TO:	[redacted] Vineway Limited	Date:	19 December 2025
FROM:	[redacted]	Document No:	10122-017-1

DELMORE PROPOSED WWTP DISCHARGE: IMPACT ON WATER QUALITY

Background

Vineway Limited (Vineway) is proposing to develop approximately 109 ha of land in six contiguous lots at 88, 130 and 132 Upper Ōrewa Road and 53A, 53B and 55 Russell Road (‘the Delmore development’). If connecting to the Watercare wastewater network is not feasible for development Stages 1 and 2, Vineway intends to construct a private, on-site wastewater treatment plant (WWTP) at 55 Russell Road (‘the site’; Figure 1), to accommodate the domestic effluent generated by the development.

Wastewater will be treated through a membrane bioreactor (MBR) followed by reverse osmosis (RO), then discharged to land via a low-pressure disposal system, with flows directed to an infiltration bed and various irrigation areas. Water discharged to the infiltration bed is expected to ultimately reach an unnamed tributary of the Ōrewa River, which runs through the proposed Delmore development (Figure 1). For the reasons outlined under Modelling Assumptions and Methodology, irrigated flows are not expected to reach the unnamed stream and, as such, do not form part of this assessment.

Vineway engaged Viridis Limited (Viridis) to investigate the potential environmental effects of WWTP discharges to the unnamed stream during Stage 1 of the development. This memorandum presents the results of receiving-water modelling for three discharge scenarios identified by Apex (2025) (representative of summer low-flow, average, and peak wet-weather conditions) and interprets these results in the context of the stream’s baseline ecological condition. Catchment-scale context is also provided to consider potential effects on the downstream Ōrewa Estuary, and proposed ecological monitoring conditions are outlined to verify effects and support adaptive management.

Modelling Assumptions and Methodology

Receiving water flows in the unnamed stream are expected to vary through the year due to seasonal changes, as will wastewater volumes generated by the development. To represent this variability, three discharge scenarios were modelled to capture the anticipated range of operational and hydrological conditions. These scenarios are representative of summer low-flow, average, and peak wet-weather conditions.

Employing a mass balance approach, the resulting water quality of the stream in each discharge scenario was estimated with the following equation:

$$Resultant\ WQ = \frac{(Stream\ flow\ \times\ Background\ WQ) + (Discharge\ \ flow\ \times Discharge\ WQ)}{Stream\ flow + Discharge\ flow}$$

VIRIDIS Environmental Consultants

Figure 1. Site Overview

Legend

Site boundary

Wastewater details

WWTP

Land infiltration bed discharge

Freshwater Features

Ephemeral overland flow paths

Orewa River tributaries

Monitoring site

SOURCES
Nearmaps Aerial Imagery (2025)

DISCLAIMER:
This map/plan is not an engineering draft.
This map/plan is illustrative only and all information should be independently verified on site before taking any action.

SCALE	**1:1,800** @ A4
PROJECT NO.	10122
DRAWN BY:	A.G.
DATE:	9 Dec 2025

The surface water quality modelling was based on the following assumptions and limitations:

- Treated discharge flow estimates were provided by Apex (2025) for Stage 1 of the Delmore development (Table 1), which accommodates flows from approximately 475 lots. Under Scenario 3, peak wet weather flows were modelled as the WWTP discharge diluted by a factor of 1.2 (Apex 2025), with the dilution water assumed to be of a quality equivalent to that of the stream.
- Discharge loads were presumed to be consistent irrespective of discharge scenario and was based on the estimates provided by Apex (2025) for MBR and RO treatment.
- Under each scenario, the following flow distribution was assumed between the infiltration bed and irrigation areas (Figure 1):
    - Scenario 1: 15% of flows directed to the infiltration bed, 20% directed to the on-site irrigation areas, and the balance directed off-site for disposal.
    - Scenarios 2 & 3: 85% of flows directed to the infiltration bed, and 15% directed to the on-site irrigation areas.

