Technical Report J

Ecology Values Assessment

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Redvale Landfill Expansion Project

Ecological Values Assessment

for: Waste Management New Zealand



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Cover Illustration: A dabchick parent carrying two chicks on its back, on a freshwater pond at Redvale Landfill.

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1 INTRODUCTION

Bioresearches were engaged by WM New Zealand (WMNZ) to undertake an Ecological Values Assessment within the terrestrial and freshwater habitats at Redvale Landfill located in the suburb of Dairy Flat, Tāmaki Makaurau / Auckland, hereby referred to as 'the Site' (Figure 1). This assessment provides information relating to existing baseline values, to provide guidance and information for a proposed landfill expansion on the Site and continued operation to authorise landfilling beyond 2028.

The current land use consent for Redvale Landfill stipulates that the landfill must cease accepting waste by 31 December 2028 and the regional consents for discharges associated with the landfilling activity also expire on this date. Due to a delay in the authorisation and establishment of the replacement Auckland Regional Landfill (ARL) a transition plan is required. To address this potential gap in critical landfill infrastructure for residual waste disposal in the Auckland region, WMNZ is proposing to extend the operation of Redvale to the end of 2036 and develop 4.56 Mm^3 of additional airspace at the existing facility. This includes 3.13 Mm^3 in additional Class 1 Landfill expansion on top of the existing Class 1 refuse placement area and 1.43 Mm^3 of Class 2 Landfill extension. The proposed works include the following:

- Class 1 landfill expansion: placement of waste within the existing landfill footprint, involving the removal of final cover and steepening of the final cap slope to accommodate additional waste.
- Class 2 footprint extension: extension of the landfill to the southwest to accommodate disposal of waste meeting Class 2 landfill waste acceptance criteria (WAC).
- Relocation of ancillary activities: the relocation of ancillary activities to allow for the placement of waste.
- Sediment retention ponds: The removal and filling of Sediment Retention Pond 6 and the Office Pond while enlarging Pond 1 to capture and treat the stormwater from these catchments.

For a comprehensive understanding of the proposal's ecological context and effects, this assessment should be read in conjunction with the Ecological Impact Assessment (EcIA) prepared for this project (Bioresearches, 2026).

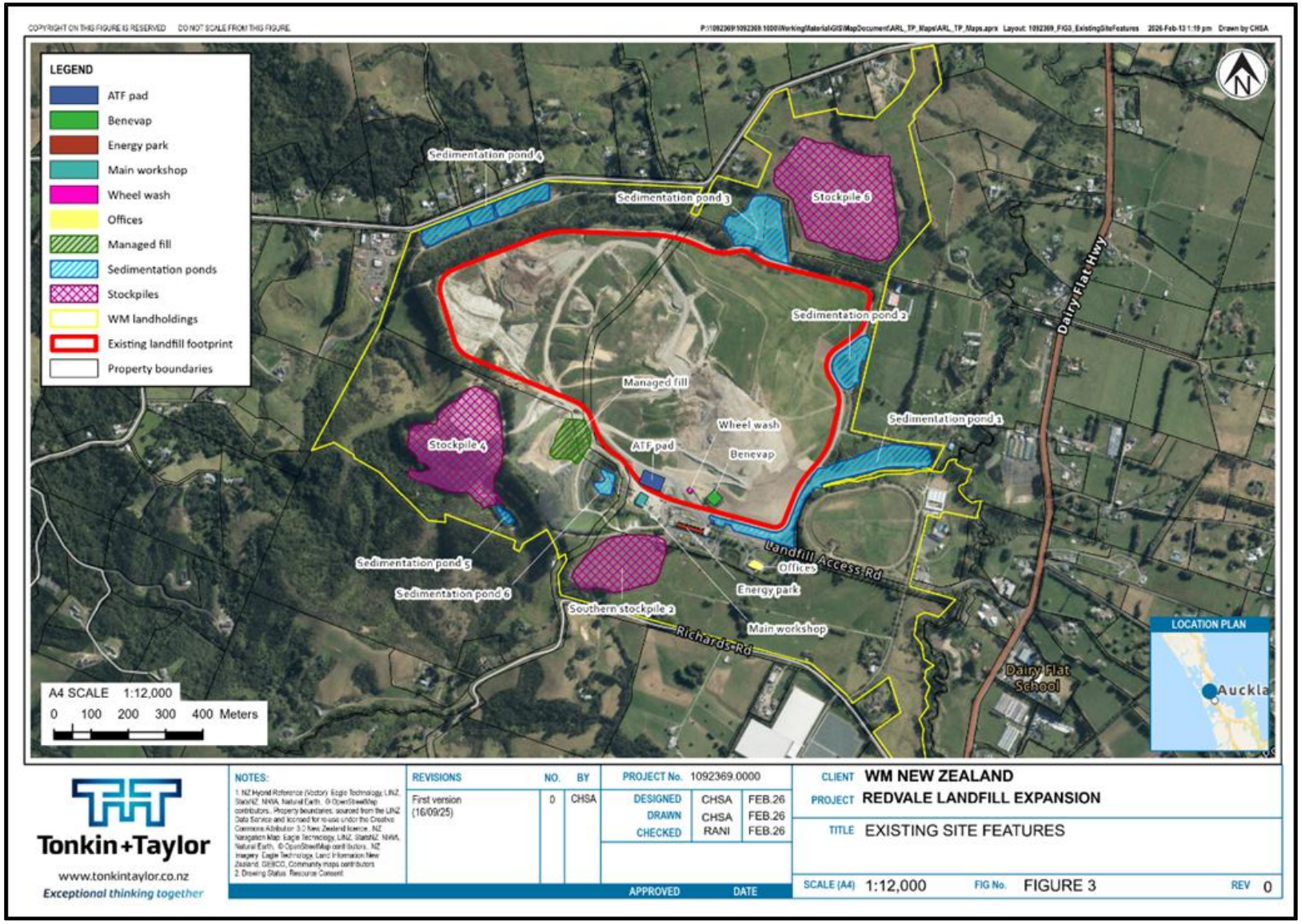


Figure 1. An overview of the WMNZ property and existing site features

2 METHODS

2.1 On-Site Assessments

The site was surveyed on several occasions between the months of November 2024 and July 2025, to assess terrestrial and freshwater habitats and native fauna presence within the Site. These on-site assessments were undertaken over the three time periods, detailed below, to maximise the detection of flora and fauna and provide an understanding of potential habitat use for different species at different life stages (e.g. flowering plants, aquatic birds, breeding seasons). Round 3 surveys specifically targeted dabchicks on the ponds outside of the breeding season to understand the temporal presence and absence on site within the early breeding season. This information is used to assess the impacts of the proposed works and inform future management recommendations for any proposed works within the ponds. The field assessments were undertaken over three rounds as follows:

Round 1: late spring/early summer (November/December) 2024;

Round 2: late summer/early autumn (February/March) 2025; and

Round 3: Pre-breeding season survey for dabchick; June 11th and July 7th 2025.

