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Milldale Stages 14-17 Surface Water Takes and Discharges

Assessment of Surface Water Quality Effects

Prepared for: Fulton Hogan Land Development Limited

August 2026

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Cover photo: The Orewa River, viewed facing upstream towards Gervin Road. Pictured 17 March 2026.

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STATEMENT OF QUALIFICATIONS AND EXPERIENCE

Amanda Good (Author)

My full name is Amanda Naude; however, I also use the name Amanda Good. I am an Environmental Scientist at Viridis Limited, a New Zealand-based environmental and ecological consultancy. Viridis specialises in the provision of environmental monitoring, assessment of environmental effects, and regulatory compliance services.

I hold a Bachelor of Engineering (Honours) degree in Chemical and Materials Engineering from the University of Auckland. I am a full member of the Environmental Institute of Australia and New Zealand (MEIANZ).

I have approximately five years of professional experience in the environmental consulting field. My professional experience includes the assessment, monitoring, interpretation, and reporting of water quality and environmental data across a range of sectors, including mining, manufacturing, local government, and residential development. I have prepared and reviewed water quality assessments and contributed to Assessments of Environmental Effects for resource consent applications, including projects currently undergoing assessment under the Fast-track Approvals Act 2024. My work has included the evaluation of surface water and stormwater discharges, ecotoxicity considerations, and the assessment of potential effects on receiving environment.

Viridis has been engaged by Fulton Hogan Land Development Limited (the Applicant) to undertake an assessment of surface water quality effects associated with the Milldale Stages 14-17 project and to prepare this report in support of the substantive application under the Fast-track Approvals Act 2024.

While this is not an Environment Court proceeding, I confirm that I have prepared this assessment in accordance with the applicable professional and ethical obligations of my profession and that the opinions expressed are within my area of expertise.

Dr Grant Allen (Reviewer)

My full name is Grant Richard Allen. I am a Director and Lead Environmental Scientist at Viridis Limited. I hold a Doctor of Philosophy (PhD) in Chemistry and am a full member of the Environmental Institute of Australia and New Zealand (MEIANZ) and the Royal Society of New Zealand (MRSNZ).

I have approximately 20 years' experience in environmental consulting, having commenced my consulting career in 2007. During this time, I have worked across the mining, natural resources, power generation, industrial, and government sectors, providing technical leadership, environmental advice, and expert review services. My professional experience includes the management and delivery of complex environmental monitoring programmes, the preparation and review of Assessments of Environmental Effects, and leadership of multidisciplinary teams supporting resource consent applications. I have overseen and reviewed assessments relating to wastewater discharges, stormwater discharges, water abstractions, leachate, and silt pond discharges, with a particular focus on effects on receiving environments and compliance with consent conditions.

In my role as reviewer of this report, I have provided senior technical oversight and quality assurance. My review has focused on the appropriateness of the methodologies applied, the robustness of the assessment undertaken, and the validity of the conclusions reached.

While this is not an Environment Court proceeding, I confirm that I have prepared this assessment in accordance with the applicable professional and ethical obligations of my profession and that the opinions expressed are within my area of expertise.

Annabelle Coates (Co-reviewer)

My full name is Annabelle Julia Coates. I am a Senior Ecologist at Viridis Limited. I hold both a Bachelor and Master of Environmental Science and am a full member of the Environmental Institute of Australia and New Zealand (MEIANZ). I am also a Certified Environmental Practitioner (CEnvP) under EIANZ's accreditation scheme.

I have approximately 12 years of professional experience in the ecological consulting field, including conducting freshwater, terrestrial and coastal ecological impact assessments for both urban and rural developments, as well as ecological restoration and monitoring. I have provided ecological input, such as reporting and reviewing, for projects approved under the COVID-19 Recovery (Fast-track Consenting) Act 2020, and for projects currently undergoing assessment under the Fast Track Approvals Act (2024) Additionally, I have been involved in reporting and reviewing for various land development projects spanning Otago, West Coast, Canterbury, Wellington, Hawke's Bay, Waikato, Auckland and Northland.

In my role as reviewer of this report, I have provided senior technical oversight and quality assurance. My review has focused on the appropriateness of the methodologies applied, the robustness of the assessment undertaken, and the validity of the conclusions reached.

While this is not an Environment Court proceeding, I confirm that I have prepared this assessment in accordance with the applicable professional and ethical obligations of my profession and that the opinions expressed are within my area of expertise.

1 INTRODUCTION

1.1 Overview

This report has been prepared for Fulton Hogan Land Development Limited ('the Applicant'), in support of the substantive application for the Milldale Stages 14-17 Project ('the Project') under the Fast-track Approvals Act 2024 (FTAA).

The Project relates to approximately 231 ha of land centred around Wainui Road in Wainui, Auckland ('the site'; Figure 1). The proposal provides for a comprehensively planned urban development including residential neighbourhoods, a supporting commercial node, transport and servicing infrastructure, open space, wetland restoration, an ecological restoration area and associated enabling works. The Project also includes a surface water take for potable water supply and the discharge of treated wastewater to land and water.

The application seeks approvals necessary to facilitate the staged development of the Project, including a suite of resource consents required under the FTAA framework. The substantive application is supported by a comprehensive set of technical assessments and plans addressing the environmental, servicing and infrastructure matters associated with the proposal. This report should be read alongside the Planning Report and the appended technical reports and drawings lodged in support of the substantive application.

1.2 Purpose and Scope

Viridis Limited (Viridis) was engaged by the Applicant to assess the potential surface water quality and aquatic ecology effects associated with the Project's proposed surface water take and treated wastewater discharges. This report presents the results of this assessment, which focused on the main receiving environment; the Ōrewa River, and considered the potential effects of these activities on downstream water quality, habitat, flow and freshwater fauna.

The assessment was informed by baseline surface water quality and ecological monitoring undertaken by Viridis. Downstream effects of the proposed activities were evaluated under three representative discharge scenarios: summer low-flow, average, and peak wet-weather conditions. Predicted changes in receiving-water quality were interpreted in the context of existing baseline conditions, relevant water quality guidelines and ecological values.

This report also outlines the proposed receiving-water monitoring programme intended to verify predicted surface water quality effects during operation and support adaptive management where required. It should be read alongside the Ecological Impact Assessment (EcIA), also prepared by Viridis (2026), which provides a comprehensive assessment of the wider Project footprint.

The assessment has been prepared having regard to the relevant statutory and technical framework applicable to the proposal, including the National Policy Statement for Freshwater Management (NPS-FM) 2020 (MfE 2025) and the Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