  These flow distributions were informed by the WWTP design (Apex 2025), and the assimilative capacity of the stream.
- All water discharged to the infiltration bed was assumed to eventually reach the stream.
- The RO reject stream and a portion of treated flows are proposed to be managed by irrigation (Apex 2025). Irrigation is proposed to be applied at sustainable agronomic rates consistent with soil infiltration capacity, slope, and vegetation demand, as outlined in the current design and supported by geotechnical/hydrological advice (Riley 2025). On this basis, irrigated flows are assumed to be retained within the root zones or soil profile, with no overland runoff or subsurface drainage recharging the unnamed stream. This assumption is conditional on irrigation being designed, operated, and maintained in accordance with the proposal and specialist recommendations.
- Stream flows under each scenario were obtained from NIWA's river flow prediction website (Whitehead & Booker 2020). These flow estimates range from 3.4 L/s (i.e., the 7-day mean annual low flow, MALF) to 81.6 L/s (the 'FRE3' flow, or three times the median flow) (Table 1).
- The background quality of the stream was based on the average water quality measured at an ultimate downstream site ('DS-2') on 31 December 2024 and 28 January 2025. Analysis reports have been included as Attachment A. Values below detection limits were modelled as half the detection limit, as is standard practice.
- The receiving water quality was only modelled for the key contaminants of most concern, where Apex was able to quantify for the discharge. As reported in Apex (2025), RO treatment provides very high removal of other constituents, including emerging organic contaminants (EOCs) and metals. On this basis, concentrations of these substances in the treated effluent are expected to be very low, and their potential effects on the stream were not assessed further.
- The influence of runoff from existing or future land uses was not modelled. Accordingly, the assessment does not account for potential increases in urban-derived contaminants within stormwater post-development, nor does it quantify any potential improvement in runoff quality associated with the removal of current agricultural land-use inputs. Background water quality has therefore been treated as unchanged between pre- and post-development conditions for the purposes of this assessment.

The three discharge scenarios that were modelled are summarised in Table 1, together with the corresponding stream flow conditions.

Table 1. The three modelled scenarios and corresponding discharge and river flows.

Scenario	Description	Discharge (Stage 1 only)		River	
		Total flows (L/s)	Flows directed to infiltration bed (L/s)	Statistic	Flow (L/s)
1	Dry weather low flow discharge	3	0.5	7-day MALF	3.4
2	Average weather discharge	3	2.5	Median flow	27.2
3	Peak wet weather discharge	3.5*	3*	FRE3**	81.6

Notes: *Allowing for a peaking factor of 1.2; **FRE3 is three times the median flow.

Effects on the Unnamed Tributary

Introduction

The results of modelling are presented in Table 2, alongside the input data for the stream and discharge. Existing stream water quality (at site DS-2) and its projected quality under each scenario were compared against the following guidance:

- National Policy Statement for Freshwater Management (NPS-FM) 2020 Attribute Bands A to D/E, with A representing best water quality, and each subsequent band indicating a decline in quality (MfE 2024).
- Australia and New Zealand Guideline (ANZG 2018) default guideline values (DGVs) for toxicants (at 99% species protection) or physicochemical stressors (based on the 80th percentile of minimally impacted reference site data).
- Ministry for the Environment (MfE 1992) guideline for biochemical oxygen demand (BOD) to limit the growth of sewage fungus.

These values have been included as Attachment B. Cells in Table 2 have been shaded to illustrate which of the NPS-FM Attribute Bands a scenario falls within (defined in the footnote to Table 2). Exceedances of an ANZG DGV (or, in the case of carbonaceous five-day BOD ($cBOD_5$), MfE guidance for preventing sewage fungus growth) have been shown in red text, and compliance has been shown in green[1].

[1] While these guidelines can help assess ecological impacts, they are best applied to comprehensive data sets rather than single data points. For example, NPS-FM Attribute Bands for annual medians should be based on the median of multiple data points collected over the course of a year or longer.

Table 2. Input data and results of modelling under each discharge scenario.