2.1.1 Vegetation

The vegetation within the site was assessed using a walk-through methodology. An experienced botanist surveyed the site during Round 1 and Round 2, noting species present and any ecosystem values. Particular search effort was spent looking for any Threatened or At-Risk (TAR) plant species (classified either at the regional or national level, as per the Conservation Status of Vascular Plant Species in Tāmaki Makaurau / Auckland, Auckland Council, Technical Report 2025/26, (Simpkins et al, 2025)).

Within the Site, the vegetation has been classified into four types: ‘planted native vegetation’, ‘mixed native and exotic vegetation’, ‘exotic vegetation’ and ‘exotic grassland’. The sites vegetation is discussed further in Section 3.1. Examples of these habitats are provided in Appendix A, Photo 26.

2.1.2 Fauna

2.1.2.1 Avifauna

Desktop Assessment

A desktop assessment was undertaken for avifauna, which collated records of species from eBird and iNaturalist (accessed December 2024) within a 10km range from the Site, and assessed their potential to breed, and/or occur on Site based on habitat preferences, and suitable habitat available on Site. Records from iNaturalist were filtered to only include those ‘verified’ or of ‘research grade’ to increase the confidence in observations. This desktop assessment was then used to design the survey methodology targeting species that may be present on site, as described in the following ‘On-Site Assessment’ section. The results of this desktop assessment are discussed in section 3.2.1. Marine specific species were omitted from the desktop analysis due to the lack of marine habitat available on-site.

On-Site Assessment

Multiple survey methods were employed to increase the likelihood of detecting cryptic species (i.e., camouflaged, inconspicuous, nocturnal or crepuscular species that can be difficult to detect) potentially present within the survey site (as identified through the desktop analysis), and to target avifauna within different habitats (i.e. wetland, freshwater ponds, indigenous forest, exotic grassland). The below survey methods were used on-site during Round 1 and Round 2 and described in further detail below:

- Five-minute bird counts (5MBC);
- Playback lures;
- Freshwater pond observations; and
- Acoustic Recorders.

2.1.2.1.1 Five Minute Bird Counts

5MBCs were undertaken at 10 randomly selected stations within vegetated areas on site as shown in Figure 2, with at least 200m spacing between each station to maintain independence. These stations were distributed using the QGIS random point function, and set to 200m distance between stations. Surveys followed the standardized 5MBC survey method (Hartley & Greene, 2012) and all birds seen and/ or heard in a c. 100 m radius were recorded in the counts. The results of these surveys are provided in Section 3.2.1.



Figure 2. Locations of 5MBC surveys on Site

2.1.2.1.2 Playback lures

Playback lure surveys were conducted at six freshwater habitats (Figure 3) targeting four threatened species that were considered as potentially present within suitable habitat on Site following the desktop assessment. These species were spotless crake *(Zapornia tabuensis),* fernbird *(Poodytes punctatus),* banded rail (*Gallirallus philippensis*), and Australasian bittern *(Botaurus poiciloptilus).* Recordings were sourced from Birds of the World – Merlin (2022) and were played twice, for up to 30 seconds, using a portable Bluetooth speaker (UE Boom) at 75% volume. Following playback, return calls were listened to for one minute. The process was repeated twice at each location and any species heard or observed were recorded.

