous factors, including wetland shape, water depth, inlet and outlet sediment loads, inflow velocity, and outlet control structures. As such, the discussion below should be considered indicative only and is intended to provide an order-of-magnitude assessment rather than precise predictions.

Mitsch *et al.* (2014)² reported net sedimentation rates for through-flow riverine wetlands ranging from approximately 1.2 to 1.4 cm/year, equivalent to 3.9±6.1 kg/m²/year. A literature review undertaken as part of the same study identified sediment accumulation rates ranging from 6 to 90 kg/m²/year, although the authors noted that the higher estimates were likely to overstate long-term net accumulation because erosional and resuspension processes were not fully accounted for. Geranmayeh *et al.* (2017)³ assessed four constructed wetlands in Sweden and reported sediment accumulation rates ranging from approximately 1 to 23 kg/m²/year.

In general, these studies indicate that shallower wetlands tend to experience lower rates of sediment accumulation, which will be the case at Mount Welcome. In order to conservatively assess the potential infill rates of the retention wetlands PDP has used values of 10 kg/m²/year (upper limit of Mitsch *et al.* assessment) and 23 kg/m²/year (upper limit of Geranmayeh *et al.* study) and assumed an average water depth of 0.4-0.5 m for the retention wetlands. Using the permanent storage volumes adopted in the stormwater design, the estimated time required for the wetlands to infill with sediment to the culvert inlet ranges from approximately 35 to 85 years.

This number does not consider the potential scour associated with flow through the wetland or the reduction in sediment inflow as a result of the land-use change.

Furthermore, for retention wetland E (K1W4), there is an existing pond, located upstream on the main flow channel near the northern boundary of the site. This will continue to act as a sediment trap for the upstream catchment. Whilst this is not a formal part of the stormwater design, it will reduce the sediment inflow into the retention wetland in this catchment further extending the estimated infilling timeframe.

Therefore, provided outlet structures are maintained free of debris and upstream treated stormwater discharge points are designed to minimise any risk of channelised flow, longer infilling timeframes are considered likely. The proposed stormwater management approach is expected to reduce sediment loads to a level that can be accommodated by the wetlands.

2.1.4 Water balance and groundwater - Comments 36 to 40

The reviewer raises some concerns around the potential reduction of groundwater inflows into some of the upper wetlands. For the majority increased run-off is likely to mitigate these effects, if they occur, but it is acknowledged that the model does have limitations when considering steep elongated wetlands as it

¹ Donovan M. (2020). Modelling soil loss from surface erosion at high-resolution to better understand sources and drivers across land uses and catchments; a national-scale assessment of Aotearoa, New Zealand

² Mitsch *et al.* (2015). Sedimentation in created freshwater riverine wetlands: 15 years of succession and contrast of methods. Ecological Engineering 72: 25-34.

³ Geranmayeh *et al.* (2017). Particle deposition, resuspension and phosphorus accumulation in small, constructed wetlands.

does not consider flow within the wetland. GWRC proposes the use of ongoing monitoring, trigger levels and a response plan to mitigate risks that are hard to fully assess. This is considered reasonable and was always part of the Applicant's strategy to manage the risks to the wetlands. These trigger levels and mitigation measures will be included in the Eco-Hydrological Management, Offsetting, and Monitoring Plan.

2.2 Issue 13

GWRC considers the purpose of the instream continuous turbidity monitoring to be unclear and recommends discharge quality limits for the earthworks. The intention has always been to use the baseline instream turbidity data to develop trigger values to prompt further investigation into management of sediment under the Erosion & Sediment Control Plan during construction. Trigger values will be included within the plan, with appropriate mitigation and response actions.

GWRC recommend the inclusion monitoring in the Kakaho East catchment. However, the scale of the earthworks in this catchment is extremely limited and the catchment is very large. It is considered more appropriate to manage sediment and water quality during construction via monitoring the instream sediment retention devices rather than catchment scale instream monitoring.

3.0 Porirua City Council comments

3.1 Contaminated Land Assessment

Porirua City Council commissioned Kevin Tearney (SLR Consulting) to undertake a review of the contaminated land aspects of the application:

- ✧ Comments on a Substantive Application under section 53 of the Fast-track Approvals Act 2024: Contaminated Land (Kevin Tearney, 15 July 2026)

The review indicates that the assessment is generally deemed to be adequate but notes some inconsistencies with lot numbers, provides recommendations around updates to the Contaminated Site Management Plan (CSMP) and recommendations for additional consent conditions. These are addressed below:

- 3.1.1 Requirement for asbestos surveys of buildings in Lot 1 DP 534864 be included in the CSMP.

Agreed and draft CSMP has been updated accordingly.

- 3.1.2 The PSIs and CSMP sometimes call Lot 1 DP 534864, Lot 3 DP 534864. This appears to be an error, and if so, it should be rectified. I note that Lot 3 DP 534864 does not appear on site plans.

PDP has cross-checked these documents as required, no residual reference to Lot 3 DP 534864 remains.

- 3.1.3 Agrees that the general scope is appropriate. However, the scope is generic and it is not clear, for example, how the investigation will be amended if groundwater is encountered and why groundwater is not being specifically targeted given that it is stated that groundwater is possibly shallow in this area of the site and contamination from sheep dips has the potential to contaminate groundwater. Recommend that the Applicant provides a Sampling and Analysis Quality Plan (SAQP) covering the proposed detailed site investigation (DSI) for review

Agree that SAQP will be provided prior to the commencement of the DSI in accordance with the proposed condition. It is assumed that groundwater within the identified HAIL areas may be present at depth, given that the proposed investigation area is located on an elevated ridgeline, the presence of shallow groundwater is not anticipated. Due to the unknown presence or concentrations of potential contaminants of concern, a phased approach to assessing groundwater risk is proposed. If elevated

contaminants of concern are identified, leachate analysis will be undertaken to determine the potential mobility of contaminants and risk to groundwater. Any additional groundwater investigation measures will be assessed at that stage. Details of the methodology proposed and potential sampling requirements will be included in the SAQP.

A detailed breakdown of the proposed sampling and staged approach to testing will be outlined in the SAQP, and provided for review prior to works being undertaken.

3.1.4 Additionally proposes further amendments to conditions around DSI, CSMP, RAP and SVP

The conditions around the DSI and CSMP are considered reasonable and can be reviewed under the conditions' updates. Whether a RAP is necessary will depend on the results of the DSI and therefore should be subject to the results of this investigation. PDP has provided slightly revised proposed conditions below, with changes in red.

Sampling and Analysis Quality Plan (SAQP)

At least 20 working days prior to DSI commencing, the consent holder must submit a Sampling and Analysis Quality Plan (SAQP) to the Manager, Resource Consents and Monitoring for certification prior to the Detailed Site Investigation (DSI) works being undertaken on the site. The purpose of the SAQP is to provide details of the proposed sampling and analysis to be completed as part of the Detailed Site Investigation to be undertaken within identified HAIL land, which may include land located on Lot 1 DP 534864 affected by asbestos and or lead from buildings. The SAQP must be prepared by a suitably qualified and experienced practitioner (SQEP) able to certify reports pursuant to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 in accordance with the current edition of *Contaminated Land Management Guidelines No. 5 – Site Investigation and Analysis of Soils (Revised 2021)*. Wellington: Ministry for the Environment.

Detailed Site Investigation

At least 20 days prior to commencement of bulk earthworks within identified HAIL land, the Consent Holder must submit a Detailed Site Investigation (DSI) report on the site to the Manager, Resource Consents and Monitoring. The DSI must be undertaken in accordance with the SAQP and in accordance with the current edition of *Contaminated Land Management Guidelines No. 5 – Site Investigation and Analysis of Soils*, Wellington: Ministry for the Environment. The DSI report must be prepared and reported in accordance with the current edition of *Contaminated Land Management Guidelines No. 1 – Reporting on Contaminated Sites in New Zealand (Revised 2021)*. Wellington: Ministry for the Environment. The DSI must be prepared by a suitably qualified and experienced practitioner (SQEP) able to certify reports pursuant to the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

Contaminated Soils Management Plan (CSMP)

Condition wording similar to that proposed by the Applicant. No issues with proposed wording."

Remediation Action Plan (RAP)

- a) **If the DSI finds risk to human health or the environment exceeding relevant guideline criteria for the proposed land use**, the consent holder must submit a Remediation Action Plan (RAP) to the Manager Resource Consents and Monitoring for certification at least 20 working days prior to the commencement of remedial action undertaken on HAIL land. The RAP must be prepared by a SQEP based on the findings of the DSI, and in accordance with the certified CSMP and the

current edition of *Contaminated Land Management Guidelines No. 1 – Reporting on Contaminated Sites in New Zealand (Revised 2021)*. Wellington: Ministry for the Environment.

- b) The RAP must include, but not be limited to the following information:
 - i. The objectives of the remediation including standards to be achieved upon completion;
 - ii. An assessment of remediation options set out in a Remedial Options Assessment (ROA);
 - iii. The remedial methods, including as required, methods for different zones or areas; and
 - iv. The means of demonstrating the remediation objectives have been met (e.g., required records of soil removal and observations, and the sampling plan for validation testing).
- c) Soil disturbance works on site must be carried out in accordance with the RAP and the CSMP.

Site Validation Report

- a) The consent holder must submit a Site Validation Report (SVR) to the Manager Resource Consents and Monitoring for certification at least 20 working days following the completion of earthworks for any stage within HAIL land **if required by the RAP**. The SVR must be prepared by a SQEP in accordance with the current edition of *Contaminated Land Management Guidelines No. 1 – Reporting on Contaminated Sites in New Zealand (Revised 2021)*. Wellington: Ministry for the Environment.
- b) The SVR must include, but not be limited to the following information:
 - i. A summary of the works undertaken, including the locations and dimensions of excavations and the volume of soil excavated;
 - ii. Conditions of the final Site contamination profile, including details and results of any validation testing undertaken (with a map of sampling locations and tabulated sampling results) and interpretation of the results in the context of the NES:CS;
 - iii. Details and results of any other contamination testing undertaken during the works (including any sampling undertaken on materials re-used on Site or imported to Site);
 - iv. Records/evidence of the appropriate disposal for any material removed from the Site;
 - v. Records of any unexpected contamination encountered during the works and response actions, if applicable;
 - vi. A Long Term Management and Monitoring Plan (LTMMMP) documenting any on-going monitoring and/or management measures required to minimise risks to human health or the environment as a result of the final Site contamination profile, **if required by the RAP**;
 - vii. Reports of any complaints, health and safety incidents related to contamination, and/or contingency events (**i.e. the unexpected discovery of contaminants**) during the earthworks; and
 - viii. A statement certifying that all works have been carried out in accordance with the requirements of the DSI, CSMP and consent, otherwise providing details of relevant breaches, if applicable.

4.0 Te Rūnanga o Toa Rangatira

Te Rūnanga o Toa Rangatira has provided a review comments in its role as the mandated iwi authority for Ngāti Toa Rangatira. The review comments provided highlight several outstanding issues of concern to Ngāti Toa Rangatira, those of relevance to the hydrology and water quality assessments include:

- ✧ Concerns around stormwater management, including:
 - The combination of wetland offsetting (addressed elsewhere) and stormwater detention;
 - The risk of increased run-off volumes exacerbating existing erosion and sedimentation issues in the catchment;
 - Uncertainties within the hydrology modelling due to limited baseline data reducing confidence in the results;
 - Water conservation and rainwater harvesting has not been considered in sufficient detail.
- ✧ Concerns around downstream water quality;
- ✧ Lack of detail regarding the management, monitoring and mitigation measurements required to achieve the proposed ecological outcomes.

The uncertainty associated with the limited baseline data available for the hydrology assessment has been rectified. As noted above in Section 2, the model used to assess the hydrology has been recalibrated based on 8 months of baseline data. There is no significant change to the overall conclusions of the report, but there are some changes to individual flows and wetland water levels. This updated assessment summarised above provides greater confidence in the results of the hydrology assessment.

In relation to concerns that increased run-off volumes may exacerbate existing erosional and sedimentation issues within the catchment, it is noted that the proposed change of land use, removal of livestock, revegetation of key slopes and treatment of stormwater runoff from urban areas are all expected to significantly reduce the erosion of sediment from the hill slopes within the site, leading to an improvement in water quality and reduction in sediment run-off from the system.

Whilst there is an increase in daily discharge from the site, particularly in the Taupō catchment, 95% of average daily flows are likely to be below 10 L/s, both pre and post development. The estimated flow rates are unlikely to significantly increase erosion of existing streams, being insufficient to remobilise sediment. The stormwater management proposed reduces the peak discharge rates associated with high intensity events, which is when the majority of sediment movement occurs. These mitigation measures are designed to reduce the hydraulic impacts and sedimentation downstream.

However, the Applicant acknowledges that monitoring and management measures are required to ensure that the downstream impacts are minimised and on-site mitigation is effective. Instream monitoring is underway and will continue throughout the development period, and for up to 3 years post development to ensure the system is working as designed. This monitoring will be used to develop trigger values to prompt investigation and remedial action where necessary. Details of the proposed monitoring and associated response plan will be included in the Eco-Hydrological Management, Offsetting, and Monitoring Plan and Erosion Sediment Control Measures, which will need to be approved by GWRC before implementation.

The water sustainability concern is addressed elsewhere, but PDP has provided a more detailed assessment of the use of rainwater tanks for this purpose on the site and downstream hydrology⁴.

⁴ PDP (2026). Mount Welcome – Roof Run-off Tanks Additional Assessment.

5.0 Conclusions

PDP has addressed the comments provided by GWRC, PCC and Ngāti Toa Rangatira which were relevant to contaminated land, hydrology and water quality. Whilst Tiaki Wai has also provided comments on the application, these will be addressed elsewhere, although the above responses may provide supporting evidence into other assessments.

The key update of note is the recalibration of the models used for the hydrology assessment using 8 months of baseline data. This makes the conclusions of the modelling more robust. The general conclusions remain unchanged, but there are some minor variations in localised areas which are addressed above. It is noted that the updated model appears to underestimate groundwater inflows into the lower parts of the streams, particularly in the Kakaho West catchment, so low flow assessments through culverts are likely to be overly conservative.

The applicant acknowledges that monitoring and mitigation will be key to ensure that the health of the wetlands and streams are maintained. It is agreed that a combined Eco-Hydrological Management, Offsetting, and Monitoring Plan is the most effective way to manage these requirements. This will include trigger values for water levels and quality, as well as ecology survey requirements. Clear response plans to breaches of trigger values will be included.

6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Pukerua Property Group LP and others (not directly contracted by PDP for the work), including Greater Wellington Regional Council, Envelope Engineering and Blue Green Ecology. 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 Pukerua Property Group LP 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.

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Mount Welcome Hydrological Baseline Monitoring Report 2025- 2026

✦ Prepared for

Pukerua Property Group LP

✦ August 2026



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Quality Control Sheet

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CLIENT	Pukerua Property Group LP
ISSUE DATE	August 2026
JOB REFERENCE	W027550002

Revision History					
REV	Date	Status/Purpose	Prepared By	Reviewed by	Approved
A	24/07/2026	Draft for client review	Gianmarco Tolomei	Katy Grant	David Whitty
B	04/08/2026	Draft for client review	Gianmarco Tolomei	Katy Grant	David Whitty

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Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Pukerua Property Group LP and others (not directly contracted by PDP for the work), including Envelope Engineering Limited, BlueGreen Ecology Limited, Classic Developments Limited and Greater Wellington Regional Council. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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Executive Summary

Pukerua Property Group LP are applying for a fast-track resource consent application for the development of a residential subdivision near Pukerua Bay known as Mount Welcome. Pattle Delamore Partners Limited (PDP) has been commissioned to assess the potential effects of the proposed development on the hydrology and water quality of the local streams and wetlands.

As part of the work, baseline hydrology and water quality monitoring was undertaken between July 2025 and May 2026 and the results are presented in this report. The monitoring included continuous measurements of water level and turbidity at three surface water locations along the site boundary (SW01 to SW03), and groundwater level monitoring at four piezometers installed within selected representative on-site wetlands (BH01 to BH04). In addition, stream samples were collected and analysed for anions, cations, nutrients, and heavy metals each quarter to characterise baseline water quality.

The results provide insight into the hydrological controls influencing wetland behaviour. The gully wetlands monitored within the Taupō catchment fluctuate more than the valley floor wetland monitored in the Kakaho catchment, reflecting their smaller catchment size and the limited contribution from groundwater and stream overflow. In contrast, the wetland in the Kakaho catchment appears to be more strongly supported by these inputs.

Stream flows were estimated using stage data and calibrated against manual flow measurements. The results indicate that baseflows in streams leaving the site range from 1 to 5 L/s, but peak significantly higher after large rainfall events. Flows of up to 3,000 L/s were estimated in the Kakaho West stream during an estimated 10% Annual Recurrence Interval (ARI) event.

The results of the hydrology monitoring support the conceptual understanding used to develop the water balance model for the site. The measured values were broadly similar to the estimated range of likely water level and flow fluctuations. However, the baseline monitoring indicates that flow within the catchments may be less peaky during smaller rainfall events than previously modelled. It is therefore recommended that the model be recalibrated to the baseline data and the hydrology assessment is checked to confirm the results remain valid.

Whilst several issues affected the continuous measurement of turbidity, the dataset is considered sufficient for a qualitative interpretation of sediment load leaving the site (the issues with cattle damaging equipment have been addressed by installing fencing enclosures around selected equipment and are not expected to cause any further data loss). Under baseflow conditions, the turbidity is very low (<12 NTU) suggesting no sediment suspension during these periods. However, following moderate to large rainfall events peaks were significantly higher (>4,000 NTU), indicating significant sediment mobilisation particularly in the Taupō Stream catchment. The effects are slightly reduced in the

Kakaho West catchment, potentially due to the more vegetated nature of the upper parts of this catchment.

The results from the water quality sampling indicate that for the majority of the parameters analysed the concentrations are similar to those measured downstream in the Taupō Stream and were below the freshwater 95% species protection guidelines. Concentrations of ammoniacal nitrogen and nitrate were higher in the stream in the Kakaho West catchment than in the Taupō Catchment, but there is no publicly available data for this catchment for comparison.

In summary, despite some data loss, the causes of which have been addressed, the monitoring programme has been effective in establishing baseline hydrological and water quality conditions at the site.

Continued monitoring is recommended to obtain further baseline data under varying climatic conditions prior to construction.

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1.0 Introduction

Classic Developments NZ Limited, on behalf of Pukerua Property Group LP (the Applicant), are applying for fast-track resource consent for the development of a residential subdivision near Pukerua Bay in an area known as Mount Welcome. Pattle Delamore Partners Limited (PDP) has been commissioned by the Applicant to obtain baseline water quality and wetland and stream hydrology data at the site to support the stormwater design and assessments required for the fast-track consent application.

The proposed development comprises 950 residential lots, a commercial centre, a new intersection with State Highway 59 and associated earthworks and infrastructure. The scope of the monitoring was based on the proposed development layout, with the focus being on obtaining baseline data on wetland water levels, surface water flows, stream turbidity and water quality to support decision-making aimed at protecting and enhancing onsite and downstream environments during the consenting and construction process.

Between 28 July 2025 and 14 May 2026, water level, flow and turbidity have been measured at selected locations across the Mount Welcome site as part of this baseline monitoring programme. This report details the data collected over this monitoring period and provides an assessment of the baseline hydrological conditions at the site. It includes:

- ✧ A summary of the existing environment, including geology, hydrogeology, hydrology and climate;
- ✧ Hydrographs for stream flow and wetland water levels;
- ✧ The turbidity variations over time;
- ✧ The results of surface water quality analysis; and
- ✧ Interpretation of the results and comparison with the existing conceptual understanding of the system.

2.0 Site Context

2.1 Site Location

The Mount Welcome site is located at 422 State Highway 59, south of Pukerua Bay (Figure 1). The site is currently covered in pasture and managed as an active deer/cattle farm. There are small pockets of native and exotic woodland, and wetland areas within the site. The site primarily comprises steep sided hills, cut by incised valleys. The lower parts of the valleys are mostly occupied by wetlands and streams.

The site is bounded to the west by State Highway 59 (formerly SH1), and to the north by the Muri Road block, which is currently undergoing development. The land to the south and east is pasture and used for farming. Figure 2 shows the areas of the site which will be developed under the current application.

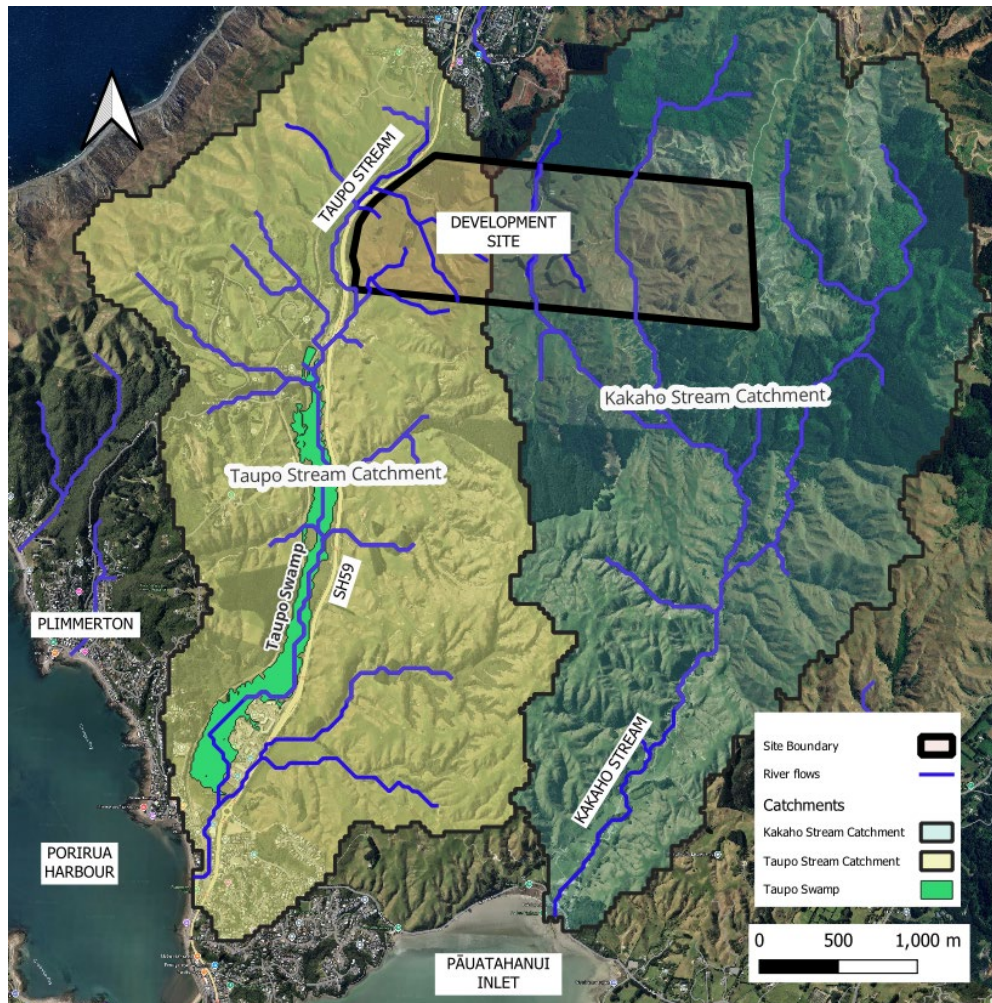




Figure 2: Proposed Site Layout (provided by Envelope Engineering)

2.2 Climate

The annual rainfall of the Wellington region is highly variable and is largely driven by the local topography. However, with the exception of the central Tararua Range and Wairarapa Plains, the majority of the region typically experiences 1,000 to 1,200 mm/year (Chappell, 2014). In lieu of site-specific data, data collected at the closest regional rain gauge at the Taupō Stream at the Whenua Tapu site (GWRC, 2025) indicates that the average annual rainfall in the general site area is approximately 1,075 mm/year (data available from 1992 to present).