Parameter	Baseline stream quality*	Discharge quality	Stream quality after discharge		
			Scenario 1	Scenario 2	Scenario 3
Flow (L/s)	Varies based on scenario (Table 1)		4	30	85
Total suspended solids	3	4	3	3	3
$cBOD_5$	<2	0.5	1	1	1
E. coli (MPN/100 mL) **	435	<4	385	398	422
Ammoniacal nitrogen	<0.01	0.3	0.04	0.03	0.01
Nitrate nitrogen	<0.002	0.5	0.06	0.04	0.02
Total nitrogen	0.30	1	0.38	0.36	0.32
DRP	<0.004	0.07**	0.010	0.008	0.004
Total phosphorus	0.015	0.07**	0.021	0.020	0.017

Notes: Units g/m^3 unless stated; $cBOD_5$ = carbonaceous five-day biochemical oxygen demand; DRP = dissolved reactive phosphorus; Attribute A is light green, Attribute B is blue, Attribute C is light orange, Attribute D is light red and Attribute E (where applicable) is dark red; exceedances of an ANZG DGV for a physiochemical stressor (or, in the case of BOD, MfE guidance for preventing sewage fungus growth) are shown in red text, and compliance is shown in green; * average result of two sampling events; **compared against median concentrations, based on *Campylobacter* infection risk for human contact; **based on the assumption that the majority of TP discharged from the WWTP will be DRP.

Scenario 1

Under Scenario 1, which is representative of summer conditions, the discharge (i.e., 15% to the infiltration bed, 20% irrigated and the balance directed off-site) is projected to increase concentrations of total ammoniacal nitrogen and dissolved reactive phosphorus (DRP) in the tributary, shifting water quality from NPS-FM Attribute Band A to Band B, for both parameters. For ammoniacal nitrogen, this transition corresponds to a level that '*starts impacting occasionally on the 5% most sensitive species*' (MfE 2024). For DRP, it signals the potential for eutrophication effects, with the ecological community expected to be '*slightly impacted by minor DRP elevation above natural reference conditions*' (MfE 2024). However, the proposed discharge is not expected to cause ammoniacal nitrogen or DRP concentrations in the stream to exceed the relevant ANZG (2018) DGV.

Despite the temporary shift in NPS-FM attribute bands expected under low flow conditions, the discharge is considered unlikely to result in an ecologically significant shift in overall macroinvertebrate community composition – that is, a meaningful change to the structure or function of the benthic community beyond the natural variability observed in similar lowland agricultural streams. The results of macroinvertebrate sampling undertaken in December 2024 (Table 3, reproduced from Viridis (2025)) indicate that the existing benthic community is largely dominated by pollution-tolerant taxa, such as chironomid midges (i.e., in the sub-family Orthocladiinae, with a soft-bottom tolerance score of 3.2) and freshwater snails (from the genus *Physa*, with a soft-bottom tolerance score of 0.1). This assemblage is typical of slow-flowing, unshaded agricultural streams (Landcare Research 2025).

Macroinvertebrate community index (MCI) and quantitative MCI (QMCI) scores for each site fell within NPS-FM Attribute Band C or D for ecosystem health, indicating the existing community is largely insensitive to nutrient related stress. While some sensitive EPT taxa were present, they comprised (on average) less than 11% of the population. If 5% of the most sensitive species are expected to experience occasional effects from increases in ammoniacal nitrogen (as per MfE 2024), this would represent fewer than 1% of the total macroinvertebrate community in the unnamed tributary. Similarly, any potential effects from increases in DRP are expected to be limited to a small proportion of the most sensitive taxa.

Table 3. Macroinvertebrate results for the unnamed tributary of the Ōrewa River.

Parameter	Sampling site*		
	UP	DS-1	DS-2
Abundance	3,035	139	763
Taxa richness	18	17	22
EPT taxa richness	3	2	4
% EPT abundance	6.6	12	14
% EPT taxa	17	12	18
MCI-sb	84	92	92
MCI NPS-FM Attribute Band	D	C	C
QMCI-sb	2	3.5	3.1
QMCI NPS-FM Attribute Band	D	D	D

Notes: EPT is the number of taxa that belong to the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxonomic groups, which are generally more sensitive to changes in water and habitat quality; *as shown in Figure 1.

Given the magnitude and duration of the predicted changes in nutrient concentrations, the discharge is also not expected to adversely affect the fish community.

Other key water quality parameters, including total suspended solids (TSS), $cBOD_5$, nitrate nitrogen, total nitrogen, and total phosphorus, remain comparable to baseline conditions under Scenario 1. While *E. coli* counts are slightly improved due to dilution from the discharge, they still remain within the NPS-FM E (Red) attribute band.