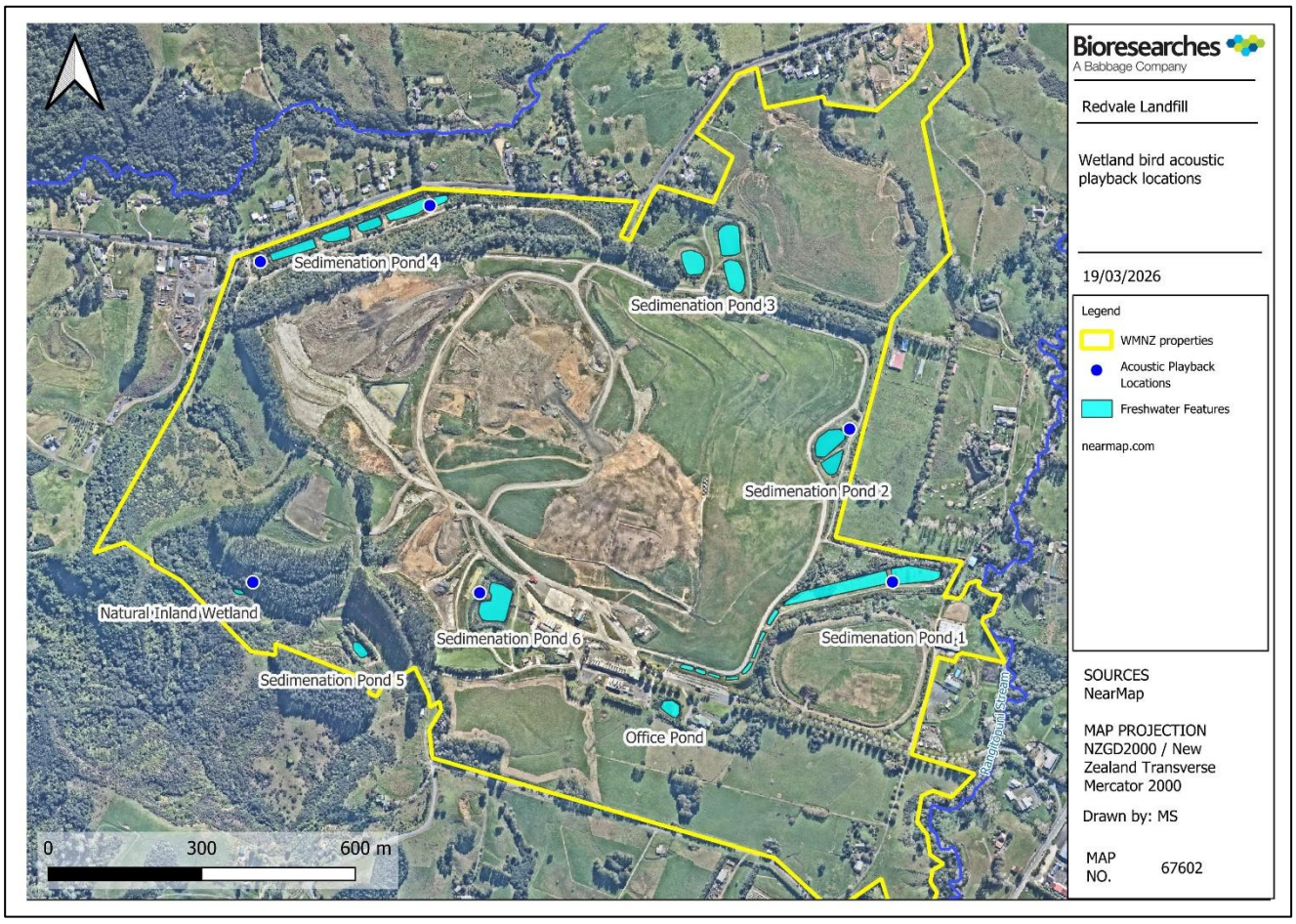


Figure 3. Avifauna Acoustic Playback Survey Locations on Site

2.1.2.1.3 Pond Observations

Freshwater avifauna were surveyed at nine locations on-site (Figure 4) using binoculars for 10 minutes on days with no precipitation. All freshwater birds heard or seen were recorded. Locations were determined in the field as those with the best vantage point, with minimal obscurities or disturbance prior to surveying avifauna.

The value of constructed ponds was assessed as potential habitat to New Zealand dabchick, following the observation of this species on some ponds. While none of the ponds are natural features, their potential to support dabchick habitat, either as a breeding habitat or other foraging or roosting area was assigned a value based on presence of features that support dabchick habitat, including presence of terrestrial edge and aquatic vegetation, and whether dabchicks were using this habitat during site survey. A value of High, Moderate or Low was assigned.

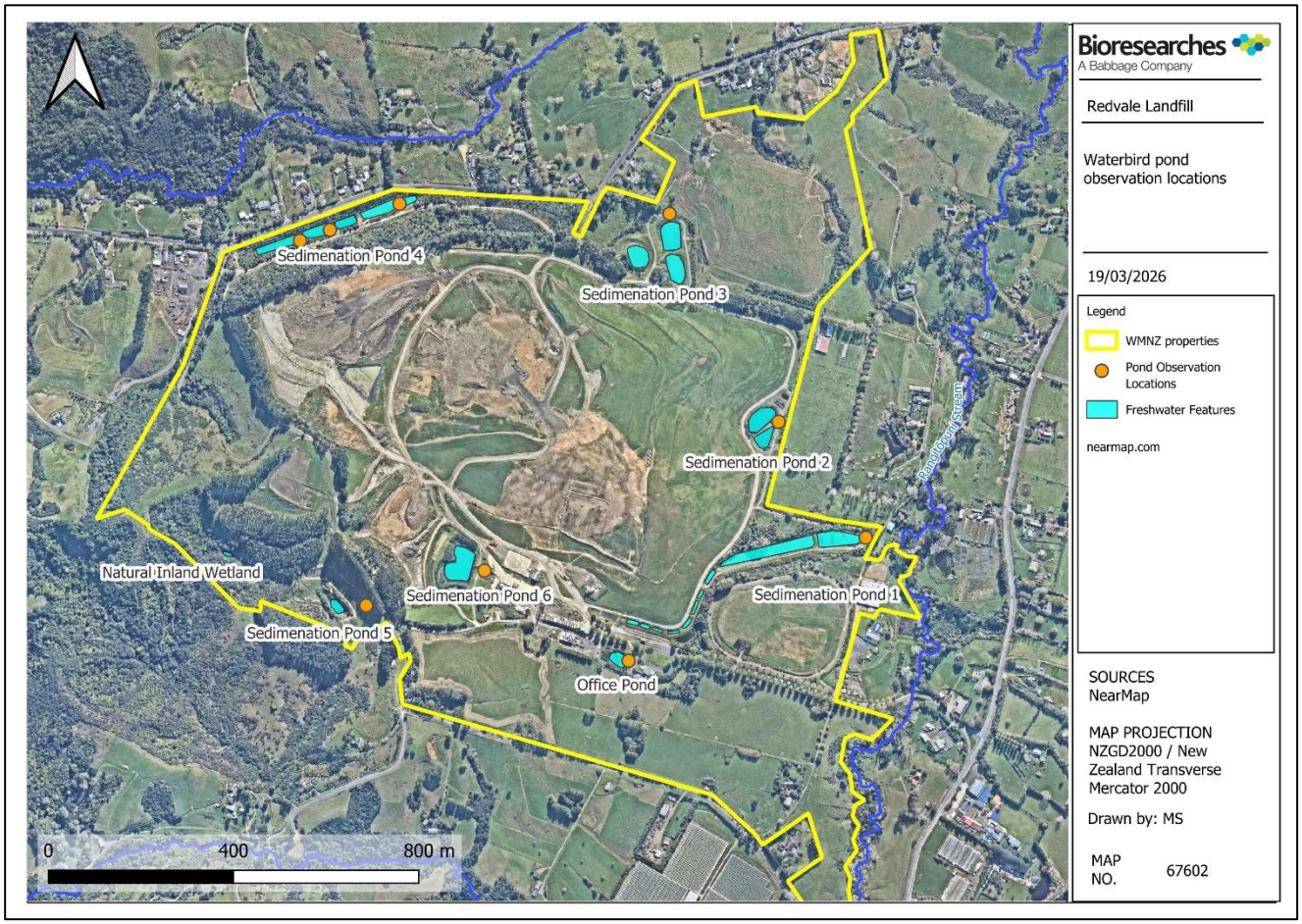


Figure 4. Avifauna Pond Observation Locations on Site

2.1.2.1.4 Acoustic Recorders

Acoustic recorders (AR4, ARs) were placed in three potentially suitable habitats targeting Australasian Bittern on Site (Figure 5) (Photo 1). The ARs recorded between twenty-one and twenty-three days from 11th January to 2nd February 2025, and eight days from the 5th to 12th March 2025, following standardized protocols for detecting Australasian Bittern (O'Donnell & Williams, 2015). The ARs were set to record from 0.5 hours before sunset for a period of four hours, and 1.5 hours before sunrise for a period of four hours. The data was analysed using AviaNZ software, and species identified within the recordings were noted.

An AR is comprised of two ultrasound sensors and microphones (50 m range), a sound-activated recording device, a timer to turn the system on and off each day, and a rain-noise detector that turns the system off in the event of heavy, persistent rainfall. Acoustic monitoring is an effective technique used to determine species composition, reducing diel and spatial restrictions of species, increasing the probability of detecting calls from cryptic species. ARs record and store data passively and remotely and have the capacity to record low frequency calls recommended for Australasian bittern.