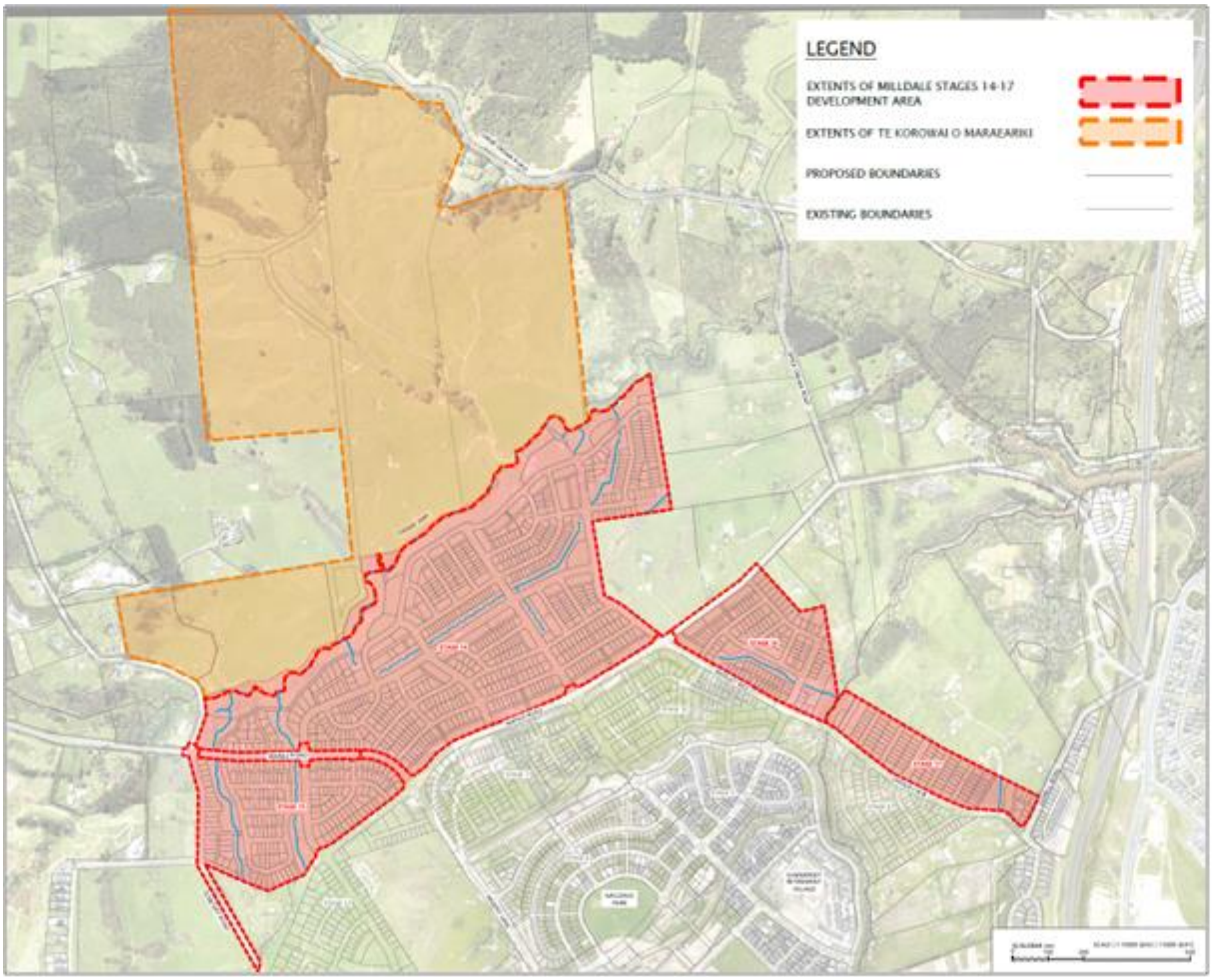

Figure 1. Map of the Project site.

2 PROPOSAL

2.1 Site Background

The site comprises approximately 231ha of land held across various records of title at Milldale, Wainui ('the site'). The site comprises two distinct areas:

- Residential subdivision area to the south of the Ōrewa River ('development site'; shown in red in Figure 1); and
- A restoration area, referred to as 'Te Korowai o Maraeariki' to the north of the Ōrewa River (shown in orange in Figure 1).

The proposed residential subdivision area is located within the Future Urban Zone under the Auckland Unitary Plan (AUP). This part of the site is characterised by gently undulating to rolling pasture, with several streams, natural wetlands, constructed ponds and artificial drains traversing the area.

Te Korowai o Maraeariki is located to the north of the Ōrewa River and is zoned Rural Production under the AUP. This area is characterised by more undulating to steep terrain, with a series of ridgelines separated by incised gullies extending from the Ōrewa River. The land is predominantly managed pasture interspersed with streams and natural wetlands, together with pine plantations, exotic vegetation and gorse scrub. Relatively large areas of indigenous vegetation are also present, including a Significant Ecological Area (SEA) – Terrestrial Overlay in the north-western portion of the site.

There is existing water, stormwater and wastewater infrastructure surrounding the site as a result of the extensive development within previous Milldale Stages. However, the site itself is not currently serviced in terms of supply and infrastructure. The surrounding roading network has been progressively developed in accordance with the staging of the Milldale development.

The surrounding area is now substantially developed. Milldale Stages 1 to 6 are complete, while Stage 7 is well advanced, with subdivision completed for Stages 7A-7C and construction of Stage 7D anticipated to commence in early 2027. Separate consents for the Stage 8 and 9 enabling works and subdivision were granted in 2024, with the associated offset and construction works now complete. The Milldale Local Centre has also been constructed, together with associated roads, accessways and drainage reserves. Community infrastructure within the surrounding area includes Ahutoetoe Primary School, two early childhood education centres and the Summerset retirement village. Beyond the urban extent of Milldale, the site adjoins a number of rural residential properties.

2.2 The Project

2.2.1 Overview

The Milldale Stages 14-17 project seeks approvals for an urban development on the site. The proposal provides for up to 1,425 dwellings across a range of housing typologies and densities. In addition, the proposal includes provision for a small commercial area, transport infrastructure, servicing and stormwater infrastructure, subdivision, earthworks, stream works, and neighbourhood parks.

To the north of the Ōrewa River within Te Korowai o Maraeariki, the project includes private water and wastewater infrastructure, ecological restoration, as well as walking and cycling trails to enhance recreation and amenity.

Development of the Project will require a suite of approvals under the FTAA, including resource consents associated with subdivision, land use activities, bulk earthworks, infrastructure works, stream works, water take, diversion and discharge; along with NES for contamination and freshwater.

The aspects of the proposal relevant to this report include a surface water take from the Ōrewa River for potable water supply and the discharge of treated wastewater, to both land and water, within the same catchment. These activities are discussed in more detail in Sections 2.2.2 and 2.2.3. Key features associated with these activities are presented in Figure 2.

A full description of the proposal is provided in the Planning Report and technical reports and drawings appended to the substantive application, and should be read in conjunction with this report.

2.2.2 Surface water take

The Applicant proposes to establish a high-flow surface water take from the main stem of the Ōrewa River, near the south-western boundary of the Project site (refer Figure 2). The take is intended to supplement a groundwater supply to provide a potable water source for the development. It is proposed that a maximum of 425 m^3/day is abstracted from the Ōrewa River.

The abstraction will be restricted to periods of higher river flow (i.e., when flows in the Ōrewa River exceed a long-term median[1]). The abstraction volume will be limited to 30% of total river flow, provided flows remain above median, implemented by a maximum abstraction rate of 25 L/s. This operating regime has been designed to ensure that abstraction does not reduce river flows below the median flow threshold.

A storage reservoir with a capacity of approximately 95,000 m^3 is proposed to be located on the true left bank of the Ōrewa River, near the intake location (refer Figure 2). The reservoir will store water abstracted during eligible flow conditions and retain water supply during periods when river flows are below the abstraction threshold.

The intake structure will consist of a wingwall-protected inlet, a precast channel housing coarse debris and fine screens, and a concrete pump chamber (WWLAb). Water will pass through a 3 mm coarse screen and a 1.5 mm fine screen before being pumped to the proposed storage reservoir. The intake entrance velocity will be limited to less than 0.15 m/s to reduce the risk of juvenile fish being trapped against the screen or drawn into the intake. Further details regarding the proposed intake, storage reservoir, operating regime and hydrological modelling are provided in WWLA (2026b).

2.2.3 Treated wastewater discharges

To service the proposed development, the Applicant proposes to construct a private wastewater treatment plant (WWTP) north of the Ōrewa River, near the eastern boundary of the Project site (refer Figure 2). Wastewater will be treated in four-stage Bardenpho activated sludge process, a membrane aerated biofilm reactor (MABR), and hollow-fibre ultrafiltration membranes at the WWTP (Apex 2026) before being conveyed to a constructed cascading wetland, located further north on site, for further polishing. Drainage from the wetland would ultimately enter the Ōrewa River, via surface runoff to a northern tributary, or via groundwater infiltration over time.

The 3.5 ha cascading wetland system has been designed to receive an average of 660 m^3/day of treated wastewater from the on-site WWTP. Modelled surface runoff and groundwater seepage flows from the

[1] Based on flow data simulated by WWLA (2026a) between 1972 and 2025, this is estimated to be 36.6 L/s.

wetland are summarised in Table 1 for summer low-flow, median-flow and peak wet-weather scenarios. The anticipated quality of water exiting the wetland, as estimated by WWLA (2026c), is summarised in Table 2.

Further details regarding the WWTP and constructed wetland are provided in the relevant servicing and wastewater design reports (Apex 2026, WWLA 2026c).

Table 1. Estimated wastewater discharge volumes exiting the constructed wetland (WWLA 2026c).

