Quarterly Water Quality Report

Kakahu River Environmental DNA (eDNA) & Biomonitoring Results

January 2024 to March 2024

Key Findings

eDNA

- eDNA sampling was undertaken at seven locations in the Kakahu River in March 2024, when the river was flowing at 23 L/s (low flow).
- **Kōura**, **freshwater mussels**, **longfin eel**, **shortfin eel**, **upland bully**, **common bully**, **Canterbury galaxias**, **torrent fish** and **brown trout** were all detected in the Kakahu River using eDNA.
- The ecological health of the Kakahu River was rated as either ***Average*** or ***Poor*** using the eDNA method.
- Future work will look at undertaking an eDNA survey when flows in the Kakahu River are higher and exploring other sites within the river.

Biomonitoring

- SLR Consulting undertook a biomonitoring survey in the Kakahu River in March 2024, when the river was flowing at 17 – 18 L/s (low flow).
- The **macroinvertebrate community index (MCI)** scores in the Kakahu River were similar, with waterway ratings of **Good** and **Fair**.
- The **quantitative macroinvertebrate community index (QMCI)** scores in the Kakahu River were higher upstream of the discharge point compared with downstream, with waterway ratings of **Good** and **Fair**.
- **Longfin eel**, **shortfin eel**, **upland bully**, **common bully** and **trout** were caught in the Kakahu River. These fish were identified upstream and downstream of the discharge point.
- SLR Consulting concluded that the collective biomonitoring results from this survey and previous surveys do not indicate any consistent patterns or significant adverse effects of the consented discharge on the freshwater communities of the Kakahu River.

Introduction

The January – March 2024 quarterly water quality report focuses on environmental DNA (eDNA) and biomonitoring results from surveys of the **Kakahu River** in March 2024.

eDNA monitoring in the Kakahu River was undertaken by Opuha Water Limited (OWL) to obtain an overview of the ecology and biodiversity in the river. eDNA is material that is left behind by organisms (fish, insects, birds *etc.*) as they move through their environment – this material can be skin, hair, scales, mucus and faeces.

eDNA can identify thousands of species of fish, insects, crustaceans, birds, mammals, amphibians, plants, fungi, bacteria and other organisms. Although the eDNA method does have the capability to provide some information about species abundance, it is generally recommended to be used as a presence/absence tool, and this is the way the results were used in this study.

The eDNA is collected by pushing water through a small filter which captures the eDNA (Figure 1). The sample is then preserved and sent for analysis to determine the organisms that left the eDNA behind. eDNA kits were obtained and analysed by Wilderlab (https://www.wilderlab.co.nz/).

Figure 1: Syringe and filter used to collect eDNA sample.

The types of species identified through eDNA allows a score to be attributed to the waterway, along with a description of the ecological health, in a similar way to the macroinvertebrate community index (MCI) (https://www.wilderlab.co.nz/tici). Depending on the eDNA score achieved, the ecological health of the waterway can be rated from *Pristine* to *Very Poor,* with higher scores indicating better ecological health (Table 1).

Table 1: eDNA scores and corresponding ecological health rating.

eDNA Score	Ecological Health Rating
>120	Pristine
110 – 120	Excellent
100 – 110	Good
90 – 100	Average
80 – 90	Poor
<80	Very Poor

The **biomonitoring** survey was undertaken by SLR Consulting (formerly 4Sight Consulting). This survey included macroinvertebrate, fish, periphyton and fine sediment monitoring. Biomonitoring surveys are undertaken to investigate the impact that the consented OWL discharge has on the Kakahu River, which is required under OWL's consent conditions for the scheme.

Macroinvertebrates are small animals without backbones that live on or just below the stream bed and are an important food source for animals further up the food chain, such as wading birds and fish. Macroinvertebrates include snails, worms, insects, larvae of insects and kōura (freshwater crayfish).