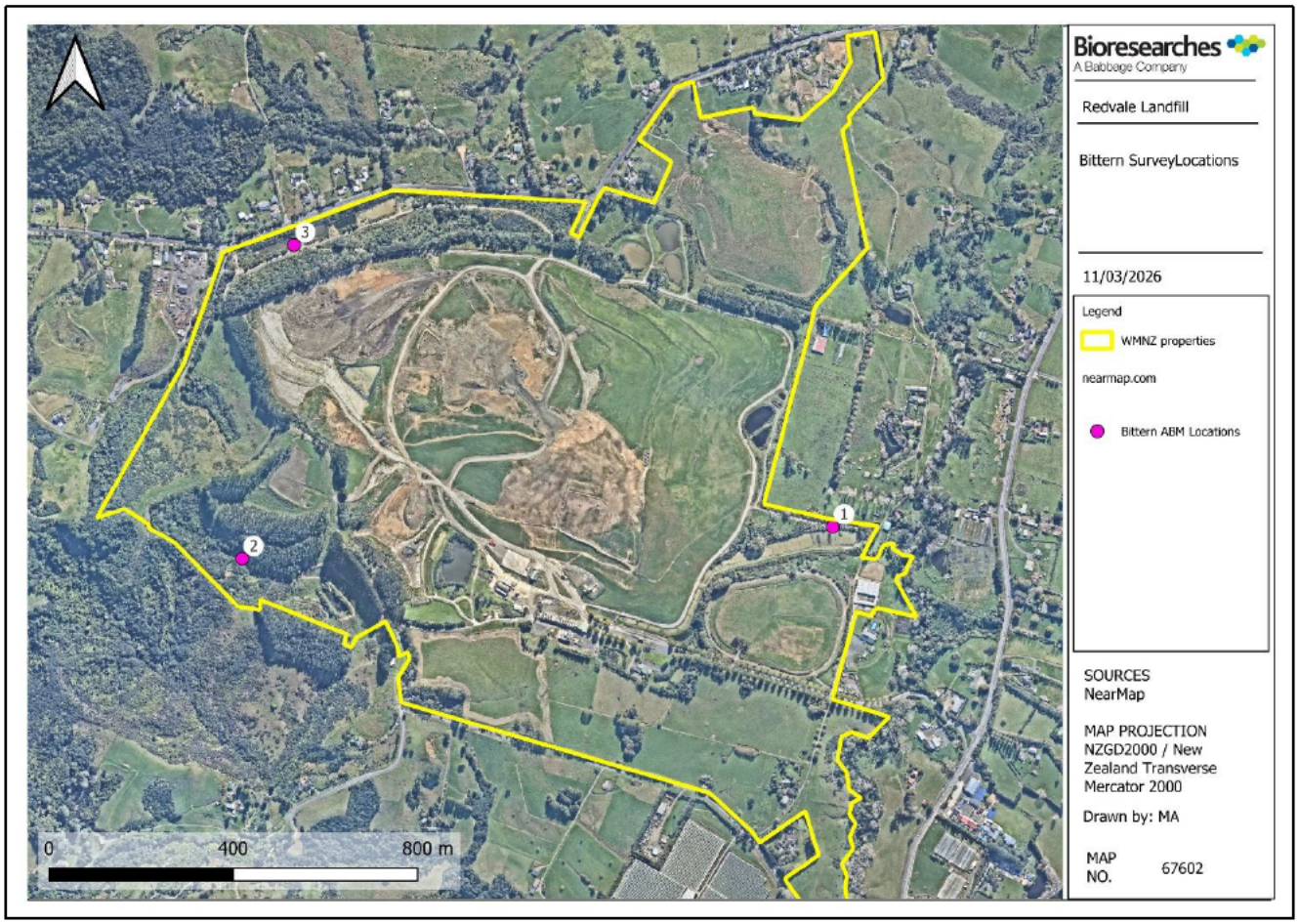


Figure 5. Acoustic Recorder Locations On Site Targeting Australasian Bittern



Photo 1. Acoustic recorder placement examples in two of the three locations on site.

2.1.2.2 Herpetofauna

2.1.2.2.1 Artificial Cover Objects

Artificial Cover Object (ACO) surveys were undertaken in accordance with the Department of Conservation's best practice (Lettink 2012). ACOs are suitable for surveying skinks and geckos that use ground-based habitats, particularly vegetated edges with sunlight exposure, as they can retain heat and enable lizards that use them to maintain elevated body temperatures relative to their surrounding habitats during use (Batson *et al.* 2015).

One hundred and sixteen (116) *Onduline* ACOs were installed throughout the project site (Figure 6) in November 2024, targeting edges with dense clusters of vegetation, logs, fallen trees and organic debris dams where potential lizard encounters were considered most likely. ACOs were left to settle in the environment for at least four weeks before they were checked for lizard presence and/ or their signs (e.g., skin, scat). Each ACO was checked four times each during two survey periods, on non-consecutive days during Round 1 and again in Round 2. As optimal conditions vary between species, ACO checks were performed under a variety of conditions and temporal periods; however, ACOs were not checked during periods of temperature extremes (<5°C and >25°C, heavy precipitation) as ACO detection efficacy and lizard activity is reduced within these conditions.

ACOs used by Bioresearches are 400 mm x 475 mm corrugated *Onduline*© sheets (distributed by GBS Group Ltd). *Onduline*© is an organic, bitumen-saturated material used in reptile surveys throughout New Zealand, due to its light weight and suitable thermal properties (Lettink & Cree 2007).