Scenario 2

Under average conditions (i.e., Scenario 2), the discharge is predicted to have minimal impact on receiving water quality. Baseline monitoring showed ammoniacal nitrogen and nitrate nitrogen concentrations within Attribute Band A, and this classification remains unchanged post-discharge. However, similar to Scenario 1, DRP concentrations shift from Attribute Band A to Band B, indicating a level above natural reference conditions (MfE 2024). Despite this shift, no significant adverse effects on the invertebrate community are expected due to the dominance of pollution-tolerant taxa, as discussed above. Any nutrient-related ecological response is therefore likely to be minor and intermittent, and limited to:

- A small reduction in the abundance/occurrence of sensitive taxa already present at low levels.
- A further strengthening of tolerant taxa dominance.
- Short-term, localised shifts in community structure during discharge events, with recovery expected between events due to their brief/intermittent nature and the availability of upstream refuges and good habitat connectivity.

Total nitrogen concentrations under Scenario 2 are also predicted to increase slightly, however, concentrations were already above the ANZG DGV during baseline monitoring. As such, this change is unlikely to cause material additional harm. Other water quality parameters, including TSS and $cBOD_5$, remain stable, and *E. coli* counts continue to fall within the E (Red) attribute band.

Scenario 3

Under peak wet weather conditions (Scenario 3), discharges from the WWTP are expected to have minimal impact on receiving water quality. The primary effect is a slight increase in contaminant concentrations compared to baseline conditions; however, these changes do not result in a shift in Attribute Bands or to an exceedance of ANZG DGVs. Overall, no meaningful change in water quality is anticipated.

Summary

The results of modelling illustrate that under summer, typical (median) and peak wet weather flow conditions, the proposed discharge of treated wastewater will avoid significant impact on receiving water quality. The increases in total ammoniacal nitrogen and DRP under Scenarios 1 and 2 are not expected to result in material harm to the stream's aquatic community, as concentrations remain within NPS-FM Attribute Band B and comply with relevant ANZG DGVs. Furthermore, the stream's invertebrate community is comprised of non-sensitive, pollution-tolerant aquatic species. Potential impacts on fish are also expected to be minimal, given the limited scale and duration of predicted changes in water quality. Overall, the proposal was found to provide sufficient protection of the water quality and ecological values of the stream, avoiding material adverse effects.

Effects on the Orewa Estuary

A key consideration following the receiving-water modelling is whether the predicted nutrient increases could translate into effects on the Ōrewa Estuary, and how the proposal compares with other nutrient sources within the upstream catchment. To provide context, the scale of the proposed discharge has been assessed relative to indicative nutrient loads from surrounding land uses.

The southern stem of the Ōrewa River is a major inflow to the estuary and drains an upstream catchment of approximately 1,615 ha (as per Auckland Council GeoMaps' overland flow path layer). Much of this catchment is currently in agricultural use and, given its rural zoning, a substantial proportion is expected to remain so (Figure 2). Although the Ōrewa Estuary receives inflows from a much wider catchment, the southern stem is considered here as a major nutrient pathway to the estuary and provides a conservative basis for comparing the proposal against existing upstream nutrient sources.

Indicative nitrogen and phosphorus loads from agricultural land uses were estimated using national average export coefficients from Monaghan *et al.* (2021a). Sheep and beef farming typically contributes around 12 kg N/ha/year and 0.8 kg P/ha/year to surface water[2]. However, given that many farms in the catchment have been retired, reductions associated with land retirement were also considered. Monaghan *et al.* (2021b) report mitigation effects of up to 1 kg N/ha/year and up to 0.65 kg P/ha/year. Conservatively assuming that half of the catchment (~808 ha) is currently retired agricultural land, the estimated nutrient contributions from this retired land equate to approximately 8,888 kg of total nitrogen and 121 kg of total phosphorus per year entering the Ōrewa River.

[2] Presumed to be total nitrogen and total phosphorus loads.