The macroinvertebrate community index (MCI) and the quantitative macroinvertebrate community index (QMCI) are two metrics widely adopted by regional councils in New Zealand to assess the health of waterways. In general terms, the MCI looks at the presence and absence of species, whereas QMCI also considers the number or

abundance of these species. Similarly to the eDNA scores, the MCI and QMCI scores (higher scores indicate better waterway health) can also be used to provide descriptive categories of the condition of the waterway such as **Excellent**, **Good,** **Fair** and **Poor**.

eDNA Results

eDNA was sampled at seven locations in the Kakahu River: *upstream of OWL discharge*, *downstream of Kakahu Gorge*, *Hornsey Road/Morrison's Bridge*, *Hall Road*, *close to Ford Road*, *Winchester Hanging Rock Road Bridge (WHR Bridge)* and *Earls Road* (Figure 2).

Six eDNA samples were collected *upstream of the OWL discharge* and *downstream of Kakahu Gorge*, with three samples collected at all other locations.

Samples were collected on 6 March 2024At the time of sampling the flow in the Kakahu River was low, 23 L/s, which is more than five times lower than the median flow of 120 L/s.

Sampling was undertaken approximately two weeks after the OWL discharge ceased – however, the discharge was turned on for one day approximately one week before the survey – and three weeks after a moderate to high flow event of 2,000 L/s.

Species identified in the Kakahu River

Numerous organisms were identified by eDNA in the Kakahu River, these included fish, insects, birds, crustaceans, molluscs, worms and plants.

Kōura (*Paranephrops planifrons)* common name freshwater crayfish) eDNA was detected in the Kakahu River at four locations: *upstream of OWL discharge*, *downstream of Kakahu Gorge*, *Hall Road* and *close to Ford Road*. The identification of the presence of kōura in the Kakahu River is a significant find as some of the Kakahu River catchment community had thought that kōura no longer existed in the Kakahu River. Kōura are more active at night and usually seek shelter from predators during the day, which is one reason why they are not easily observed in waterways during daylight hours.

Freshwater mussel/kākahi (Echyridella menziesii) was identified at all locations except *Earls Road*. Freshwater mussels have previously been observed at Hornsey Road during routine sampling in the Kakahu River, however the eDNA results suggest that there are populations of freshwater mussel at other locations in the Kakahu River. Freshwater mussels are common and widespread throughout New Zealand, however they are under threat and declining (https://niwa.co.nz/our-science/freshwater/tools/kaitiaki_tools/species/kakahi).

A variety of fish species were identified in the Kakahu River including **longfin eel**, **shortfin eel**, **upland bully**, **common bully**, **Canterbury galaxias**, **torrent fish** and **brown trout** (Table 2). eDNA for shortfin eel and upland bully were identified at all locations, longfin eel at all locations except *close to Ford Road*, brown trout at all locations except *Earls Road*, common bully at *upstream of OWL discharge*, *downstream of Kakahu Gorge* and *Earls Road*, and Canterbury galaxias and torrent fish only at *Earls Road*.

A variety of **birds** were also identified by eDNA, including bellbird, New Zealand pigeon (kereru), fantail, silvereye, little shag, common starling, house sparrow, thrush, dunnock, common chaffinch, paradise shelduck, mallard duck, pigeon and pukeko.

eDNA scores and ecological health

eDNA scores in the Kakahu River ranged from 83 to 96 with ecological health ratings of ***Poor*** and ***Average***. The ecological health was rated as ***Average*** for *upstream of OWL discharge*, *Hall road* and *Earls road*, and ***Poor*** for *downstream of Kakahu Gorge*, *Hornsey road*, *close to Ford road* and *Winchester hanging rock road bridge* (Figure 2).

It is important to note that changes in the eDNA ecological health rating do not just reflect water quality but also reflects changes in physical habitat – there will be some parts of the river that have better habitat for organisms

than other parts and will achieve higher ecological health ratings. It is also unclear what impact the low flow in the Kakahu River (23 L/s) has had on the eDNA results.

