Sensitivity: General

# Lake Waikare – Ecological Impact Assessment

Te Kauwhata Wastewater Treatment Plant

Prepared for Watercare Services Ltd
Prepared by Beca Limited

**4 March 2025**

# Contents



# Appendices

## Revision History

| Revision Nº | Prepared By | Description | Date |
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| 1 | Kimberley DSouza | Draft for client | 13/02/25 |
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## Document Acceptance

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| Prepared by | Kimberley DSouza | pp | 04/03/25 |
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| on behalf of | Beca Limited | | |

# Executive Summary

Beca Limited has been engaged by Watercare Services Limited to prepare an Ecological Impact Assessment to support a resource consent application for an enhanced wastewater discharge from the Te Kauwhata Wastewater Treatment Plant. This assessment is focused on the receiving environment of the treated wastewater discharge which includes the downstream channel and Lake Waikare.

In late 2024, Stage One of the Te Kauwhata Wastewater Treatment Plant upgrades was completed, which involved installing a Membrane Aerated Biofilm Reactor (MABR) /Membrane Bioreactor (MBR). This upgrade was essential to address environmental concerns, improve water quality, and improve sustainable management. Monitoring since 2024 has indicated that treatment quality has significantly improved.

The key ecological effect associated with the ongoing discharge of treated wastewater into the drainage channel and Lake Waikare is the potential additional nutrients contributed to these environments. This would further degrade these ecosystems and subsequently impact the survival and reproductive abilities freshwater fish and birds known to utilise the channel and lake.

The Water Quality Effects Assessment produced by Beca Limited (2025) provides a detailed analysis of the water quality conditions of these receiving environments and the effects of ongoing discharge on water quality parameters. Overall, prior to the MABR upgrade, water quality parameters were consistently exceeding consented limits. However, following the upgrade, monitoring of the discharge exiting the WWTP itself has improved and is meeting consented limits and for most parameters, with the exception of phosphorus, the discharged water quality is higher than the Lake.

As such, the high nutrient concentrations, total suspended solids, *E. coli,* and decrease dissolved oxygen within the receiving environment are not attributed to the discharge itself and is more likely due to the rural catchment to the west and influence of the wider Lake water.

Lake Waikare has a highly modified catchment and with lake levels being manually managed, the Lake has been degraded for many decades. The ongoing discharge of highly treated wastewater is expected to result in barely distinguishable changes in the water quality conditions, and therefore, ecological conditions of the drainage channel and Lake Waikare. As such, the magnitude of effect of the treated wastewater discharge on freshwater fauna and birds which utilise these environments is assessed as **Negligible,** with an overall **Very Low** level of effect, and no further (ecological) management is deemed necessary.

Furthermore, the improvements of wastewater discharge quality are expected to contribute to the betterment of Lake Waikare through making sure the quality of discharge is meeting consented limits and is not contributing additional nutrients and solids into the channel and Lake.

# 1 Introduction

## 1.1 Purpose and Scope

Beca Limited (Beca) have been engaged by Watercare Services Limited (Watercare) to prepare an Ecological Impact Assessment (EcIA) to support a resource consent application for an enhanced wastewater discharge from the Te Kauwhata Wastewater Treatment Plant (WWTP). This EcIA is focused on the receiving environment of the treated discharge, which includes the immediate channel downstream of the Te Kauwhata WWTP and Lake Waikare, the ultimate receiving environment of the discharge.

The scope of this EcIA includes:

- A desktop review of available ecological data for the channel and Lakes Waikare.
- An assessment of the ecological features and values within the channel and Lake Waikare.
- An assessment of the potential and actual ecological effects and recommended mitigation measures, prepared in general accordance with the Ecological Impact Assessment Guidelines (Roper-Lindsay et al., 2018).

## 1.2 Project Overview

### 1.2.1 Site Location

The WWTP is located south of the Te Kauwhata township and 40 km north of Hamilton City. The treated wastewater discharges into a modified channel, which drains into Lake Waikare (Figure 1). The Te Kauwhata area comprises residential housing, within the township as well as extensive agricultural properties including dairy, dry stock, and horticulture.

### 1.2.2 Summary of the Project

The consent authorising the discharge of treated wastewater from the WWTP into Lake Waikare was obtained in 2013 and expires in 2028. However, since 2013, the population of Te Kauwhata has grown significantly, increasing the amount of wastewater flow through the WWTP. The plant was not designed to treat those flows, resulting in breaches of consent conditions relating to water quality standards in the discharge.

At the end of 2023, the Te Kauwhata WWTP upgrades was completed, which involved installing a Membrane Aerated Biofilm Reactor (MABR) Membrane Bioreactor (MBR) treatment process. A full description of the wastewater scheme can be found in Section 2 of the Water Quality Effects Assessment[1].

The enhanced discharge options also includes restoration planting around the existing discharge location.

### 1.2.3 Description of Current Discharge Consent

The existing discharge consent, which expires in 2028 has a maximum volume of treated wastewater which is not to exceed 3,600 $m^3$/day and the annual average shall not be more than 1,100 $m^3$/day.

[1] Beca Limited. (2025). Te Kauwhata Wastewater Treatment Plant – Water Quality Effects Assessment. Prepared for Watercare Services Limited.

The average annual outflow of discharge between 2019 and 2023 has ranged from 861 $m^3$ to 1005 $m^3$, and, on average, has been below the consented limit.