Scenario	Wetland discharge volumes (m^3/day)	
	Via surface runoff	Via groundwater
Summer / dry weather	484	44
Median	595	44
Peak wet weather	850	44

Table 2. Anticipated wastewater quality exiting the constructed wetland (WWLA 2026c).

Parameter	Wetland surface discharge	Wetland groundwater discharge
Total suspended solids	4	- *
$cBOD_5$	2.75	- *
E. coli (MPN/100 mL)	<1	<1
Ammoniacal nitrogen	<0.002	<0.002
Nitrate nitrogen	0.75**	<0.002
Total nitrogen	0.75	<0.002
Dissolved reactive phosphorus	0.007***	0.00021
Total phosphorus	0.06	0.0018

Notes: *Considered by WWLA (2026c) to be negligible; **conservatively assumed that the majority of nitrogen is present as nitrate-nitrogen; ***concentrations were estimated by dividing the predicted TP concentrations by 8.5, as advised by WWLA (WWLA 2026c).

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Figure 2. Milldale North - Water take, discharge and monitoring locations.

Legend

- Milldale North Fast-track area

Proposed water infrastructure

- Water reservoir
- WWTP
- Constructed wetland
- Surface water take

Receiving environment

- Monitoring sites
- Ōrewa River

SOURCES
Nearmaps Aerial Imagery (2026)

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 **1:8,000** @ A4

PROJECT NO.	10015
DRAWN BY:	A.G.
DATE:	13 August 2026

3 METHODOLOGY

3.1 Baseline Survey

3.1.1 Monitoring sites

To evaluate the baseline condition of the main environmental receptor for the proposed surface water take and discharges, Viridis surveyed the Ōrewa River and a key northern tributary on 17 March and 25 May 2026. These investigations were a targeted subset of the broader ecological field programme undertaken for the Project, as described in the EcIA prepared for the application (Viridis 2026).

Three representative sites were selected for in-stream habitat assessment, water quality monitoring and invertebrate sampling. These sites are described in Table 3 and presented in Figure 2. Sites were selected to characterise conditions upstream and downstream of the proposed surface water take and treated wastewater discharge locations. Further details of the monitoring methods applied at each site are provided in Sections 3.1.2 to 3.1.5.

Table 3. Location and site description for each monitoring site.

Site	Type	Description
Upstream	Control	Located within the main stem of the Ōrewa River, immediately upstream of the proposed surface water take location, and approximately 50 m downstream of the Gervin Road culvert.
Trib	Impact	Located within a northern tributary of the Ōrewa River, approximately 250 m upstream of its confluence with the main stem.
Downstream	Impact	Located within the main stem of the Ōrewa River, approximately 350 m downstream of the proposed direct discharge location.

3.1.2 In-stream habitat assessment

At each monitoring site, a survey reach of approximately 50 m was established. Estimates of in-stream habitat characteristics included channel morphology, streambed substrate composition, riparian shading and hydrological heterogeneity. The species of aquatic flora (i.e., periphyton or macrophytes present (if any) was noted.

3.1.3 Water quality

Spot measurements of dissolved oxygen (DO), water temperature, specific conductance (conductivity at 25 °C) and pH were recorded at each site using a calibrated hand-held meter.

In addition to in-situ measurements, a water quality sample was collected from each monitoring site and stored on ice, in a chilly bin, before being sent to an IANZ accredited laboratory for analysis of physicochemical parameters, nutrient concentrations, microbiological indicators, and suspend solids.

3.1.4 Macroinvertebrate sampling

Sampling

The semi-quantitative sampling method (NEMS 2022) was used to collect a composite sample from each site on 17 March 2026, using a kick net (400 mm wide, 0.5 mm mesh). Sampling actions were adapted to the local substrate and habitat types present. This included jabbing or sweeping the net through bank margins, edge vegetation, and/or macrophytes, and lightly disturbing soft substrates immediately upstream of the net to dislodge organisms. Each sampling action was followed by cleaning sweeps of the water column to collect dislodged organisms.

Substrates were sampled in proportion to their prevalence along the reach, with sampling undertaken at multiple locations within the survey reach. All samples were preserved in 70% ethanol for later identification and enumeration.

Analysis

Macroinvertebrates were identified and counted to a level suitable for calculating taxa richness, abundance, EPT taxa richness and % EPT, macroinvertebrate community index (MCI) and quantitative MCI (QMCI) following protocols outlined in NEMS (2022). EPT is the number of taxa that belong to the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) taxonomic groups.

Taxa richness is a measure of the number of invertebrate taxa in a sample. In general, watercourses that support a high number of invertebrate taxa are more likely to be of a higher environmental quality than watercourses with few taxa present. However, interpretation of taxa number data as an environmental indicator is dependent on the pollution sensitivity or tolerance of taxa present. Abundance is a measure of the total number of invertebrates in a sample. Invertebrate abundance tends to increase in the presence of organic or nutrient enrichment and decreases in the presence of toxic contaminants.

EPT taxa are generally sensitive to changes in water and habitat quality[2]. Percent EPT (%EPT) is a measure of the proportion of EPT taxa making up the community. EPT and % EPT values can provide a good indication of stream health, with high values indicating good water/habitat quality and low values indicating poor water/habitat quality.

The MCI and QMCI are biological indices that are based on species tolerance scores between 1 and 10, which are assigned to each taxon based on their sensitivity to organic enrichment. Different tolerance scores have been developed for hard-bottom (stony riffle) and soft-bottom (fine-sediment/silt dominated) stream habitats, recognising that community composition and tolerance patterns differ between these habitat types[3]. Accordingly, the soft-bottom variants of these indices (MCI-sb and QMCI-b) were used for this assessment to reflect the predominantly soft-bottom nature of the Ōrewa River and its tributaries.

MCI scores are based on presence/absence data, while the QMCI incorporates abundance data. Higher MCI and QMCI indicate better habitat and water quality. Scores were compared to the attribute bands and national bottom line (NBL) defined in the NPS-FM (MfE 2025). The relevant NPS-FM attribute bands and NBLs are reproduced in Table 4.

Table 4. NPS-FM estimates of stream health using MCI and QMCI indices.

NSP-FM attribute band	**Description**	**Numeric attribute ranges**	
		MCI	**QMCI**
A	Pristine conditions	>130	≥6.5
B	Mild pollution	≥110 and <130	≥5.5 and <6.5
C	Moderate pollution	≥90 and <110	≥4.5 and <5.5
National bottom line		90	4.5
D	Severe pollution	<90	<4.5

[2] Caddisflies belonging to the genera *Oxyethira* and *Paroxyethira* are not sensitive to nutrient enrichment so are excluded from EPT calculations, as per guidance in NEMS (2022).

[3] Not all taxa have tolerance scores. Scores were assigned based on those outlined in NEMS (2022).

3.1.5 Fish

Environmental DNA (eDNA) sampling, electric fishing, and a review of records from the NIWA New Zealand Freshwater Fish Database (NZFFD) was undertaken as part of the EcIA undertaken for the Project (Viridis 2026). Where relevant, these data were considered as supplementary information to inform the understanding of fish species likely to reside within the receiving environment. The reader is referred to Viridis (2026) for the detailed methodology.

Particular consideration was given to the replicate eDNA samples collected from the Ōrewa River main stem near the Downstream site, as these were most representative of the principal receiving environment assessed in this report.

3.2 Surface Water Quality Modelling

3.2.1 Overview

A simple mass-balance model was used to estimate receiving-water concentrations downstream of each discharge point. The model combined receiving-water and discharge flows and concentrations under three scenarios: summer low flow, median flow and peak wet weather.

The modelling focused on key constituents of concern relevant to the proposed discharges and the receiving environment (i.e., nutrients, microbiological indicators, and suspend solids[4]). It assumed complete and instantaneous mixing and did not account for in-stream attenuation, uptake or transformation.

Background concentrations of these constituents in the receiving environment were based on the average of baseline monitoring results for the relevant monitoring site. Values below laboratory detection limits were modelled as half the detection limit, as is standard practise. Potential changes in receiving-water quality associated with the transition from agricultural to urban runoff were not accounted for. Discharge concentrations were based on the estimated median quality exiting the wetland, as detailed in WWLA (2026c).

The scenario-specific flows, concentrations and resulting downstream water-quality predictions are presented in Section 5.2.