Future work will look at undertaking an eDNA survey when flows in the Kakahu River are higher and will also explore other sites within the river.

Table 2: Fish eDNA identified in the Kakahu River at the seven sampling locations.

Fish	Upstream of OWL discharge	Downstream of Kakahu Gorge	Hornsey Road	Hall Road	Close to Ford Road	Winchester Hanging Rock Road Bridge	Earls Road
Longfin eel	✓	✓	✓	✓	✗	✓	✓
Shortfin eel	✓	✓	✓	✓	✓	✓	✓
Upland bully	✓	✓	✓	✓	✓	✓	✓
Common bully	✓	✓	✗	✗	✗	✗	✓
Canterbury galaxias	✗	✗	✗	✗	✗	✗	✓
Torrent fish	✗	✗	✗	✗	✗	✗	✓
Brown Trout	✓	✓	✓	✓	✓	✓	✗

Figure 2: Kakahu River sampling points, eDNA scores and ecological health ratings.

Biomonitoring Results

Biomonitoring was undertaken by SLR Consulting at five locations in the Kakahu River. Two sites upstream of the discharge point (*Kakahu at Mulvihill Bridge* and *Kakahu upstream of discharge*) and three sites downstream of the discharge point (*Kakahu downstream of discharge*, *Kakahu at Morrison's Bridge* and *Kakahu WHR Rd Bridge*), were surveyed – sampling locations are shown in Figure 5.

The survey was undertaken on 7 – 8 March 2024 (the day after the eDNA survey) when the Kakahu River was flowing at 17 – 18 L/s.

The Kakahu River survey included observations of stream embeddedness, periphyton coverage, macroinvertebrates and fish. Stream Embedeness (fine sediment cover) was low throughout the Kakahu River (<1%), which might have been due to the high flow event prior to the survey scouring fine sediment from the bed of the river. Periphyton is the material that grows on the surface of rocks on the bottom of a stream or river. Periphyton levels in the Kakahu River were below guidelines set by Environment Canterbury or the Ministry for the Environment. SLR Consulting conclude that there were no patterns in periphyton cover that would indicate any adverse effects of the discharge, although algae mats immediately downstream of the discharge were likely compromised of didymo, which would have entered the Kakahu River via the discharge.

Macroinvertebrates

The **MCI** data is reasonably similar for most of the sampling sites upstream and downstream of the discharge point (Figure 3). Average MCI scores for the Kakahu River ranged from 87 to 113 with *Kakahu at Mulvihill Bridge* rated as **Good**, *Morrison's Bridge* rated as **Fair**/**Good** and all other locations rated as **Fair**. The average MCI score for *Kakahu upstream of discharge* was 96 and the MCI score for *Kakahu downstream of discharge* was 92. Although there are differences in the MCI scores between sites, statistical analysis of the data showed that there is only a significant difference between the score of *Kakahu at Mulvihill Bridge* and all other sites, *i.e.* there are no significant differences in the MCI scores between *Kakahu upstream of discharge, Kakahu downstream of discharge*, *Kakahu at Morrison's Bridge* and *Kakahu WHR Rd Bridge.*