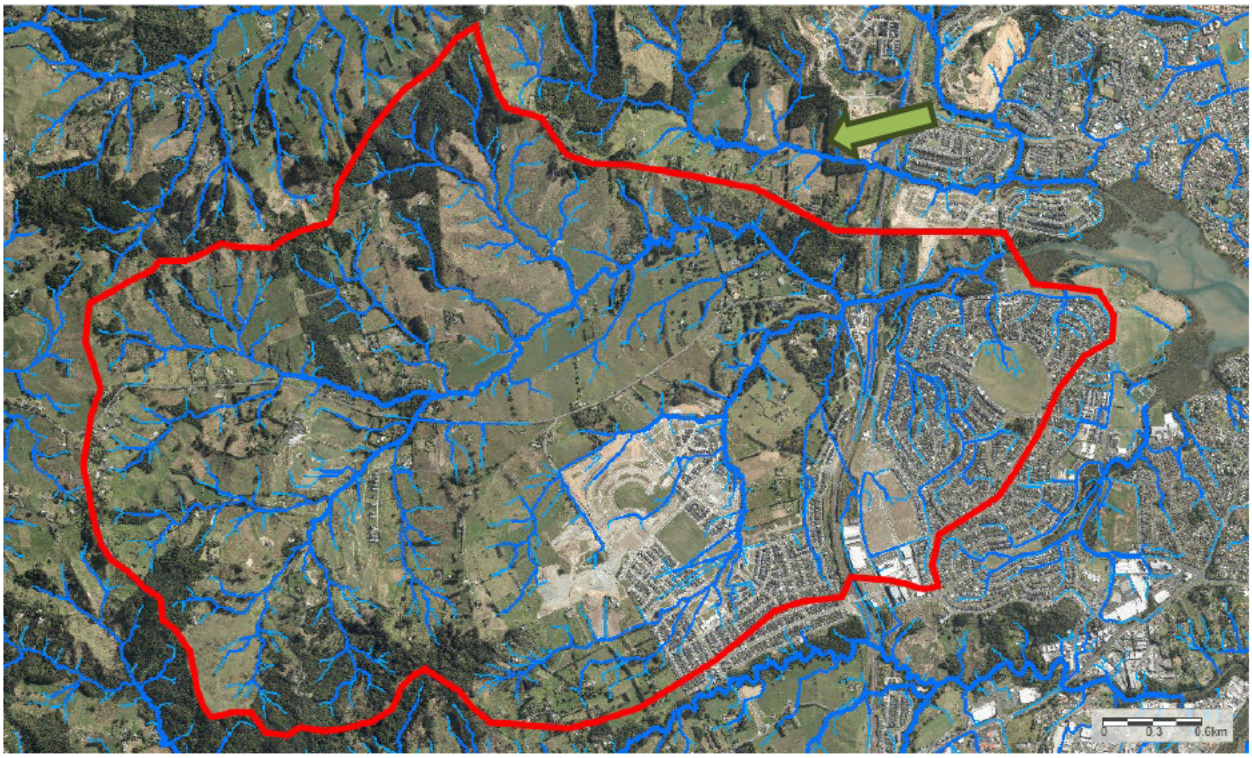

Figure 2. Approximate catchment boundary contributing to the Orewa River shown in red, with overland flow paths in blue. Site location shown by green arrow. Aerial imagery dated 2024–2025, sourced from AC GeoMaps.

By comparison, the proposed discharge, under typical conditions (i.e., Scenario 2) is modelled to contribute approximately 81 kg N/year and 5.7 kg P/year. This represents just under 1% of the estimated nitrogen load and just under 5% of the estimated phosphorus load from retired agricultural land within the southern stem catchment. These proportions would decrease further when considered across the larger estuarine catchment and when accounting for other land uses and authorised discharges upstream. Notably, this comparison does not account for the fact that, relative to the site's current agricultural land use, the proposal represents a substantial reduction in nutrient losses to the catchment.

In addition, the discharge enters a small headwater tributary. Nutrient concentrations are therefore expected to reduce between the discharge point and the estuary via natural processes such as uptake by riparian and aquatic vegetation, sedimentation, and in-stream assimilation. The Ōrewa Estuary is a permanently open tidal lagoon with relatively high flushing capacity, which limits nutrient residence time and reduces the risk of eutrophication. These receiving-environment characteristics further reduce the likelihood of detectable estuarine water quality effects attributable to the proposal.