During the baseline monitoring period (1 August 2025 to 14 May 2026) the precipitation amounted to a total of 877 mm. This indicates that the monitoring period is likely to be slightly wetter than average based on historical records.

Figure 3 shows the daily totals of the rainfall data recorded at the meteorological station Taupō Stream at Whenua Tapu during the monitoring period.

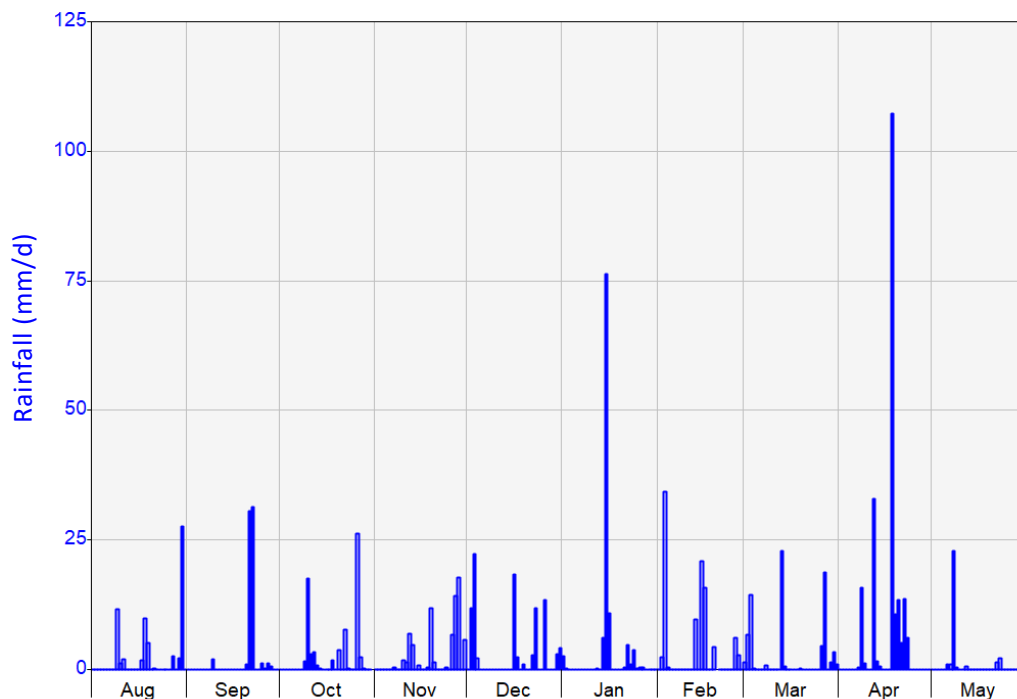


Figure 3: Daily rainfall at station Taupō Stream at Whenua Tapu

A notable rainfall event occurred on 18 April 2026, which resulted in significant flooding in the parts of the catchment located downstream of the site. Annual Recurrence Intervals (ARI) were evaluated by GWRC for this event and are summarised in Table 1.

Table 1: Taupō Stream at Whenua Tapu rainfall intensities and ARI for event on 18/04/2026

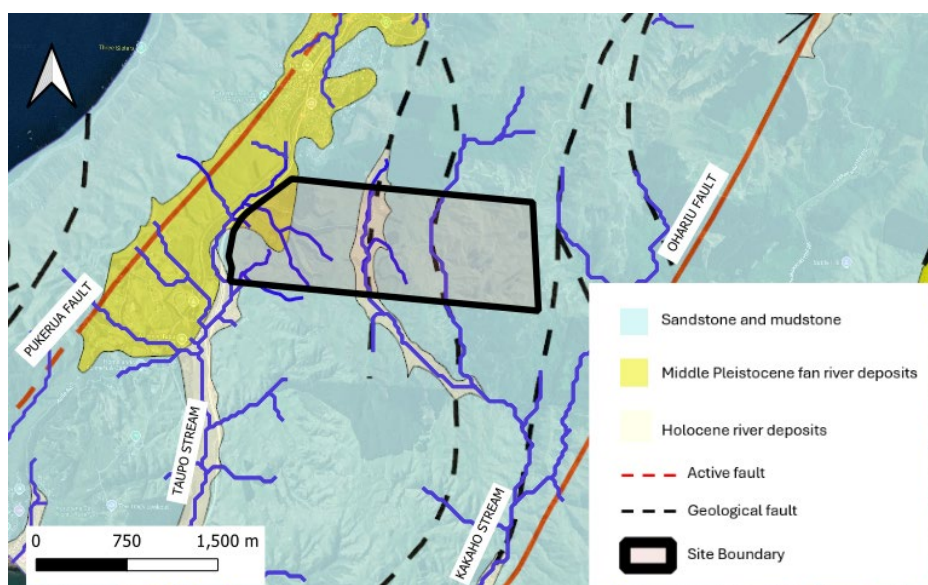
Duration	10 min	20 min	30 min	1 h	2 h	6 h	12 h	24 h
Rainfall (mm)	12.6	16.2	22.4	29	41.5	80.1	91.1	107.2
ARI	5–10 years	5–10 years	10–20 years	10–20 years	10–20 years	20–30 years	20–30 years	10–20 years

2.3 Geology and Hydrogeology

The regional geological map (Begg and Johnson, 2000) shows that most of the site is underlain by exposed greywacke (sandstone and mudstone). Across ridges, slopes, and plateaus, this greywacke is typically mantled by loess and colluvium, while recent alluvial gravel deposits occur along the axes of gullies and valleys.

The Pukerua and Ohariu Faults trend in a northeast–southwest direction west and east of the site.

No large-scale regional aquifer is present at the site. However, groundwater is likely to occur within fractures and weathered zones of the greywacke bedrock, as well as within the alluvial gravel deposits in the valleys. Groundwater from the site is understood to discharge to the lower perennial reaches of the streams. There are no bores, groundwater takes, or surface water abstractions within the catchments.

**Figure 4: Geological Map (GNS Science 2023)**

2.4 Hydrology

There are four main catchments at the site (see Figure 5):

- ✧ Taupō Stream
- ✧ Western tributary of Kakaho Stream (referred to as Kakaho West in this report)
- ✧ Eastern tributary of Kakaho Stream (referred to as Kakaho East in this report)
- ✧ Waimapihi Stream (referred to as the Muri Road catchment in this report)

The Taupō Stream catchment comprises three main sub-catchments within the development area (referred to as T1, T2 and T3 for this assessment), which consist of ephemerally flowing steep gullies containing wetlands, and form part of the headwaters of Taupō Stream and Taupō Swamp. The lower parts of these gullies include perennial streams, which discharge via culverts across the site boundary into the Taupō Stream on the west side of SH59. This stream then flows south into the top of the Taupō Swamp. The Taupō Swamp complex is a regionally significant lowland freshwater wetland of high ecological value and has been protected under a QEII covenant since 1988.

The two eastern catchments (Kakaho West and East) drain south into Kakaho Stream, which flows into the Pāuatahanui Arm of Te Awarua-o-Porirua Harbour approximately 4.6 km downstream of the site. This tidal inlet forms a highly sensitive estuarine environment.

The site also includes a small part of the upper Waimapihi Stream catchment, which drains north into the Muri Road block and discharges to the sea at Pukerua Bay.

Most streams on the site are ephemeral, although perennial reaches occur in the lower parts of the catchments. Stream flows are generally low but respond rapidly to rainfall runoff from the steep terrain. The ecology assessment indicates that streams draining west into the Taupō catchment are modified, with low diversity and function, and are in poor condition with no features of rarity, and are therefore classified as low-value systems. Whilst streams in the Kakaho catchments are in better condition, they remain modified, with limited shading, nutrient inputs, stock impacts, bank slumping, and increased sedimentation.

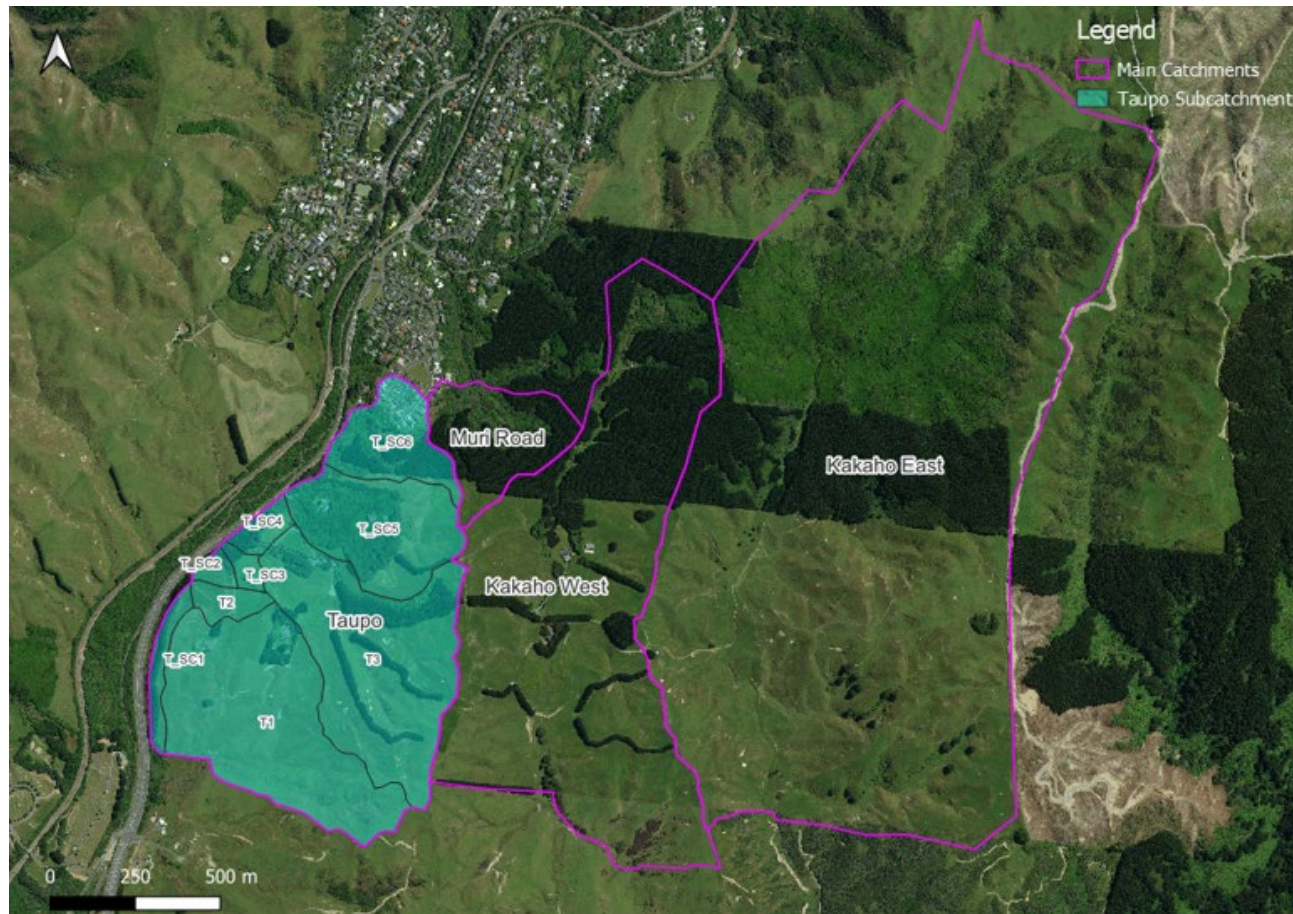


Figure 5: Key Site Catchments

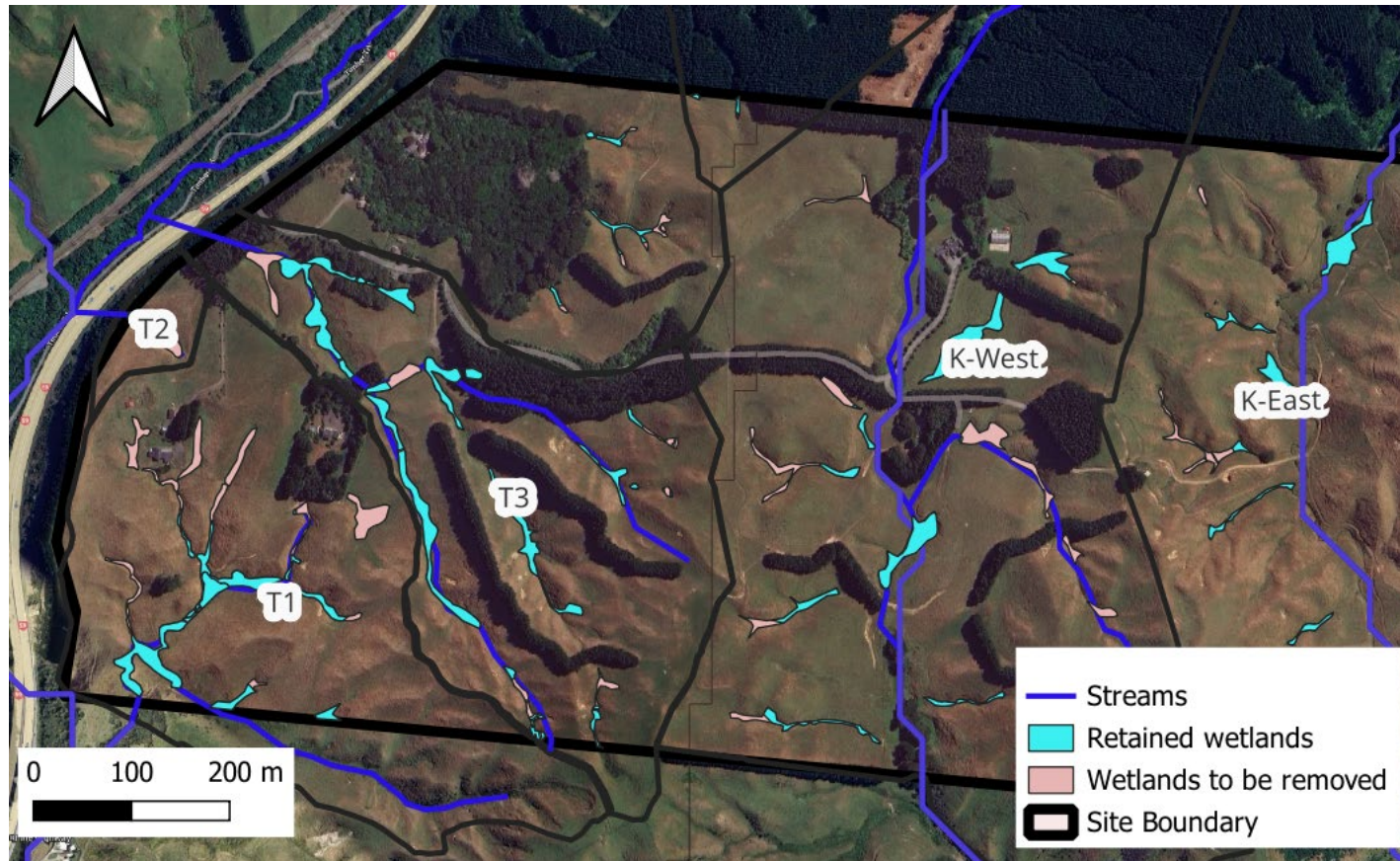


Figure 6: Wetland extents

2.5 Wetlands

Wetlands on site have previously been identified by Boffa Miskell Limited (Boffa Miskell Limited, 2023) and further assessed by BlueGreen Ecology (2025), and are shown in Figure 6. No significant indigenous vegetation has been identified in the natural wetlands at the site, with all wetlands including only exotic wetland flora species common on farmland (BlueGreen Ecology Limited, 2025).

Significant earthworks are planned during development, leading to approximately 1.5 ha of natural inland wetland likely to be affected. The offset and enhancements proposed to mitigate this loss are detailed in the values assessment and offset calculations reported elsewhere (BlueGreen Ecology Limited, 2025).

There are two key types of wetland hydrology at the site, with examples of both being retained at the site post-development:

1. Wetlands in the upper gully systems, which are fed principally by direct rainfall and run-off, and may dry out periodically in the summer months; and
2. Wetlands in the valley floors, which are fed by direct rainfall and run-off, but also have contributions from groundwater discharge and stream flow/flooding, which are likely to have more stable water levels (albeit with some seasonal variation).

The baseline monitoring focuses primarily on the wetlands in the T1 and T3 Taupo catchments and the Kakaho West catchment, as this is where the majority of the construction occurs.

2.5.2 Taupō Catchment Wetlands

There are a series of relatively small, interconnected wetlands in the gullies within the T1 catchment, with the area to be retained in the centre and southwest of the catchment. These wetlands are primarily sustained by surface runoff, although some groundwater contribution may occur in the lower reaches where a small perennial tributary of Taupō Stream is present.

The T2 catchment is relatively small (approximately 2 ha) and contains a minor wetland area immediately upstream of the culvert where it discharges via culvert beneath SH59 into Taupō Stream. There is no permanent flow from this catchment, and the wetland is mainly supported by runoff and direct rainfall.

The T3 catchment contains a series of elongated, ephemeral flowing, narrow gully wetlands. These are largely supported by direct rainfall, surface runoff, and a combination of streams and farm drains (in the lower reaches). A minor

groundwater contribution may occur in the lowest reaches where a small perennial tributary of Taupō Stream is present.

2.5.3 Kakaho Catchment Wetlands

The wetlands within the Kakaho catchments consist mostly of a series of small steep gully wetlands which discharge into the valleys. These are primarily ephemeral and are supported by run-off and direct rainfall and are likely to dry out periodically in the summer. Flow from these wetlands discharges onto the valley floor and into the tributaries of the Kakaho Stream. There are several small wetlands present on the valley floor in each catchment, which are also likely to be primarily run-off supported, with contributions from local groundwater discharge and streamflow/flooding. The water level in these wetlands is likely to be more stable than the ephemeral wetlands in the surrounding gullies.

3.0 Monitoring Network

The monitoring network has been designed to capture baseline conditions in key streams and wetlands, but also to be effective for monitoring during and post-development, if required.

3.1 Surface Water Monitoring Locations

Three key catchments have been selected for surface water monitoring because they have perennial flow under baseline conditions and their catchments are the most affected by the proposed earthworks (see Figure 7):

- ✧ SW01 – Taupō Stream T3 catchment
- ✧ SW02 – Taupō Stream T1 catchment
- ✧ SW03 – Kakaho West catchment

At each of these locations a surface water monitoring station was installed. These continuously measure stage and turbidity in the streams, allowing an estimation of:

- ✧ Flows leaving the site, and
- ✧ Sediment discharge from the site.

In addition, quarterly sampling and manual measurements of water quality, stage and turbidity was undertaken at these locations. The aim of these measurements is to characterise the baseline hydrology and water quality of these streams to allow an assessment of potential effects of the development on key downstream receptors such as Taupō Swamp and the Pauatahanui Inlet.

The Kakaho East catchment will remain mostly undeveloped and therefore was not included in the baseline monitoring.

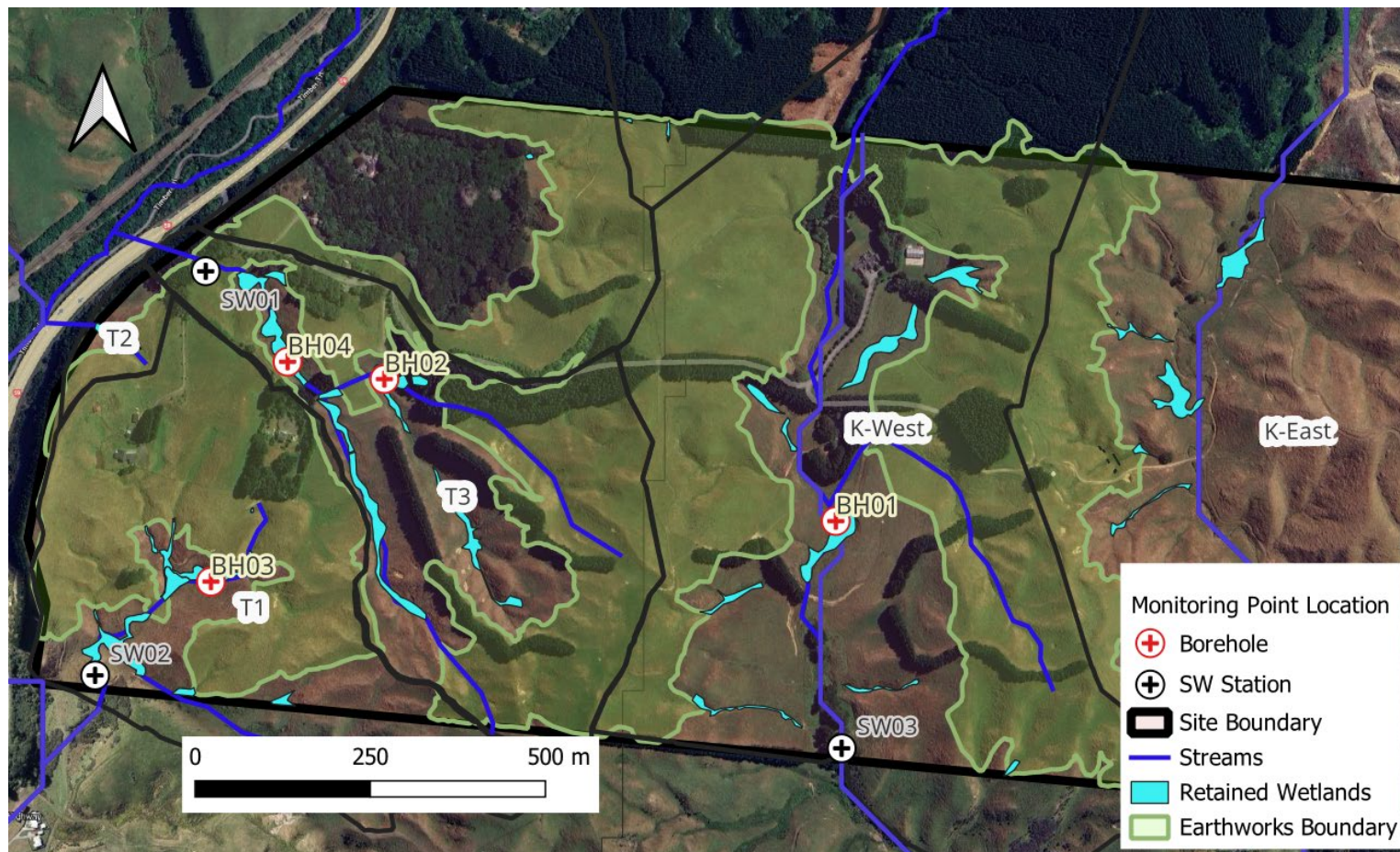


Figure 7: Monitoring network at the site

3.2 Wetland Monitoring Piezometers

Four piezometers were installed between 23 and 28 July 2025 in key retained wetlands at the site. These were located within the same catchments as the surface water monitoring sites and targeted wetlands located near stormwater detention dams.