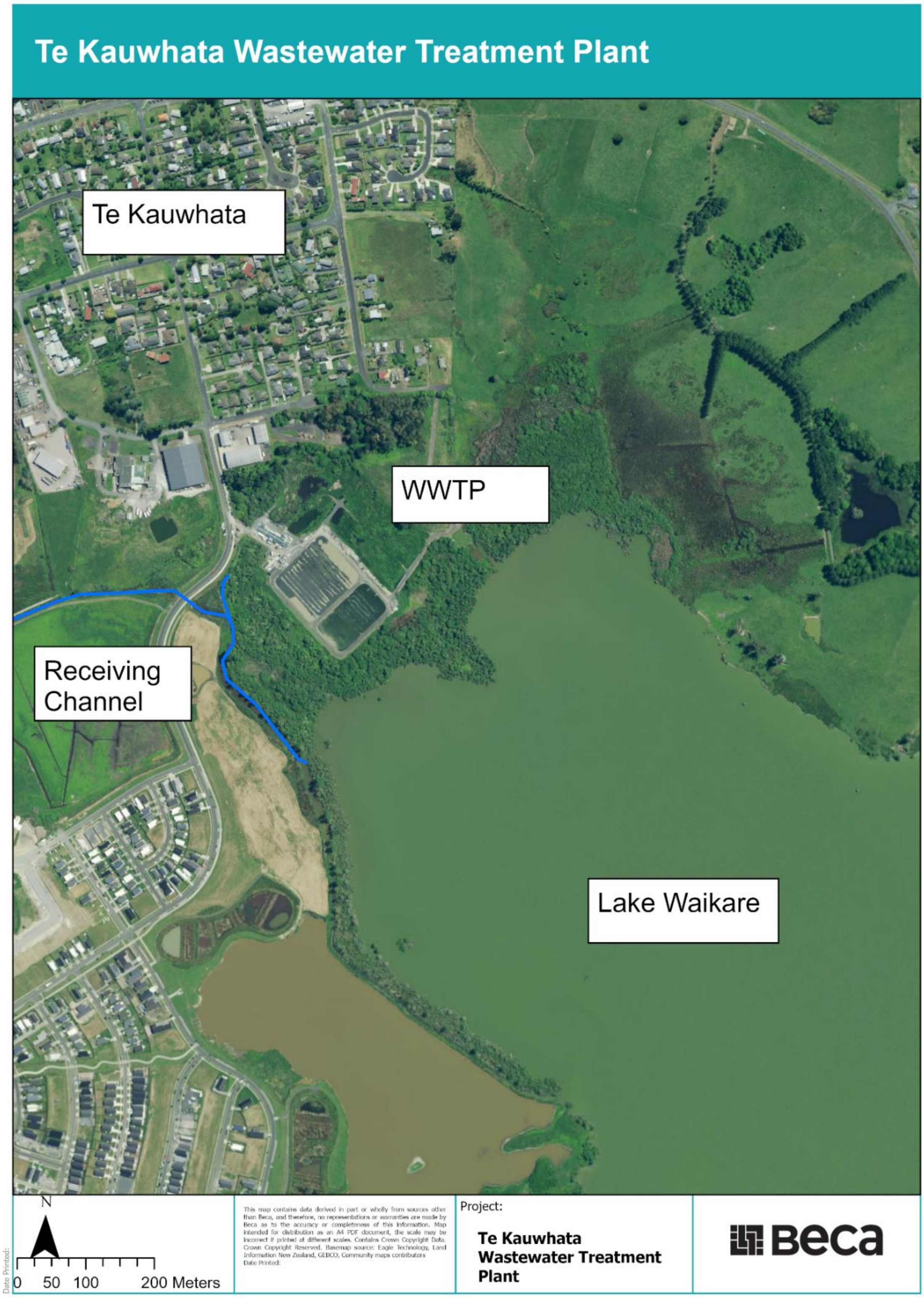


Figure 1. The TKWWTP, located north of the Te Kauwhata township. The treated wastewater discharges into a modified channel (blue line), and eventually into Lake Waikare.

# 2 Methodology

## 2.1 Desktop Review

A desktop review was undertaken to identify and assess the ecological features and values of the receiving environment of the treated wastewater discharge from the WWTP. Sources include:

- The New Zealand Freshwater Fish Database (Sotffels, 2022);
- Ecological district history (McEwen, 1987);
- Ridley Dunphy Environmental Limited. (2018). Lake Waikare and Whangamarino Wetland Catchment Management Plan;
- Wildlands Consultants. (2012). Ecological impacts of the flood control scheme on Lake Waikare and the Whangamarino Wetland, and potential mitigation options;
- Environmental Resources Information Network . (2002). Ramsar Wetlands;
- eBirds (Sullivan et al., 2009);
- iNaturalist (*INaturalist*, n.d.);
- Waikato Regional Council Maps: biodiversity and environment; and
- Beca Limited. (2025). Lake Waikare Catchment Analysis: Desktop Assessment of Contributing Catchments, Ecology, and Water Quality.

## 2.2 Field Investigations

A site visit was undertaken to the Te Kauwhata WWTP on 10 September 2024 to conduct a walkover and general observations. Weather at the time of the site visit was overcast with moderately heavy rain. During the site visit one environmental DNA (eDNA) sample was collect from the channel, and all birds heard and seen were recorded.

### 2.2.1 eDNA Sampling

Mini eDNA kits with 1.2 μm and 5 μm CA filters were used in accordance with the methodology recommended by Wilderlab Limited. Multi-species analyses by DNA metabarcoding were undertaken on eDNA samples by Wilderlab Ltd to produce a list of all DNA sequences detected within a broad taxonomic group (e.g., fish, insects, birds, mammals) and the number of times each appears in the sample. These DNA sequences are then compared against a reference database to assign species names and characterise the community as a whole.

## 2.3 Assessment Methodology

An assessment of ecological effects was undertaken in accordance with Ecological Impact Assessment (EcIA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (Roper-Lindsay et al., 2018).

The EIANZ guidelines set out a methodology to assign ecological value to species and ecosystems based on four assessment criteria which are consistent with significance assessment criteria set out in the Proposed National Policy Statement for Indigenous Biodiversity (2019) Appendix 1: Criteria for identifying significant indigenous vegetation and significant habitat of indigenous fauna. These are reproduced in this report as Appendix 1: Tables 1.1-1.4. In summary:

- Attributes are considered when considering ecological value or importance. They relate to matters such as representativeness, the rarity and distinctiveness, diversity and patterns, and the broader ecological context.
- Determining Factors for valuing terrestrial species; terrestrial species span a continuum of very high to negligible, depending on aspects such as whether species are native or exotic, have threat status, and their abundance and commonality at the site impacted
- Ecological Values are scored based on an expert judgement, qualitative and quantitative data collected.

Once ecological values have been identified and valued, the severity of potential impacts is assessed by determining the change from baseline ecological values likely to occur as a result of the proposal along the lines of a magnitude of effect as determined by the criteria set out in Appendix 1:Table 1.5.

Finally, once these two factors have been determined (the ecological value and the magnitude of effect), an overall level of effect on each of the identified ecological values is determined by applying the matrix shown in Appendix 1:Table 1.6.

# 3 Ecological, Historical, and Cultural Context

## 3.1 Ecological Context

Te Kauwhata is located within the Waikato Ecological Region and the Meremere Ecological District (ED). This ED is described as a well-defined interior basin with alluvial flats, swamps, shallow lakes, and wetlands which border the lower reaches of the Waikato River. Prior to human modification, vegetation across the ED was dominated by kahikatea forest around wetland areas and drier country forests across the remainder of the ED (McEwen, 1987). Since then, deforestation has occurred to support agriculture and horticultural activities.