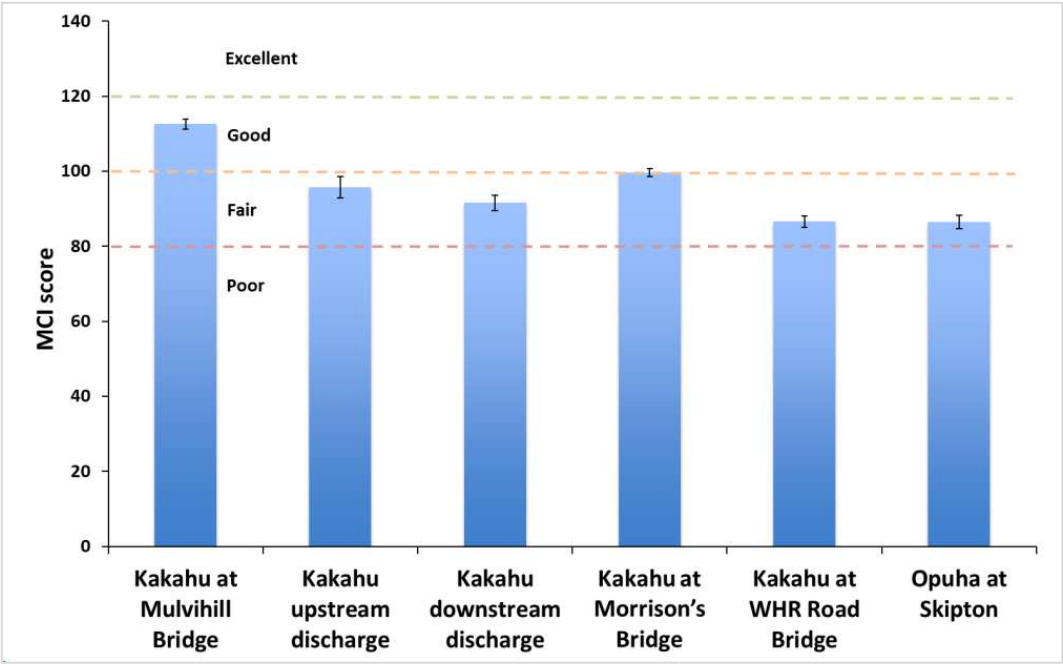

Figure 3: Average MCI scores for March 2024 (mean ± one standard error).

The **QMCI** data shows higher scores upstream of the discharge point compared with sites downstream of the discharge point (Figure 4). Average QMCI scores ranged from 4.3 (*Kakahu downstream of discharge*) to 5.5 (*Kakahu at Mulvihill Bridge* and *Kakahu upstream of discharge*) with *Kakahu at Mulvihill Bridge* and *Kakahu upstream of discharge* rated as **Good** and *Kakahu downstream of discharge*, *Kakahu at Morrison's Bridge* and *Kakahu at WHR Road Bridge* rated as **Fair**. Statistical analysis of the data showed that there is a significant difference in QMCI scores

between *Kakahu at Mulvihill Bridge* and all other sites, and between *Kakahu upstream of discharge* and the downstream survey sites; there was no significant statistical difference in QMCI between any of the downstream survey sites. The decrease in QMCI between *Kakahu upstream of discharge* and *Kakahu downstream of discharge* might be due to a localised effect of the discharge or could also be influenced by river works in the Kakahu river earlier in the irrigation season. However, SLR Consulting conclude that the QMCI scores from this survey and the previous two surveys do not indicate any consistent patterns related to the discharge and that the macroinvertebrates were very diverse and abundant in the Kakahu River.

The MCI and QMCI waterway condition ratings and the eDNA ecological health ratings are in reasonable agreement – generally, better ratings are observed upstream in the Kakahu River with a reduction in the ratings as you move downstream. It is not surprising that a decrease in ecological health or water way rating is observed in the Kakahu River as you move from upstream to downstream, with catchment activities such as farming, forestry, other industry and OWL's discharge likely contributing to differences in ecology within the river. Furthermore, the macroinvertebrate community will also vary throughout the Kakahu River as there are a range of habitat types present at the different sites – differences in water velocity, bed substrate composition and periphyton community composition would all influence the diversity and abundance of macroinvertebrates at the different sites, leading to different MCI and QMCI scores. Further monitoring would assist with further assessing the potential effects of the discharge on the macroinvertebrate community in relation to other site-specific effects.