The piezometers were installed in boreholes excavated using a hand auger to minimise the impact on the wetlands. The boreholes were excavated to depths of between 1.1 and 1.5 m, and slotted between 0.3 and 1.2 m below ground level (bgl). The cuttings indicated that the soils within the wetlands in the Taupō catchment consist mostly of clayey silt and grey clay with some organics. However, in the Kakaho West Catchment gravelly sand was encountered from a depth of 0.8 m, which is consistent with the alluvial deposits indicated from the geological map (Figure 4).

The four wetlands described above will be developed into detention wetlands following development and will retain some standing water. The piezometers were installed for long-term monitoring and are therefore generally located along the margins of the wetlands to ensure they remain functional after the retention wetlands are constructed. These marginal areas are at a higher elevation than the main wetland bodies, meaning that water levels at the monitoring points are deeper relative to the ground surface than in the central parts of the wetlands, where the ground is lower and water levels are closer to the surface.

The purpose of the wetland monitoring is to provide sufficient baseline information to assess potential effects of development on the hydrology of existing wetlands. Continuous water levels are measured using pressure transducers, compensated for barometric pressure using local data and calibrated using quarterly manual dip measurements.

3.3 Summary

Table 2 below gives a summary of the monitoring network and Figure 7 shows the locations of each of the monitoring points.

Table 2: Summary of monitoring network					
Site	Catchment	Water level	Turbidity	Flow Gauging	Date Installed
BH01	Kakaho West	15 min interval	-	-	July 2025
BH02	Taupō T3	15 min interval	-	-	July 2025
BH03	Taupō T1	15 min interval	-	-	July 2025 ²
BH04	Taupō T3	15 min interval	-	-	July 2025
SW01	Taupō T3	15 min interval	15 min interval	Quarterly ¹	July 2025
SW02	Taupō T1	15 min interval	15 min interval	Quarterly ¹	July 2025
SW03	Kakaho West	15 min interval	15 min interval	Quarterly ¹	July 2025
Notes: 1. Quarterly monitoring undertaken in August 2025, November 2025, February 2026 and May 2026 2. Damaged by cattle so reinstalled March 2026 and again May 2026					

3.4 Limitations and Data Gaps

Throughout the monitoring period, several sites experienced issues due to cattle damaging equipment, limited flow within the streams and equipment failure. A summary of the issues encountered, and the resulting data loss is provided in Table 3. Due to issues with cattle damaging equipment, the majority of the locations have now been fenced.

Table 3: Summary of data gaps for each monitoring site				
Site	Data type	Gaps ¹	Reason for gap	Impact
Baro	Atmospheric pressure	22/07/2025-26/08/2025	Site barometer malfunctioned	Had to use regional barometric pressure data ² for correction of water level data which proved unreliable ³ .
SW01	Turbidity	22/07/2025-05/11/2025	Vegetation entangled around installation,	Inaccurate turbidity data until November when vegetation was cleared and sensor was cleaned
		03/01/2026-22/05/2026	Malfunctioning of turbidity sensor,	Scaling and malfunction led to lower values than measured manually. Cleaned and recalibrated.

Table 3: Summary of data gaps for each monitoring site				
SW02	Turbidity	10/12/2025-30/04/2026	Cattle destroyed solar panel and sensor	Data gap whilst sensor was sent to manufacturer for repair.
BH03	Water Level	23/11/2025-13/03/2026	Piezometer trampled by cattle	Retrieved and reinstalled but data gap for damaged period.
		14/04/2026-15/05/2026	Piezometer trampled by cattle	Retrieved, reinstalled and fenced but data gap for damaged period.

Notes:

- Small data gaps (hours) are present when data was being downloaded and logger reinstalled. These are not included in the data gap summary.
- Porirua Eldson Ave EWS transducer was used (NIWA, 2023).
- Water level data from this period has been excluded from this report.

4.0 Results

4.1 Surface Water Flow

The aim of the monitoring is to understand baseline conditions for flows leaving the site. Surface water level hydrographs are presented in Appendix A, and the data have been plotted alongside rainfall data from the GWRC site 'Taupō Stream at Whenua Tapu'. The results of quarterly flow gauging are presented in Table 4.

Table 4: Flow gauging results (L/s)				
	26/08/2025	5/11/2025	19/02/2025	14/05/2026
SW01	2.0	1.0	2.0	1.0
SW02	2.0	0.8	1.0	1.2
SW03	5.0	4.8	3.0	6.8

The results from the surface water level have been used to estimate flow using Manning's equation, calibrated to observed flow data. Due to a lack of high-flow measurements, the flows were further calibrated by matching the peaks estimated for the 18 April 2026 event (equivalent to a defined 10% ARI; see Section 2.2) and the peak flow estimates for the 10% AEP event previously derived through hydrological modelling (PDP 2025 and Envelope 2025).

The flow hydrographs are presented in Appendix B. The results indicate the following:

- ∴ SW01 (Taupō T3 catchment):

- Baseflow at this location is estimated to range between 1 and 2 L/s.
 - Flows are likely to exceed 100 L/s following heavy rainfall events (i.e. more than 20 mm/day).
 - The estimated peak during a comparable 10% AEP (ARI) rainfall event is approximately 800 L/s, which is consistent with previous model estimates (829 L/s in Envelope Engineering stormwater design and assessment).
- ∴ SW02 (Taupō T1 catchment):
- Baseflow is also estimated to be between 1 and 2 L/s, which is unsurprising given the broadly similar size and nature of the T1 and T3 catchments.
 - Flows may be up to 200 L/s following heavy rainfall events (more than 20 mm/day).
 - The estimated peak during a comparable 10% AEP (ARI) rainfall event is approximately 1,500 L/s, which aligns with previous model estimates (1,583 L/s from the Envelope Engineering stormwater design and assessment).
- ∴ SW03 (Kakaho West catchment):
- As expected, given the larger catchment area, SW03 exhibits a more consistent baseflow ranging between 3 and 5 L/s,
 - Flows from the catchment regularly exceed 500 L/s following heavy rainfall events (more than 20 mm/day).
 - The estimated peak during a comparable 10% AEP (ARI) rainfall event is approximately 3,000 L/s, which is consistent with previous modelling (3,319 L/s for a 10% AEP event in the Envelope Engineering stormwater design and assessment).

The results are broadly similar to the modelled outputs from the PDP hydrology assessment (PDP, 2025). However, the flows from the Kakaho West catchment in the model are higher than estimated from the monitoring data to date and the model appears to simulate a greater number of flow peaks than have been observed during the baseline monitoring period. Given the limited baseline data used to develop and calibrate the model and the conservative nature of the modelling results, it is recommended that the model be recalibrated to check the results of the hydrology assessment remain valid.

4.2 Surface Water Quality

4.2.1 Turbidity

The turbidity results provide an indication of the volume of sediment leaving the site via the streams. Whilst there are some data gaps, the information obtained over this baseline monitoring period is considered reasonably representative. At all three monitoring locations numerous peaks in turbidity were recorded which do not correlate with rainfall and have been attributed to other causes such as stream bed disturbance by wildlife and cattle.

The results indicate the following:

- ∴ SW01, which had some data limitations due to sensor issues;
 - Baseline turbidity ranges between 2 and 6 NTU, typical of a low flow environment.
 - Peaks following rainfall events can range up to 4,000 to 4,500 NTU, suggesting that there may be some scour or slumping in the upper parts of the catchment leading to sediment mobilisation.
- ∴ SW02, where there was a sensor failure between December 2025 and April 2026;
 - Baseline turbidity levels ranged between 4 and 6 NTU, typical of a low flow environment.
 - Turbidity peaks following rainfall were observed to peak at up to 9,000 NTU, which suggests some scour and sediment mobilisation within the catchment.
- ∴ SW03, had the most complete record;
 - The baseline at this site varies from 2 to 12 NTU, consistent with low flows and the larger catchment area.
 - The turbidity peaked to a maximum of 10,000 NTU during the 18 April 2026 rainfall event (estimated 10% ARI), which is the maximum value of the sensor.
 - Following other rainfall events, the turbidity peaks range from 1,000 to 3,000 NTU. These slightly lower values are consistent with the more vegetated nature of the upstream catchment at this location.

The turbidity data collected will prove valuable for the establishment of trigger thresholds and to assess potential impacts of the proposed earthworks on the streams.

4.2.2 Water Quality Analysis

During the four quarterly monitoring visits, water samples were collected at all three surface water monitoring locations (SW01, SW02 and SW03) for laboratory analysis. Parameters analysed included pH, electrical conductivity, anions, cations, heavy metals and nutrients.

The on-site water quality monitoring data collected were compared with publicly available data from the downstream receptor (GWRC water quality station “Taupō Stream at Plimmerton Domain”) to help characterise baseline water quality.

Charts showing the results of the water quality monitoring at SW01, SW02 and SW03 and a summary table are included in Appendix E. The laboratory reports are presented in Appendix F. The key findings of the monitoring results are:

- ✧ Water quality at SW01 and SW02 (both within the Taupō catchment) is very similar; no parameters show significant differences between the two locations.
- ✧ Water quality at SW03 (located in the Kakaho Stream catchment) is generally slightly poorer than at SW01 and SW02 (both in the Taupō Stream catchment), with higher measured ammoniacal and nitrate nitrogen, as well as zinc and copper.
- ✧ The nitrate concentration at SW03 on 26 August 2025 (Q1) and 14 May 2026 (Q4) exceeded the freshwater guideline values for 99% species protection (ANZG, 2018), but did not exceed the 95% threshold.
- ✧ The ammoniacal nitrogen concentration at SW03 during the sampling on 5 November 2025 (Q2) exceeded the 95% species protection threshold.
- ✧ Dissolved zinc concentration at SW03 exceeded the 99% species protection value in both Q3 and Q4 sampling, but did not exceed the 95% species protection.
- ✧ Dissolved copper concentration at SW03 slightly exceeded the 99% species protection on 14 May 2026 (Q4).
- ✧ All other parameters tested are lower than the freshwater guideline values for 99% species protection (ANZG, 2018).

On the basis of the four sampling rounds collected over a 1-year period, some key similarities and contrasts to the baseline data collected by GWRC at Taupō Stream at Plimmerton Domain have been noted.

- ✧ Nitrate levels at all three monitoring stations are considerably higher than the mean value at Taupō Stream. This may be due in part to the current land use of the area as a deer farm. However, the GWRC monitoring point is downstream of the Taupō Swamp which will also remove significant nitrate from the system.

- ✧ Zinc concentrations measured on-site were similar to the ones in Taupō Stream, which exceed the 99% species protection threshold regularly. The only value notably higher than the ones measured in Taupō Stream was measured at SW03 during Q4, but this monitoring location discharges into the Kakaho Stream for which there is no publicly available data.
- ✧ Copper concentrations were within the same range or below those in Taupō Stream.
- ✧ Calcium and magnesium (and consequently hardness) measured on site were generally lower than the mean values at Taupō Stream.
- ✧ Electrical Conductivity (EC) is significantly lower than measured in the Taupō Stream.
- ✧ Phosphorus is similar or lower than the values measured for the Taupō Stream.
- ✧ The pH values on site appears to be in the same range or slightly higher than at Taupō Stream. This is also confirmed by the manual pH measurements.

The baseline monitoring results support the preliminary water quality assessment (PDP, 2025b) completed in 2025.

4.3 Wetlands

A summary of the water levels collected from the four wetland sites (BH01 – BH04) are presented in Appendix D. The water levels have been plotted alongside rainfall data from the GWRC site 'Taupō Stream at Whenua Tapu'.

The wetland groundwater levels indicate that:

- ✧ BH01, which is located in a wetland on the floor of the valley in the Kakaho West catchment
 - Relatively consistent groundwater level that is not highly responsive to climatic variations such as rainfall events or short-term dry periods.
 - Seasonal variations in water levels are of the order of 0.1 to 0.2 m.
 - This indicates that the wetland is sustained by contributions from groundwater and overflow from the stream, as well as run-off and direct rainfall, which supports the conceptual understanding of the hydrology of this wetland.
 - The observed water level variations appear to be broadly similar to those predicted by the model. However, further monitoring is required to confirm these trends given the limited data available to

date and the wetter than average weather during the monitored period.

- ∴ BH02 and BH04 are located in two wetlands situated along the same ephemeral stream within the Taupō T3 catchment, with BH02 installed upstream of BH04.
 - Both piezometers show similar water level patterns with variations ranging between 0.2 and 0.4 m and rapid response to rainfall events.
 - The results support the conceptual understanding that these wetlands primarily sustained by surface-water runoff and direct rainfall, and significant contributions from groundwater are unlikely.
 - The measured range of water level variation is similar to the modelled range for these wetlands, although the observed variations appear to be slightly greater than those calculated by the model. Additional monitoring data are required to verify these trends.
- ∴ BH03 within the wetland in ephemeral gully of the Taupō T1 catchment has an incomplete data record due cattle damage.
 - Based on the available data, variations in water level are approximately 0.5m, with a rapid increase following rainfall.
 - This wetland appears to be supported almost entirely by surface runoff and direct rainfall, which supports the conceptual understanding.
 - The range of water level variation is similar to the modelled range. However, given the limited dataset currently available, additional monitoring is required to confirm whether this pattern is representative of longer-term conditions.

The data collected to date confirms the conceptual understanding of the system adopted in the model and will prove valuable if it becomes necessary to establish alert and alarm hydrology trigger thresholds to assess wetland health during and post construction of the proposed development.

5.0 Conclusions and Recommendations

This report presents the results of quarterly monitoring undertaken at the Mount Welcome site between July 2024 and May 2025. Continuous stage and turbidity records and quarterly water quality samples have been collected for 3 sub-catchments (Taupo Stream T1 and T3 and Kakaho West Stream) to obtain representative estimates of flows, surface water quality and sediment loads leaving the site. Continuous water level data has been collected for four representative wetlands located within the same catchments to provide baseline data on wetland hydrology.

The results indicate that baseflow to the streams is relatively low (1 to 5 L/s), but flows peak rapidly following rainfall and can exceed 800 to 3,000 L/s for large rainfall events depending on the size of the catchment (estimated 10% AEP).

Whilst there were issues with some of the turbidity sensors, the available data indicates that under low flow conditions there is very little sediment in the streams. However, during rainfall events the turbidity increases significantly, particularly for the smaller catchments, suggesting significant sediment mobilisation may be occurring.

The water quality data indicates that nitrate and ammoniacal nitrogen may be higher than concentrations measured downstream in the Taupō catchment, possibly due to the current land use as a deer farm. The remaining analyte had similar concentrations to those measured downstream and were mostly below the freshwater 95% species protection values (ANZG, 2018).

Continuous monitoring of wetland water levels indicates that wetland water levels within the Taupō catchment fluctuate between 0.3 and 0.5 m, raising rapidly after rainfall. This suggests that these systems are primarily supported by surface runoff and direct rainfall, with limited groundwater or sustained surface water inputs. The wetland on the valley floor of the Kakaho catchment (BH01) show less pronounced seasonal fluctuations, suggesting a more consistent contribution from groundwater and stream overflow.

Monitoring undertaken to date indicates that the assumptions adopted for the modelling of surface water flows and wetland groundwater levels were broadly appropriate. The observed variations in hydrology were within the range of modelled values and are consistent with natural climatic variability, seasonal conditions, land use and catchment responses to rainfall. Nevertheless, recalibration to the baseline data is recommended to improve the model fit to the observed data and check the validity of the conclusions of the hydrology assessment.

The turbidity and wetland water level data collected will be valuable for establishing alert and alarm trigger thresholds and for identifying potential impacts of construction or the proposed development on the streams and wetlands at the site and the downstream environment.

Overall, the monitoring was effective in providing baseline data to characterise the hydrology and water quality. There were some data losses due to sensor issues and cattle damage. To minimise the risk of this reoccurring, fencing enclosures were installed in May 2026 around all piezometers and surface water station SW02. Continued monitoring is recommended to obtain further baseline data under varying climatic conditions before construction commences.

6.0 References

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<https://graphs.gw.govt.nz/envmon?view=graph&collection=Rainfall&site=Taupō+Stream+at+Whenua+Tapu&measurement=Rainfall&interval=Hourly>
- Ministry for the Environment. (2025). River Environment Classification New Zealand. Retrieved from MfE Data Service: <https://data.mfe.govt.nz/data/>
- PDP 2025a, Mount Welcome – Hydrology Assessment November 2025
- PDP 2025b, Mount Welcome – Water Quality Assessment November 2025
- PDP 2025c, Assessment of proposed roundabout on SH59 on water quality of Taupō Stream, November 2025

Appendix A: Measured Water Levels

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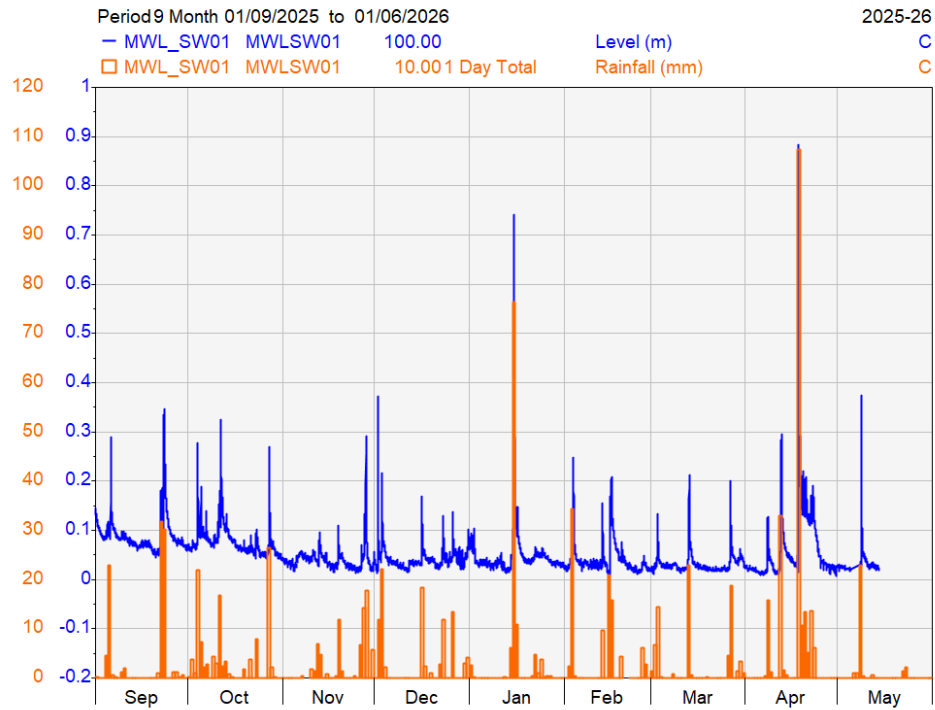


Figure A1: Water Level recorded at SW01

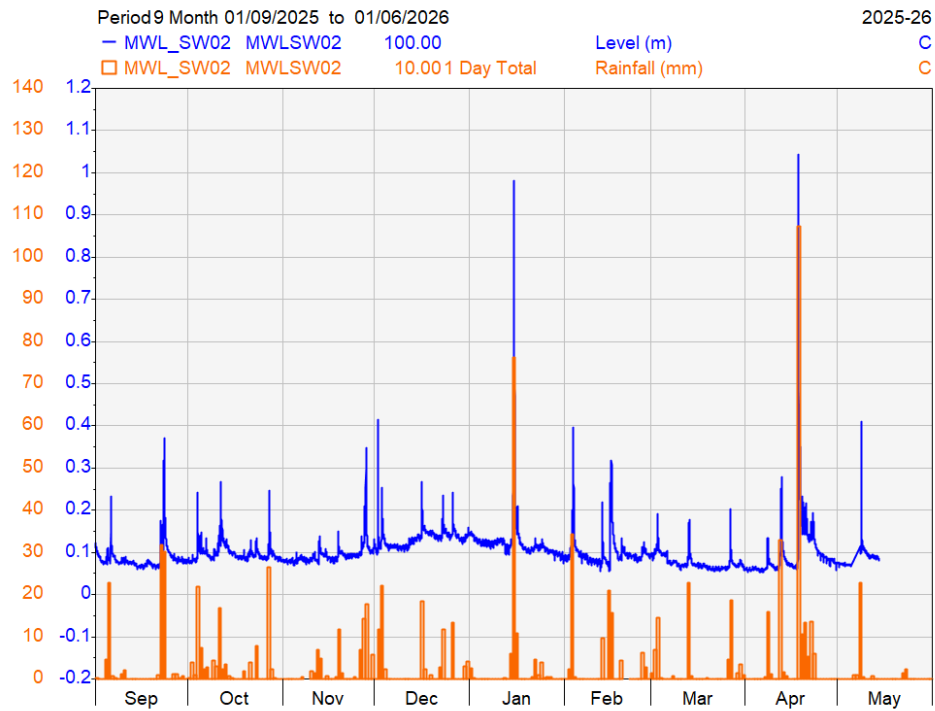


Figure A2: Water Level recorded at SW02

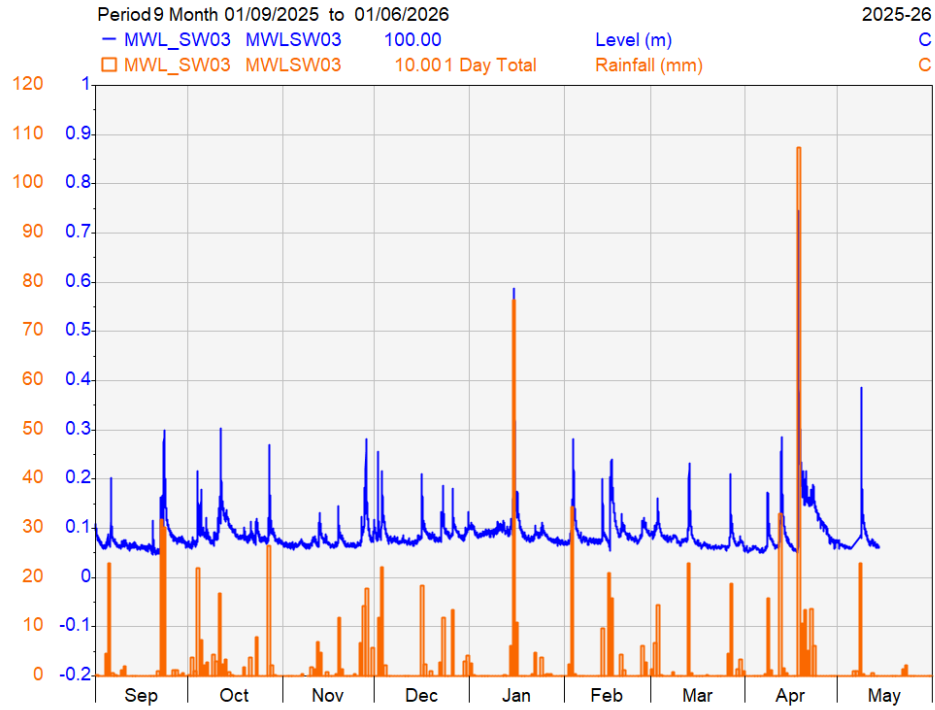


Figure A3: Water Level recorded at SW03

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Appendix B: Flow Estimates and Gauging