3.2.2 Guidelines

Existing stream water quality and projected quality under each scenario were compared against the following guidance:

- NPS-FM attribute bands (A to E, with A representing best water quality, and lower bands showing declining quality) (MfE 2025).
- ANZG (2018) default guideline values (DGVs) for physicochemical stressors (based on the 80th percentile of minimally impacted reference site data) and toxicants.

Ministry for the Environment (MfE 1992) guideline for soluble five-day carbonaceous biochemical oxygen demand (soluble $cBOD_5$) to limit the growth of sewage fungus.

[4] The proposed treatment trains provide very high removal of other constituents, including emerging organic contaminants (EOCs) and metals, as discussed in Apex (2026). 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.

These guideline values have been reproduced in Table 5. While such benchmarks are ideally applied to datasets spanning at least a full year to account for temporal variability (and noting the limitations of comparing guideline statistics to two baseline measurements), they have been used here as a proxy to provide context for interpreting modelled downstream effects.

Table 5. Guideline values for various water quality parameters.

Parameter	NPS-FM attribute bands[1]					ANZG DGV[2]	MfE (1992)
	A	B	C	D	E		
Total suspended solids						8.8	
Soluble $cBOD_5$ ($g\ O_2/m^3$)							2
Escherichia 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		0.24**	
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, where applicable; [1]as an annual median, unless stated otherwise; [2]physical or chemical stressors, for the 80^{th} %ile, unless stated otherwise and are based on the unnamed tributary's river environment classification (REC) of a warm wet, low elevation stream (Whitehead & Brooker 2020); *assessed against numeric attribute band for median concentrations, based on risk of *Campylobacter* infection for human contact. Whether values fell within Bands A-B determined based on other metrics – refer MfE (2024); ** toxicant DGV for 99% species protection at standard conditions of pH 7.5 and temperature 20°C.

4 RECEIVING ENVIRONMENT

4.1 Ōrewa River Catchment

The Ōrewa River catchment is located on Auckland's northeast coast and drains from the rural uplands south of Wainui to the Ōrewa Estuary, before entering Whangaparāoa Bay. Land use within the wider catchment comprises a mix of rural and residential land, and several areas currently undergoing urban expansion. The Project is located within the upper reaches of the catchment, and the Ōrewa River traverses the site from west to east. The reach of the river intersecting the site is fed by several small headwater tributaries draining retired pastoral land, including a northern tributary that joins the main stem near the centre of the Project site (Figure 2).

The Ōrewa River is known to occasionally cease flowing during prolonged summer dry periods (Lorrey *et al.* 2025), which is considered to reflect, at least in part, the influence of well-draining limestone geology within the catchment (LAWA 2026).

4.2 Existing Conditions

4.2.1 Habitat

During both site visits, habitat conditions across the three representative monitoring sites in the Ōrewa River were characterised by low flows and limited hydrological diversity. Run habitat dominated the main stem, while the Trib site comprised a pooled reach with deep standing water. Streambed composition was dominated by silt and sand, although cobble substrate was also present at the Upstream site. Water clarity was generally high within the main stem of the Ōrewa River but poor at the Trib site, where the water was murky and appeared to contain a relatively high load of fine suspended sediment. Substantial bank erosion was also evident at this site likely accounting for the suspended sediment load. Coarse organic material, particularly fallen logs, was common within the surveyed reaches.

Riparian shading across the watercourse was generally limited. Vegetation at the Upstream site consisted largely of overgrown reed sweet grass (*Glyceria maxima*) and common pasture grasses, while scattered exotic and native trees, including pine (*Pinus* sp.), mānuka (*Leptospermum scoparium*), tōtara (*Podocarpus totara*) and tree fern, provided partial cover further downstream. Aquatic macrophytes were abundant at each site, particularly during the first survey event. Species observed included *Nitella* sp., oxygen weed (*Lagarosiphon* sp.), water pepper (*Persicaria hydropiper*), watercress (*Nasturtium officinale*) and water purslane (*Ludwigia palustris*). Long filamentous periphyton was also observed at the unshaded Upstream site during the March site visit but not in May, reflecting the influence of warmer temperatures on periphyton growth.

As discussed in Viridis (2026), the section of the Ōrewa River (and its tributaries) that intersect the Project site exhibits clear evidence of historical modification, stock access and sedimentation associated with the site’s former pastoral land use.

Figure 3. Habitat conditions at the Upstream (a), Trib (b) and Downstream (c) monitoring sites on 17 March 2026. Pictured facing upstream.

4.2.2 Flow

As discussed in Section 4.1, the Ōrewa River is known to experience very low flows, and occasionally cease to flow in some reaches, during extended dry periods in summer. Auckland Council's hydrological monitoring site on the river at Kowhai Avenue, located approx. 1 km further downstream of the Project site, reports a seven-day mean annual low flow (MALF) of 1.1 L/s, based on a flow monitoring record extending from July 1980 to July 2024 (Lorrey *et al.* 2025).

To support the assessment of the proposed activities, WWLA simulated a long-term streamflow record for the period between 1972 and 2025, at locations within the catchment corresponding or in close proximity to the Upstream, Trib and Downstream monitoring sites. Each model was calibrated against flow data from the Auckland Council monitoring site at Kowhai Avenue (WWLA 2026a, 2026c and 2025d).

The simulated records indicate a highly variable flow regime in the catchment, characterised by frequent periods of both low and high flow. A summary of key hydrological statistics (MALF, median and FRE3 flows[5]) derived from the simulated record are presented in Table 6.

[5] Peak wet-weather conditions were represented using a river flow of three times the median flow. This threshold aligns with the FRE3 hydrological statistic, which describes the frequency of flow events exceeding three times the median and is commonly used as an indicator of freshes or flushing flows.

Table 6. Simulated flow statistics for each of the monitoring sites (WWLA 2026a, 2026c, 2026d).

Site	**Simulated flow statics (L/s)**		
	7-day MALF	**Median**	**FRE3 flow***
Upstream	0.36	37	111
Trib	0.013	1.1	3.3
Downstream	0.66	49	147

Notes: *Three times the median flow, a threshold used to estimate frequency of high flow events in hydrological assessments.

4.2.3 Water quality

A summary of spot water quality measurements and laboratory analyses for samples collected during the March and May surveys are presented in Table 7. The analytical reports for each sampling occasion are included as Appendix A. The key findings from the water quality data were:

- pH was circumneutral across all sites and within the range generally considered protective of New Zealand freshwater biota (6.5–8.0) (Davies-Colley *et al.* 2013).
- Although sampling did not coincide with peak warm-weather conditions, water temperature on each occasion was well below the 24°C threshold identified by Davies-Colley et al. (2013) for New Zealand freshwater fauna, providing some indication that thermal conditions were generally suitable for aquatic life during the monitoring period.
- DO concentrations were lowest during the March 2026 survey, likely reflecting the influence of warmer temperatures and lower summer flows. The lowest concentration, recorded at the Downstream site (2.9 g O_2/m^3), was below the NPS-FM national bottom line (4 g O_2/m^3) for a 1-day minimum. In contrast, DO concentrations recorded in May were consistent with NPS-FM attribute band A, indicating that DO on this occasion was not likely to cause stress for aquatic organisms.
- Specific conductance (i.e., conductivity at 25°C) was moderate and comparable between sites, consistent with 2005 medians reported for Auckland sites included the National River Water Quality Network (NRWQN)6 (MfE 2006).
- Soluble five-day carbonaceous biochemical oxygen demand ($cBOD_5$) concentrations were consistently below the laboratory limit of detection at each site, indicating minimal risk of oxygen depletion or sewage fungus growth.
- Total suspended solids (TSS) were equally low, often below detection, meeting the ANZG physicochemical stressor DGV for the relevant REC class (i.e., 8.8 g/m^3; (Whitehead & Brooker 2020).
- Microbiological indicators varied across the catchment, though Enterobacteriaceae was consistently the most elevated, particularly at the Downstream site. *Escherichia coli* (*E. coli*) counts were consistent with NPS-FM attribute band D (Orange) or E (Red), indicating a high human health risk. The elevated results are expected to be due to the agricultural landuse in the upper catchment.