Overall, the proposed discharge represents a minor, localised nutrient source within the wider river-estuary system. Proposed consent conditions requiring ongoing water quality and ecological monitoring in the receiving tributary will provide an effective mechanism to confirm these predictions and to identify and respond to any unexpected effects before they propagate downstream.

Proposed Conditions

Vineway proposes to implement ecological and water quality monitoring conditions to complement this assessment. These conditions provide a verification and adaptive-management framework, confirming that discharge effects remain consistent with predictions, enabling early detection of any unforeseen changes, and requiring an appropriate management response where necessary. Accordingly, Vineway proposes the following conditions for inclusion in the consent:

- The consent holder must undertake water quality monitoring and ecological surveys at the following locations within the unnamed tributary of the Orewa River:
    - A control site, 'US', situated approximately 100m upstream from the infiltration bed discharge.
    - An impact site, 'DS-1', situated approximately 50 downstream from the infiltration bed discharge.
    - A second impact site, 'DS-2' situated approximately 50 m downstream of the main channel's confluence with a tributary.

  Monitoring should be undertaken by a suitably qualified ecologist or environment scientist.
- Surface water quality sampling shall be undertaken:
    - For a period of at least 12 months prior to commencement of discharge, at quarterly intervals, to establish baseline conditions and seasonal variability.
    - Following the commencement of the discharge, at quarterly intervals.
    - Once the development has been operating at design capacity for a minimum of two years, the sampling frequency may be reduced to once every three years, in consultation with the Consent Authority, provided monitoring demonstrates no significant discharge-related reduction in surface water quality.
- All surface water quality samples must be tested for the following parameters:
    - pH
    - Total suspended solids
    - Total ammoniacal nitrogen
    - Nitrate-nitrogen
    - Total nitrogen
    - Dissolved reactive phosphorous
    - Total phosphorous
    - *Escherichia coli*
    - Enterococci
    - Soluble carbonaceous five-day biochemical oxygen demand ($cBOD_5$)

  Sample analyses must be undertaken by an IANZ accredited (or equivalent) laboratory.

- Ecological surveys shall be undertaken:
  - Once, prior to the commencement of the discharge, during summer.
  - Annually, following the commencement of the discharge, during summer.
  - Once the development has been operating at design capacity for a minimum of two years, the sampling frequency may be reduced to once every three years, in consultation with the Consent Authority, provided monitoring demonstrates no significant discharge-related deterioration in ecological condition.
- Each ecological surveys will include, at each monitoring site:
  - A qualitative assessment of physical habitat characteristics.
  - Collection and analysis of macroinvertebrate samples.
  - Overnight fish trapping.
- Monitoring results shall be compiled, interpreted, and reported in an Annual Environmental Monitoring Report, to be submitted to the Consent Authority by each anniversary of consent commencement. The report shall compare monitored results against baseline conditions (including seasonal variability) and relevant guideline values and shall assess whether any observed changes are attributable to the WWTP discharge.
- Where monitoring identifies a deterioration in water quality and/or ecological health that is attributable to the WWTP discharge, the Consent Holder shall:
  - Investigate the cause and extent of the deterioration.
  - Provide a report to the Council within 20 working days of becoming aware of the deterioration, including recommended actions.
  - Implement any remedial measures required to address discharge-related effects.

Conclusion

Based on receiving-water modelling, baseline ecological data, and catchment-scale context, the proposed Delmore WWTP discharge is not expected to result in significant adverse effects on water quality or ecological values within the unnamed tributary of the Ōrewa River or the downstream Ōrewa Estuary. Predicted increases in nutrient concentrations are small, localised, and short-lived, and are unlikely to cause material effects on macroinvertebrate or fish communities. The proposed monitoring conditions provide an appropriate verification and adaptive-management framework to confirm these outcomes and ensure that any unforeseen effects are identified and addressed promptly.