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REPORT 2025-2026

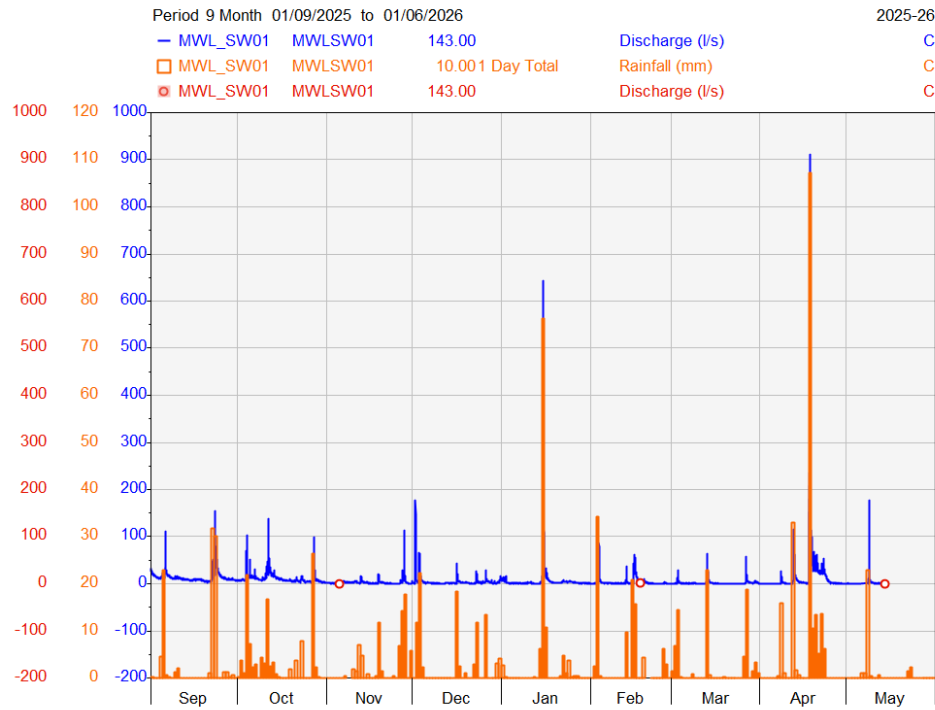


Figure B1: Flow hydrograph estimated for SW01

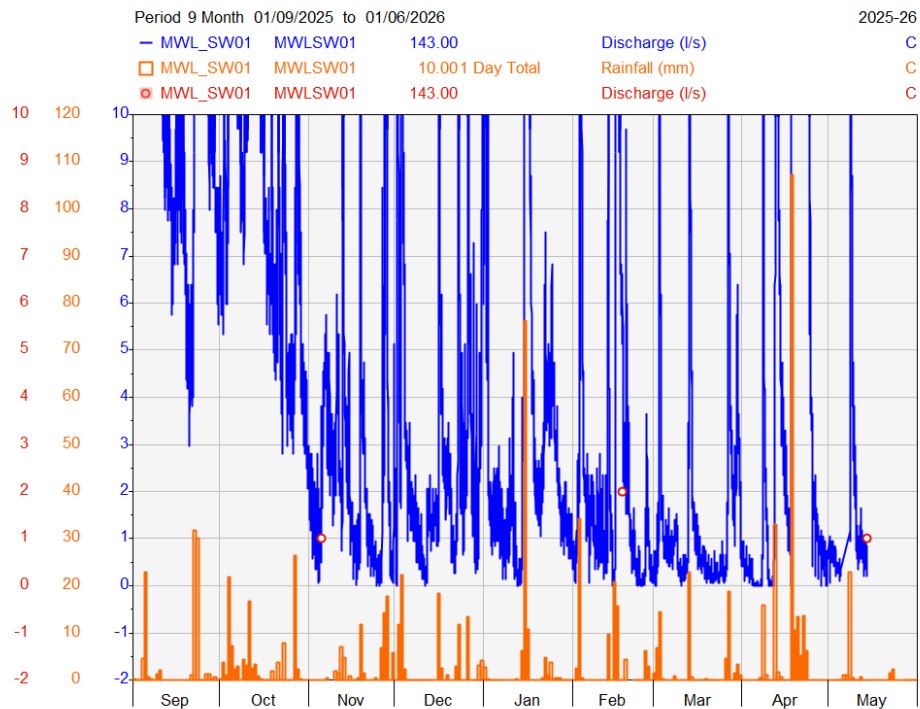


Figure B2: Flow hydrograph estimated for SW01 – baseflow

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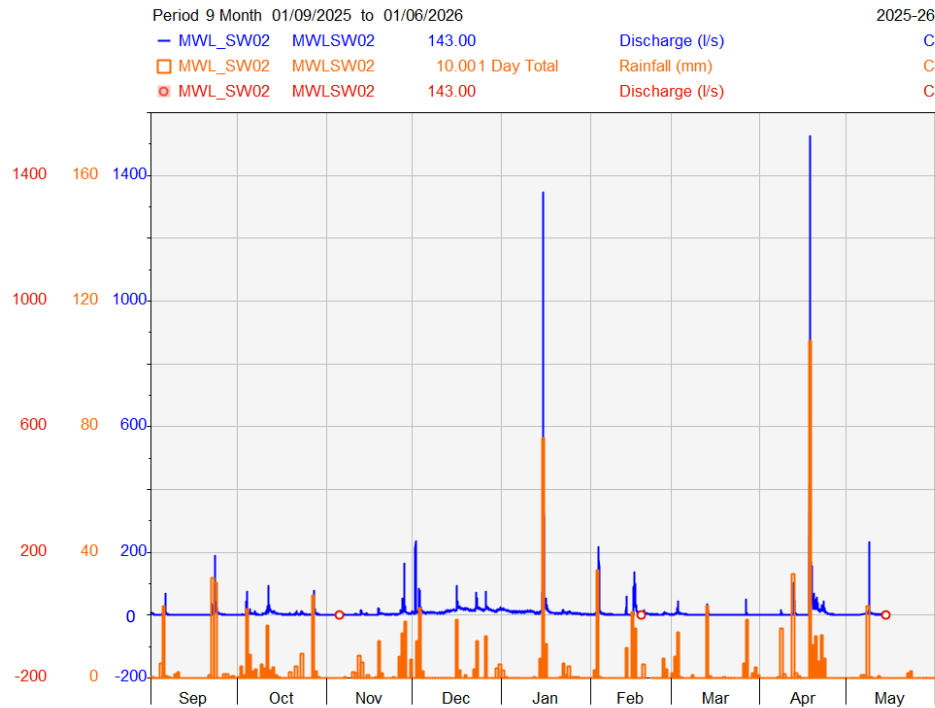


Figure B3: Flow hydrograph estimated for SW02

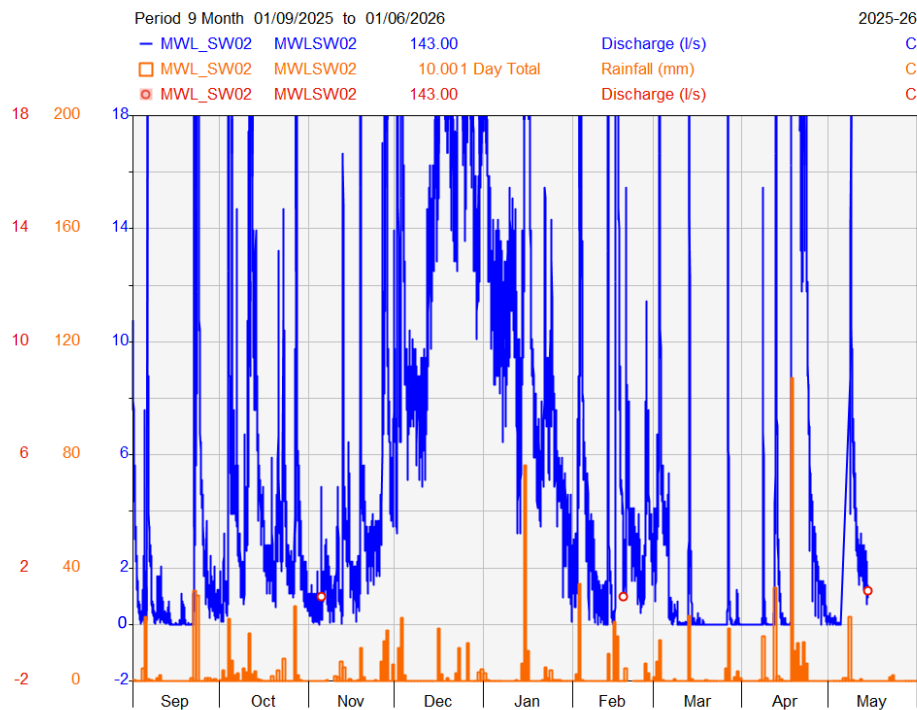


Figure B4: Flow hydrograph estimated for SW02 – baseflow

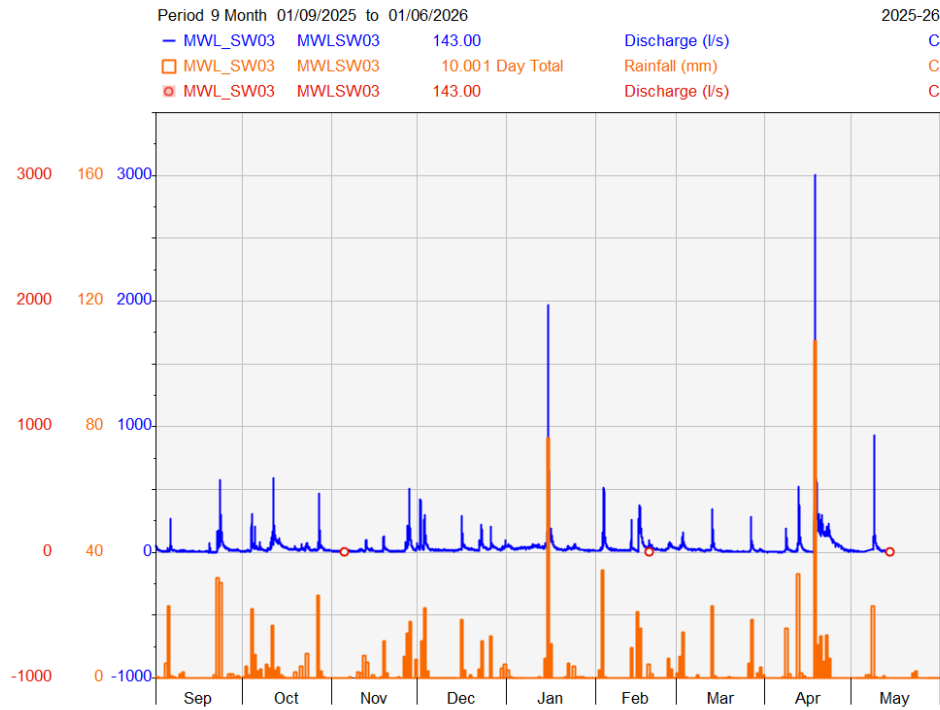


Figure B5: Flow hydrograph estimated for SW03

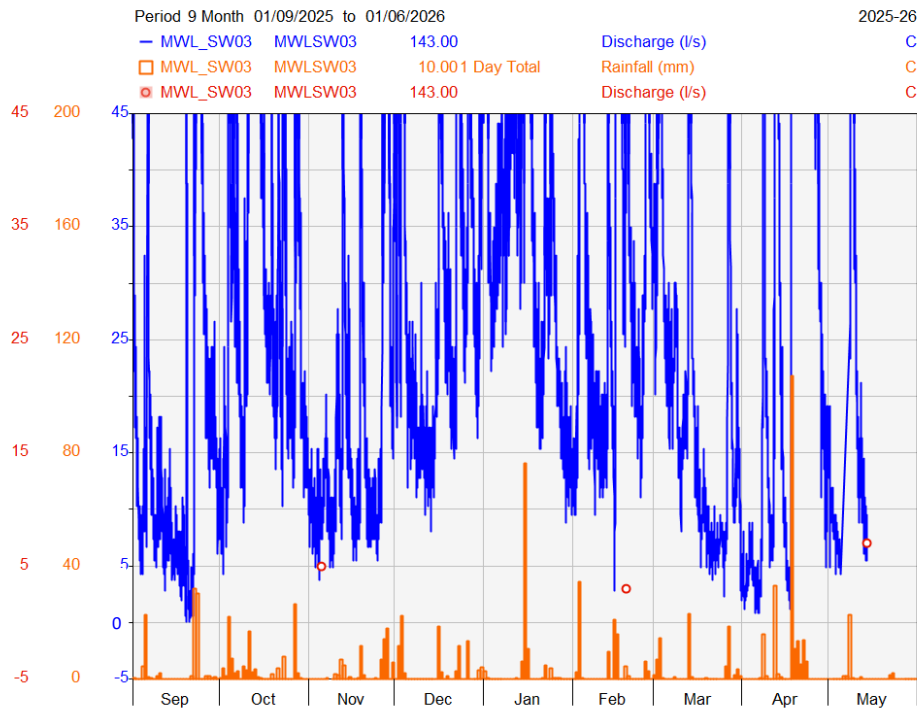


Figure B6: Flow hydrograph estimated for SW03 – baseflow

Appendix C: Turbidity

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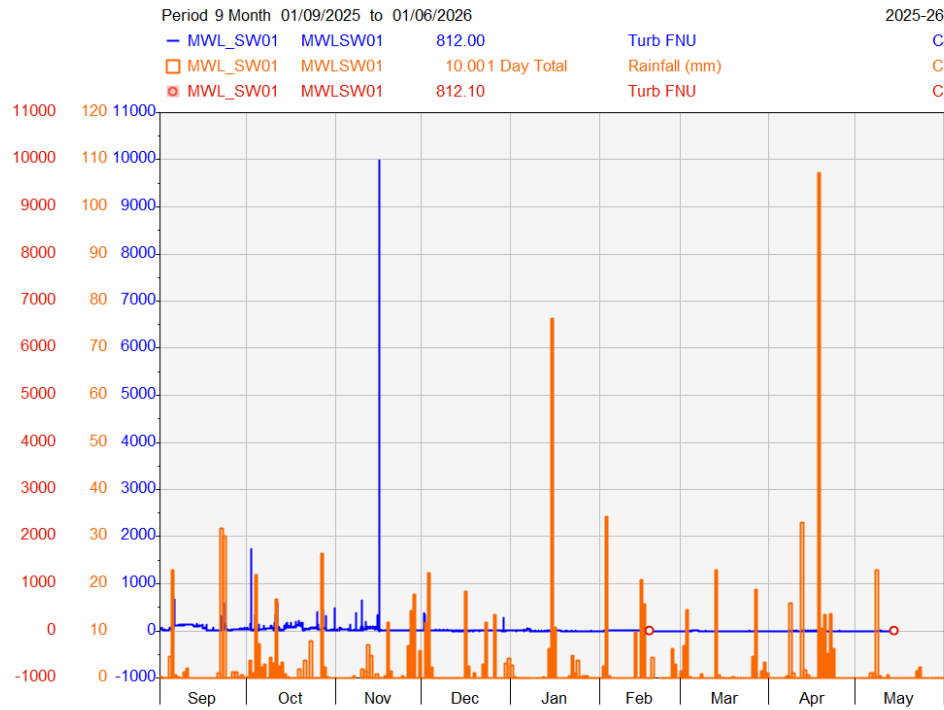


Figure C1: Measured turbidity at SW01

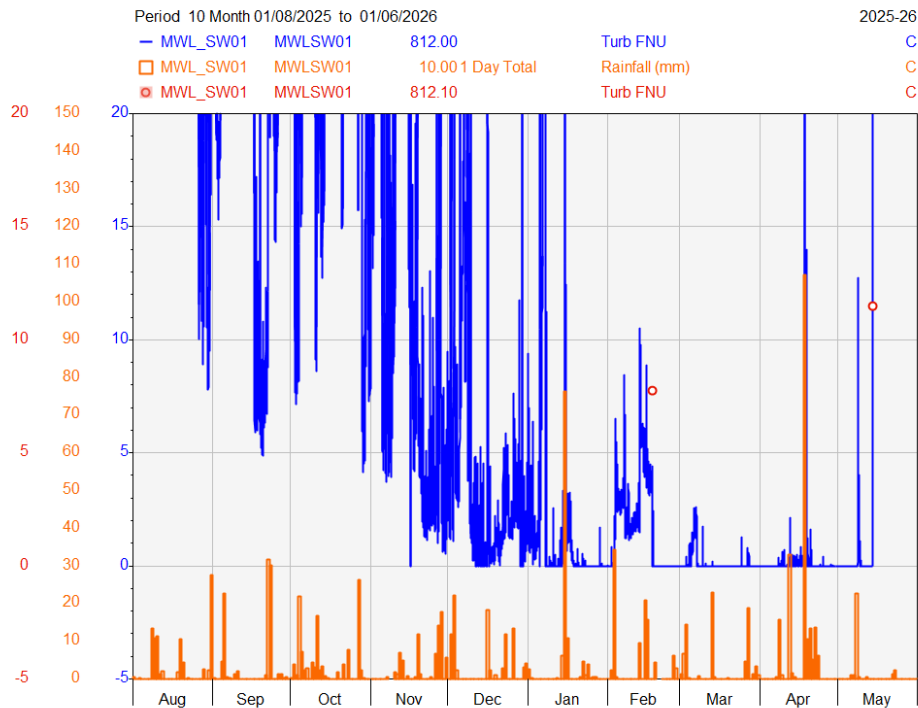


Figure C2: Measured baseline turbidity at SW01

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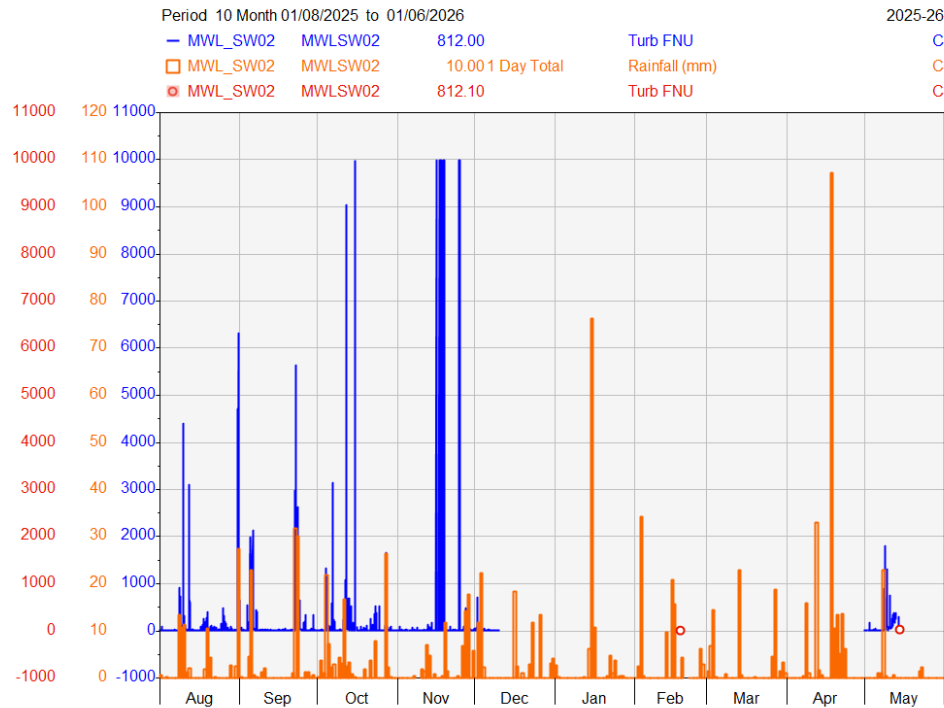