[6] The NRWQN is a long-running national monitoring network (operating since 1989) that samples a selection of rivers across New Zealand to provide an assessment of state and trends in river water quality at the national scale.

- Across sites and sampling occasions, nitrogen was largely present in organic forms, particularly at the Downstream site. This was indicated by total Kjeldahl nitrogen (TKN) comprising a large proportion of total nitrogen, alongside low ammoniacal nitrogen concentrations, suggesting that nitrogen inputs were primarily associated with organic matter (e.g., decaying vegetation or animal wastes).
- Ammoniacal nitrogen fell within NPS-FM attribute band A (for annual median) at all sites, consistent with no expected toxicity effects (MfE 2025). Concentrations were also well below the ANZG toxicant DGV value of 0.24 g/m^3 for 99% species protection (under standard index conditions of 7.5 pH and 20°C).
- Nitrate nitrogen concentrations for each site were also within NPS-FM attribute band A, indicating that nitrate is not a key driver of ecological effects at the reach scale (considered a 'high conservation value system' under the NPS-FM). However, concentrations exceeded the more conservative ANZG DGV for nitrate as a physicochemical stressor (i.e., 0.065 g/m^3 at the relevant REC class).
- Phosphorus in the stream was predominantly present in particulate forms. Dissolved reactive phosphorus (DRP), which is generally considered the most bioavailable form of phosphorus, was consistently below the laboratory detection limit of 0.004 g/m^3 at each site. These concentrations are consistent with NPS-FM attribute band A and natural reference conditions, with no adverse effects associated with DRP enrichment expected (MfE 2025)[7].

Overall, the water quality sampling results indicate that the baseline receiving environment for the Project is generally of high quality with respect to key physicochemical and nutrient parameters, although microbiological contamination associated with the existing and historical pastoral setting is evident.

[7] Although the NPS-FM DRP attribute is derived from data for hard-bottomed rivers, it is used here to provide context for the potential risk of eutrophication within this predominantly soft-bottomed reach of the Ōrewa River.

Table 7. Water quality at the Ōrewa River and northern tributary monitoring sites.

Parameter	Monitoring site					
	Upstream		Trib		Downstream	
	Mar-26	May-26	Mar-26	May-26	Mar-26	May-26
In-situ measurements						
pH	7	6.8	6.5	6.5	6.6	6.9
Temperature (°C)	18.1	14.4	17.5	14.2	17.4	14.3
Dissolved oxygen (g/m^3)	6.7	10	4.4	9.8	2.9	8
Dissolved oxygen (%)	70	98	42	96	31	78
Specific conductance (µS/cm)*	230	184	214	222	224	183
Laboratory analysis						
Total suspended solids	<6	<4	<6	4	<6	<4
Soluble $cBOD_5$	<2	<2	<2	<2	<2	<2
Enterobacteriaceae	13000	<100	9600	820	5300	2800
Faecal coliforms	230	79	330	170	490	1600
Escherichia coli	230	49	330	170	490	1600
Total Kjeldahl nitrogen	0.4	0.34	0.38	0.26	0.35	0.29
Total ammoniacal nitrogen	0.012	<0.01	0.02	0.033	<0.01	<0.01
Nitrite nitrogen	<0.002	<0.002	0.011	<0.002	<0.002	<0.002
Nitrate nitrogen	0.008	0.044	0.086	0.032	<0.002	0.027
Total nitrogen	0.41	0.38	0.47	0.3	0.35	0.32
Dissolved reactive phosphorus	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Total phosphorus	0.027	0.025	0.036	0.022	0.022	0.019

Notes: All units are in g/m^3 unless state otherwise; $cBOD_5$ is five-day carbonaceous biochemical oxygen demand; *conductivity at 25°C.

4.2.4 Macroinvertebrates

The results of macroinvertebrate sampling undertaken in the Ōrewa River and main tributary are summarised in Table 8, with raw taxonomic data provided in Appendix B.

The macroinvertebrate community at each site was dominated by pollution-tolerant taxa, particularly mud snails (*Potamopyrgus* sp.) and crustaceans, such as ostracods (Ostracoda) and *Paracalliope* sp., which are commonly associated with slow-flowing, weedy or silty streams (Landcare Research 2026a, 2026b). EPT taxa[8] were absent from all sites. The only taxon with a comparatively high soft-bottomed tolerance score was limited to one chironomid midge in the *Polypedilum* genus, recorded at the Trib site. However, larvae within this genus are known to occur across streams of widely varying water quality and are therefore considered to have limited value as indicators of ecological condition (Landcare Research 2026c).

Total macroinvertebrate abundance was broadly comparable between sites and did not indicate a clear spatial pattern. Taxonomic richness was lowest at the Downstream site, where only eight distinct taxa were recorded, and highest at the Trib site, where 19 taxa were identified.

MCI-sb and QMCI-sb scores for each site fell within NPS-FM attribute band D for ecosystem health, and below the relevant NBL. Such low scores are generally associated environments affected by severe organic pollution or nutrient enrichment, where macroinvertebrate communities are dominated by taxa that are relatively insensitive to these stressors (MfE 2025). However, the low nutrient concentrations and generally good physicochemical water quality described in Section 4.2.3 suggest that the results are more reflective of degraded habitat conditions and a high sediment load than pollution or nutrient enrichment. At the monitoring sites, these conditions include limited shading, low habitat diversity, high sediment loads, and influence of historical channel modification associated with pastoral land sue (refer Section 4.2.1).

Overall, the macroinvertebrate results indicate that the Ōrewa River and its main tributary were in a degraded ecological condition. The low biotic index scores, absence of EPT taxa and dominance of tolerant organisms were consistent with the degraded habitat conditions observed on site.

Table 8. Summary of macroinvertebrate sampling results for Ōrewa River monitoring sites.

Parameter	Monitoring site		
	Upstream	Trib	Downstream
Abundance	206	200	217
Taxa richness	13	19	8
EPT taxa richness	0	0	0
%EPT abundance	0	0	0
MCI-sb	57	51	52
QMC-sb	2.2	2	2.5
NPS-FM attribute band*	D	D	D

Notes: *Both MCI-sb and QMCI-sb scores fell within the same attribute band for each site.

[8] Caddisflies belonging to the genera *Oxyethira* and *Paroxyethira* are not sensitive to nutrient enrichment so are excluded from EPT calculations, as per guidance in NEMS (2022).

4.2.5 Fish

A review of the NZFFD for the Ōrewa River catchment shows shortfin eel (*Anguilla australis* – not threatened) and the pest fish gambusia (*Gambusia affinis* – listed unwanted organism) have been recorded previously, although there have not been any recent records added to the database. Other indigenous species recorded downstream within the wider Ōrewa River catchment have included banded kōkopu (*Galaxias fasciatus* – At Risk – Naturally Uncommon), longfin eel (*Anguilla dieffenbachii* – At-Risk, declining), īnanga (*Galaxias maculatus* – Threatened – Nationally Vulnerable), kōura (*Paranephrops planifrons* – not threatened), freshwater shrimp (*Paratya curvirostris* – not threatened), and giant bully (*Gobiomorphus gobioides* – At-Risk, naturally uncommon).

Replicate eDNA samples collected from the Ōrewa River main stem between the Trib and Downstream sites detected a broadly similar fish assemblage to that indicated by the NZFFD records. Additional detections included goldfish (*Carassius auratus* - Introduced and Naturalised), redfin bully (*Gobiomorphus huttoni* - At Risk – Naturally Uncommon), and fish within the order Cypriniformes, which includes carps and minnows (though the signal was comparatively weak and occurred in only one replicate).

Electric fishing undertaken for the EcIA within several tributaries across the Project site did not capture any fish (Viridis 2026). However, these results do not demonstrate that fish are absent from the wider receiving environment. The fishing survey was undertaken during winter (in July 2026) and primarily targeted smaller tributary reaches, where fish abundance and detectability may be lower and vary seasonally. The eDNA and NZFFD results provide stronger evidence that a range of indigenous and introduced fish species may occur within the main stem of the Ōrewa River. As discussed in the EcIA (Viridis 2026), the Project site is situated relatively close to the coast, and some permanent reaches of the Ōrewa River and its tributaries contain long grasses, sedges and dense marginal vegetation. These characteristics may provide suitable spawning habitat for īnanga.