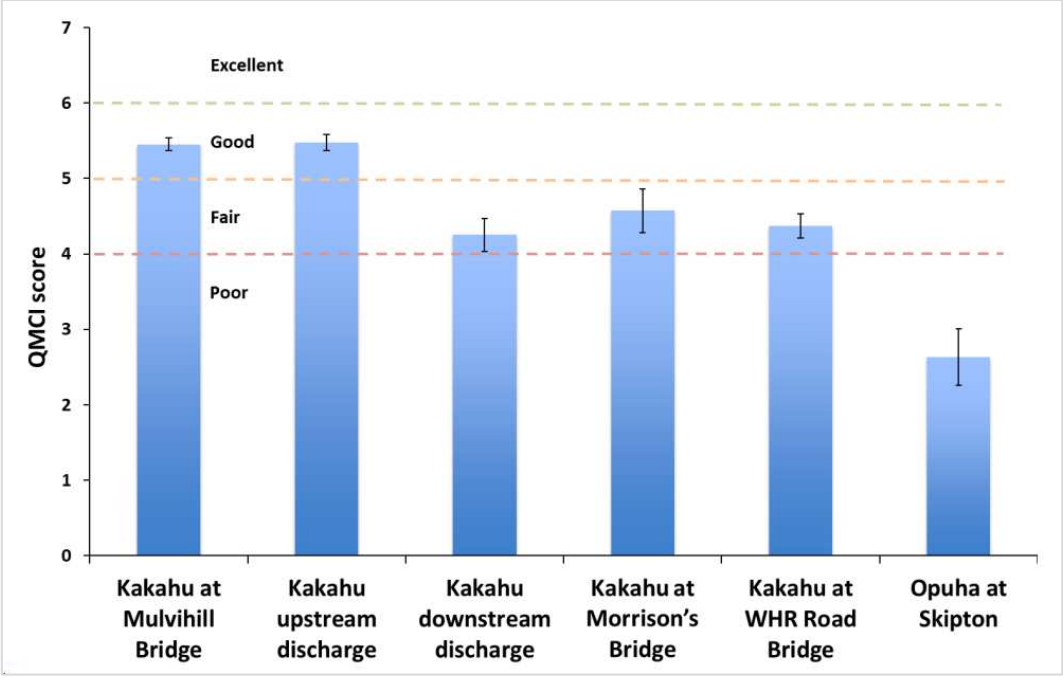

Figure 4: Average QMCI scores for March 2024 (mean ± one standard error).