Figure C3: Measured turbidity at SW02

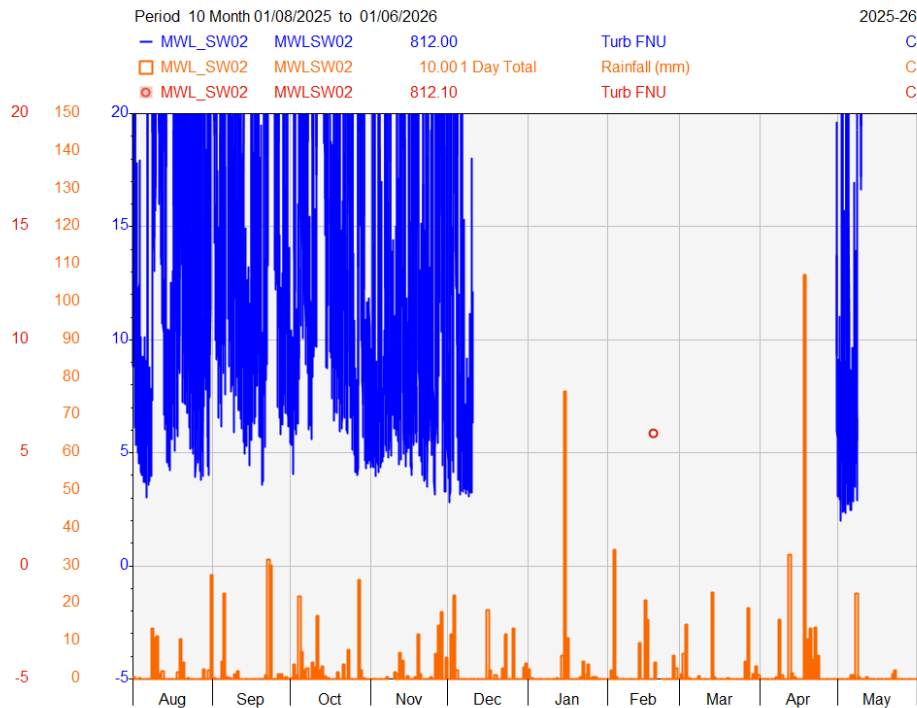


Figure C4: Measured baseline turbidity at SW02

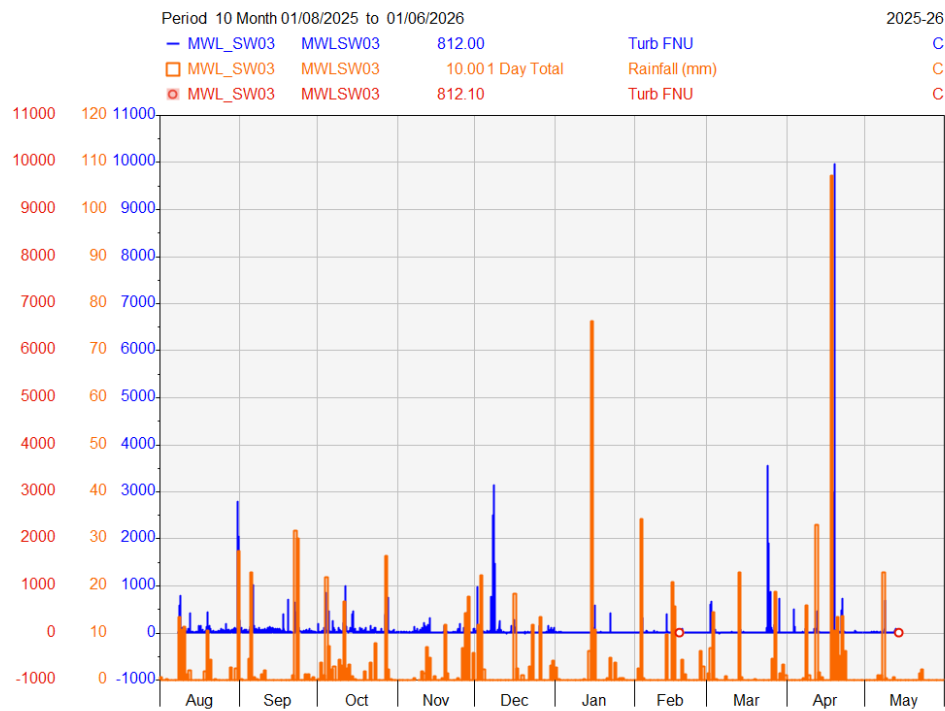


Figure C5: Measured turbidity at SW03

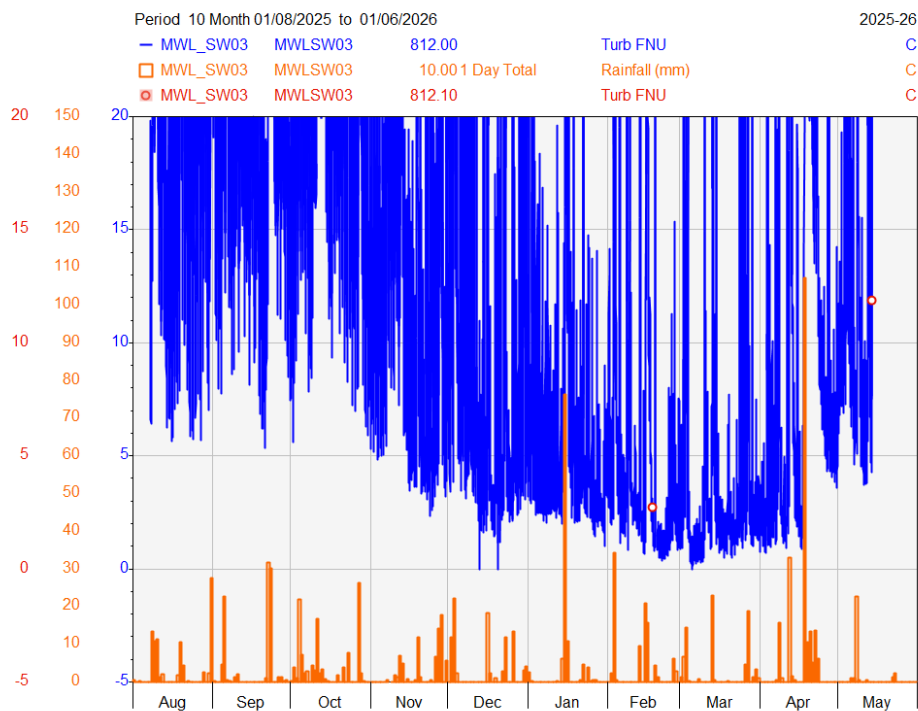


Figure C6: Measured baseline turbidity at SW03

Appendix D: Wetland Water Levels

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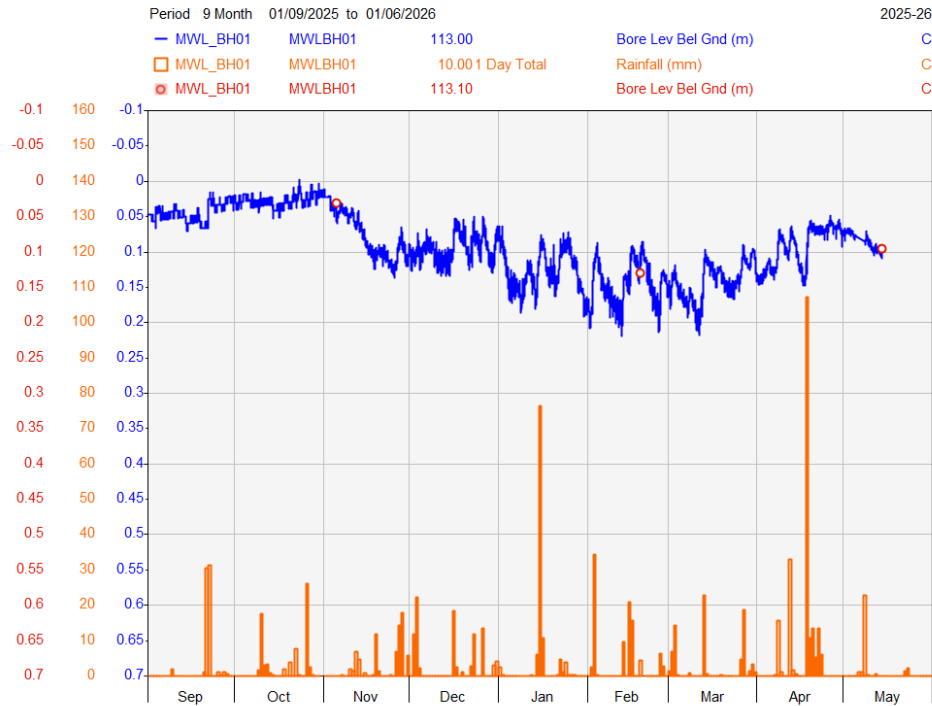


Figure D1: Groundwater level at BH01

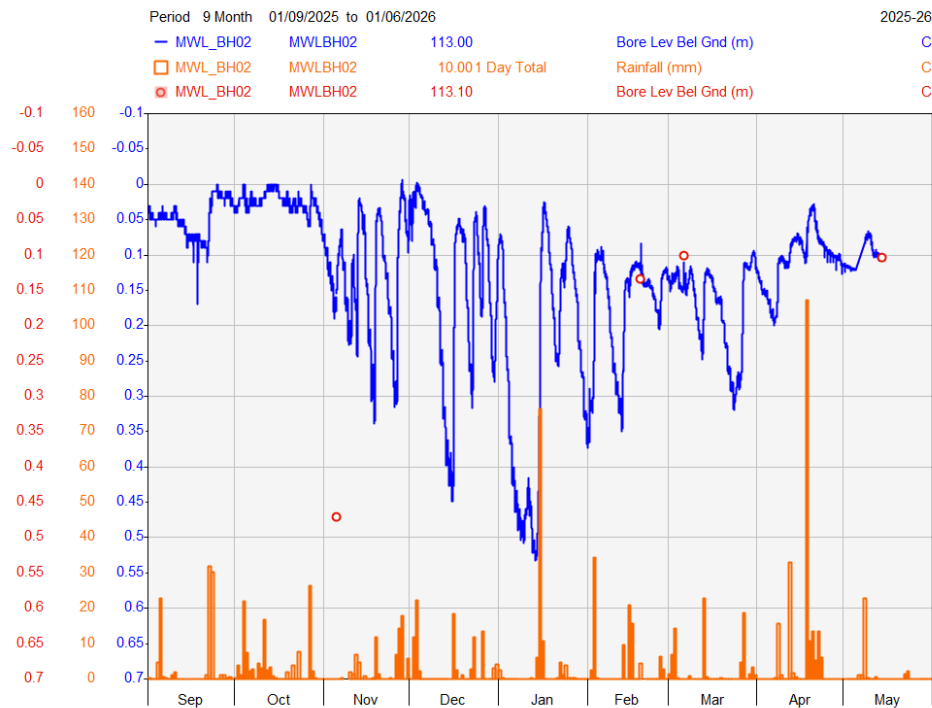


Figure D2: Groundwater level at BH02

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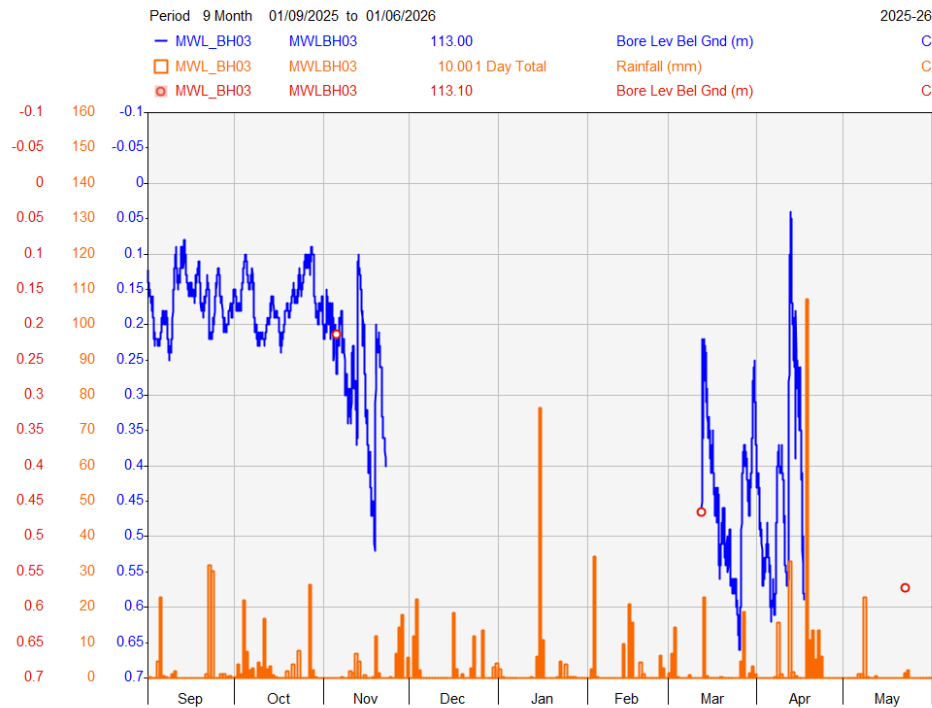


Figure D3: Groundwater level at BH03

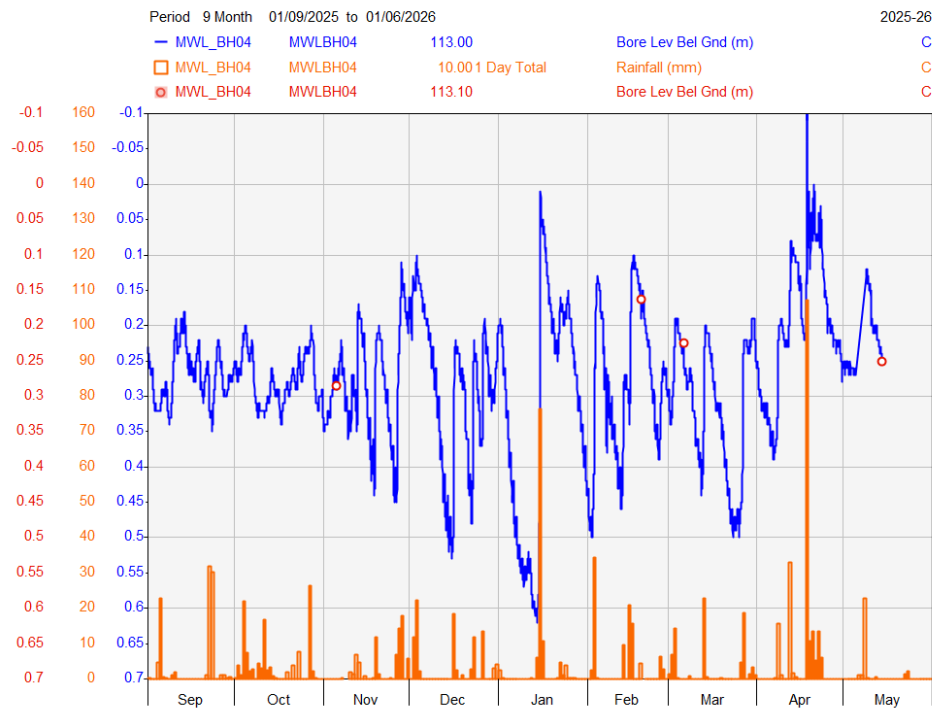


Figure D4: Groundwater level at BH04

Appendix E: Water Quality

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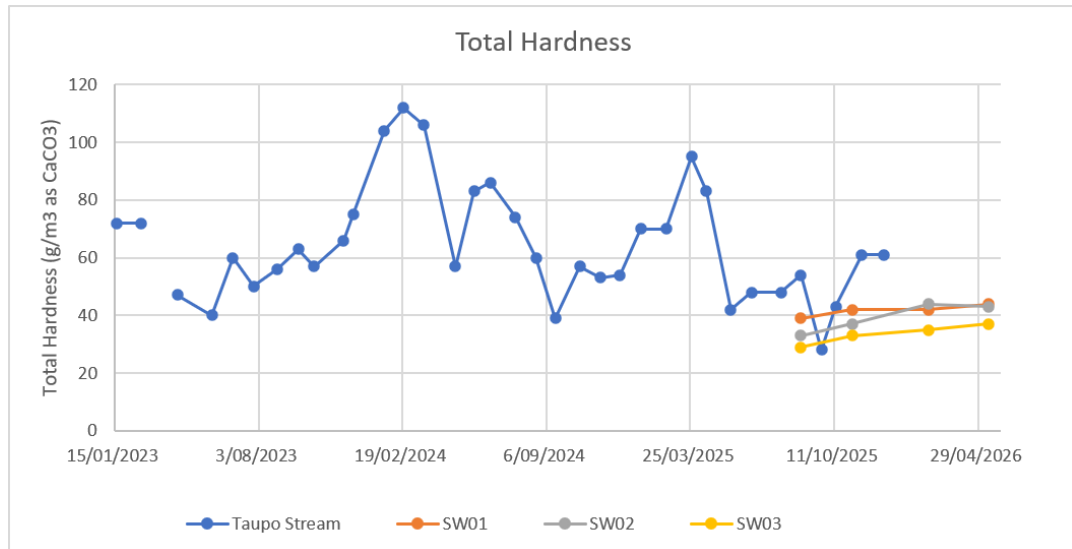


Figure E1: Total Hardness measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

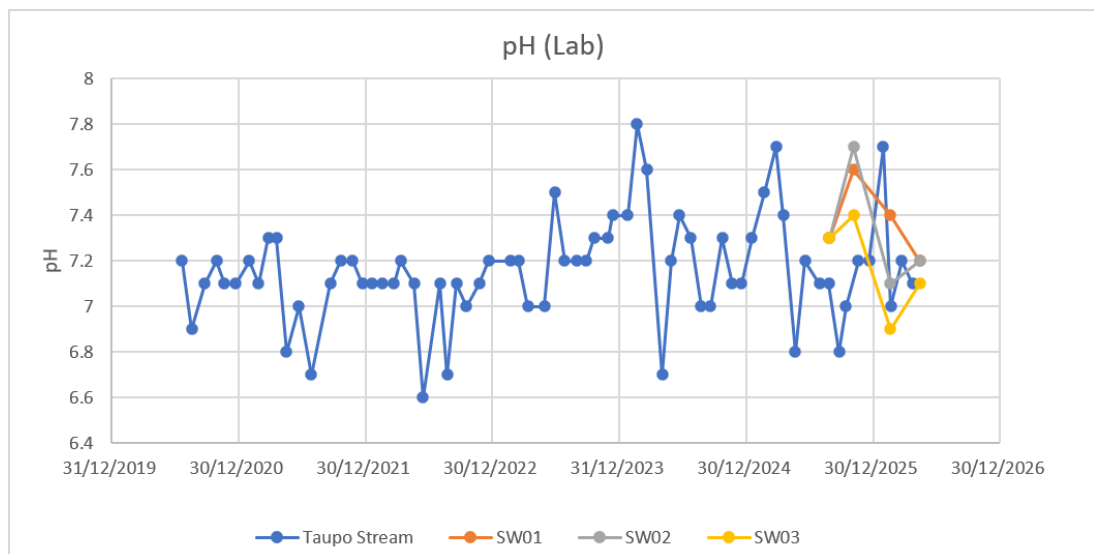


Figure E2: pH measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

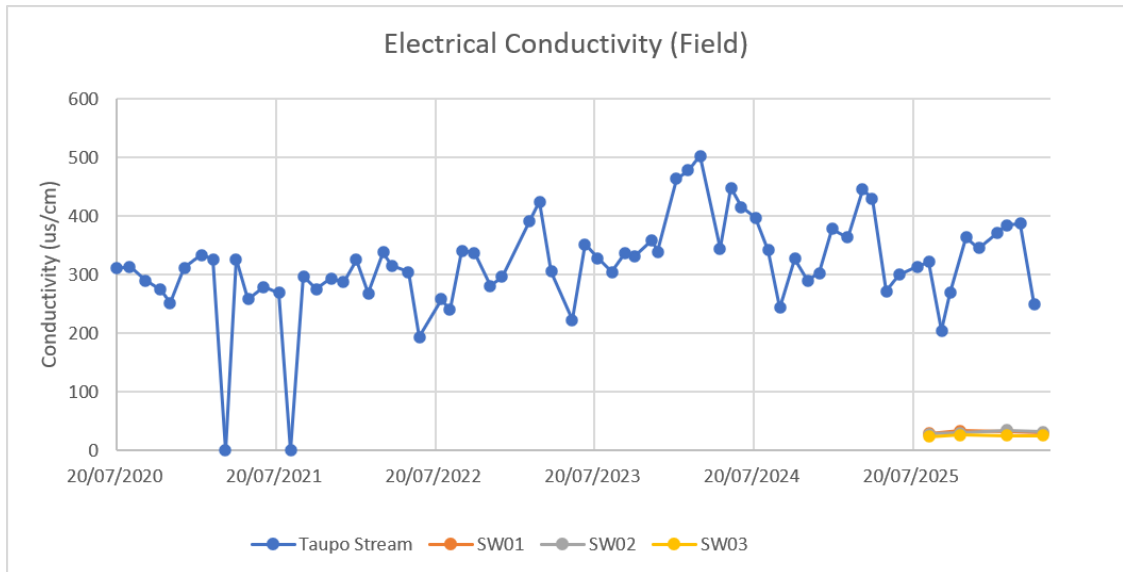


Figure E3: Electrical Conductivity measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

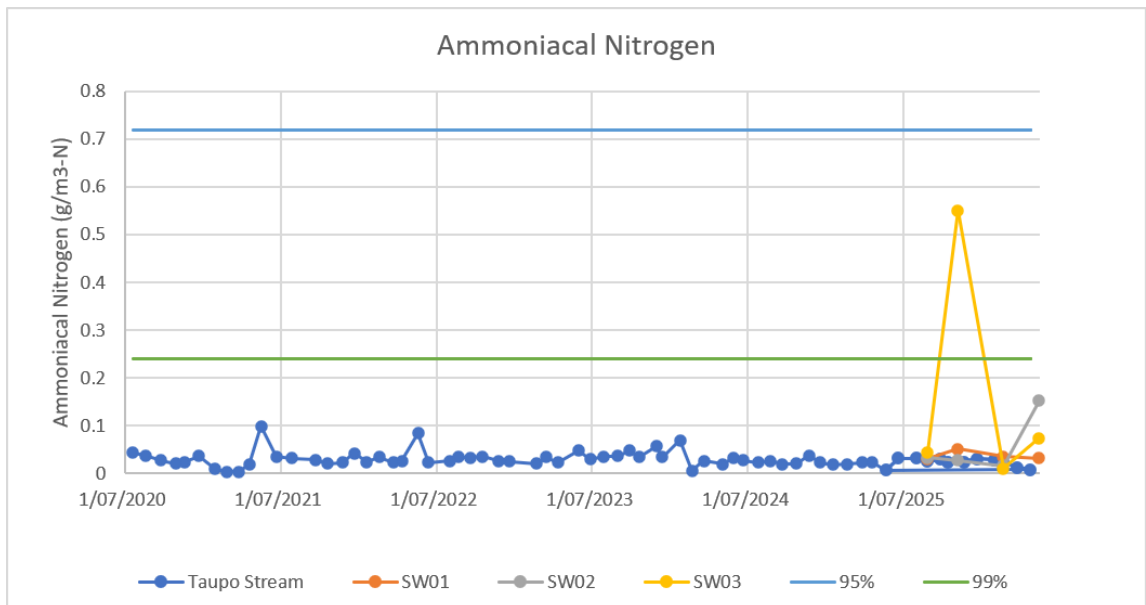


Figure E4: Ammoniacal Nitrogen measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

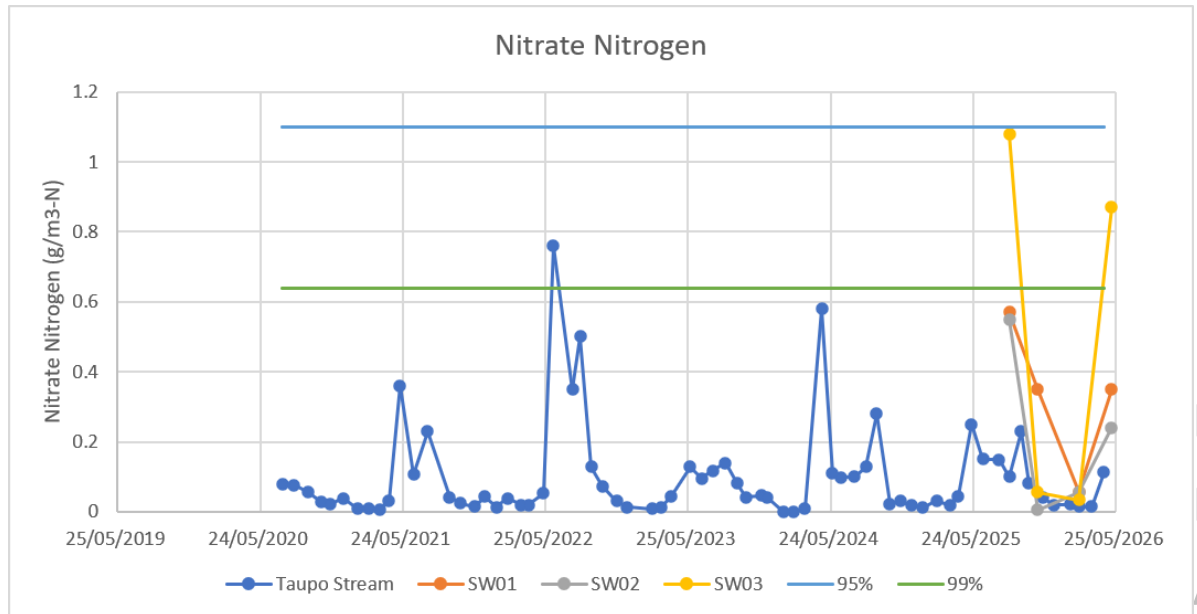


Figure E5: Nitrate Nitrogen measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