The WWTP is located approximately 40 km north of Hamilton and the history of wastewater discharge from the Te Kauwhata WWTP is further detailed in Section 3.3. The immediate receiving environment of the treated wastewater discharge from the Te Kauwhata WWTP is a channel and Lake Waikare. The lake is a shallow riverine lake system with a catchment area of 210 $km^2$, of which 83% is agriculture/horticulture. Stands of remnant and regenerative vegetation are present in steeper areas and within the riparian margins of the Waikato River. Prior to human intervention, the hydrological connectivity between the Waikato River and Lake Waikare resulted in extensive flooding, which drowned out much of the nearby productive land. To manage this, in 1953 the Lower Waikato Flood Control Scheme was implemented (further details in Section 3.2).

There are several ecologically significant wetland and lake systems in proximity to the WWTP which are hydrologically connected to Lake Waikare, and these are described in detailed below.

### 3.1.1 Significant Freshwater Ecosystems in the Surrounding Area

#### 3.1.1.1 Whangamarino Wetland

Approximately 3 km north of the WWTP is the Whangamarino Wetland. This wetland is the second largest bog and swamp complex in the North Island and is internationally significant. The wetland has numerous significant ecological features and provides habitat to a diverse range of native water birds and freshwater fish (Environmental Resources Information Network, 2002; Ridley Dunphy Environmental Limited, 2018).

The Lower Waikato Flood Control Scheme has had significant impacts on the Whangamarino Wetland with the redirection of water between the wetland and Lake Waikare resulting in an increase in frequency and volume of water discharged. This floodwater has high concentrations of suspended sediment and nutrients (Wildlands Consultants Ltd, 2012). This has reduced water quality within the wetland and introduced invasive aquatic weeds and pest fish, which have resulted in a decline in native biodiversity.

In 2023, an avian botulism outbreak within the wetland occurred following a blackwater event (low dissolved oxygen levels), which resulted in the death of thousands of birds. This event occurred following mass fish die-back, flooding, and an increase in algal blooms in late 2022[2].

#### 3.1.1.2 Lake Rotokawau

Lake Rotokawau is a peat lake located southwest of Lake Waikare and is connected by a 500 m channel. The lake is unique as it is surrounded by a 145 ha wetland reserve that is administered by the Department of Conservation (Stewardship Land).

Several rare species are present within the wetland and around the margins of the lake including black mudfish (*Neochanna diversus,* At Risk – Declining), Australasian bittern (*Botaurus poiciloptilis,* Threatened - Nationally Critical), banded rail (*Gallirallus philippensis assimilis,* At Risk - Declining), marsh crake (*Zapornia pusilla affinis,* At Risk - Declining), spotless crake (*Zapornia tabuensis tabuensis,* At Risk - Declining) and

[2] Waikato Regional Council. 2023. Response to Whangamarino avian botulism.

North Island fernbird (*Poodytes punctatus vealeae,* At Risk - Declining) (Waikato Regional Council, 2018; Woolly et al., 2024).

As the lake is hydrologically connected with Lake Waikare, the Lower Waikato Flood Control Scheme has resulted in regular fluctuations of the lake's water level as well as in the surrounding wetland. Consequently there has been a substantial decline in biodiversity values and the lake is now classified as hyper-eutrophic (Waikato Regional Council, 2018).

## 3.2 Historical Modifications of the Lake Waikare Catchment

Lake Waikare has experienced at least 100 years of modification within its catchment through the drainage of wetlands, the lowering of the lake level and numerous flood events. Additionally, the wider catchment is intensively farmed and 88% of the lowland area is either crop or pasture, with limited remnant native vegetation and wetlands remaining.

The introduction of the Lower Waikato Flood Scheme, which was completed in 1982, significantly altered the natural water levels of the lake from seasonal fluctuation of 2.71m down to 0.35m of fluctuation. The scheme aimed to prevent flooding (and its consequences) on farmland and infrastructure. However, the scheme has had long term adverse impacts on the ecology and natural hydrological functioning of the lake, as well as restricted the ability for the lake to be resilient against environmental fluctuations and nutrient loading from the wider catchment (Collier et al., 2017).

## 3.3 Historical Wastewater Discharge from the Te Kauwhata Wastewater Treatment Plant

The discharge of wastewater into Lake Waikare has been occurring since 1939 from the Te Kauwhata township. For the first 30 years the wastewater was untreated. In the early 1970s, sewerage reticulation of the township was completed and oxidation ponds were constructed, and the discharge of treated wastewater was authorised in 1974.

Once treated wastewater leaves the WWTP it enters Lake Waikare through a modified channel. From Lake Waikare, it flows enter the Pungarehu Canal and into the Whangamarino River which winds through the Whangamarino Wetland. The river then confluences with the Waikato River to the west, and the Maramarua River to the east.

# 4 Ecological Values Assessment

## 4.1 Ecological Features and Values

### 4.1.1 Lake Waikare

The ecological value of Lake Waikare is assessed as **Moderate**. The reasons for this assessment are outlined in the table below and has been made following extensive review and analysis of available information on Lake Waikare.

Table 1. Assessment and justification for the assigned ecological value to Lake Waikare.

| Matter | Rating | Justification |
|---|---|---|
| Representativeness | Low | It is the largest lake in the lower Waikato catchment, with 3,442 ha of open water. It has an average depth of 1.5 metres and a maximum depth of 1.8 metres.<br>The ecology and functioning of Lake Waikare are not representative of pre-human conditions (1840 is used as the baseline), with a century of modification causing the lake to potentially reach it's tipping point.<br>Historically, Lake Waikare historically provided habitat to a greater diversity of native fish and birds, some of which are no longer present.<br>Wave action, shallow water depth and a large population of exotic carp has resulted in sediment resuspension and high turbidity levels that also limit light penetration, creating an unsuitable habitat for native fish and birds. |
| Rarity/Distinctiveness | High | At Risk native freshwater fish have been recorded within Lake Waikare.<br>Several At Risk water birds have been recorded within and within proximity to Lake Waikare.<br>While there is habitat to support At Risk native fish and birds, both water and habitat quality has been historically degraded. |
| Diversity and Pattern | Low | Biodiversity levels within Lake Waikare are not representative of underlying diversity.<br>Low distribution of biological components across the lake. |
| Ecological context | Moderate | Modification of the catchment has been occurring for well over 100 years with over 83% of the catchment used for agriculture, 5% for cropping, and only 7% and 4% for forest and riparian vegetation, respectively[3].<br>Lake Waikare is highly polluted and is considered the most polluted lake in New Zealand. It is classified as being in a super trophic state, with a LakeSPI of 0 – indicating no submerged plants present (Land Air Water Aotearoa, n.d.).<br>There are several high value freshwater ecosystems that are hydrologically connected to Lake Waikare including Lake Rotokawau and the Whangamarino Wetland, the latter of which is internationally recognised. These systems provided habitat to a range of native species that are expected to also utilise Lake Waikare. |

[3] Beca Limited. (2024). Lake Waikare Catchment Analysis: Desktop Assessment of Contributing Catchments, Ecology, and Water Quality.

| Matter | Rating | Justification |
|---|---|---|
| | | Modifications have led the lake to have low resilience to environmental (biotic and abiotic) changes. |
| | | Overall value: **Moderate** |

### 4.1.2 Discharge Channel

The immediate receiving environment of the treated wastewater discharge is a modified channel system. Aerial imagery from 1969 (prior to the construction of the WWTP) does identify the presence of a natural channel draining into Lake Waikare.