Attachments

Attachment A – Analysis Reports

Attachment B – Receiving Water Guidelines

References

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

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Certificate of Analysis

Client:	Viridis Limited	**Lab No:**	3748012	SPv2
Contact:	[redacted]	**Date Received:**	30-Dec-2024	
		Date Reported:	24-Jan-2025	**(Amended)**
		Quote No:	135466	
		Order No:	10122	
		Client Reference:		
		Submitted By:	[redacted]	

Sample Type: Aqueous

	Sample Name:	Up-North 30-Dec-2024 2:50 pm	DS-1 30-Dec-2024 3:00 pm	DS-2 30-Dec-2024 3:15 pm
	Lab Number:	3748012.1	3748012.2	3748012.3
Individual Tests				
Turbidity	NTU	5.4	4.4	5.0
pH	pH Units	7.2	7.1	7.4
Total Suspended Solids	g/m³	< 3	< 3	4
Total Nitrogen	g/m³	0.36	0.33	0.31
Total Kjeldahl Nitrogen (TKN)	g/m³	0.35	0.32	0.31
Total Phosphorus	g/m³	0.022	0.021	0.017
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	g O_2/m³	< 2	< 2	< 2
Enterococci	MPN / 100mL	249 #1	411 #1	96 #1
Faecal Coliforms and E. coli profile				
Faecal Coliforms	MPN / 100mL	700 #1	1,100 #1	790 #1
Escherichia coli	MPN / 100mL	490 #1	1,100 #1	790 #1
Nutrient Profile				
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	0.003 #2	< 0.002
Nitrate-N	g/m³	< 0.002	< 0.002	< 0.002
Nitrate-N + Nitrite-N	g/m³	0.002	< 0.002	< 0.002
Dissolved Reactive Phosphorus	g/m³	< 0.004	< 0.004	< 0.004

Analyst's Comments

#1 Please interpret this result with caution as the sample was > 10 °C on receipt at the lab. The sample temperature is recommended by the laboratory's reference methods to be less than 10 °C on receipt at the laboratory (but not frozen). However, it is acknowledged that samples that are transported quickly to the laboratory after sampling, may not have been cooled to this temperature.

#2 It has been noted that the result for Nitrite-N was greater than that for Nitrate-N + Nitrite-N, but within the analytical variation of these methods.

Amended Report: This certificate of analysis replaces report '3748012-SPv1' issued on 07-Jan-2025 at 11:50 am. Reason for amendment: Testing added as requested.

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
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Turbidity	Analysis by Turbidity meter. APHA 2130 B (modified) : Online Edition.	0.05 NTU	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 Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) : Online Edition.	3 g/m^3	1-3
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3. In-house calculation.	0.05 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
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) : Online Edition.	0.10 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
Total Phosphorus	Total phosphorus digestion, automated ascorbic acid colorimetry. Flow Injection Analyser. APHA 4500-P H (modified) : Online Edition.	0.002 g/m^3	1-3
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, seeded. APHA 5210 B (modified) : Online Edition.	2 g O_2/m^3	1-3
Enterococci	MPN count using Enterolert, Incubated at 41°C for 24 hours. MIMM 12.4, APHA 9230 D : Online Edition.	1 MPN / 100mL	1-3
Nutrient Profile		0.0010 - 0.010 g/m^3	1-3
Faecal Coliforms and E. coli profile			
Faecal Coliforms	MPN count in LT Broth at 35°C for 48 hours, EC Broth at 44.5° C for 24 hours. APHA 9221 E : Online Edition.	2 MPN / 100mL	1-3
Escherichia coli	MPN count in LT Broth at 35°C for 48 hours, TBX confirmation. APHA 9221 F (modified) : Online Edition.	2 MPN / 100mL	1-3

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

Testing was completed between 31-Dec-2024 and 24-Jan-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.