Overall, the available information indicates that the main stem of the Ōrewa River is likely to support a mixed indigenous and introduced fish community, including several species with elevated conservation status. Despite the predominantly agricultural land use within the catchment, and the highly modified nature of many of its tributaries, the potential presence of longfin eel, īnanga and giant bully gives the receiving environment a moderate freshwater ecological value for fish.

5 ASSESSMENT OF EFFECTS

5.1 Surface Water Take

5.1.1 Overview

The proposed surface water take is expected to alter flows in the Ōrewa River during periods when river flows exceed the median. Accordingly, the take will not affect low- to moderate-flow conditions, and river flows at or below the median would remain unchanged from the natural flow regime. Potential effects would therefore be limited to higher-flow periods and relate primarily to changes in flushing flows, instream habitat availability, and risks to fish associated with the intake structure.

5.1.2 Effects on flushing flows

Higher-flow events contribute to the natural ecological function of rivers by mobilising deposited sediment, removing accumulated macrophytes and periphyton, maintaining channel form, and disrupting extended periods of reduced oxygen and high eutrophication risk. Reducing the magnitude of these events through extraction of surface water could therefore lessen their flushing effectiveness and increase the potential for sediment or aquatic vegetation to accumulate within a watercourse.

However, the proposed abstraction regime is expected to retain the river's flushing function. Modelling undertaken by WWLA (2026a) indicates that the FRE3 statistic, representing the annual frequency of events exceeding three times the median flow, would remain virtually unchanged under the proposed take. Although the magnitude of some moderate- to high-flow events may be reduced by up to 30% when above the median, the frequency of flushing events would be maintained. The relative reduction in flow would also diminish downstream as tributary inflows and the Project's treated wastewater discharges contribute additional flow to the river (refer Section 5.2.2).

On this basis, the proposed take is not expected to materially reduce the frequency or ecological effectiveness of flushing flows. A small positive effect may arise from reduced bank erosion and limited attenuation of peak flows during some higher-flow events.

5.1.3 Effects on instream habitat

River flow influences water depth, wetted width, current velocity and the availability of habitat for fish and macroinvertebrates. Reductions in flow can decrease the extent and connectivity of wetted habitat, with the greatest potential for adverse effects occurring during low-flow periods when habitat is already constrained.

The proposed abstraction regime would avoid these more sensitive conditions by limiting the take to periods when flows exceed the median. The operating rules would also prevent abstraction from reducing flows below the median, meaning the take would not increase the frequency or duration of low-flow conditions, including prolonged summer base-flow periods.

Although some reduction in water depth, wetted width or velocity may occur during moderate- to high-flow abstraction periods, these changes would occur when instream habitat is relatively abundant as a result of increased flows and are expected to be small and temporary. Any localised reduction in habitat availability would also lessen downstream due to additional inflows (i.e., the Project's treated wastewater discharges - refer Section Effects on flow).

On this basis, the proposed take is not expected to result in a material loss or alteration to instream habitat or adversely affect habitat availability for fish or macroinvertebrates.

5.1.4 Effects on fish

Surface water intakes can affect fish by drawing them onto and holding them against the intake screen or by entraining them into the abstraction system. The likelihood of these effects depends on the intake location and configuration, screen aperture, approach and sweep velocities, and the swimming abilities and life stages of fish present in the river.

The preliminary intake design incorporates a fish screen with a 1.5 mm aperture and limits the approach velocity at the screen to less than 0.15 m/s. The fine screen aperture is expected to substantially reduce the potential for fish to pass into the abstraction system, while the low approach velocity will reduce the likelihood of fish being drawn toward or held against the screen. This velocity is below the NIWA good-practice criterion of 0.3 m/s for through-screen velocity, which is intended to prevent the entrainment of most native fish (Hickford *et al.* 2023). It is also below the mean sustained swimming speed(0.2 m/s) and critical swimming speed (0.28 m/s) of īnanga (Franklin *et al.* 2025). Īnanga are considered likely to be among the weaker-swimming fish species present within the affected reach of the Ōrewa River (refer Section 4.2.5).

The final screen configuration, intake level and equipment specifications will be confirmed during detailed design, with input from a freshwater ecologist and reference to current good-practice guidance (Franklin *et al.* 2025; Hickford *et al.* 2023; Irrigation NZ 2023). The design will account for the swimming abilities, behaviour and life stages of fish likely to occur at the site and will seek to maintain suitable approach and sweep velocities across the screen.

Subject to these measures being incorporated into the final design, the proposed intake is expected to present a low risk of fish becoming trapped against the screen or entrained into the abstraction system and is unlikely to result in a material adverse effect on fish communities within the Ōrewa River.

5.1.5 Summary

The potential effects of the proposed high-flow surface water take are expected to be managed through:

- Restricting abstraction to periods when river flows exceed the median.
- Limiting the abstraction volume so that moderate to high flow events are reduced by only 30% if flows are above the median.
- Applying a maximum abstraction rate of 25 L/s.
- Retaining the frequency of larger flushing events.
- Incorporating an appropriately designed fish screen and low intake velocity (i.e., 0.15 m/s).

In addition, flow monitoring will be implemented at the take to confirm compliance with the proposed abstraction limits (refer WWLA 2025a), together with the ecological monitoring recommended in Section 6 to verify that effects on the receiving environment remain within those assessed.

Subject to these measures and confirmation of the final intake design, the proposed surface water take is expected to have a low level of effect on river flows, instream habitat and freshwater ecology.

5.2 Treated Wastewater Discharges

5.2.1 Modelling results

Surface water quality modelling results for the Project's treated wastewater discharges, comprising surface water runoff and drainage from the constructed wetland system, are presented in Table 9 alongside baseline water quality at the Downstream site. Modelling considered dry-weather, average-flow and peak wet-weather scenarios, using the discharge inputs detailed in Section 2.2.3 and the methodology in Section 3.2. Modelled receiving-water quality under each scenario is compared against the guidance in Section 3.2.2, with cells in Table 9 shaded to indicate compliance with this guidance.

The peak wet-weather scenario also incorporates the proposed surface water take, capped at 30% of total river flow, which reduces baseline river flow from 147 L/s to 103 L/s.

5.2.2 Effects on flow

The proposed treated wastewater discharges will alter downstream flows differently under the three modelled scenarios, as shown in Table 9.

During the dry summer periods, discharges from the constructed wetland will supplement naturally low flows in the downstream reaches of the Ōrewa River. This is expected to have positive ecological effects by providing more permanent instream habitat and flow continuity. It may also reduce the potential for elevated water temperatures, low dissolved oxygen concentrations and excessive aquatic plant or algal growth, typically associated with prolonged dry periods.

Under median-flow conditions, the discharges are expected to increase river flows by approximately 15%. While this may increase the total area of aquatic habitat available within the reach, it could also alter habitat type and heterogeneity, for example by converting shallow riffles or margins into deeper, faster-flowing runs. However, given the existing dominance of run habitat and fine bed substrates in the main stem (refer Section 4.2.1), the projected change is not expected to materially alter habitat type or the river's overall hydrological character.

Under the peak wet-weather scenario, river flow will remain lower than baseline due to the reduction associated with the upstream surface water take. The ecological implications of this temporary reduction during higher-flow periods are assessed in Section 5.1.

Under each scenario, the discharges have the potential to increase localised erosion, scour or sediment mobilisation, particularly where discharges interact with unstable banks or fine bed material. However, the resulting disturbance is therefore expected to be no more than what occurs naturally when the river experiences periods of higher flushing flows. The constructed wetland system also offers land contact and flow dissipation before water enters the receiving environment (WWLA 2026c). Subject to appropriate detailed design, the discharges are therefore not expected to cause material bed or bank erosion, channel instability or increased fine-sediment loading.

Overall, the proposed discharges are expected to have a generally positive effect on flow permanence and aquatic habitat during dry-weather and average-flow conditions. Potential adverse effects associated with erosion, scour or changes in habitat character are expected to be minor, provided that the discharge systems are designed to adequately dissipate flow energy.

Table 9. Ōrewa River quality at the Downstream site, before and after the proposed discharges.