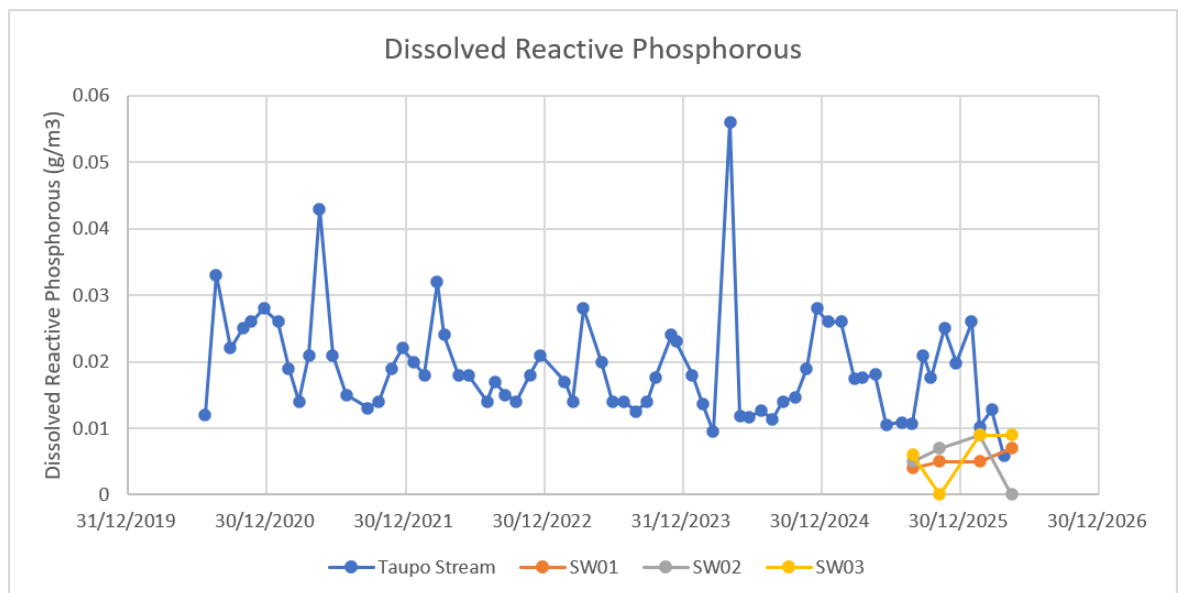


Figure E6: Dissolved Reactive Phosphorus measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

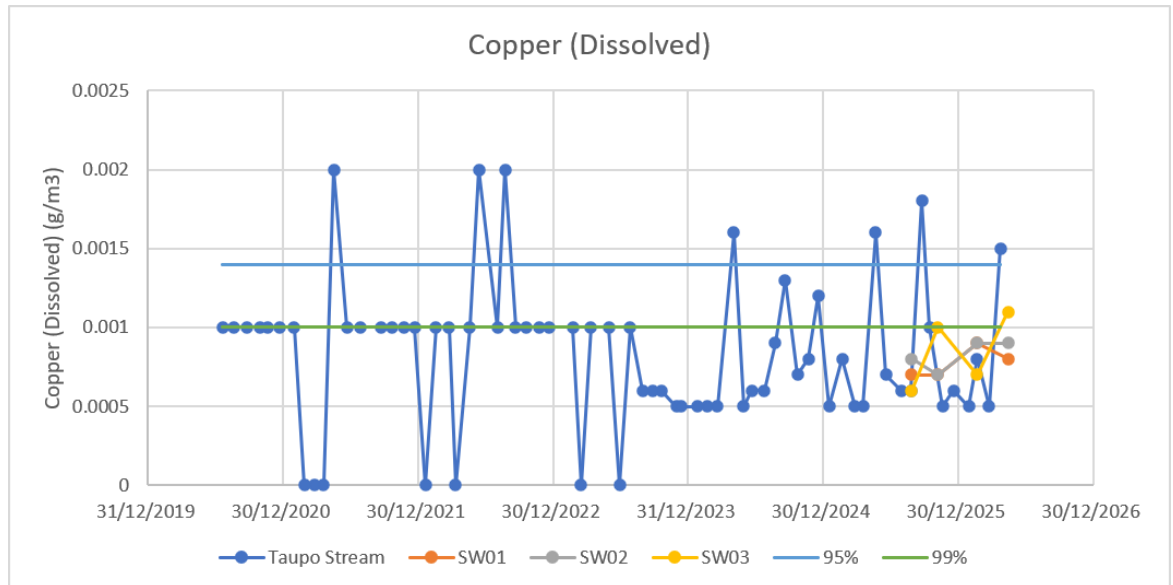


Figure E7: Dissolved Copper measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

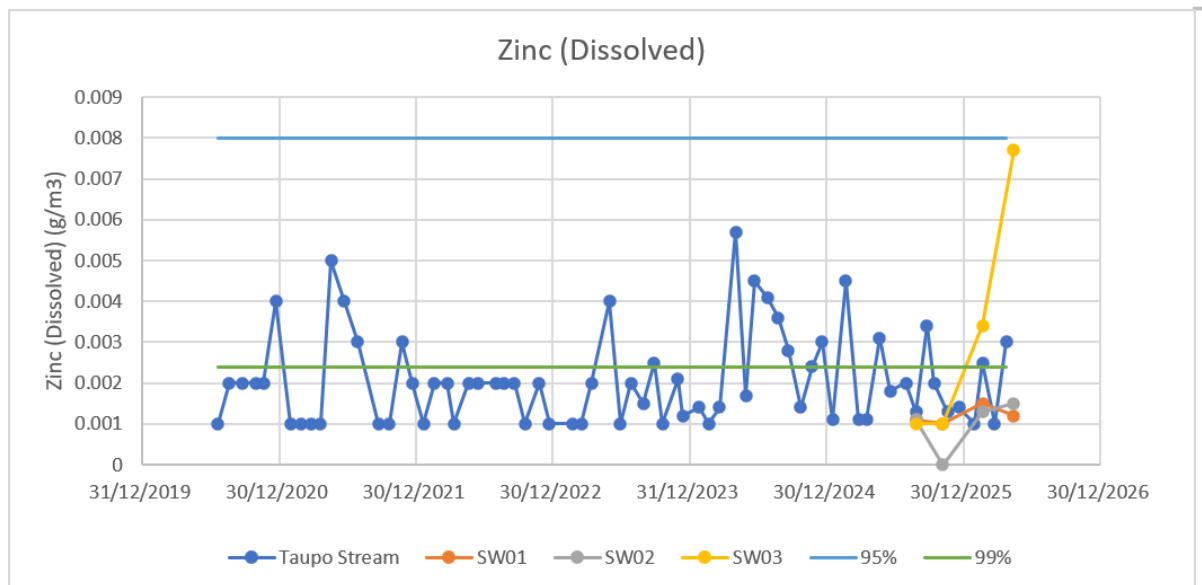


Figure E8: Dissolved Zinc measured at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

Table E1: Summary of sampling at Taupō Stream at Plimmerton Domain, SW01, SW02 and SW03

Water Quality Sampling Results Summary																		
Analyte	Unit	Taupo Stream			SW01				SW02				SW03				ANZ Guidelines for Fresh Water Quality ¹	
		min	max	mean	26/08/2025	5/11/2025	19/02/2026	14/05/2026	26/08/2025	5/11/2025	19/02/2026	14/05/2026	26/08/2025	5/11/2025	19/02/2026	14/05/2026	95% Species Protection	99% Species Protection
Total Hardness	g/m ³ as CaCO ₃	28	112	64	39	42	42	44	33	37	44	43	29	33	35	37		
Sum of Anions	meq/L				2.6	3.0	2.8	2.7	2.4	2.7	3.0	2.7	2.1	2.4	2.2	2.2		
Sum of Cations	meq/L				2.8	3.0	3.1	3.0	2.6	2.8	3.3	3.1	2.2	2.3	2.5	2.6		
pH	pH	6.6	7.8	7.2	7.3	7.6	7.4	7.2	7.3	7.7	7.1	7.2	7.3	7.4	6.9	7.1	-	-
Total Alkalinity	g/m3 as CaCO ₃				37.0	44.0	46.0	44.0	32.0	40.0	48.0	40.0	25	34	35	28		
Bicarbonate	g/m3 at 25°C				45.0	53.0	56.0	53.0	39.0	48.0	58.0	48.0	30	41	42	35		
Electrical Conductivity (EC)	mS/cm	194	502	317	29.1	34.2	32.9	30.6	28.0	30.7	34.4	31.8	23.7	26.9	25.8	25.7	-	-
Dissolved Calcium	g/m ³	4.8	21	10.7	5.2	5.9	5.7	6.1	5.0	5.5	6.6	6.4	4.6	5.2	5.3	5.8		
Dissolved Magnesium	g/m ³	3.6	14.3	7.62	6.40	6.60	6.70	7.10	5.10	5.60	6.60	6.60	4.4	4.8	5.2	5.6		
Dissolved Potassium	g/m ³				1.93	1.83	2.80	2.50	1.78	0.78	2.70	2.80	1.69	2.2	1.59	2.5		
Dissolved Sodium	g/m ³				45.00	49.00	51.00	47.00	44.00	46.00	55.00	49.00	36	36	40	41		
Chloride (Cl ⁻)	g/m ³				52.00	63.00	57.00	55.00	54.00	58.00	66.00	59.00	44	50	47	47		
Sulfate (SO ₄ ²⁻)	g/m ³				15.10	15.80	13.00	12.80	12.40	12.60	8.80	12.20	13.3	12.7	9.7	12.1		
Ammonia-N (NH ₃ -N)	g/m ³	0.003	0.099	0.03	0.030	0.051	0.035	0.032	0.033	0.027	0.016	0.152	0.044	0.55	0.01	0.074	0.72	0.24
Nitrate-N (NO ₃ -N)	g/m ³	0.001	0.76	0.097	0.570	0.350	0.058	0.350	0.550	0.092	0.056	0.240	1.08	0.056	0.033	0.87	1.1 (2.6) ²	0.64 (1) ²
Nitrite-N (NO ₂ -N)	g/m ³	0.001	0.015	0.004	0.007	0.015	0.005	< 0.02	0.010	0.005	0.003	0.013	0.009	0.72	< 0.002	0.019		
Nitrate-N + Nitrite-N	g/m ³	0.001	0.76	0.76	0.58	0.37	0.063	0.36	0.56	0.097	0.059	0.25	1.08	0.78	0.034	0.89		
Dissolved Reactive Phosphorus (DRP)	g/m ³	0.0059	0.056	0.02	< 0.004	0.005	0.005	0.007	0.005	0.007	0.009	< 0.004	0.006	< 0.004	0.009	0.01		
Heavy Metals, trace																		
Dissolved Arsenic	g/m3				< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.024	0.001
Dissolved Cadmium	g/m ³				< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.0002	0.00006
Dissolved Chromium	g/m ³				< 0.0005	< 0.0005	0.0006	< 0.0005	< 0.0005	0.0006	< 0.0005	0.0006	< 0.0005	< 0.0005	< 0.0005	0.0006	0.0067 (CrIII)	0.00095 (CrIII)
Dissolved Copper (Cu)	g/m ³	0.001	0.002	0.001	0.0007	0.0007	0.0009	0.0008	0.0008	0.0007	0.0009	0.0009	0.0006	0.0010	0.0007	0.0011	0.0014	0.001
Dissolved Lead	g/m ³				0.00012	0.00013	0.00015	0.00014	0.00011	0.00011	0.00014	0.00021	< 0.00010	0.00011	0.00012	0.00016	0.0034	0.001
Dissolved Nickel	g/m ³				< 0.0005	< 0.0005	0.0006	0.0006	0.0005	< 0.0005	0.00075	0.0005	< 0.0005	< 0.0005	< 0.0005	0.0006	0.011	0.008
Dissolved Zinc	g/m3	0.001	0.0057	0.002057	0.0011	< 0.0010	0.0015	0.0012	0.0011	< 0.0010	0.0017	0.0015	< 0.0010	0.0010	0.0034	0.0077	0.008	0.0024
Total Metals																		
Total Arsenic	g/m3				< 0.0011	0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.0013	< 0.0011	< 0.0011	< 0.0011	< 0.0011		
Total Cadmium	g/m3				< 0.000053	0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053	< 0.000053		
Total Chromium	g/m3				0.00069	0.00066	< 0.00053	0.00099	< 0.00053	< 0.00053	< 0.00053	0.00159	0.00065	0.00108	< 0.00053	0.00066		
Total Copper	g/m3	0.001	0.00	0.001	0.0012	0.00079	0.00092	0.00132	0.00115	0.0008	0.00107	0.00191	0.00091	0.00134	0.00074	0.00132		
Total Lead	g/m3				0.00099	0.00027	0.00021	0.00092	0.00050	0.00023	0.00026	0.00155	0.00051	0.00029	0.00015	0.00026		
Total Nickel	g/m3				0.00070	< 0.00053	0.00056	0.00094	0.00050	0.00057	0.00075	0.00148	0.0006	< 0.00053	< 0.00053	0.0007		
Total Zinc	g/m3	0.001	0.023	0.004	0.0045	0.0038	0.0014	0.0043	0.0029	< 0.0011	0.0017	0.0062	0.0034	0.0031	0.0011	0.0062		

Appendix F: Water Quality Lab Reports

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Certificate of Analysis

Page 1 of 3

Client:	Pattle Delamore Partners Limited	Lab No:	3971511	SPv1
Contact:	Lee Boon	Date Received:	28-Aug-2025	
	C/- Pattle Delamore Partners Limited	Date Reported:	03-Sep-2025	
	233 Collingwood Street	Quote No:	81087	
	Hamilton Lake	Order No:		
	Hamilton 3204	Client Reference:	W027550002	
		Submitted By:	Lee Boon	

Sample Type: Aqueous

Sample Name:		SW01 26-Aug-2025	SW02 26-Aug-2025	SW03 26-Aug-2025
Lab Number:		3971511.1	3971511.2	3971511.3
Individual Tests				
Sum of Anions	meq/L	2.6	2.4	2.1
Sum of Cations	meq/L	2.8	2.6	2.2
pH	pH Units	7.3	7.3	7.3
Total Alkalinity	g/m ³ as CaCO ₃	37	32	25
Bicarbonate	g/m ³ at 25°C	45	39	30
Total Hardness	g/m ³ as CaCO ₃	39	33	29
Electrical Conductivity (EC)	mS/m	29.1	28.0	23.7
Dissolved Calcium	g/m ³	5.2	5.0	4.6
Dissolved Magnesium	g/m ³	6.4	5.1	4.4
Dissolved Potassium	g/m ³	1.93	1.78	1.69
Dissolved Sodium	g/m ³	45	44	36
Chloride	g/m ³	52	54	44
Sulphate	g/m ³	15.1	12.4	13.3
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Dissolved Arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m ³	< 0.0005	< 0.0005	< 0.0005
Dissolved Copper	g/m ³	0.0007	0.0008	0.0006
Dissolved Lead	g/m ³	0.00012	0.00011	< 0.00010
Dissolved Nickel	g/m ³	< 0.0005	0.0005	< 0.0005
Dissolved Zinc	g/m ³	0.0011	0.0011	< 0.0010
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Arsenic	g/m ³	< 0.0011	< 0.0011	< 0.0011
Total Cadmium	g/m ³	< 0.000053	< 0.000053	< 0.000053
Total Chromium	g/m ³	0.00069	< 0.00053	0.00065
Total Copper	g/m ³	0.00120	0.00115	0.00091
Total Lead	g/m ³	0.00099	0.00050	0.00051
Total Nickel	g/m ³	0.00070	0.00076	0.00060
Total Zinc	g/m ³	0.0045	0.0029	0.0034
Nutrient Profile				
Total Ammoniacal-N	g/m ³	0.030	0.033	0.044
Nitrite-N	g/m ³	0.007	0.010	0.009
Nitrate-N	g/m ³	0.57	0.55	1.08
Nitrate-N + Nitrite-N	g/m ³	0.58	0.56	1.08
Dissolved Reactive Phosphorus	g/m ³	< 0.004	0.005	0.006

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m ³	1-3
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.000053 - 0.0011 g/m ³	1-3
Nutrient Profile		0.0010 - 0.010 g/m ³	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-3
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E : Online Edition.	0.07 meq/L	1-3
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E : Online Edition.	0.05 meq/L	1-3
pH	pH meter. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D : Online Edition.	1.0 g/m ³ at 25°C	1-3
Total Hardness	Calculation from Dissolved Calcium and Dissolved Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-3
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-3
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ I (modified) : Online Edition.	0.002 g/m ³	1-3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-3
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ I (modified) : Online Edition.	0.002 g/m ³	1-3
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) : Online Edition.	0.004 g/m ³	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 30-Aug-2025 and 03-Sep-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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A handwritten signature in blue ink, appearing to read 'G Corban', is positioned above the printed name.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 3

Client:	Pattle Delamore Partners Limited	Lab No:	4026774	SPv1
Contact:	Lara Kerrigan C/- Pattle Delamore Partners Limited PO Box 9528 Newmarket Auckland 1149	Date Received:	07-Nov-2025	
		Date Reported:	13-Nov-2025	
		Quote No:	81087	
		Order No:		
		Client Reference:	W027550002	
		Submitted By:	Lara Kerrigan	

Sample Type: Aqueous

Sample Name:		SW01 05-Nov-2025	SW02 05-Nov-2025	SW03 05-Nov-2025
Lab Number:		4026774.1	4026774.2	4026774.3
Individual Tests				
Sum of Anions	meq/L	3.0	2.7	2.4
Sum of Cations	meq/L	3.0	2.8	2.3
pH	pH Units	7.6	7.7	7.4
Total Alkalinity	g/m ³ as CaCO ₃	44	40	34
Bicarbonate	g/m ³ at 25°C	53	48	41
Total Hardness	g/m ³ as CaCO ₃	42	37	33
Electrical Conductivity (EC)	mS/m	34.2	30.7	26.9
Dissolved Calcium	g/m ³	5.9	5.5	5.2
Dissolved Magnesium	g/m ³	6.6	5.6	4.8
Dissolved Potassium	g/m ³	1.83	0.78	2.2
Dissolved Sodium	g/m ³	49	46	36
Chloride	g/m ³	63	58	50
Sulphate	g/m ³	15.8	12.6	12.7
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Dissolved Arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m ³	< 0.0005	0.0006 #1	< 0.0005
Dissolved Copper	g/m ³	0.0007	0.0007	0.0010
Dissolved Lead	g/m ³	0.00013	0.00011	0.00011
Dissolved Nickel	g/m ³	< 0.0005	< 0.0005	< 0.0005
Dissolved Zinc	g/m ³	< 0.0010	< 0.0010	0.0010
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Arsenic	g/m ³	< 0.0011	< 0.0011	< 0.0011
Total Cadmium	g/m ³	< 0.000053	< 0.000053	< 0.000053
Total Chromium	g/m ³	0.00066	< 0.00053	0.00108
Total Copper	g/m ³	0.00079	0.00080	0.00134
Total Lead	g/m ³	0.00027	0.00023	0.00029
Total Nickel	g/m ³	< 0.00053	0.00057	< 0.00053
Total Zinc	g/m ³	0.0038	< 0.0011	0.0031
Nutrient Profile				
Total Ammoniacal-N	g/m ³	0.051	0.027	0.55
Nitrite-N	g/m ³	0.015	0.005	0.056
Nitrate-N	g/m ³	0.35	0.092	0.72
Nitrate-N + Nitrite-N	g/m ³	0.37	0.097	0.78
Dissolved Reactive Phosphorus	g/m ³	0.005	0.007	< 0.004



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Analyst's Comments

#1 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m ³	1-3
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.000053 - 0.0011 g/m ³	1-3
Nutrient Profile		0.0010 - 0.010 g/m ³	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-3
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E : Online Edition.	0.07 meq/L	1-3
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E : Online Edition.	0.05 meq/L	1-3
pH	pH meter. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D : Online Edition.	1.0 g/m ³ at 25°C	1-3
Total Hardness	Calculation from Dissolved Calcium and Dissolved Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-3
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-3
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-3
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ ⁻ I (modified) : Online Edition.	0.002 g/m ³	1-3
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) : Online Edition.	0.004 g/m ³	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 08-Nov-2025 and 13-Nov-2025. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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A handwritten signature in purple ink, consisting of a large stylized 'K' followed by the name 'Harrison' in a cursive script.