The channel is assessed as having **Moderate** ecological value. This assessment has been made for the following reasons:

- The channel retains fragments of its former values, however, has been largely modified due wider catchment changes including clearance of riparian vegetation, high-intensity agricultural catchment, and stormwater and treated wastewater inputs (Low) (Figure 2).
- eDNA data identifies fish species present are dominated by exotic and pest species, with four Not Threatened native species recorded (High) (Section 4.1.3).
- Benthic invertebrate community is expected to have low diversity, species richness and abundance (Low), as indicated with the eDNA data (Appendix 2) as well as the highly polluted nature of Lake Waikare.
- eDNA provides supporting evidence that benthic invertebrate community are dominated by taxa that are not sensitive to organic enrichment and settled sediments (Low).
- The channel is expected to provide some suitable foraging habitat for avifauna, with pied shag (*Phalacrocorax varius;* At Risk - Recovering) observed during the site visit. Bird records from public databases (Section 4.1.4) identifies the numerous records of At Risk species (High).
- Riparian vegetation habitat is highly modified, with no vegetation along the true right bank. Existing vegetation is expected to provide little to no shading to the stream, and limited buffering and organic inputs (Low) (Figure 2).

Figure 2. Receiving discharge channel of the treated wastewater. Top photo: shows the downstream near the confluence with Lake Waikare. Bottom photo: shows the upstream end closer to the WWTP discharge. (Photos taken 10/10/2024)

### 4.1.3 Freshwater Fish

The freshwater fish values of the channel and Lake Waikare are assessed as **High.** This assessment has been made due to existing records of At Risk species found permanently and seasonally within the lake and are expected to access the channel (Table 2).

Data from several sources (Ridley Dunphy Environmental Limited, 2018; Sotffels, 2022) records the presence of both native and exotic freshwater fish in Lake Waikare including three At Risk species as identified in the table below.

Table 2. Native and introduced fish species identified in Lake Waikare from the last 10 – 15 years (Allibone, et al., 2018; McDowall & Richardson, 1983).

| Common Name | Scientific Name | Source[4] | Conservation Status |
|---|---|---|---|
| Longfin eel | *Anguilla dieffenbachii* | NZFFD | At Risk – Declining |
| Giant kōkopu | *Galaxias argenteus* | NZFFD | At Risk – Declining |
| Īnanga | *Galaxias maculatus* | NZFFD | At Risk – Declining |
| Banded kōkopu | *Galaxias fasciatus* | eDNA | Not Threatened |
| Shortfin eel | *Anguilla australis* | NZFFD, eDNA | Not Threatened |
| Common bully | *Gobiomorphus cotidianus* | NZFFD, eDNA | Not Threatened |
| Common smelt | *Retropinna retropinna* | NZFFD | Not Threatened |
| Common carp / koi carp | *Cyprinus carpio / C. rubrofuscus* | NZFFD, eDNA | Introduced |
| Gambusia/mosquito fish | *Gambusia affinis* | NZFFD, eDNA | Introduced |
| Goldfish | *Carassius auratus* | NZFFD, eDNA | Introduced |
| Brown bullhead catfish | *Ameiurus nebulosus* | NZFFD, eDNA | Introduced |

Before 1965, Lake Waikare supported a diverse range of native freshwater fish species including eels, mullet, a range of *Galaxiids*, lamprey, brown trout, smelt, and bullies. However, changes in catchment use and declining water quality have significantly reduced the diversity over the years. Additionally, the multiple sources of nutrient and sediment input into Lake Waikare has resulted in algal blooms and increase turbidity, which has degraded water quality (Ridley Dunphy Environmental Limited, 2018).

In addition to the freshwater fish species found within Lake Waikare itself, there are records of black mudfish within the Whangamarino wetland and the surrounding area of Lake Rotokawau. Given that black mudfish have specific habitat preferences and are generally found in swamps and wetlands that can become seasonally dry, there is a low likelihood for them to be present and successfully survive within Lake Waikare.

### 4.1.4 Native birds

The native bird values of the site are assessed as **High** as there are a range of At Risk and Threatened species within and within proximity to Lake Waikare.

[4] NZFFD data identifies species recorded in Lake Waikare. eDNA data identifies species recorded only within the channel.

Records from available sources (*INaturalist*, n.d.; Ridley Dunphy Environmental Limited, 2018; Sullivan et al., 2009) indicate the presence of range of native birds along the edges of Lake Waikare and are expected to utilise the lake as a feeding habitat, and the lake edges as roosting habitat

Additionally, Lake Waikare has historically been known to provide significant habitat for a diverse range of aquatic birds. However, due to habitat changes from catchment use and a reduction in adequate food supply, bird life within the Lake and surrounding areas has significantly declined[5].

Table 3. Native birds recorded within proximity to Lake Waikare (iNaturalist, n.d; New Zealand Birds Online, 2013; Ridley Dunphy Environmental Limited, 2018; Sullivan, et al., 2009).