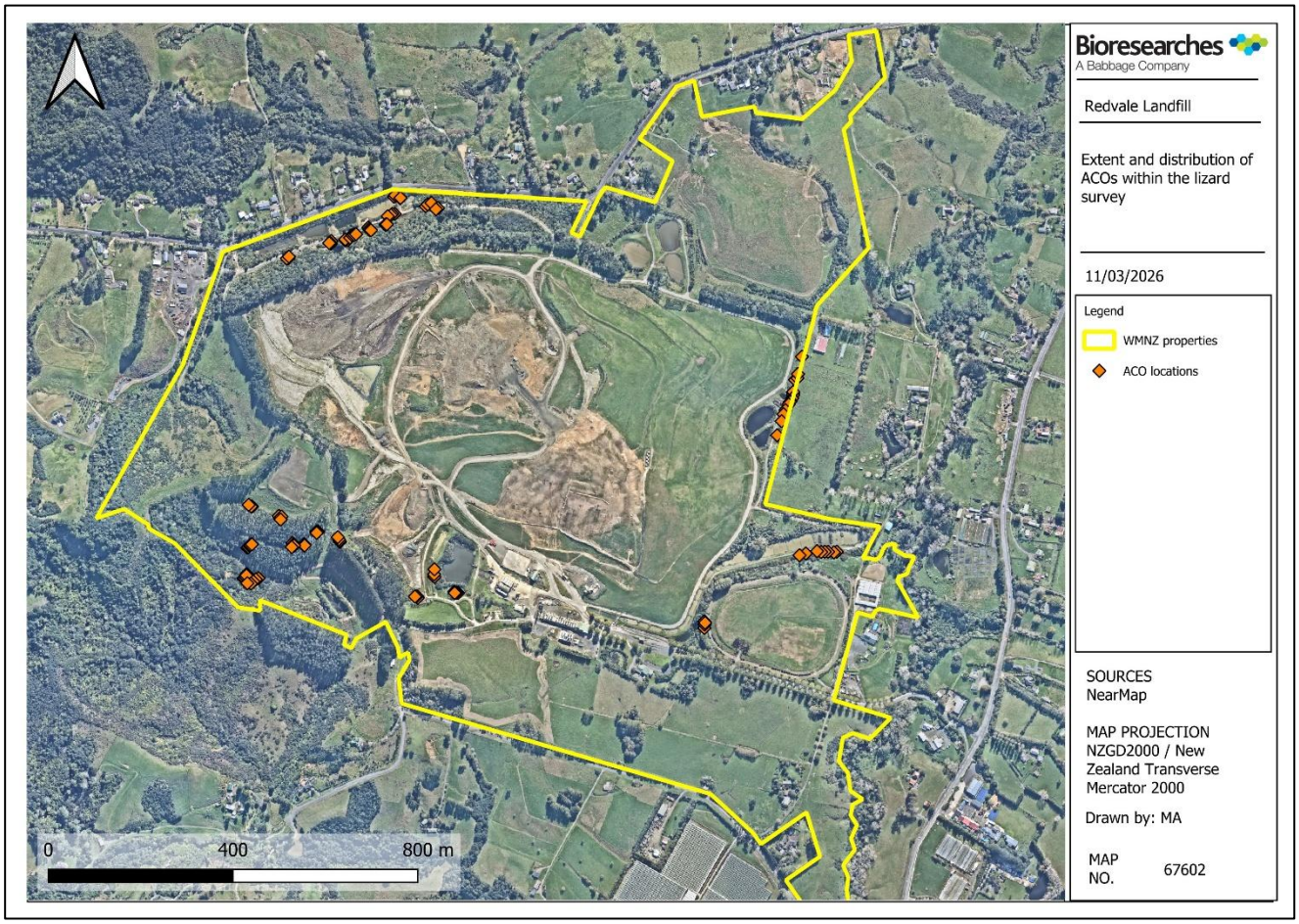


Figure 6. ACO survey extent and distribution across the Site.

2.1.2.2.2 Nocturnal Searches

Two nocturnal visual encounter searches (VES) were undertaken on the 20th and 24th March 2025, targeting areas with suitable gecko habitat i.e. tree canopy within indigenous forest and forest scrub. Focused headlamps (*Fenix* ™ HP 11) aided by 8 x 42 Nikon *Monarch* binoculars were used to search for geckos on the ground, on tree branches and in foliage. Searches involved walking slowly along the track edges where a greater profile of the forest edge was more visible. Particular attention was placed on scanning native trees and epiphytes, where gecko encounters were considered most likely. A total of 9.7 nocturnal VES person-search hours were conducted along predominantly track edge vegetation (Figure 7). Nocturnal VES were performed on nights where the ambient temperature was >12°C to target geckos during periods of activity and improve survey detectability.

Where any lizards were encountered, an encounter rate was calculated as *n / (h x s)*, where:
n = number of geckos encountered
h = number of hours spent searching
s = number of surveyors searching

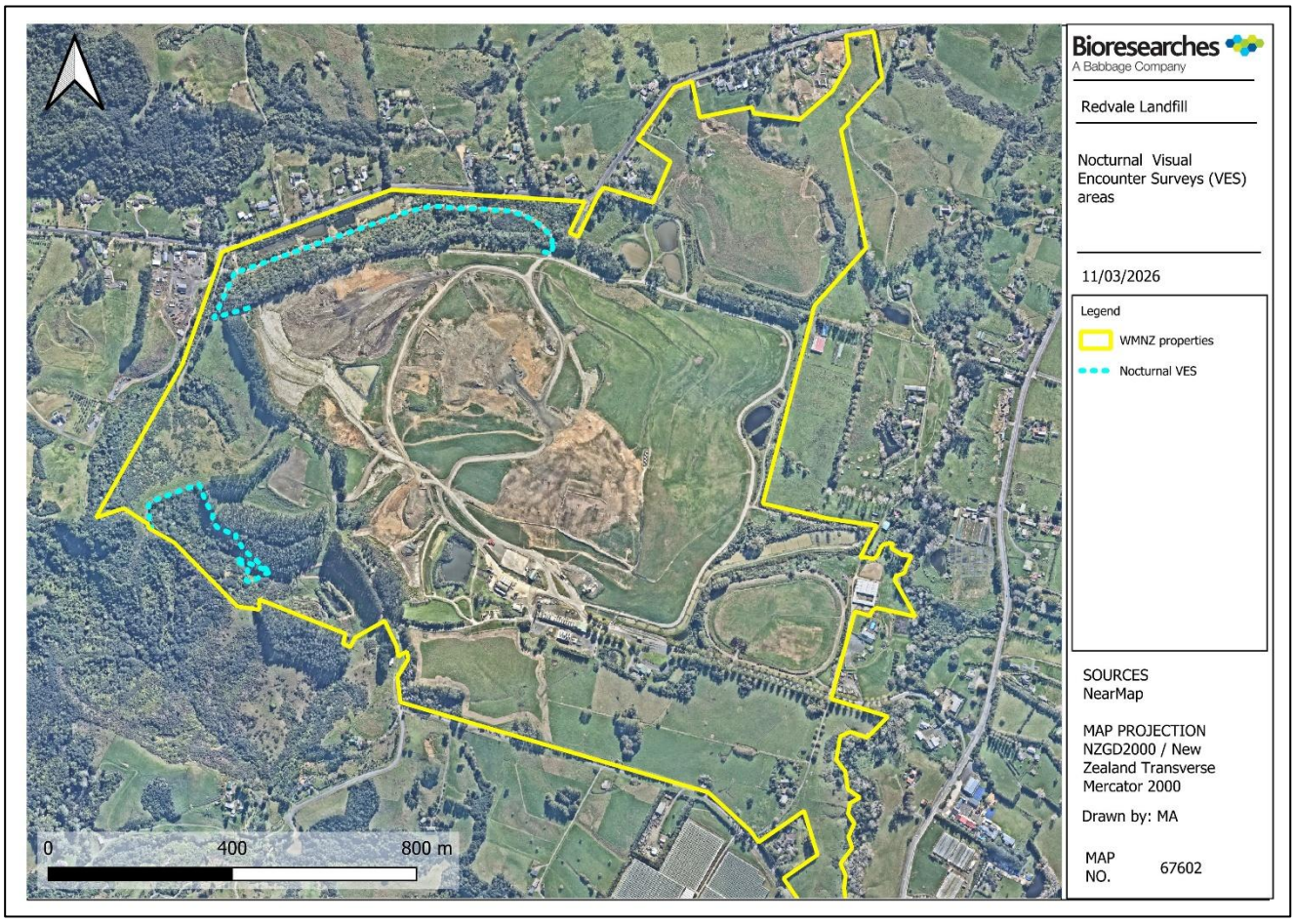


Figure 7. Nocturnal VES survey locations and extent

2.1.2.3 Long Tailed Bat

Long-tailed bats are classified as "Threatened – Nationally Critical" (O'Donnell *et al*. 2023), the highest threat classification possible for wildlife in New Zealand and the category of wildlife most at risk of extinction. They