Parameter	Baseline Ōrewa River quality	Ōrewa River quality after discharges		
		Scenario 1: Dry	Scenario 2: Average	Scenario 3: Wet
Flow (L/s)	Varies based on scenario (refer Table 6)	6.8	56	113
Total suspended solids	<3	3.6	2.7	2.6
Soluble $cBOD_5$ ($g\ O_2/m^3$)	<2	2.4	1.2	1.1
Escherichia coli (MPN/100 mL)*	1,045	104	908	950
Ammoniacal nitrogen	<0.01	0.0014	0.004	0.005
Nitrate nitrogen	0.014	0.62	0.10	0.078
Total nitrogen	0.34	0.65	0.38	0.37
Dissolved reactive phosphorus**	<0.004	0.006	0.0026	0.0025
Total phosphorus	0.021	0.05	0.03	0.02

Notes: Units g/m^3 unless stated; Values rounded to two significant figures; $cBOD_5$ = carbonaceous five-day biochemical oxygen demand; Values meeting NPS-FM attribute A are presented in light green, and attribute E (where applicable) in dark red; Exceedances of an ANZG DGV for a physiochemical stressor (or, in the case of BOD, MfE guidance for preventing sewage fungus growth) have been shown in red text, and compliance has been shown in green; *compared against median concentrations, based on *Campylobacter* infection risk for human contact; **based on the conservative assumption that the majority of phosphorus discharged will be dissolved reactive phosphorus; ^ the modelled peak wet-weather scenario also accounts for the proposed surface water take, which is limited to 30% of flows. Under this scenario, the baseline river flow was reduced from 147 L/s to 103 L/s.

5.2.3 Effects on water quality

The predicted downstream water quality indicates that the overall condition of the Ōrewa River will be largely maintained under each discharge scenario. This reflects the close alignment between baseline receiving-water quality and the predicted quality of the treated wastewater. In particular:

- TSS is predicted to increase slightly under each scenario but remains below the ANZG physicochemical stressor DGV of 8.8 g/m³ for the relevant REC class (Whitehead & Booker 2020).
- A small increase in soluble $cBOD_5$ is predicted during the summer scenario, from below the analytical detection limit to approximately 2.4 g/m³. Although this marginally exceeds the MfE (1992) guideline of 2 g/m³ for limiting sewage-fungus growth, the increase is small and not accompanied by other conditions favourable for substantial growth (i.e., high nutrients). Appreciable sewage-fungus growth or oxygen depletion relative to the baseline condition is therefore unlikely.
- Concentrations of *E. coli* and ammoniacal nitrogen are predicted to decrease, representing a net improvement in two key water-quality stressors.
- Nitrate nitrogen is predicted to increase above the applicable ANZG physicochemical DGV but remains within NPS-FM attribute band A for toxicity effects. The ANZG DGV represents the 80th percentile of reference-site concentrations for warm, wet, low-elevation streams and identifies departure from reference conditions rather than a direct ecological effect threshold. Maintenance of band A indicates that effects on even sensitive species are unlikely (MfE 2025).
- Total nitrogen is predicted to remain above the applicable ANZG DGV of 0.292 g/m³, consistent with the existing baseline condition.
- DRP remains within NPS-FM attribute band A for eutrophication effects. Although this attribute is informed largely by data from hard-bottom streams, concentrations within band A are associated with a low risk of enrichment effects.
- Total phosphorus is predicted to increase above the applicable ANZG DGV under at least the summer and median-flow scenarios. However, the more bioavailable fraction, DRP, is predicted to remain very low in the receiving environment.

Overall, the proposed discharge is predicted to result in only small changes to selected water-quality parameters, while maintaining the compliance NPS-FM bands for toxicity and DRP enrichment. Although some ANZG physicochemical DGVs are exceeded, these values indicate departure from reference-site conditions rather than direct adverse-effect thresholds. Provided the treated wastewater quality specified by WWLA (2026c) is consistently achieved, effects on receiving-water quality are therefore assessed as low.

5.2.4 Effects on fauna

As outlined in Section 5.2.3, the proposed discharge is expected to largely maintain the existing water-quality condition of the receiving environment. Although small increases are predicted for selected parameters, the discharge is not expected to result in a material increase in the principal drivers of toxicity or eutrophication, which can impact fish and invertebrate health.

The existing macroinvertebrate community in the Ōrewa River is strongly dominated by pollution-tolerant taxa, with MCI and QMCI scores indicative of degraded ecological condition (Section 3.2.4).

Across the monitored sites, generally more sensitive EPT taxa were absent. Given the limited magnitude of the predicted water-quality changes and the low abundance of sensitive taxa, a measurable decline in macroinvertebrate community condition is unlikely. The small, predicted increase in TSS is also not expected to materially affect benthic habitat or feeding conditions.

Effects on fish are similarly expected to be negligible. The modelled concentrations remain below levels associated with appreciable toxicity, and no material change is predicted in the key water-quality parameters that influence fish health, habitat suitability or food availability. The slight summer increase in soluble $cBOD_5$ is also unlikely to result in sufficient microbial growth or oxygen demand to affect fish habitat.

Overall, provided the treated wastewater quality specified by WWLA (2026c) is consistently achieved, the proposed discharge is not expected to result in adverse effects on the macroinvertebrate or fish communities of the receiving environment.

6 RECOMMENDATIONS

Based on the assessment undertaken in this report, an ecological and water quality monitoring programme is recommended to verify that discharge effects remain consistent with predictions, identify any unforeseen changes at an early stage, and support an appropriate management response where required.

Accordingly, the following monitoring conditions are recommended:

- The consent holder must undertake water quality monitoring and ecological surveys at the following locations within the Ōrewa River catchment:
  - At the 'Upstream' control site within the main stem of the Ōrewa River, situated upstream from the surface water take location.
  - A northern tributary impact site, 'Trib', situated downstream from the constructed wetland discharge.
  - A second impact site, 'Downstream', situated in the main stem of the Ōrewa River, downstream of its confluence with the northern tributary.

Monitoring should be undertaken by a suitably qualified ecologist or environment scientist and include the following.

- 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 each year.
  - 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, during summer, 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 summer, in consultation with the Consent Authority, provided monitoring demonstrates no significant discharge-related deterioration in ecological condition.
- Each ecological survey 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 discharge.
- Where monitoring identifies a deterioration in water quality and/or ecological health that is attributable to the operation of the surface water take or wastewater 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 activity-related effects.

7 CONCLUSIONS

Based on the receiving-water modelling and baseline ecological survey data, the surface water take and treated wastewater discharges proposed for the Project are not expected to result in significant adverse effects on water quality or freshwater ecology within the Ōrewa River catchment. Restricting abstraction to periods in which the river flows above the median is expected to avoid effects during sensitive low-flow periods, and the proposed maximum abstraction rate will maintain the frequency and ecological function of flushing flows. Subject to finalising an appropriately screened intake with low approach velocities, risks to fish and effects on instream habitat are expected to remain low.

The treated wastewater discharges are predicted to result in only small changes to receiving-water quality, while generally maintaining existing compliance with NPS-FM attribute bands and avoiding appreciable toxicity, enrichment or sediment-related effects. The discharges are also expected to support greater flow permanence and habitat availability during dry periods, with potential adverse effects on macroinvertebrate and fish communities assessed as low, provided the specified treatment performance and discharge-design measures are achieved. The recommended monitoring conditions provide an appropriate verification and adaptive-management framework to confirm these outcomes and ensure that any unforeseen discharge-related changes are identified and addressed.

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WWLA 2026c. Treated Wastewater Cascading Wetland: Milldale Stages 14-17 Fast-Track. A report prepared by Williamson Water & Land Advisory Limited for Fulton Hogan Land Development Limited. 10 August 2026. Revision 2.

WWLA 2026d. Milldale North - Simulated Flow Record. Data supplied by Williamson Water & Land Advisory Limited. 27 May 2026.