Kim Harrison MSc
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 3

Client:	Pattle Delamore Partners Limited	Lab No:	4107402	SPv1
Contact:	Lara Kerrigan C/- Pattle Delamore Partners Limited PO Box 9528 Newmarket Auckland 1149	Date Received:	21-Feb-2026	
		Date Reported:	05-Mar-2026	
		Quote No:	81087	
		Order No:	868985	
		Client Reference:	WO27550002	
		Submitted By:	Lara Kerrigan	

Sample Type: Aqueous

Sample Name:		SWO1 19-Feb-2026	SWO2 19-Feb-2026	SWO3 19-Feb-2026
Lab Number:		4107402.1	4107402.2	4107402.3
Individual Tests				
Sum of Anions	meq/L	2.8	3.0	2.2
Sum of Cations	meq/L	3.1	3.3	2.5
pH	pH Units	7.4	7.1	6.9
Total Alkalinity	g/m ³ as CaCO ₃	46	48	35
Bicarbonate	g/m ³ at 25°C	56	58	42
Total Hardness	g/m ³ as CaCO ₃	42	44	35
Electrical Conductivity (EC)	mS/m	32.9	34.4	25.8
Dissolved Calcium	g/m ³	5.7	6.6	5.3
Dissolved Magnesium	g/m ³	6.7	6.6	5.2
Dissolved Potassium	g/m ³	2.8	2.7	1.59
Dissolved Sodium	g/m ³	51	55	40
Chloride	g/m ³	57	66	47
Sulphate	g/m ³	13.0	8.8	9.7
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Dissolved Arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m ³	0.0006 #1	< 0.0005	< 0.0005
Dissolved Copper	g/m ³	0.0009	0.0009	0.0007
Dissolved Lead	g/m ³	0.00015	0.00014	0.00012
Dissolved Nickel	g/m ³	0.0006 #1	0.0008 #1	< 0.0005
Dissolved Zinc	g/m ³	0.0015 #1	0.0013	0.0034 #2
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Arsenic	g/m ³	< 0.0011	< 0.0011	< 0.0011
Total Cadmium	g/m ³	< 0.000053	< 0.000053	< 0.000053
Total Chromium	g/m ³	< 0.00053 #1	< 0.00053	< 0.00053
Total Copper	g/m ³	0.00092	0.00107	0.00074
Total Lead	g/m ³	0.00021	0.00026	0.00015
Total Nickel	g/m ³	0.00056 #1	0.00075 #1	< 0.00053
Total Zinc	g/m ³	0.0014 #1	0.0017	< 0.0011 #2
Nutrient Profile				
Total Ammoniacal-N	g/m ³	0.035	0.016	0.010
Nitrite-N	g/m ³	0.005	0.003	< 0.002
Nitrate-N	g/m ³	0.058	0.056	0.033
Nitrate-N + Nitrite-N	g/m ³	0.063	0.059	0.034
Dissolved Reactive Phosphorus	g/m ³	0.005	0.009	0.009



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Analyst's Comments

#1 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

#2 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, and outside the analytical variation of the methods. Both results have been confirmed by reanalysis.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m ³	1-3
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.000053 - 0.0011 g/m ³	1-3
Nutrient Profile		0.0010 - 0.010 g/m ³	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-3
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E : Online Edition.	0.07 meq/L	1-3
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E : Online Edition.	0.05 meq/L	1-3
pH	pH meter. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D : Online Edition.	1.0 g/m ³ at 25°C	1-3
Total Hardness	Calculation from Dissolved Calcium and Dissolved Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	1-3
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). APHA 4500-NH ₃ H (modified) : Online Edition.	0.010 g/m ³	1-3
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ I (modified) : Online Edition.	0.002 g/m ³	1-3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-3
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ I (modified) : Online Edition.	0.002 g/m ³	1-3
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) : Online Edition.	0.004 g/m ³	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 23-Feb-2026 and 05-Mar-2026. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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A handwritten signature in blue ink, appearing to read 'G Corban', is positioned above the printed name.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Certificate of Analysis

Page 1 of 3

Client:	Pattle Delamore Partners Limited	Lab No:	4215505	SPV2
Contact:	Katy Grant	Date Received:	16-May-2026	
	C/- Pattle Delamore Partners Limited	Date Reported:	02-Jun-2026	(Amended)
	PO Box 6136	Quote No:	81087	
	Wellington 6141	Order No:		
		Client Reference:		
		Submitted By:	Gianmarco Tolomei	

Sample Type: Aqueous

Sample Name:		SW01 14-May-2026 1:45 pm	SW02 14-May-2026 3:36 pm	SW03 14-May-2026 9:15 am
Lab Number:		4215505.1	4215505.2	4215505.3
Individual Tests				
Sum of Anions	meq/L	2.7	2.7	2.2
Sum of Cations	meq/L	3.0	3.1	2.6
pH	pH Units	7.2	7.2	7.1
Total Alkalinity	g/m ³ as CaCO ₃	44	40	28
Bicarbonate	g/m ³ at 25°C	53	48	35
Total Hardness	g/m ³ as CaCO ₃	44	43	37
Electrical Conductivity (EC)	mS/m	30.6	31.8	25.7
Dissolved Calcium	g/m ³	6.1	6.4	5.8
Dissolved Magnesium	g/m ³	7.1	6.6	5.6
Dissolved Potassium	g/m ³	2.5	2.8	2.5
Dissolved Sodium	g/m ³	47	49	41
Chloride	g/m ³	55	59	47
Sulphate	g/m ³	12.8	12.2	12.1
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Dissolved Arsenic	g/m ³	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m ³	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m ³	< 0.0005	0.0006	0.0006
Dissolved Copper	g/m ³	0.0008	0.0009	0.0011
Dissolved Lead	g/m ³	0.00014	0.00021	0.00016
Dissolved Nickel	g/m ³	0.0006	0.0005	0.0006
Dissolved Zinc	g/m ³	0.0012	0.0015	0.0077 #1
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Arsenic	g/m ³	< 0.0011	0.0013	< 0.0011
Total Cadmium	g/m ³	< 0.000053	< 0.000053	< 0.000053
Total Chromium	g/m ³	0.00099	0.00159	0.00066
Total Copper	g/m ³	0.00132	0.00191	0.00132
Total Lead	g/m ³	0.00092	0.00155	0.00026
Total Nickel	g/m ³	0.00094	0.00148	0.00070
Total Zinc	g/m ³	0.0043	0.0062	0.0062
Nutrient Profile				
Total Ammoniacal-N	g/m ³	0.032	0.152	0.074
Nitrite-N	g/m ³	< 0.02	0.013	0.019
Nitrate-N	g/m ³	0.35	0.24	0.87
Nitrate-N + Nitrite-N	g/m ³	0.36	0.25	0.89
Dissolved Reactive Phosphorus	g/m ³	0.007	< 0.004	0.009



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked * or any comments and interpretations, which are not accredited.

Analyst's Comments

#1 It has been noted that the result for the dissolved fraction was greater than that for the total fraction, but within analytical variation of the methods.

Amended Report: This certificate of analysis replaces report '4215505-SPv1' issued on 25-May-2026 at 1:23 pm.
Reason for amendment: Heavy metals dissolved added.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively simple matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Aqueous			
Test	Method Description	Default Detection Limit	Sample No
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m ³	1-3
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.000053 - 0.0011 g/m ³	1-3
Nutrient Profile		0.0010 - 0.010 g/m ³	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-3
Total anions for anion/cation balance check	Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E : Online Edition.	0.07 meq/L	1-3
Total cations for anion/cation balance check	Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H ⁺) also included in calculation if available. APHA 1030 E : Online Edition.	0.05 meq/L	1-3
pH	pH meter. APHA 4500-H ⁺ B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used.	0.1 pH Units	1-3
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Bicarbonate	Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO ₂ D : Online Edition.	1.0 g/m ³ at 25°C	1-3
Total Hardness	Calculation from Dissolved Calcium and Dissolved Magnesium. APHA 2340 B : Online Edition.	1.0 g/m ³ as CaCO ₃	1-3
Electrical Conductivity (EC)	Conductivity meter, 25°C. APHA 2510 B : Online Edition.	0.1 mS/m	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Dissolved Calcium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Magnesium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Dissolved Potassium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.05 g/m ³	1-3
Dissolved Sodium	Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.02 g/m ³	1-3
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3
Total Ammoniacal-N	OPA fluorometry. Flow injection analyser. (NH ₄ -N = NH ₄ ⁺ -N + NH ₃ -N). In-house (FIALab).	0.010 g/m ³	1-3
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO ₃ I (modified) : Online Edition.	0.002 g/m ³	1-3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m ³	1-3
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO ₃ I (modified) : Online Edition.	0.002 g/m ³	1-3
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) : Online Edition.	0.004 g/m ³	1-3
Sulphate	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m ³	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Testing was completed between 18-May-2026 and 02-Jun-2026. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

A handwritten signature in purple ink, consisting of a large 'K' followed by the name 'Harrison' in a cursive script.

Kim Harrison MSc
Client Services Manager - Environmental



4 August 2026

William Dorset
Regional Manager
Classic Developments Limited
10A Norrie Street
Porirua City Centre
PORIRUA 5024

Kia Ora Will,

MOUNT WELCOME – ROOF RUN-OFF TANKS ADDITIONAL ASSESSMENT

1.0 Introduction

Classic Developments Limited on behalf of Pukerua Property Group LP (the Applicant) are seeking to obtain fast-track consent for the development of a residential subdivision near Pukerua Bay in an area known as Mount Welcome. The Mount Welcome site is located at 422 State Highway 59, near Pukerua Bay.

The site is currently used for farming and comprises a series of paddocks, small streams, wetlands, and areas of native and indigenous vegetation. The proposed land use change will increase impervious coverage and alter the direction and magnitude of surface water flows, which may in turn affect the wetlands and streams present on the site and downstream receptors.

In order to assess the scale and potential mitigation of the development, Pattle Delamore Partners Limited has completed a hydrology assessment of the catchment (PDP 2025¹) with the focus being on the wetlands and downstream flows. Detailed quantitative water balance models were developed in GoldSim™ for the two catchments most affected by the development, known as the Taupō and Kakaho West catchments. These models were recalibrated and updated based on the available baseline data in July 2026. This letter report focusses primarily on the Taupō catchment.

As part of the assessment, a continuous simulation over 25 years (1991 to 2025) at a 1-day timestep was run using local rainfall and evaporation data to evaluate long-term variations in surface water discharge and wetland water levels under different climatic conditions.

The results of the modelling indicate that:

- The wetlands will not suffer increased drought during summer periods post-development but, on the contrary, will be generally wetter. The wetlands, designed as retention wetlands with permanent water levels, will be replanted with native species in accordance with the BlueGreen Ecology planting plan. This will represent a considerable improvement, given that the existing wetlands are predominantly composed of exotic species.

¹ Pattle Delamore Partners, 2025. Mount Welcome Hydrological Report.



- ✧ The streams within the Taupō catchment are predominantly ephemeral, with perennial flow in the lower recharges. Whilst they are expected to receive increased flows post-development the majority of the system will remain ephemeral. The creation of retention wetlands will reduce periods of no flow and attenuate peak flows during high-intensity rainfall events. This is expected to reduce sediment inputs to downstream environments and improve ecological conditions.
- ✧ A preliminary assessment of the use of rainwater tanks within the Taupō catchment indicated that the reduction in discharge into the downstream environment would be minimal.

The fast-track resource consent was filed in April 2026 and Pukerua Property Group Limited Partnership is in discussion with various stakeholders to facilitate the consenting process. Following discussions with Porirua City Council, this report was commissioned to provide a more detailed assessment of the environmental effects of water reuse on total site discharge and wetland water levels, and to quantify potential water reuse to provide supplementary information for inclusion in an expanded cost-benefit analysis of rainwater storage tanks for outdoor and greywater reuse in the development.

2.0 Methodology

This assessment focuses solely on the Taupō catchment part of the development (see Figure 1) due to time constraints. Rainwater storage tanks were incorporated into this model during the hydrology assessment as a larger proportion of this catchment will be developed for residential use. It is considered that the effects of using rainwater tanks would be more apparent in this catchment, but the overall findings of this assessment can also be considered applicable to the Kakaho catchments.

The post-development water balance model uses 25 years of local rainfall and evaporation data to simulate water levels within the wetlands and surface water discharge from the site. It includes the stormwater detention structures but does not include other stormwater infrastructure. It models effects using changes to catchment area and impervious surfaces and was calibrated using site specific data. It has been cross-checked for accuracy against the stormwater modelling completed by Envelope Engineering.

This existing model was updated to assess three post-development water re-use scenarios for the Taupō catchment:

- ✧ Scenario 0: No tanks
- ✧ Scenario 1: Rainwater harvesting with 2 m³ tanks for indoor non-potable (greywater) uses and outdoor use on all residential lots.
- ✧ Scenario 2: Rainwater harvesting 2 m³ tanks for outdoor use only on all residential lots

Scenarios including 3 m³ tanks were also modelled but as the results did not differ significantly from those obtained for the 2 m³ tanks this report focusses on these scenarios. The modelling indicates that the use of 3 m³ tanks does not provide significant additional buffering of discharges.

The following assumptions were adopted for the modelling:

- ✧ 2 m³ tanks installed on all residential lots within the Taupō catchment;
- ✧ Lots size assumed to be 350 m² on average. No differentiation was made between lot and tank sizes across the development;
- ✧ Roof area assumed to be 50% of lot area, so 175 m² on average,
- ✧ 75% of roof runoff directed to the tank, with the remainder going to the stormwater network;
- ✧ 66 L use of greywater (non-potable, toilet use) from the tanks per day per person;

- ✧ 2.5 people per lot, equating to 165 L/day of indoor reuse per lot;
- ✧ Conservative outdoor water demand of 0.1 m³/day per lot when the 10-day average rainfall is less than 0.1 mm/day; and
- ✧ Full tank volume assumed to be available for use (i.e. no dead storage).

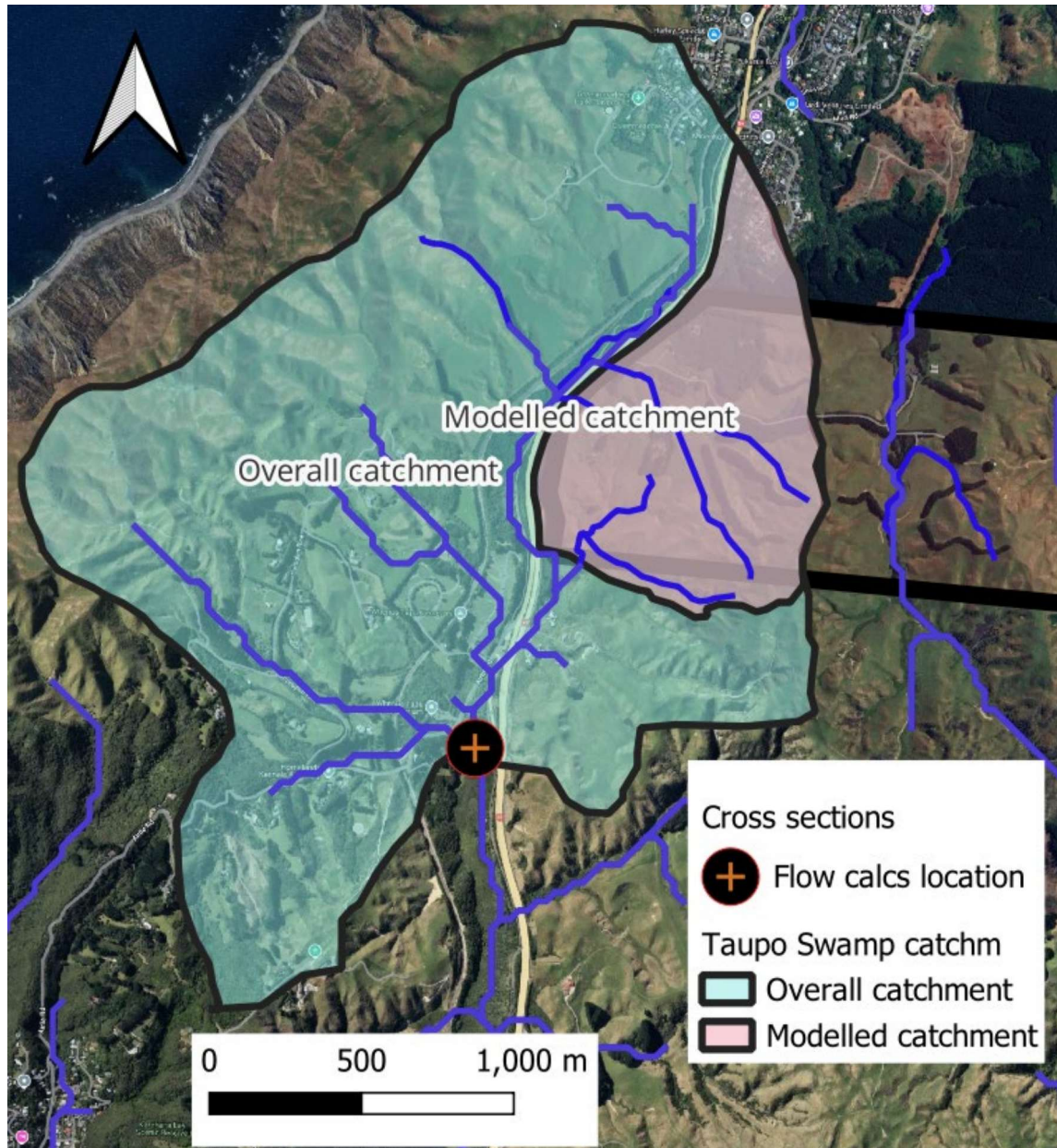


Figure 1: Map showing location used to evaluate the flow to the Taupō Swamp and the contribution from the site.

3.0 Results

3.1 Discharge

The total discharge from the site to the Taupō Stream was evaluated with the 25-years model for the scenarios mentioned above and the results are summarised in Table 1.

Table 1: Summary of modelling results – Decrease of average annual flow from site to Taupō Swamp			
	Scenario 0	Scenario 1	Scenario 2
Average discharge from site (m ³ /y)	5,460,123	5,275,033	5,442,406
Decrease discharge compared to Scenario 0 (m ³ /y)	-	185,089	17,717
Decrease discharge compared to Scenario 0 (%)	-	3.4%	0.3%
Average total discharge at Taupō swamp (m ³ /y)	14,490,432	14,305,343	14,472,715
Decrease in Taupō Swamp compared to Scenario 0 (%)	-	1.3%	0.1%

The average discharge from the site to the Taupō catchment is estimated to decrease by 3.4% if 2 m³ rainwater tanks with both indoor (greywater) and outdoor use are implemented for all residential lots (Scenario 1). If the tanks are used for outdoor irrigation only (Scenario 2), the reduction in annual average discharge would be approximately 0.3% of the calculated post-development discharge without tanks.

To assess the effect of the development on the Taupō Swamp, it is necessary to consider the total flow entering the wetland rather than only the contribution from the development site, which represents a relatively small proportion of the overall catchment (Figure 1). The total inflow to the Taupō Swamp was estimated by applying a scaling factor based on the ratio of the site catchment area to the total catchment draining to the swamp, using the pre-development site discharge to extrapolate the wider catchment contribution.

While this approach is approximate and assumes that the remainder of the catchment has characteristics broadly similar to the portion contained within the site (including land use and topography), it is considered appropriate for estimating the overall change in the absence of field flow data.

The analysis indicates that implementing tanks for both greywater reuse and outdoor irrigation would reduce the average annual flow entering the Taupō Swamp by approximately 1.3%. If the tanks are used for outdoor irrigation only, the reduction would be approximately 0.1%. In conclusion, the benefits of rainwater tanks in terms of reducing flows to the Taupō Swamp are expected to be minor.

3.2 Re-use and resilience

One advantage of rainwater tanks is the potential to reduce demand on water supply services and provide an alternative supply for resilience following an earthquake. The results of the modelling indicate that the use of rainwater tanks could potentially supply approximately 185,000 m³/year for combined indoor use (greywater) and outdoor irrigation, and 17,700 m³/y for outdoor irrigation alone. This equates to respective savings of approximately 451 m³ and 43 m³ per lot per year.

Regarding resilience the modelling indicates that under scenario 1 the tanks will contain greater than 1 m³ approximately 62% of the time. This increases to 97% when only outdoor use is considered (scenario 2), which offers significantly more resilience in the event of an earthquake.

Under scenario 1 tanks are likely to contain less than 50 L approximately 17% of the time, whereas this is reduced to <2% of the time under scenario 2. This indicates that the re-use of greywater reduces the usefulness of the tanks for earthquake resilience.

3.3 Wetlands

With respect to the effects of tank implementation on wetland water levels, the modelling results indicate that both Scenario 1 (tanks used for outdoor and greywater reuse) and Scenario 2 (tanks used for outdoor reuse only) result in negligible changes from the no tank post development option (Scenario 0). Wetland water levels remain virtually unchanged, with 99% to 100% of the values within ± 5 cm of those predicted under Scenario 0 (post-development without tanks). None of the wetlands show any significant increase in drying risk if tanks are included.

3.4 Peak flows

The use of the 1-day timestep 25-year model is not appropriate for the assessment in changes to peak flows following rainfall events. However, it is possible to use the available free volume of the tanks to consider whether changes to peak flows will be significant. Given that the tanks are more than 50 % full for the majority of the time under scenario 2, any significant detention of flow is considered unlikely. Under scenario 1 there is more capacity within the tanks but it is not possible to determine whether this is sufficient to affect the peak flows from the site using this version of the model. However, the detention dams located downstream of the stormwater outlets have been designed to attenuate peak flows such that post-development peak flows remain lower than pre-development flows. Consequently, rainwater tanks are not required for this purpose.

4.0 Conclusions

The environmental effects of including rainwater tanks on residential lots in the Taupō catchment has been assessed against a base case post-development scenario which includes no tanks. The results indicate that the inclusion of 2 m³ tanks will result in a small decrease in the off-site discharge (3.4% when both greywater and outdoor use is considered and 0.3% when only outdoor use is considered). This equates to a reduction in the overall discharge into Taupō Swamp of respectively 1.3% and 0.1%. The environmental benefits to the downstream receptors of including re-use tanks is therefore limited.

With respect to the effects on the on-site wetlands, only a negligible difference in modelled water levels between the tank and no tank scenarios was observed.

It is noted that the inclusion of tanks provides some potential benefits for re-use and earthquake resilience. However, the use of stored water as greywater will reduce available capacity for earthquake resilience.

5.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Classic Developments Limited and the Ministry for Environment. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Classic Developments Limited for the limited purposes described in the report. PDP accepts no liability if the report 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.

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Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by



Gianmarco Tolomei

Environmental Scientist

Reviewed and approved by



Katy Grant

Technical Director

Contaminated Site Management Plan – Mount Welcome Development

✦ Prepared for

Pukerua Property Group LP

✦ November 2025



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Quality Control Sheet

TITLE	Contaminated Site Management Plan – Mount Welcome Development
CLIENT	Pukerua Property Group LP
ISSUE DATE	August 2026
JOB REFERENCE	W027550004

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REV	Date	Status/Purpose	Prepared By	Reviewed by	Approved
0	14/11/2025	Final	Bryn Taiapa	Jess Campbell	Nerena Rhodes
A	04/08/2026	Updates following peer review	Bryn Taiapa	Jess Campbell	Nerena Rhodes

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1.0 Introduction

Pattle Delamore Partners Limited (PDP) have been engaged by Classic Development Limited (on behalf of Pukerua Property Group LP) to complete a 'Contaminated Site Management Plan' (CSMP) for the disturbance, handling and disposal of soil in the Lower Terrace at the Mount Welcome development located at Pukerua Bay, Mount Welcome (the Site). Shown as the "proposed development area" in Figure 1.

The whole development comprises approximately 949 residential lots and neighbourhood centre with associated roads and infrastructure. This CSMP applies to soil disturbance and removal works to be undertaken in the western portion of the site only, outlined in Figure 1.

This CSMP has been prepared to support the preliminary site investigation report prepared for the resource consent application for the site and has been written in general accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guideline (CLMG) No. 1 – *Reporting on Contaminated Sites in New Zealand*. The CSMP has been prepared by a suitably qualified and experienced practitioner (SQEP) in Contaminated Land.

2.0 Site Description and Background

The site is legally described as:

- ✧ Lot 1000 DP 608433 (34 Muri Road).
- ✧ Lot 1 DP 534864 (422 SH59).
- ✧ Lot 2 DP 534864 (422A SH59).
- ✧ Lot 2 DP 89102 (422B SH59).
- ✧ Part Lot 1 DP 89102 (422A SH59).
- ✧ Road Reserve (SH59 Corridor).