currently have an estimated population decline rate of 5-9% per annum, which is thought to be significantly impacted by habitat loss, predation, and disease (O'Donnell *et al.* 2023).

Long-tailed bats are considered highly mobile fauna in the National Policy Statement on Indigenous Biodiversity (Ministry for the Environment, 2023), ensuring bat management is a high priority for councils nationwide. Given their critical conservation status afforded to them, comprehensive surveys were undertaken to determine their presence or absence at the site.

Surveys were conducted over three periods to determine the presence of long-tailed bats at the site (Habitat NZ 2025). Acoustic Bat Monitors (ABMs) were deployed at the site and throughout the surrounding landscape to ensure a spread of monitoring across the summer season, being:

- November – December 2024
- January – Early February 2025

Late February – March 2025A total of 2,007 survey nights were recorded across the three monitoring rounds, providing comprehensive coverage of the site and surrounding landscape during the peak activity periods for long-tailed bats.

2.2 Freshwater Assessments

Freshwater assessments included on-site ecological valuation and classification of aquatic habitats on the site (focussing primarily on the south-western area), complemented by water quality, sediment quality and biological surveys at four (Spring) / five (Autumn) monitoring locations in or near the adjacent Rangitopuni Stream, four of which are existing WMNZ stream monitoring locations.

2.2.1 On Site Stream Classifications

On site overland flow paths were ground-truthed and classified under the definitions in the Auckland Unitary Plan – Operative in Part (AUP) as to their permanent, intermittent or ephemeral status (Table 1). In addition, these watercourses were assessed as to whether they were natural or artificial, in accordance with AUP definitions, using information from both the desktop review and site visit.

Table 1. AUP criteria for permanent, intermittent rivers and streams and ephemeral streams

Criteria	Definition
Permanent Stream	
1	The continually flowing reaches of any river or stream
Intermittent or ephemeral stream*	
1	Evidence of natural pools
2	Well defined banks and bed
3	Retains surface water present more than 48 hours after a rain event
4	Rooted terrestrial vegetation not established across channel
5	Organic debris from flooding present on floodplain
6	Evidence of substrate sorting, including scour and deposition
*If three or more of the six assessment criteria can be met with confidence, the watercourse is considered intermittent. If at least three criteria cannot be met, the watercourse is considered ephemeral.	

The ecological value of the stream was then assigned based upon factors such as:

- The intactness of the riparian zone;
- Permanency of flow and complexity of habitat present within the stream;
- Observable water quality parameters; and
- Modifications to the hydrology and catchment of the stream.

2.2.2 Wetlands

Potential wetland areas were assessed following the RMA and the Ministry for the Environment (MfE) Wetland Delineation Protocols (2022), including vegetation assessments and wetland hydrology to determine whether the areas meet the definition of a 'natural inland wetland' under the NPS-FM.

Under the NPS-FM, a natural inland wetland is defined as not:[1]

> *"a wetland (as defined in the [Resource Management] Act) that is not:*
> *(a) in the coastal marine area; or*
> *(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or*
> *(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or*
> *(d) a geothermal wetland; or*
> *(e) a wetland that:*
> *(i) is within an area of pasture used for grazing; and*
> *(ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless*
> *(iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply."*

Consequently, the first step in delineating a natural inland wetland is to ensure it meets the definition of a wetland under the Resource Management Act (RMA), referred to as 'the Act' in the above definition.

A wetland is defined by the RMA as:

> *'permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions'.*

Vegetation was assessed based on the dominance and prevalence of:

[1] NPS-FM, subpart 3, cl 3.21.

- Obligate wetland vegetation (OBL) – almost always a hydrophyte, rarely in uplands;
- Facultative wetland (FACW) – usually a hydrophyte but occasionally found in uplands;
- Facultative (FAC) – commonly occurs as either a hydrophyte or non-hydrophyte;
- Facultative upland (FACU) – occasionally a hydrophyte by usually occurs in uplands; and
- Upland (UPL) – rarely a hydrophyte, almost always in uplands.

Where the dominance and/or prevalence tests showed unclear results, the 'FAC neutral' test would be used, and if necessary, hydric soils and hydrology tests would be undertaken in accordance with the associated protocols (Fraser *et al.* (2018) and MfE (2021)). These tests, if undertaken, will be described in the following results sections.

2.2.3 Water Quality

Spot measurements of basic water quality parameters (temperature, dissolved oxygen and conductivity) were also taken using a Yellow Springs Instrument (YSI) Professional Series meter in all stream monitoring sites (Figure 8) and in the ponds, prior to setting nets.

At the Rangitopuni Stream monitoring locations, water samples were analysed for parameters that can indicate leachate or contamination (Table 2).

Table 2. Water Quality Sample Parameters.

Sampling Parameter
Total Alkalinity
Total Suspended Solids
Chloride
Total Ammoniacal-N
Chemical Oxygen Demand (COD)
Oil and Grease
Heavy metals, total and dissolved:
Arsenic
Cadmium
Chromium
Copper
Lead
Nickel
Zinc
Total Petroleum Hydrocarbons in Water

Water quality results were compared to the Australia and New Zealand Guidelines for Freshwater and Marine Water Quality (ANZECC Guidelines – ANZG 2018, ANZECC and ARMCANZ 2000); the NPS-FM criteria for protecting aquatic ecosystems, (Ministry for the Environment (MfE) 2020); habitat indicators of stream health from the National Institute of Water and Atmosphere (NIWA) (Hickey 2001, 2014 and Biggs *et al.* 2002). The raw water quality data are presented in Appendix E.