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

[redacted]

[redacted] BSc (Tech)
Client Services Manager - Environmental

Hill Labs

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Certificate of Analysis

Client:	Viridis Limited	**Lab No:**	3764687 SPv2
Contact:	[redacted]	**Date Received:**	28-Jan-2025
		Date Reported:	07-Feb-2025
		Quote No:	135466
		Order No:	10122
		Client Reference:	
		Submitted By:	[redacted]

Sample Type: Aqueous

	Sample Name:	Up-North 28-Jan-2025 2:55 pm	DS-1 28-Jan-2025 3:05 pm	DS-2 28-Jan-2025 3:15 pm
	Lab Number:	3764687.1	3764687.2	3764687.3
Individual Tests				
Turbidity	NTU	1.82	3.0	2.4
pH	pH Units	7.2	7.3	7.4
Total Suspended Solids	g/m^3	< 3	< 3	< 3
Total Nitrogen	g/m^3	0.34	0.28	0.29
Total Kjeldahl Nitrogen (TKN)	g/m^3	0.34	0.28	0.29
Total Phosphorus	g/m^3	0.012	0.016	0.013
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	$g\ O_2/m^3$	< 2	< 2	< 2
Enterococci	MPN / 100mL	365 #1	156 #1	308 #1
Faecal Coliforms and E. coli profile				
Faecal Coliforms	MPN / 100mL	130 #1	240 #1	79 #1
Escherichia coli	MPN / 100mL	130 #1	240 #1	79 #1
Nutrient Profile				
Total Ammoniacal-N	g/m^3	< 0.010	< 0.010	< 0.010
Nitrite-N	g/m^3	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m^3	< 0.002	< 0.002	< 0.002
Nitrate-N + Nitrite-N	g/m^3	0.002	0.002	< 0.002
Dissolved Reactive Phosphorus	g/m^3	< 0.004	< 0.004	< 0.004

Analyst's Comments

#1 Please interpret this result with caution as the sample was > 10 °C on receipt at the lab. The sample temperature is recommended by the laboratory's reference methods to be less than 10 °C on receipt at the laboratory (but not frozen). However, it is acknowledged that samples that are transported quickly to the laboratory after sampling, may not have been cooled to this temperature.

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**
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Turbidity	Analysis by Turbidity meter. APHA 2130 B (modified) : Online Edition.	0.05 NTU	1-3

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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 Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) : Online Edition.	3 g/m^3	1-3
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3. In-house calculation.	0.05 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
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) : Online Edition.	0.10 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
Total Phosphorus	Total phosphorus digestion, automated ascorbic acid colorimetry. Flow Injection Analyser. APHA 4500-P H (modified) : Online Edition.	0.002 g/m^3	1-3
Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)	Incubation 5 days, DO meter, nitrification inhibitor added, seeded. APHA 5210 B (modified) : Online Edition.	2 g O_2/m^3	1-3
Enterococci	MPN count using Enterolert, Incubated at 41°C for 24 hours. MIMM 12.4, APHA 9230 D : Online Edition.	1 MPN / 100mL	1-3
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Faecal Coliforms and E. coli profile			
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Escherichia coli	MPN count in LT Broth at 35°C for 48 hours, TBX confirmation. APHA 9221 F (modified) : Online Edition.	2 MPN / 100mL	1-3

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Client Services Manager - Environmental

Table B1. Guideline values for various water quality parameters.

Parameter	NPS-FM attribute states[1]					ANZG DGV[2]	Other	
	A	B	C	D	E		Value	Source
Total suspended solids						8.8		
Five-day carbonaceous biochemical oxygen demand							2	MfE (1992)
E. coli (MPN/100 mL)*	≤130	≤130	≤130	>130	>260			
Total ammoniacal nitrogen	≤0.03	>0.03 and ≤0.24	**>0.24** and ≤1.3	>1.3		0.32**		
Nitrate nitrogen	≤1	>1 and ≤2.4	**>2.4** and ≤6.9	>6.9		0.065		
Total nitrogen						0.292		
Dissolved reactive phosphorus	≤0.006	>0.006 and ≤0.01	>0.01 and ≤0.018	>0.018		0.014		
Total phosphorus						0.024		

Notes: Units are g/m^3 unless stated otherwise; Values in **bold** indicate the national bottom line (NBL), where applicable; [1]as an annual median, unless stated otherwise; [2]physical or chemical stressors, for the 80th %ile, unless stated otherwise, based on the unnamed tributary's river environment classification (REC) of a warm wet, low elevation stream; *assessed against median concentrations based on risk of *Campylobacter* infection for human contact. Whether samples fell within Bands A-B determined based on other metrics – refer MfE (2024); ** toxicant DGV for 99% species protection.