A preliminary site investigation (PSI) was undertaken by PDP (PDP, 2025) to assist with the fast-track consent application for the site. The PSI identified potential sheep dip/spray race operations and the weathering of pre-2000s buildings at the site as potential sources of contamination. These site features are considered locations where activities listed on the Hazardous Activities and Industries List (HAIL¹) are likely to have been undertaken (Category A8 and I respectively). To confirm the presence/absence of HAIL activities at the site and identified any associated contaminants within soils at the site, a Detailed Site Investigation is to be undertaken.

¹ See <https://environment.govt.nz/publications/contaminated-land-management-guidelines-no-3-risk-screening-system/appendix-b-hazardous-activities-and-industries-list/>

This CSMP has been prepared in advance of the completion of the aforementioned DSI. Should the DSI identify contaminants in soil at concentrations not covered by this CSMP (i.e. asbestos requiring Class B controls), the plan should be amended prior to the onset of earthworks activities in the identified contaminated area (refer to Section 3.0 for greater detail).

3.0 Future Reporting Requirements

3.1 Detailed Site Investigation

As per the recommendations of the PSI, a Detailed Site Investigation (DSI) is to be completed to investigate the potential sheep dip and halo soils around buildings at the site (limited to buildings constructed prior to 2000). The DSI is to be completed prior to the onset of soil removal works in these areas.

Prior to the DSI being undertaken, a sampling and analysis quality plan (SAQP) will be completed and submitted for review. The SAQP will also consider the potential risk to groundwater in the event of shallow groundwater being encountered during the investigation. Although groundwater is not expected to be encountered during the DSI, contingency for additional laboratory analysis through a phased investigation will be considered.

Should the DSI identify contaminants in soil which pose a risk to human health or environmental receptors, remediation of the identified contaminated soils may be required.

It is proposed that the sampling will comprise the following:

- ✧ Underground service locate at each proposed investigation location.
- ✧ Approximately 11 locations will be advanced to 2 m bgl, or to groundwater, which has potential to be shallow in parts of the site and a further six sample locations to 0.5 m bgl to assess the potential for residual ACM and lead in shallow soil in the halo of the two farm buildings still present on the site and the footprint of the historical shed.
- ✧ Approximately 28 samples to be analysed for heavy metals, 10 for semi-quantitative asbestos and 11 for organochlorine, organonitro and organophosphate pesticides.
- ✧ Preparation of a letter report.

A preliminary proposed sampling plan has been appended.

3.2 Remediation, Validation Sampling and CSMP updates

Following the completion of the DSI, the following sections of the CSMP may require updating prior to finalisation:

- ✧ Soil handling requirements including PPE and RPE.

- ✧ Soil disposal requirements.
- ✧ Soil re-use requirements.

In addition, a site plan identifying the extent of the contaminated area will need to be attached to this CSMP.

The Greater Wellington Regional Council shall be notified of any changes to the CSMP and provided with a copy of the revised CSMP prior to the onset of earthworks in identified contaminated areas as per timeframes stipulated in the consent.

Validation sampling may be required following remedial works (if required) to demonstrate that all identified contaminated soils have been removed from the site. The requirement for validation sampling, including the location and frequency of validation samples, and production of a subsequent Site Validation Report (SVR) will be addressed in the DSI. If required, the SVR will include:

- ✧ The results of all validation samples collected at the site.
- ✧ Photographs showing the remedial area.
- ✧ A record of all soil disposal receipts for the site.
- ✧ The total volume of soil removed from the site.
- ✧ A statement confirming that all soil disturbance and soil removal works were undertaken in accordance with this CSMP.
- ✧ Details of any unexpected contamination (if encountered) at the site.
- ✧ Details of any complaints made in regard to soil disturbance works at the site.

3.3 Pre Demolition Asbestos Survey

Due to the age of the structures on site within Lot 1 DP 534864 the likelihood of asbestos building materials being present is high. Therefore, prior to demolition an intrusive pre demolition survey will be required to be undertaken by a licensed asbestos surveyor followed by a pre demolition survey report.

The report will include a record of any identified asbestos containing material (ACM) and recommendations for removal protocols.

4.0 Why is the CSMP required and where does it apply?

This CSMP aims to provide guidance and controls for the excavation of potentially contaminated soil within the identified HAIL areas, accidental discovery of contaminants across the entirety of the development area and during the demolition of the residential properties and associated structures. Note that the accidental discovery protocol is applied to the wider development area in the event of uncovering previously unknown areas of contamination. It also aims to minimise the exposure risk to the environment and excavation workers.

The CSMP details:

- ✧ Roles and responsibilities and contact details for the parties involved, including the suitably qualified and experienced practitioner (SQEP).
- ✧ Consenting requirements.
- ✧ Excavation site controls.
- ✧ Procedures for excavation of potentially contaminated soil.
- ✧ Management of on-site stockpiling of potentially contaminated soil.
- ✧ Sediment and erosion controls.
- ✧ Procedures for soil removal and transport.
- ✧ Measures to control health and safety during the works, including dust, and odour control, personal protective equipment (PPE) and personal hygiene.

5.0 Management Procedures

This section sets out general management procedures and requirements for the site.

1. This plan applies to the western portion of the Mount Welcome development area, legally described as Part Lot 1 DP 89102, Lot 2 DP 89102 and Lot 3 DP 89102 as outlined in attached Figure 1.
2. All personnel involved in the excavation works are to be familiar with this plan and must ensure that the requirements of this plan have been followed.
3. A copy of this plan is to remain available at the site office at all times so that reference can be made to the plan when undertaking any excavations works within the site.
4. Overall responsibility for the implementation of this plan shall be held by Pukerua Property Group LP. However, the specific requirements and

provisions of the management plan will be under the control of the Site Manager (see Section 7.2).

5. This plan relates solely to potential soil contamination from HAIL activities associated with small scale farming and accidental discovery of contaminants within the wider development area. Should impacts from other contaminants be discovered during works, a SQEP should assess the requirement for any additional investigation and/or management controls.

The CSMP is limited to assisting Pukerua Property Group LP and its agents and contractors in meeting their legal obligations with respect to health, safety and the environment in dealing with potentially contaminated soil within the HAIL area and western portion of the site. It is not intended to cover the general safety procedures required for typical excavation and redevelopment works. The CSMP is not intended to relieve the owner of their legal responsibilities.

6.0 Risk Assessment

A risk (e.g. to human health) can only arise if there is a hazard (e.g. contaminated soil), a receptor (e.g. people) and an exposure pathway between the hazard and the receptor.

As outlined in the PSI, the primary risk is to human health, this CSMP aims to reduce the short-term exposure risk to construction workers.

The risk assessment will be updated following completion of the DSI.

Table 1: Preliminary Conceptual Site Model			
Source	Pathway	Receptor	Pathway Linkage
Sheep Dip (HAIL Category A8)	Dermal contact with soil and dust	Construction workers	Potentially complete - Short term exposure may be possible during soil disturbance works if elevated contaminants are present. Heavy metals associated with a potential former sheep dip, specifically arsenic, possibly the organochlorine pesticides DDT and dieldrin, and possibly zinc and copper may be present in soil in the vicinity of the dip, race and associated holding pens.
Building materials from pre-2000's buildings (potential HAIL Category I)	Inhalation of ingestion of soil and dust		

Table 1: Preliminary Conceptual Site Model			
Source	Pathway	Receptor	Pathway Linkage
			Given the age of some buildings, it is possible that lead paint and asbestos containing materials may have been used with residual contamination in shallow soils, around the footprint of current and former buildings.
	Dermal contact with soil and dust	Future users	Potentially complete – If contaminants are present in soils in concentrations which could pose a risk to human health and are accessible following development (noting that it is likely that surficial impacted soil will be removed during site development).
	Inhalation and indigestion of soil and dust		
Asbestos from historical buildings and demolition activities	Inhalation of asbestos fibres in air mobilised by construction activities.	Construction workers	Potentially Complete – short term exposure possible during soil disturbance works. Asbestos containing material (ACM) may be present in residual soils from the demolition of buildings and around the footprint of older buildings still standing.
	Inhalation and indigestion of soil and dust.	Future users	Potentially incomplete – The residual risk ACM will depend on soil removal and the amount of exposed soils. Areas where the surface becomes sealed will not have an exposure pathway, however areas of soft landscaping may contain residual ACM.

7.0 Roles and Responsibilities

7.1 Role of Landowner (Pukerua Property Group)

Pukerua Property Group LP is the landowner of the site and is responsible for implementing the requirements of this CSMP in relation to the development activities at the site. Pukerua Property Group must distribute this CSMP and communicate the known extent of residual contamination and associated hazards to workers and contractors conducting work at the site.

7.2 Role of the Project Manager (Classic Development NZ Limited)

The Project Manager is responsible for providing general oversight for the entire project and is the link between the contractor, the SQEP and the client. It is the Project Managers responsibility to ensure site works are undertaken in accordance with the Resource Consent.

7.3 Role of the Contractor

Contractors engaged to work on the site must comply with the CSMP. Should the contractor engaging other relevant parties working at the site, the Contractor is responsible for ensuring that all workers they engage adhere to the requirements of the CSMP. This includes:

- ✧ The implementation, management and monitoring of the erosion and sediment control systems.
- ✧ The management and disposal of surplus materials disturbed, including any unexpected, contaminated soil identified/encountered during the works.
- ✧ Monitoring and record keeping throughout the duration of the works.
- ✧ Implementing spill response procedures in the event of a spillage of hazardous substances.

7.4 Role of SQEP (Pattle Delamore Partners)

The SQEP is an experienced person in contaminated land engaged to provide guidance on environmental matters. The SQEP is responsible for undertaking the DSI and updating the CSMP as required.

The SQEP can also assist with identifying appropriate facilities for disposal of contaminated material from the site.

8.0 Health and Safety

The Contractor shall mobilise to site with all the necessary equipment to undertake the redevelopment works (including the remediation of any potential contaminated soils as identified in the DSI) in a safe manner and in compliance with the controls detailed in this CSMP.

Under the *Health and Safety at Work Act* (HSWA, 2015), the Contractor must undertake the works in accordance with the relevant health and safety regulations and meet all their obligations as a ‘*person in control of a business or undertaking*’ (PCBU). The main potential hazards associated with the soil disturbance works are expected to be personal physical injury, and site worker human health exposure to surface soil contaminants.

8.1 PPE Requirements

The Contractor shall ensure that during soil disturbance works across the site, all personnel are wearing standard PPE. The minimum PPE shall include:

- ✧ Sturdy steel cap footwear (not exposed steel cap);
- ✧ Full coverage overalls/clothing;
- ✧ Safety glasses; and
- ✧ Hard hats (when earthmoving equipment is present).

In addition, during the removal of the contaminated soils at the site (if identified during the DSI), the contractors must wear nitrile gloves and maintain strong hygiene controls (as outlined in the following section). The soil to be excavated and removed, may be hazardous to workers and/or other receptors in the site vicinity. The use of dust masks may be required if there is potential for the dust generation and inhalation of contaminated dust during the remedial works.

8.2 Personal Hygiene

All personnel working on the site should:

- ✧ Avoid skin contact with contaminated soil.
- ✧ Not consume food or beverages anywhere near excavated soil.
- ✧ Always wash their hands before smoking/vaping or eating, and do not touch their face after handling contaminated soil.

9.0 Environmental Management Controls

The following section provides details for controls that are to be followed for general earthworks across the wider site.

9.1 Erosion and Sediment Control

The Contractor shall be responsible for implementing measures to control site stormwater runoff so that no silt/sediment laden runoff is able to leave the site or enter adjacent waterways. Sediment control/runoff measures shall be designed and implemented in general accordance with the *Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region (2021)*. In summary the ESC measures will include:

- ✧ A stabilised construction entrance to be formed to minimise tracking of sediment onto roads and trucks movements to be restricted to stabilised surfaces.
- ✧ The stormwater watercourse and any catch pits are to be protected with silt fences, diversion bunds, silt socks and geotextile fabric (under catch pit grates), as appropriate, to prevent the discharge of sediment laden runoff.
- ✧ Minimising the extent of soil disturbance/earthworks areas and stabilising immediately with mulch or hardfill as required to minimise erosion and sediment runoff.
- ✧ Limiting soil disturbance/earthworks during heavy rain and prior to forecast storm events.

The Contractor will be responsible for undertaking periodic inspections/maintenance of the ESC measures throughout the soil disturbance works.

9.2 Dust Suppression

Exposed earthwork areas shall be maintained to minimise the release of dust into the atmosphere, and appropriate measures to reduce the dust release to acceptable levels must be implemented as required. Appropriate dust control measures include the following:

- ✧ All site workers will be advised of the need to minimise dust by the responsible operation of machinery and vehicles (e.g. limit site traffic speed to reduce the production of dust, access into/out of the site to be via the stabilised surfaces);
- ✧ Exposed areas will be minimised as far as practicable;
- ✧ Water sprays will be used on exposed soils to suppress dust, ensuring that any water used is not allowed to migrate beyond the work zone; and
- ✧ Dust generating activities will be limited or suspended during periods of high wind.

9.3 Stockpile Management

All stockpiles shall be located within the site boundary and monitored for dust generation. In addition, earth bunds shall be installed around stockpiles where required to ensure sediment laden stormwater from the stockpile cannot enter stormwater.

Stockpiling of contaminated material should be avoided where possible, if temporary stockpiling (of potential or confirmed contamination) is required then the stockpiles shall be managed as follows:

- ✧ Be placed on polythene sheeting or similar impervious material to prevent contamination of the underlying material;
- ✧ Controls shall be installed to prevent runoff from leaving the area and stormwater from other areas entering the stockpile area;
- ✧ Be covered or dampened during dry and windy conditions; and
- ✧ If significant rainfall is forecast, the stockpiles shall be covered by a suitable material to prevent contaminated stormwater discharge.

Any material removed during the works that is potentially or confirmed as contaminated shall be disposed of at a facility authorised indicated as appropriate by the SQEP to receive such material.

10.0 Soil Management Controls

10.1 Soil Reuse

Soils generated as a result of the redevelopment earthworks may be reused elsewhere over the site assuming geotechnical suitability. The DSI will confirm if soils within the potential HAIL areas are suitable for re-use.

10.2 Soil Disposal

The DSI will include a soil disposal assessment for soils in the halo of some site buildings and for soils in the vicinity of a potential sheep dip. The contractor should liaise with the SQEP regarding the intended soil disposal locations, to ensure compliance against the applicable waste acceptance criteria is maintained.

The conceptual site model (as per the PSI) for the remaining soils at the site does not identify potential sources of contamination. As the primary land use of the site has historically been for pastoral purposes, it is likely that these soils are cleanfill. However, landfill facilities may require additional testing to confirm this hypothesis. It is recommended that preapproval be obtained for soil disposal prior to the onset of any soil disposal works.

Documentation showing the landfill acceptance of all soil at the site shall be provided to the SQEP along with disposal certificates/dockets.

10.3 Contaminated Soil Handling Measures

Contaminated soil (if identified during the DSI) shall be loaded directly into covered and water-tight trucks for off-site disposal to an approved facility. Trucks and other contractor vehicles shall not drive across the contaminated area prior to or during the removal of the contaminated soils and should remain on stabilised areas wherever possible. Truck wheels shall be inspected and cleaned (via manual sweeping) as necessary prior to egress from the site to prevent tracking of soil onto public roads.

All plant working within the contaminated area shall remain within the area for the duration of the works. Any plant being removed off-site or out of the contaminated area (that has been in contact with the contaminated soils from the remedial excavation) shall be washed clean prior to moving to avoid cross-contamination. The Contractor shall ensure that any wash down water is diverted back into the excavation pits, to ensure that no contaminated or silty water leaves the site.

On this basis wheel washing is not anticipated to be required, the backhoe excavator used for the excavation works may be washed down within the excavation prior to moving off-site or out of the contaminated areas.

10.4 Importation of Fill Material

Imported material, shall be certified cleanfill, or shall be certified as suitable for the intended land use. Dockets confirming that imported hardfill has been sourced from a cleanfill supplier shall be provided to the SQEP and the Project Manager for site validation record purposes.

10.5 Record Keeping

The Contractor shall ensure that records are kept of all excavation, handling and disposal of soil at the site. This includes soil disposal dockets. Photographs and a detailed site plan showing the final extent and dimensions of the excavated areas, including after the removal of any identified contaminated soils is to be provided by the Contractor to the SQEP for verification and provided to the Project Manager for their records.

11.0 Complaints Procedures

The Contractor shall have a procedure in place for recording and responding to any complaints resulting from the development operations. Contact details for the site supervisor shall be displayed on the noticeboard at the entrance of the site. The Contractor shall advise the SQEP of any soil disturbance complaints

received and the SQEP shall provide technical advice to the Contractor on how to respond.

12.0 Unexpected Discovery Protocols

Whenever actual or potential unexpected conditions or discharges occur, or are identified, the Contractor shall immediately cease works in that area and inform the Project Manager and the SQEP. The SQEP will provide advice on interim controls to be implemented and shall inspect the site at the earliest opportunity to assess the situation and provide further direction to the Contractor.

The following general controls relating to unexpected contamination shall apply to the site at all stages of the development:

- ✧ The Contractor shall be responsible for identifying any potential unexpected soil contamination as follows:
 - Visual – e.g. stained soil, asbestos containing materials (ACM) / fragments, fill material (e.g. refuse), charred soil/debris, buried drums/tanks.
 - Olfactory – hydrocarbon or other chemical odour.
- ✧ The Contractor shall be responsible for implementing interim/emergency controls detailed below:
 - Stop all soil disturbance works in the vicinity of the unexpected, contaminated soil/materials (i.e. leave in an undisturbed state if possible) and isolate the area using a physical or visual barrier (temporary fencing or exclusion tape).
 - Notify the SQEP and Project Manager.
 - Stabilise any stockpiled potentially contaminated soil as necessary using covers and other erosion and sediment controls as appropriate.
 - Keep potential asbestos contaminated soil moist and/or cover with an impervious polythene cover.
 - Ensure appropriate PPE is available and used by anyone in the vicinity of the potentially contaminated soil.

13.0 References

Health and Safety at Work Act 2015 (HSWA, 2015)

MfE, 2021. *Contaminated Land Management Guidelines No. 1 Reporting on Contaminated Sites in New Zealand*. Ministry for the Environment.

MfE, 2021. *Contaminated Land Management Guidelines No. 5 Site Investigation and Analysis of Soils*. Ministry for the Environment.

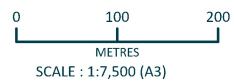
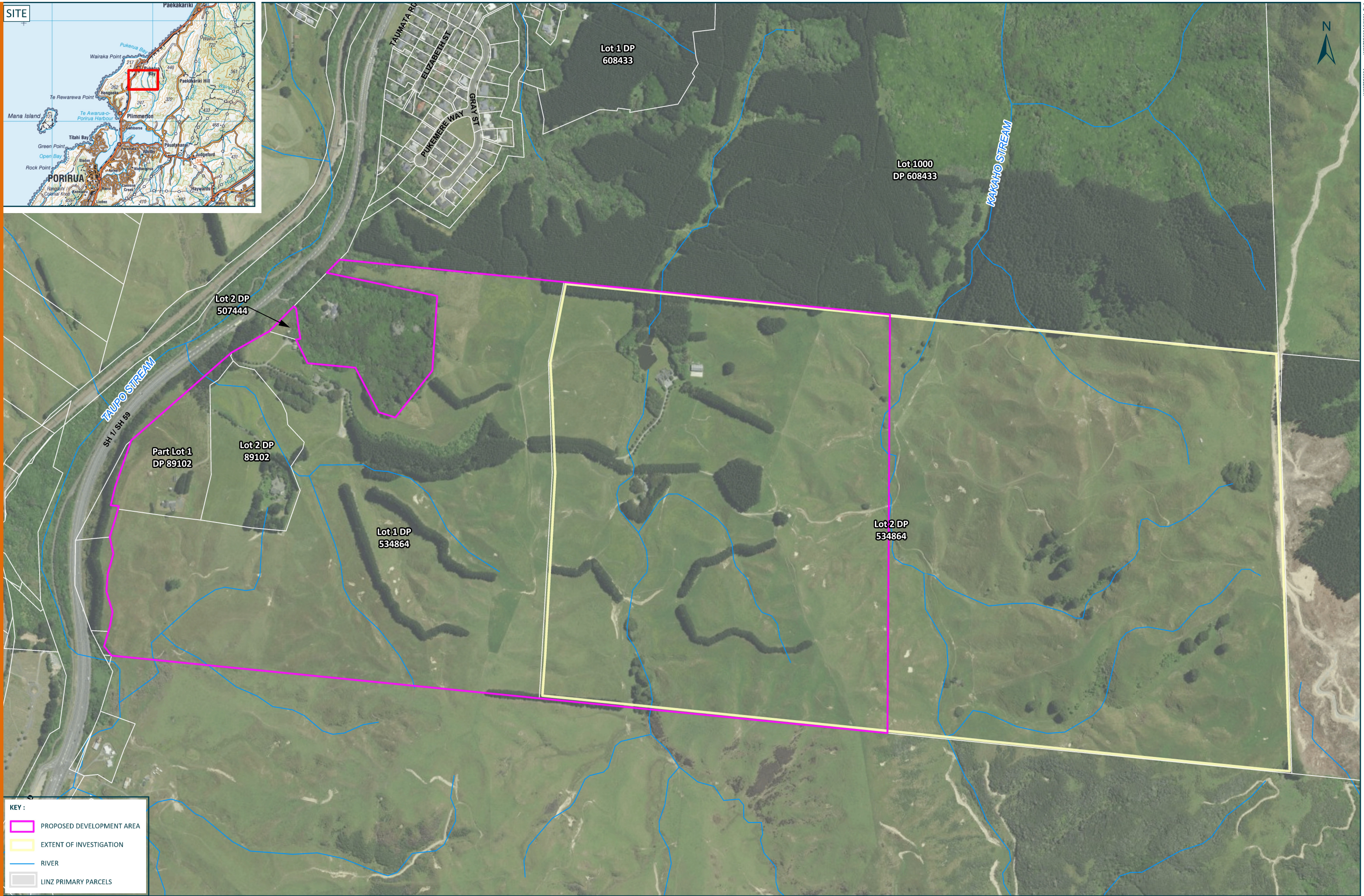
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WasteMINZ, 2023. *Technical Guidelines for Waste Disposal to Land*. Waste Management Institute New Zealand.

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Figures



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FIGURE 1: SITE LOCATION PLAN

PROJECT

CONTAMINATED SITE MANAGEMENT PLAN – MOUNT WELCOME, PUKERUA BAY



KEY :

- PROPOSED SAMPLING LOCATION
- HAIL AREA
- POTENTIALLY CONTAMINATED AREA
- PROPOSED DEVELOPMENT AREA
- EXTENT OF INVESTIGATION
- LINZ PRIMARY PARCELS



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FIGURE
FIGURE 2: PROPOSED SAMPLING LOCATIONS
PROJECT
CONTAMINATED SITE MANAGEMENT PLAN – MOUNT WELCOME, PUKERUA BAY