2.2.4 Sediment Quality

Composite sediment samples were collected at Rangitopuni Stream monitoring sites 1, 2, 3 and 4 on 27-28 November 2024, and Rangitopuni Stream monitoring sites 1, 2, 3, 4 and 5 on 25-26 March and 3 April 2025,

shown in Figure 8. Six sediment cores (80mm x 100mm) were collected from each location(two from true left bank, two from true right bank, two from centre of tributary) and combined. A representative sub-sample was taken from this composite sample and sent to Hills Laboratories, Hamilton for analyses of the following heavy metals:

- Arsenic (As);
- Cadmium (Cd);
- Chromium (Cr);
- Copper (Cu);
- Lead (Pb);
- Nickel (Ni); and
- Zinc (Zn).

Sediment quality results were compared to the ANZECC Guidelines – ANZG 2018 guidelines (refer Appendix F). The raw sediment quality data are presented in Appendix E.

2.2.5 Native fish

Fish communities can be good indicators of stream ecosystem health. Freshwater fish were sampled using marmite baited fykes and Gee's minnow traps, which were deployed overnight at each freshwater survey site in the Rangitopuni Stream sites and in the on-site artificial ponds (Table 3, Figure 8). Timings for surveys are provided in Table 4. Traps and nets were set in general accordance with the New Zealand Freshwater Fish Sampling Protocols (Joy et al, 2013), with two Gee's minnow traps set near each fyke, and six fyke nets (with internal exclusion chambers) set over a 150 m reach of the stream, where habitat allowed, and around the edges of the ponds. All fish captured were identified and counted, and their size estimated before being returned to their habitats. A Fish Index of Biotic Integrity (IBI) for the Auckland Region was calculated for each survey location based on fish species present, altitude and distance inland (Joy and Henderson 2004). New Zealand Freshwater Fish Database (NZFFD, NIWA) forms were completed for each survey location. The raw freshwater fish data are presented in Appendix D.

2.2.6 Biological Surveys – Rangitopuni Stream

In additional to water quality and sediment quality, biological assessments were undertaken in the Rangitopuni Stream and Site 4 Tributary in Spring/early Summer 2024 and Autumn 2025. The biological surveys were comprised of fish surveys (refer Section 2.2.5 above), habitat characteristics, macroinvertebrates and macrophytes.

2.2.6.1 Habitat Characteristics

In-stream and riparian habitat characteristics were recorded within each survey site, provided for in Table 3 and shown in Figure 8. Habitat characteristics assessed included estimates of channel width, depth, substrate composition, proportion of each habitat type (e.g., run, riffle, pool and cascades) stream bank erosion and riparian shading.

2.2.6.2 Macroinvertebrates

Macroinvertebrates were sampled from instream habitats (Table 3, Figure 8) to obtain semi-quantitative data in accordance with the Ministry for the Environment's current "Protocols for Sampling Macroinvertebrates in

Wadeable Streams" (Stark *et al*. 2001). Sampling was undertaken using protocol 'C2: soft-bottomed, semi-quantitative' as the survey sites were predominantly soft bottomed. The macroinvertebrate sample was preserved in 70% ethyl alcohol (ethanol), returned to the laboratory and sorted (using protocol 'P3: full count with subsampling option' (Stark *et al*. 2001)). Macroinvertebrates were then identified to the lowest practicable level and counted to enable biotic indices to be calculated.

Several biotic indices were calculated, namely the number of taxa (i.e., species), the number and percentage of Ephemeroptera (mayflies); Plecoptera (stoneflies) and Trichoptera (caddisflies) recorded in a sample (%EPT), the Macroinvertebrate Community Index (MCI) and the Semi-Quantitative Macroinvertebrate Community Index (SQMCI) (Stark & Maxted, 2007a). EPT are three orders of insects that are generally sensitive to organic or nutrient enrichment but exclude *Oxyethira* and *Paroxyethira* as these taxa are not sensitive and can proliferate in degraded habitats. The MCI and SQMCI are based on the average sensitivity score for individual taxa recorded within a sample; although the SQMCI is calculated using coded abundances instead of actual scores. The raw macroinvertebrate data are presented in Appendix 2. For the MCI and SQMCI, respectively, scores of:

- ≥ 120 and ≥ 6.0 are indicative of excellent habitat quality;
- 100 – 119 and 5.0 – 5.9 are indicative of good habitat quality;
- 80 – 99 and 4.0 – 4.9 are indicative of fair habitat quality; and
- < 80 and < 4.0 are indicative of poor habitat quality (Stark & Maxted, 2007b).

The AUP, Chapter E1, provides additional MCI values criteria (AUP Table E1.3.1) for freshwater ecosystem health associated with various land uses within catchments:

- Native forest 123
- Exotic forest 111
- Rural areas* 94
- Urban areas 68

*MCI guideline applicable to the Rangitopuni Stream reaches.

Policy E1.3(2) guides the management of discharges that could potentially impact freshwater systems to maintain or improve water quality, flow rates, stream channels, margins, and other freshwater values. This policy applies when the current condition is either above (for maintenance) or below (for enhancement) the NPS-FM National Bottom Lines and the relevant MCI guidelines.

2.2.6.3 Macrophytes

Macrophyte coverage was estimated at each freshwater stream survey location (Table 3, Figure 8). The species present and type of macrophytes (i.e. submerged or emergent) were recorded. At each survey site the percentage cover (proportion of the total line width impinged) of algae and/or macrophytes was recorded along twelve random replicate transects which ran from bank to bank. Transect locations were determined using a random number table. From the centre of the survey site, six transects were completed in an upstream direction at random intervals in metres determined by the table, followed by six transects returning in a downstream direction. At each transect the stream width, and the length of the transect impinged by the plant taxa were recorded and converted to percentage plant cover. Incidental species present at the survey site but not recorded along the transects were also noted. The raw macrophyte survey results are present in Appendix B.

2.2.7 Results Comparison

All results were evaluated against guideline values, where applicable. These water quality guidelines indicate threshold concentrations of nutrients and toxicants beyond which possible adverse effects occur. Additionally, results from Spring 2024 samples were compared with those from Autumn 2025 to assess temporal changes.

2.2.8 Site Locations

Locations and descriptions of the sampling sites for water quality and biological monitoring surveys are provided in Table 3 (Sites 1 – 5) and illustrated in Figure 8.

Table 3. Location and NZTM2000 map series grid references for Stream monitoring sites and Pond surveys.