Appendix A
Water Quality Analytical Reports

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Certificate of Analysis

Client:	Viridis Limited	**Lab No:**	4139784 SPv2
Contact:	Amanda Good C/- Viridis Limited PO Box 301709 Albany Auckland 0752	**Date Received:**	17-Mar-2026
		Date Reported:	30-Mar-2026
		Quote No:	143905
		Order No:	
		Client Reference:	
		Submitted By:	Amanda Good

Sample Type: Aqueous

Sample Name:		Trib 17-Mar-2026 11:00 am	Downstream 17-Mar-2026 12:00 pm	Upstream 17-Mar-2026 1:00 pm
Lab Number:		4139784.1	4139784.2	4139784.3
Individual Tests				
Total Suspended Solids	g/m^3	< 6 #1	< 6 #1	< 6 #1
Total Nitrogen	g/m^3	0.47	0.35	0.41
Total Kjeldahl Nitrogen (TKN)	g/m^3	0.38	0.35	0.40
Total Phosphorus	g/m^3	0.036	0.022	0.027
Dissolved C-Biochemical Oxygen Demand ($CBOD_5$)	$g\ O_2/m^3$	< 2	< 2	< 2
Enterobacteriaceae*	cfu / 100mL	9,600	5,300	13,000
Faecal Coliforms and E. coli profile				
Faecal Coliforms	MPN / 100mL	330	490	230
Escherichia coli	MPN / 100mL	330	490	230
Nutrient Profile				
Total Ammoniacal-N	g/m^3	0.020	< 0.010	0.012
Nitrite-N	g/m^3	0.011	< 0.002	< 0.002
Nitrate-N	g/m^3	0.086	< 0.002	0.008
Nitrate-N + Nitrite-N	g/m^3	0.097	0.003	0.010
Dissolved Reactive Phosphorus	g/m^3	< 0.004	< 0.004	< 0.004

Analyst's Comments

#1 There was insufficient sample to filter the usual amount for the Total Suspended Solids test, so the detection limit is higher than normal.

Appendix No.1 - Chain of Custody

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, Glass Fibre for Soluble BOD	Sample filtration through glass fibre filter.	-	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	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

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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, automated phenol/hypochlorite colorimetry. APHA 4500-N_{org} D (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
Dissolved C-Biochemical Oxygen Demand ($CBOD_5$)	Filtered sample (1.2um glass fibre filter), Incubation 5 days, $CBOD_5$, DO meter, nitrification inhibitor, seeded. APHA 5210 B (modified) : Online Edition.	2 g O_2/m^3	1-3
Enterobacteriaceae*	Membrane filtration, Count on VRBG agar, Incubated at 37°C for 24 hours, Confirmation. APHA 9.62 5th Ed (modified).	1 cfu / 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 18-Mar-2026 and 30-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.

K Harrison

Kim Harrison MSc
Client Services Manager - Environmental

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Certificate of Analysis

Client:	Viridis Limited	**Lab No:**	4224421 SPv1
Contact:	Amanda Good C/- Viridis Limited PO Box 301709 Albany Auckland 0752	**Date Received:**	25-May-2026
		Date Reported:	04-Jun-2026
		Quote No:	143905
		Order No:	
		Client Reference:	
		Submitted By:	Amanda Good

Sample Type: Aqueous

Sample Name:		Milldale North - US 25-May-2026 1:00 pm	Milldale North - DS 25-May-2026 12:00 pm	Milldale North - Trib 25-May-2026 12:30 pm	Waterloo Creek - Upstream 25-May-2026 10:30 am	Orewa River - Downstream 25-May-2026 11:15 am
Lab Number:		4224421.1	4224421.2	4224421.3	4224421.4	4224421.5
Individual Tests						
pH	pH Units	7.1	6.9	6.9	7.9	7.8
Total Suspended Solids	g/m³	< 4 #1	< 4 #1	4	< 4 #1	13
Total Nitrogen	g/m³	0.38	0.32	0.30	0.59	0.86
Total Kjeldahl Nitrogen (TKN)	g/m³	0.34	0.29	0.26	0.49	0.86
Total Phosphorus	g/m³	0.025	0.019	0.022	0.035	0.110
Dissolved C-Biochemical Oxygen Demand ($CBOD_5$)	g O_2/m³	< 2	< 2	< 2	< 2	2
Enterobacteriaceae*	cfu / 100mL	< 100	2,800	820	3,700	1,560
Faecal Coliforms and E. coli profile						
Faecal Coliforms	MPN / 100mL	79	1,600	170	1,600	240
Escherichia coli	MPN / 100mL	49	1,600	170	1,600	130
Nutrient Profile						
Total Ammoniacal-N	g/m³	< 0.010	< 0.010	0.033	< 0.010	< 0.010
Nitrite-N	g/m³	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Nitrate-N	g/m³	0.044	0.027	0.032	0.098	< 0.002
Nitrate-N + Nitrite-N	g/m³	0.045	0.028	0.034	0.099	< 0.002
Dissolved Reactive Phosphorus	g/m³	< 0.004	< 0.004	< 0.004	0.009	0.015

Analyst's Comments

#1 There was insufficient sample to filter the usual amount for the Total Suspended Solids test, so the detection limit is higher than normal.

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, Glass Fibre for Soluble BOD	Sample filtration through glass fibre filter.	-	1-5
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-5
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	1-5

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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	1-5
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	1-5
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	1-5
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) : Online Edition.	0.002 g/m^3	1-5
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.	0.0010 g/m^3	1-5
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	1-5
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, automated phenol/hypochlorite colorimetry. APHA 4500-N_{org} D (modified): Online Edition.	0.10 g/m^3	1-5
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) : Online Edition.	0.004 g/m^3	1-5
Total Phosphorus	Total phosphorus digestion, automated ascorbic acid colorimetry. Flow Injection Analyser. APHA 4500-P H (modified) : Online Edition.	0.002 g/m^3	1-5
Dissolved C-Biochemical Oxygen Demand ($CBOD_5$)	Filtered sample (1.2um glass fibre filter), Incubation 5 days, $CBOD_5$, DO meter, nitrification inhibitor, seeded. APHA 5210 B (modified) : Online Edition.	2 g O_2/m^3	1-5
Enterobacteriaceae*	Membrane filtration, Count on VRBG agar, Incubated at 37°C for 24 hours, Confirmation. APHA 9.62 5th Ed (modified).	1 cfu / 100mL	1-5
Nutrient Profile		0.0010 - 0.010 g/m^3	1-5
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	1-5
Escherichia coli	MPN count in LT Broth at 35°C for 48 hours, TBX confirmation. APHA 9221 F (modified) : Online Edition.	2 MPN / 100mL	1-5

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

Testing was completed between 26-May-2026 and 03-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.

Kim Harrison MSc
Client Services Manager - Environmental

Appendix B
Raw Macroinvertebrate Data

Table B1. Macroinvertebrate counts for samples collected at Ōrewa River sites on 17 March 2026.

Group	Taxa	MCI-hb	MCI-sb	Upstream	Trib	Downstream
Trichoptera	Oxyethira	2	1.2	31	1	3
Trichoptera	Paroxyethira	2	3.7	2	0	0
Odonata	Xanthocnemis	5	1.2	1	4	1
Hemiptera	Microvelia	5	4.6	0	1	1
Hemiptera	Sigara	5	2.4	2	1	0
Coleoptera	Enochrus	5	2.6	1	0	0
Diptera	Austrosimulium	3	3.9	8	0	0
Diptera	Muscidae	3	1.6	0	1	0
Diptera	Orthocladiinae	2	3.2	2	2	0
Diptera	Polypedilum	3	8	0	1	0
Collembola	Collembola	6	5.3	0	0	1
Crustacea	Copepoda	5	2.4	0	1	0
Crustacea	Isopoda	5	4.5	1	0	0
Crustacea	Ostracoda	3	1.9	1	46	0
Crustacea	Paracalliope	5	5.5	10	2	27
Acarina	Acarina	5	5.2	0	3	0
Mollusca	Ferrissia	3	2.4	0	1	0
Mollusca	Gyraulus	3	1.7	0	1	0
Mollusca	Lymnaeidae	3	1.2	0	8	0
Mollusca	Physella (Physa)	3	0.1	0	2	2
Mollusca	Potamopyrgus	4	2.1	145	113	174
Oligochaeta	Oligochaeta	1	3.8	1	0	0
Hirudinea	Hirudinea	3	1.2	1	5	0
Platyhelminthes	Platyhelminthes	3	0.9	0	6	8
Nemertea	Nemertea	3	1.8	0	1	0

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