| Common Name | Scientific Name | Conservation Status | Habitat preference |
|---|---|---|---|
| Caspian tern | *Hydroprogne caspia* | Threatened – Nationally Vulnerable | Generally found in sheltered bays and harbours but can also be found at inland lakes and rivers within Waikato. |
| Spotless crake | *Zapornia tabuensis* | At Risk – Declining | Freshwater wetlands dominated by dense emergent vegetation. |
| Marsh crake | *Zapornia pusilla* | At Risk – Declining | Found in a variety of inland and coastal wetlands, as well as wet modified pastures. |
| New Zealand dabchick | *Poliocephalus rufopectus* | At Risk – Nationally Increasing | Freshwater lakes and ponds. Breeds in shallow waters with dense vegetation. |
| Black shag | *Phalacrocorax carbo* | At Risk – Relict | Coastal and freshwater habitat, and nest in large trees over-hanging water. |
| Little black shag | *Phalacrocorax sulcirostris* | At Risk – Naturally Uncommon | Coastal and freshwater habitat, and nest in large trees over-hanging water. |
| Royal spoonbill | *Platalea regia* | At Risk – Naturally Uncommon | Found in estuaries and wetlands after breeding and prefers freshwater bodies. |
| Little shag | *Microcarbo melanoleucos* | At Risk – Relict | Coastal and freshwater habitat, and nest in large trees over-hanging water. |
| Pied shag | *Phalacrocorax varius* | At Risk – Recovering | Coastal and freshwater habitat, and nest in large trees over-hanging water. |
| Black swan | *Cygnus atratus* | Not Threatened | Freshwater habitats include lakes, rivers, and streams. |
| Grey teal | *Anas gracilis* | Not Threatened | Prefer shallow freshwater lakes, lagoons, and swamps. Nests in trees and on the ground under tall grasses. |
| Paradise shelduck | *Tadorna variegate* | Not Threatened | Widely distributed and can be found in pastoral landscapes and |

[5] Ridley Dunphy Environmental Limited. (2018). Lake Waikare and Whangamarino Wetland Catchment Management Plan. Prepared for Waikato Regional Council.

| Common Name | Scientific Name | Conservation Status | Habitat preference |
|---|---|---|---|
| | | | recreational grasslands, lakes, ponds, rivers, and streams. |
| Pied stilt | *Himantopus himantopus* | Not Threatened | Brackish estuaries, saltmarshes, freshwater lakes, swamps, and braided rivers. |
| Pukeko | *Porphyrio melanotus* | Not Threatened | Typically, near fresh or brackish systems, adjacent to open grassy areas and pastures. |
| Sacred kingfisher | *Todiramphus sanctus* | Not Threatened | Coastal and inland freshwater habitats |
| White faced heron | *Egretta novaehollandiae* | Not Threatened | Common near the coast. Breeds in colonies on sand dunes and shingle riverbeds. |
| Spur winged plover | *Vanellus miles* | Not Threatened | Wide range of nesting habitat including low vegetation, near water, margins of wetlands/rivers/lakes, estuaries, and parks/recreational areas. |

Given the close presence of several higher value freshwater ecosystems including Lake Rotokawau and the Whangamarino Wetland, it is expected that some of these species regularly utilise these freshwater ecosystems which would also provide suitable roosting and feeding habit.

## 4.2 Potential Ecological Value of Lake Waikare

The National Policy Statement for Freshwater Management (NPS-FM, 2020) directs that the potential ecological value of any freshwater body be considered. Potential value considers the value of a freshwater body following reasonable and realistic restoration efforts.

With regard to Lake Waikare, a suite of remediation and restoration recommendations have been put forward in the last 10 – 12 years including catchment management (livestock exclusion, re-forestation), wind barriers, removal of pest fish, improving light conditions, and growing aquatic vegetation within the lake (Wildlands Consultants Ltd, 2012). Realistically, measures to improve the water quality and ecological conditions must start with the primary root cause of the ongoing degradation which is the wider catchment use and increasing rates of sediment and nutrient runoff (Cox & Cooke, 2015) as well as the ongoing lake lowering scheme. Given the high level of effort and expense to undertake such work, interim measures (e.g. replanting of riparian banks, increasing native macrophyte dominance, pest fish control) are not expected to substantially improve the potential ecological value of Lake Waikare.

With regards to the channel, reasonable levels of restoration are limited to replanting of the streambanks. This will improve shading, increase organic debris inputs, improve habitat, and provide some buffering of nutrient inputs. However, efforts are hampered by the agricultural upstream catchment, the stormwater inputs from the Lakeside Development, and the connection with the highly degraded Lake Waikare. As such, reasonable restoration efforts are not expected to substantially improve the potential value of the discharge channel.

It is noted that Waikato-Tainui, Rivercare and WDC have funded and undertaken restoration planting for many years in the Lake Waikare catchment.

# 5 Summary of the Water Quality Conditions of the Discharge, the Drainage Channel, and Lake Waikare

This section provides a summary of the water quality conditions of the drainage channel and Lake Waikare, based on monitoring by WRC, and the water quality parameters of the treated wastewater discharge. Refer to the Water Quality Effects Assessment[6] for detailed analysis of the water quality conditions observed as a result of the recent MABR upgrade.

The water quality assessment has found in summary that:

- Biochemical Oxygen Demand ($cBOD_5$) is very low in the discharge and is highly unlikely to contribute to the wider dissolved oxygen depletion observed in the discharge channel and Lake, in fact the dissolved oxygen in the discharge is likely to be higher than the Lake.
- Total Suspended Solids (TSS) concentrations in the discharge are much lower than the discharge channel, again showing the discharge is of a higher quality than the Lake.
- The Total Nitrogen (TN) concentration of the discharge is of a higher quality than the Lake, and on the day of sampling showed lower concentrations in the discharge channel.
- The Total Phosphorus (TP) concentration is higher than the Lake, however on the day of sampling the concentrations in the discharge channel were similar to the long-term Lake water quality, showing no obvious effects on TP concentrations in the discharge channel.
- For E. coli, the discharge is of a much higher quality than the Lake.

Overall it was considered that the MABR discharge is of a higher quality than the Lake Waikare water quality, with the only exception being for phosphorus, which shows no observable effects in the discharge channel, compared to the background Lake water.

A long-term assessment has also been undertaken and shows that the WWTP can provide for population growth through to 2050, with proposed treatment limits ensuring that the ultimate 2050 nitrogen and phosphorus loads to the Lake remained below pre-MABR upgrade levels (with additional treatment trains).

[6] Beca Limited. (2025). Te Kauwhata Wastewater Treatment Plan – Water Quality Effects Assessment. Prepared for Watercare Services Limited.

# 6 Assessment of Ecological Effects of the Existing Discharge

The main activity assessed within the scope of this report is the potential ecological effects of the continued discharge of treated wastewater into the receiving discharge channel and Lake Waikare. The ecological effects discussed here are dependent on the water quality conditions and effects, which are summarised above and detailed in the Water Quality Effects Assessment[7].

While connected, the drainage channel and Lake Waikare are also considered to be two ecosystems and effects on these systems are assessed separately.

## 6.1 Ecological Effects – Magnitude of Effect

### 6.1.1 Potential effects of the ongoing discharge of treated wastewater on the nutrient and dissolved oxygen levels within the drainage channel and the ecotoxic impacts on freshwater fauna

Increasing anthropogenic nutrient inputs into freshwater ecosystems has the potential to significantly impact freshwater fish and macroinvertebrates. Similarly, inadequate dissolved oxygen levels within freshwater systems can limit the survival and reproductive success of freshwater fauna.