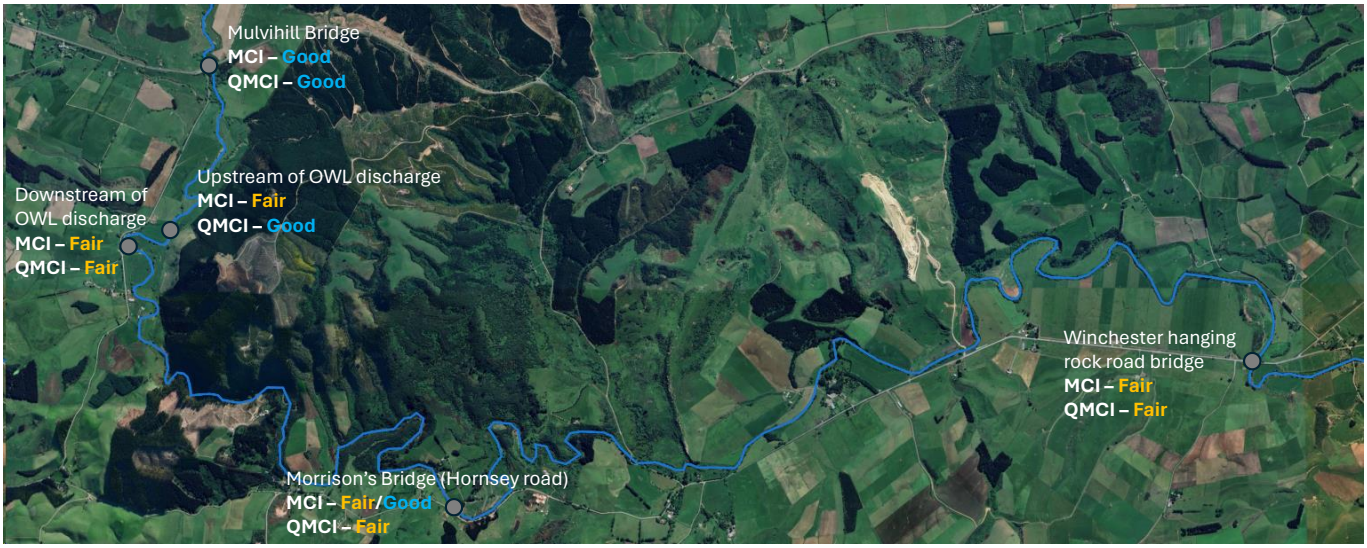

Figure 5: Kakahu River sampling points and MCI and QMCI waterway ratings.

Fish

The fish component of the survey was carried out using electric fishing, nets and traps. Five species of fish were caught during the survey – shortfin eel (juveniles and adults), longfin eel (juveniles and adults), upland bully, common bully and brown trout (Figure 6). All fish species were present upstream and downstream of the discharge point.

Since the previous survey in August 2023, there has been an increase in abundance and diversity of fish in the Kakahu River; SLR Consulting conclude that the discharge is not adversely affecting the fish community in the Kakahu River.

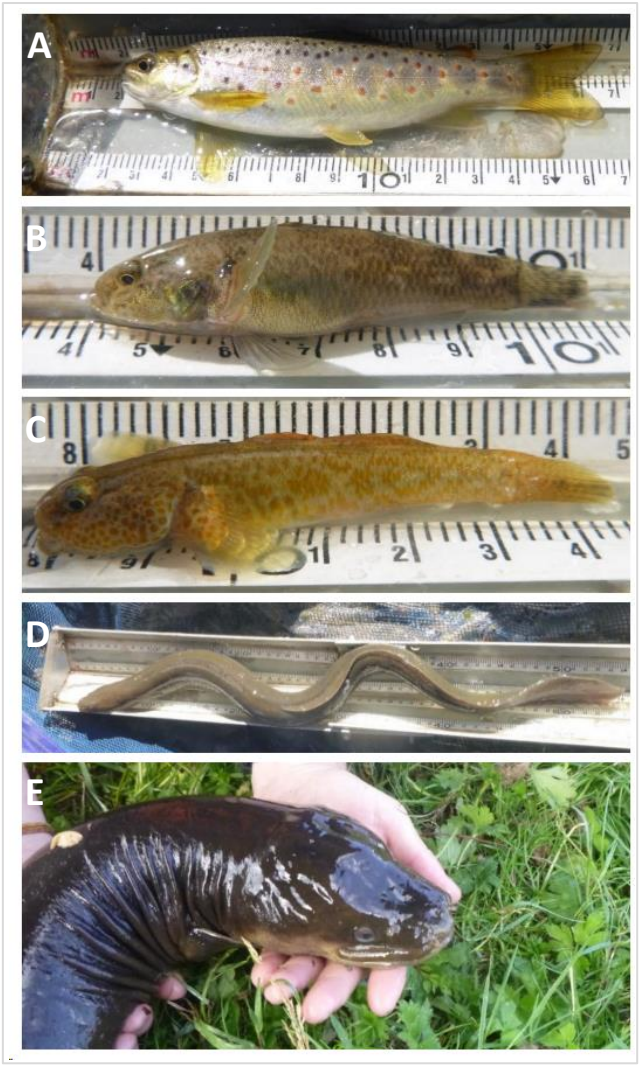

Figure 6: Fish caught in the Kakahu River March 2024: A) brown trout; B) common bully; C) upland bully; D) shortfin eel; and E) longfin eel.

The next quarterly water quality report will examine the effects of reduced rainfall and low flows that the Opuha Scheme and wider catchment has experienced since October 2023.

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