The magnitude of effect of the continuation of treated wastewater discharge from the Te Kauwhata WWTP on freshwater fauna within the drainage channel is assessed as **Negligible,** with an overall **Very Low** level of effect**.**

This assessment has been made primarily due to the improvements in water quality following the upgrade with the MABR system. Prior to the upgrade, water quality parameters were consistently higher than the consented limited (between 2017 to 2023), with only total phosphorus being below the consented limit in 2023-2024, and *E.coli* being below the limit from 2022 – 2024 (as a result of the new UV disinfection unit being commissioned).

With the MABR upgrade in effect from December 2023, the quality of the discharge meeting consent limits and in most cases the discharged water is of a higher quality than the Lake. Therefore not having a detectable adverse change to any water parameters that would impact ecological functions.

Given this, changes from the ongoing discharge of treated wastewater are likely to be barely distinguishable and have a negligible effect on the known freshwater fish and birds utilising the channel. Given this, no further management (with regard to ecology) is deemed necessary.

### 6.1.2 Potential effects of the ongoing discharge of treated wastewater on the nutrient concentrations and the effects of this on freshwater fauna and birds within Lake Waikare

Lake Waikare is a large lake within a highly modified catchment. Monitoring undertaken by WRC from the lake shows consistent exceedances for nutrients, chlorophyll, and clarity.

The magnitude of effect of the treated wastewater discharge on freshwater fauna and birds which utilise the lake is assessed as **Negligible,** with an overall **Very Low** level of effect.

This assessment, as detailed in Section 6.1.1, is largely due to the improved quality of discharge from the WWTP following the upgrade with the MABR. This is relative to other catchment land uses. Furthermore,

[7] Beca Limited. (2025). Te Kauwhata Wastewater Treatment Plant – Water Quality Effects Assessment. Prepared for Watercare Services Limited.

dilution is occurring within the drainage channel due to the input from the west catchment. Based on this, the discharge of treated wastewater will have a negligible effect on the clarity and nutrient concentrations of Lake Waikare.

Despite the highly polluted nature of Lake Waikare, which has impacted the ecology and diversity of the lake, the quality of discharge monitoring provides strong indication that the discharge itself is not a key contributor to this degradation and will not contribute to the ongoing degradation of the lake. Instead, it is likely that the upgrade of the WWTP will contribute to the betterment of Lake Waikare through making sure the quality of discharge is meeting water quality guidelines and is not contributing additional nutrients and solids into the lake.

# 7 Conclusion

The ongoing discharge of treated wastewater from the WWTP into the receiving drainage channel and Lake Waikare is assessed as having an overall **Very Low** level of effect on the freshwater fish and birds known to be utilising these environments.

Monitoring of the discharge, following the instalment of the MABR, indicates that the discharge quality exiting the WWTP is of high quality and meeting consented limits and water quality guidelines. As such, despite the water quality exceedances identified within the channel and the lake, the WWTP discharge is not a key contributor to this pollution and the continuation of this discharge will not contribute to the ongoing degradation of the receiving freshwater environments.

Instead, it is likely that the upgrade of the WWTP will contribute to the betterment of Lake Waikare through improving discharge quality and limiting the contribution of additional nutrients and solids into the lake and channel.

# 8 References

Collier, K. J., Baker, C., David, B. O., Górski, K., & Pingram, M. A. (2017). Linking ecological science with management outcomes on New Zealand's longest river. *Iver Reserch and Applications*, *35*(5), 476–488.

Cox, T. J., & Cooke, J. G. (2015). Lake Waikare Water Quality Modeling: Using a New Model to Investigate Flushing Strategies. *Water NZ Annual Conference*.

Environmental Resources Information Network. (2002). *Ramsar Wetlands*.

*iNaturalist*. (n.d.). https://www.inaturalist.org/home

Land Air Water Aotearoa. (n.d.). *Lake Waikare*. Retrieved October 6, 2023, from https://www.lawa.org.nz/explore-data/waikato-region/lakes/lake-waikare/

McEwen, W. M. (1987). *Ecological Regions and Districts of New Zealand*. Department of Conservation.

Ridley Dunphy Environmental Limited. (2018). Lake Waikare and Whangamarino Wetland Catchment Management Plan. *Waikato Regional Council*, *September*.

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

Sotffels, R. (2022). *New Zealand Freshwater Fish Database. Version 1.7.* National Institute of Water and Atmospheric Research (NIWA). https://doi.org/https://doi.org/10.15468/ms5iqu accessed via GBIF.org on 2022-05-10.

Sullivan, B. L., Wood, C. L., Iliff, M. J., Bonney, R. E., Fink, D., & Kelling, S. (2009). eBird: a citizen-based bird observation network in the biological sciences. *Biological Conservation*, *142*, 2282–2292. https://science.ebird.org/en/atlasnz/use-ebird-data/citation

Waikato Regional Council. (2018). *APPENDIX EIGHT - Shallow Lakes Project Assessments*.

Wildlands Consultants Ltd. (2012). *Ecological Impacts of the flood control scheme on Lake Waikare and the Whangamarino Wetland, and potential mitigation options* (Issue 1).

Woolly, J., Lovegrove, T., Robertson, H., Ariccia, G. D., & Melzer, S. (2024). *Conservation Status of Birds in Tāmaki Makaurau / Auckland* (Issue August).

# 1

## Appendix 1 – Assessment Methodology

# Appendix 1: Ecological Impact Assessment Guidelines

## Assigning Ecological Value

### Freshwater and Terrestrial Habitat / Community

The freshwater habitat features were assessed considering each of the attributes in Table 1, and terrestrial habitat features were assessed considering attributes in Table 2. Features of interest were subjectively given a rating on a scale of 'Very Low' to 'High' for each attribute and assigned a value in accordance with the description provided in Table 3.

Table 1. Attributes to be considered when assigning ecological value to a freshwater site or area (adapted from Roper-Lindsay et al., 2018).

| Value | Explanation | Characteristics |
|---|---|---|
| Very High | A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation e.g., stream within a native forest catchment | Benthic invertebrate community typically has high diversity, species richness and abundance.<br>Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments.<br>Benthic community typically with no single dominant species or group of species.<br>MCI scores typically 120 or greater.<br>EPT richness and proportion of overall benthic invertebrate community typically high.<br>SEV scores high, typically >0.8.<br>Fish communities typically diverse and abundant.<br>Riparian vegetation typically with a well-established closed canopy.<br>Stream channel and morphology natural.<br>Streambanks natural typically with limited erosion.<br>Habitat natural and unmodified. |
| High | A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g., exotic forest or mixed forest/agriculture catchment. | Benthic invertebrate community typically has high diversity, species richness and abundance.<br>Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments.<br>Benthic community typically with no single dominant species or group of species.<br>MCI scores typically 80-100 or greater.<br>EPT richness and proportion of overall benthic invertebrate community typically moderate to high.<br>SEV scores moderate to high, typically 0.6-0.8.<br>Fish communities typically diverse and abundant.<br>Riparian vegetation typically with a well-established closed canopy.<br>No pest or invasive fish (excluding trout and salmon) species present.<br>Stream channel and morphology natural.<br>Streambanks natural typically with limited erosion.<br>Habitat largely unmodified. |
| Moderate | A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g., high-intensity agriculture catchment. | Benthic invertebrate community typically has low diversity, species richness and abundance.<br>Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments.<br>Benthic community typically with dominant species or group of species.<br>MCI scores typically 40-80.<br>EPT richness and proportion of overall benthic invertebrate community typically low. |

| Value | Explanation | Characteristics |
|---|---|---|
| | | SEV scores moderate, typically 0.4-0.6.<br>Fish communities typically moderate diversity of only 3-4 species.<br>Pest or invasive fish species (excluding trout and salmon) may be present.<br>Stream channel and morphology typically modified (e.g., channelised)<br>Streambanks may be modified or managed and may be highly engineered and/or evidence of significant erosion.<br>Riparian vegetation may have a well-established closed canopy.<br>Habitat modified. |
| Low | A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g., modified urban stream | Benthic invertebrate community typically has low diversity, species richness and abundance.<br>Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments.<br>Benthic community typically with dominant species or group of species.<br>MCI scores typically 60 or lower.<br>EPT richness and proportion of overall benthic invertebrate community typically low or zero.<br>SEV scores low to moderate, typically less than 0.4.<br>Fish communities typically low diversity of only 1-2 species.<br>Pest or invasive fish (excluding trout and salmon) species present.<br>Stream channel and morphology typically modified (e.g. channelised).<br>Streambanks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion.<br>Riparian vegetation typically without a well-established closed canopy.<br>Habitat highly modified. |

Table 2. Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/ habitat/community.

| Matters | Attributes to be assessed |
|---|---|
| Representativeness | Criteria for representative vegetation and aquatic habitats:<br>Typical structure and composition<br>Indigenous species dominate<br>Expected species and tiers are present<br>Thresholds may need to be lowered where all examples of a type are strongly modified<br>Criteria for representative species and species assemblages:<br>Species assemblages that are typical of the habitat<br>Indigenous species that occur in most of the guilds expected of the habitat type |
| Rarity/distinctiveness | Criteria for rare/ distinctive vegetation and habitats:<br>Naturally uncommon, or induced scarcity<br>Amount of habitat or vegetation remaining<br>Distinctive ecological features<br>National priority for protection<br>Criteria for rare/ distinctive species or species assemblages:<br>Habitat supporting nationally Threatened or At Risk species, or locally uncommon species<br>Regional or national distribution limits of species or communities<br>Unusual species or assemblages<br>Endemism |
| Diversity and pattern | Level of natural diversity, abundance, and distribution |

| Matters | Attributes to be assessed |
|---|---|
| | Biodiversity reflecting underlying diversity<br>Biogeographical considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation |
| Ecological context | Site history, and local environmental conditions which have influenced the development of habitats and communities<br>The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (form "intrinsic value" as defined in RMA)<br>Size, shape and buffering<br>Condition and sensitivity to change<br>Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material<br>Species role in ecosystem functioning – high level, key species identification, habitat as proxy |

Table 3. Rating system for assessing ecological value of a freshwater or terrestrial system (Roper-Lindsay et al. 2018).

| Value | Description |
|---|---|
| Negligible | Feature rates Very Low for at least three assessment attributes and Low to Moderate for the remaining attribute(s). |
| Low | Feature rates Very Low to Low for most assessment attributes and moderate for one.<br>Limited ecological value other than providing habitat for introduced or tolerant indigenous species. |
| Moderate | Feature rates High for one assessment attribute and Low to Moderate for the remainder, OR the project area rates Moderate for at least two attributes and Very Low to Low for the rest.<br>Likely to be important at the level of the Ecological District. |
| High | Feature rates High for at least two assessment attributes and Low to Moderate for the remainder, OR the project area rates High for one attribute and Moderate for the rest. Likely to be regionally important. |
| Very High | Feature rates High for at least three assessment attributes.<br>Likely to be nationally important. |

## Species

The EIANZ provides a method for assigning value (Table 4) to species for the purposes of assessing actual and potential effects of activities.

Table 4. Criteria for assigning ecological values to species (Roper-Lindsay et al. 2018).

| Ecological Value | Species |
|---|---|
| Very High | Nationally Threatened species, found in the ZOI either permanently or seasonally |
| High | Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally |
| Moderate | Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally |
| Moderate | Locally (ED) uncommon or distinctive species |
| Low | Nationallly and locally common indigenous species |
| Negligible | Exotic species, including pests, species having recreational value |

# 2

## Appendix 2 – eDNA Results

# Appendix 2 – eDNA Results

| Scientific Name | Rank | Tax ID | Common Name | Group | 550489 |
|---|---|---|---|---|---|
| *Carassius auratus* | species | 7957 | Goldfish; morihana | Fish | 14562 |
| *Cyprinus rubrofuscus* | species | 1221224 | Koi carp; toretore | Fish | 3570 |
| *Gobiomorphus cotidianus* | species | 226931 | Common bully; tīpokopoko; toitoi | Fish | 3296 |
| *Anguilla australis* | species | 7940 | Shortfin eel; tuna; hao; aopori; hikumutu | Fish | 2404 |
| *Ameiurus nebulosus* | species | 27778 | Brown bullhead catfish | Fish | 938 |
| *Gobiomorphus basalis* | species | 432095 | Crans bully; titikura | Fish | 617 |
| *Paratanytarsus grimmii* | species | 288873 | Chironomid | Insects | 330 |
| *Chrysophyceae sp.* | species | 1955566 | | Heterokont algae | 207 |
| *Dero obtusa* | species | 212255 | Worm | Worms | 171 |
| *Gambusia affinis* | species | 33528 | Mosquitofish | Fish | 159 |
| *Orthonychiurus folsomi* | species | 2581074 | Springtail | Springtails | 73 |
| *Trichosurus vulpecula* | species | 9337 | Common brushtail possum; paihamu; paihama | Mammals | 70 |
| *Rhopalosiphum padi* | species | 40932 | Bird cherry-oat aphid | Insects | 63 |
| *Mugil cephalus* | species | 48193 | Grey mullet; kanae; kanae raukura | Fish | 44 |
| *Chaetogaster diaphanus* | species | 212246 | Oligochaete worm | Worms | 44 |
| *Bos taurus* | species | 9913 | Cattle; kau | Mammals | 43 |
| *Galaxias fasciatus* | species | 89555 | Banded kokopu; kokōpu | Fish | 38 |
| *Limnodrilus hoffmeisteri* | species | 76587 | Redworm | Worms | 35 |
| *Hyalinella punctata* | species | 350064 | | Bryozoans | 30 |
| *Mesocyclops leuckarti* | species | 669471 | Copepod | Crustaceans | 29 |
| *Lumbricus rubellus* | species | 35632 | Red earthworm | Worms | 24 |
| *Physella acuta* | species | 109671 | Left handed sinistral snail | Molluscs | 22 |
| *Ceratophysella aff. denticulata L3* | species | 2449137 | Mushroom springtail | Springtails | 22 |

| | | | | | |
|---|---|---|---|---|---|
| *Potamothrix bavaricus* | species | 745771 | Aquatic oligochaete worm | Worms | 21 |
| *Lumbriculus variegatus* | species | 61662 | Blackworm | Worms | 19 |
| *Acyrthosiphon kondoi* | species | 34664 | | Insects | 18 |
| *Eiseniella tetraedra* | species | 1302610 | Squaretail worm | Worms | 18 |
| *Zygoribatula undulata* | species | 2978531 | | Mites and ticks | 16 |
| *Acanthocyclops robustus* | species | 415614 | Copepod | Crustaceans | 14 |
| *Ilyodrilus templetoni* | species | 170993 | Aquatic worm | Worms | 13 |
| *Octolasion lacteum* | species | 334871 | Worm | Worms | 12 |
| *Paraphysomonas sp.* | species | 1955561 | Golden-brown alga | Heterokont algae | 12 |
| *Poteriospumella lacustris* | species | 1117027 | Protist | Heterokont algae | 11 |
| *Dero digitata* | species | 66488 | Worm | Worms | 10 |
| *Eukerria saltensis* | species | 169929 | Worm | Worms | 10 |
| *Cochliopodium kieliense* | species | 1512276 | Amoeba | Amoebae | 10 |
| *Ranoidea aurea* | species | 8371 | Green bell frog; poraka; poroka | Amphibians | 8 |
| *Agrotis ipsilon* | species | 56364 | Dark sword-grass; Black cutworm; Greasy cutworm; Floodplain cutworm;Ipsilon dart | Insects | 8 |
| *Chydorus brevilabris* | species | 362310 | Water flea | Crustaceans | 8 |
| *Cygnus atratus* | species | 8868 | Black swan; wāna; wani | Birds | 6 |
| *Porcellio scaber* | species | 64697 | Woodlouse; Slater | Crustaceans | 6 |
| *Octolasion cyaneum* | species | 302033 | Worm | Worms | 6 |
| *Corynoneura scutellata* | species | 611450 | Non-biting midge | Insects | 6 |
| *Carpelimus zealandicus* | species | 1587141 | | Insects | 6 |
| *Paracyclops fimbriatus* | species | 1606834 | Copepod | Crustaceans | 6 |
| *Mecyclothorax sp. sc_09291* | species | 1901309 | | Insects | 6 |
| *Isotomurus palustris* | species | 36144 | Marsh springtail | Springtails | 5 |
| *Neanura muscorum* | species | 106920 | Springtail | Springtails | 5 |
| *Nais communis* | species | 188228 | Sludgeworm | Worms | 5 |

| | | | | | |
|---|---|---|---|---|---|
| *Rhynchodemus sylvaticus* | species | 1520503 | | Flatworms | 5 |
| *Gobiomorphus* | genus | 86236 | Bullies | Fish | 1232 |
| *Mugil* | genus | 8190 | Mullets | Fish | 246 |
| *Nais* | genus | 74730 | Sludgeworm | Worms | 62 |
| *Chironomus* | genus | 7150 | Midges | Insects | 39 |
| *Turdus* | genus | 9186 | Thrush; manu pango | Birds | 26 |
| *Dero* | genus | 66487 | Worm | Worms | 19 |
| *Phytophthora* | genus | 4783 | Water mold | Oomycetes | 13 |
| *Ilyodrilus* | genus | 170992 | Worm | Worms | 11 |
| *Arcitalitrus* | genus | 1238132 | Sandhopper | Crustaceans | 10 |
| *Dictyota* | genus | 2875 | | Heterokont algae | 9 |
| *Spumella* | genus | 89043 | Golden-brown alga | Heterokont algae | 8 |
| *Pinnularia* | genus | 216736 | Freshwater diatom | Diatoms | 8 |
| *Eiseniella* | genus | 1302608 | Worm | Worms | 8 |
| *Nitzschia* | genus | 2857 | Pennate diatom | Diatoms | 7 |
| *Nylanderia* | genus | 710235 | | Insects | 6 |
| *Phalacrocorax* | genus | 9207 | Cormorants; kawau | Birds | 5 |
| *Anserinae* | subfamily | 2068722 | Swans and geese | Birds | 166 |
| *Aphidinae* | subfamily | 133076 | | Insects | 24 |
| *Isotomidae* | family | 36141 | Smooth springtails | Springtails | 12 |
| *Helicoidea* | superfamily | 87862 | | Molluscs | 6 |
| *Actinopteri* | class | 186623 | | Other | 11330 |
| *root* | no rank | 1 | Unidentified | Other | 10642 |
| *Metazoa* | kingdom | 33208 | Metazoans | Other | 755 |
| *Clitellata* | class | 42113 | | Worms | 333 |
| *Insecta* | class | 50557 | Insects | Other | 85 |
| *Cyprinoidei* | suborder | 30727 | Cyprinid fish | Fish | 55 |
| *Arthropoda* | phylum | 6656 | Arthropods | Other | 47 |
| *Annelida* | phylum | 6340 | Annelid worms | Other | 43 |
| *Lepidoptera* | order | 7088 | Butterflies and moths | Insects | 18 |
| *Hemiptera* | order | 7524 | | Insects | 15 |

| | | | | | |
|---|---|---|---|---|---|
| *Eurotatoria* | class | 2816136 | | Rotifers | 8 |
| *unclassified Chaetogaster* | no rank | 2664999 | | Worms | 6 |
| *Bacillariophyta* | phylum | 2836 | Diatoms | Heterokont algae | 5 |
| *Lumbricus rubellus complex* | no rank | 1050932 | | Worms | 5 |