Site	Stream/River	Location description	NZTM 2000	
			Northing	Easting
Site 1	Rangitopuni Stream	Rangitopuni Stream bridge on shared driveway to 190, 192 & 194B-D Horseshoe Bush Road	5942212	1744927
Site 2	Rangitopuni Stream	Horseshoe Bush Road bridge	5942481	1746615
Site 3	Rangitopuni Stream	Landfill Access Road bridge	5940963	1746319
Site 4	Rangitopuni Stream tributary	Tributary south of WMNZ Pond 1	5941266	1746091
Site 5	Rangitopuni Stream	Richards Road bridge	5940378	1746204
Pond 1	WMNZ	Series of long linear ponds south-east of the fill area	5941307	1746077
Pond 2	WMNZ	Two rounded ponds east of the fill area	5941546	1745999
Pond 3	WMNZ	Three ponds in north-east of the fill area	5941928	1745801
Pond 4	WMNZ	Linear series of pond north and north-west of fill area	5941977	1745063
Pond 5	WMNZ	Small remote pond south-west of fill area	5941165	1745076
Pond 6	WMNZ	Large, rounded pond south of fill, west of offices	5941250	1745353
Wetland	A small western tributary to Rangitopuni Stream	Natural wetland complex with ponded water up-stream of, but offline of, Pond 5	5941275	1744843
Office Pond	WMNZ	Small pond located between the offices and work-shops	5941049	1741049

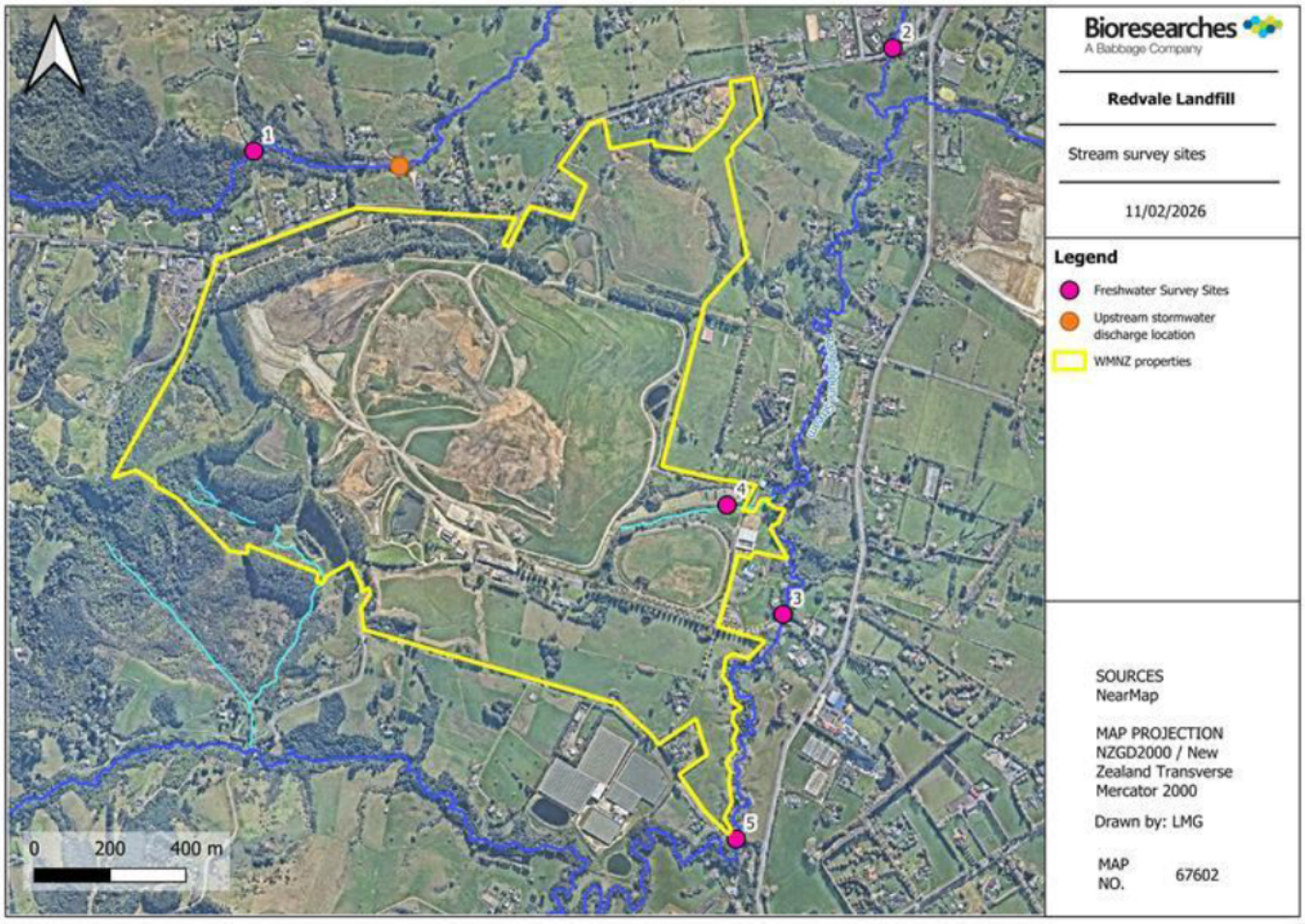


Figure 8. Rangitopuni Stream Monitoring Sites

The freshwater sampling activities undertaken at the stream sites are identified in Table 4. The spring survey was carried out on 27-29 November and 5-6 & 16-17 of December 2024 (for the fishing), while the autumn survey was carried out on 25-27 March and 3-4 April 2025.

Table 4. Summary Table of Sampling Type and Frequency

Sample Type	Frequency	Sites	Methods	Parameters
Fish	Spring (November – December) Autumn (March-April)	Site 1, Site 2, Site 3, Site 4, Pond 1, Pond 2 & Pond 6 Pond 3 and 4, Site 5	Traps & Nets (Gee Minnow & Fyke)	Species numbers Species abundance Fish lengths
Macroinvertebrates	Spring (November) Autumn (March-April)	Site 1, Site 2, Site 3 & Site 4	Macroinvertebrate Net. C2 Protocols.	Taxa richness Total abundance MCI, SQMCI, % EPT.
Water Quality	Spring (December) Autumn (March-April)	Site 1, Site 2, Site 3 & Site 4; plus Site 5 in Autumn	Spot sampling; Sample container to Hill Labs.	All parameters listed in Section 2.2.3
Sediment	Spring (December) Autumn (March-April)	Site 1, Site 3 & Site 4; plus Site 5 in Autumn	Sediment core sampling to Hill Labs.	Metals (refer section 2.2.4

2.2.9 Rangitopuni Sampling Sites

Site 1

Site 1 is located on Rangitopuni Stream north of the Site, at a bridge crossing down a long-shared driveway. There is no surface catchment between WMNZ and Site 1, which provides an upstream control to any surface water discharges from the WMNZ Site.

The stream averages about 3m wide near Site 1, with an average width of 3.6m in late Spring and 2.9m in early Autumn. Depths averaged 0.6m and 0.8m in spring and autumn respectively, with the maximum depth recorded in an autumn cross-section. The depths ranged from 0.01 m near the banks to 1.8 in the deeper sections. The stream hydrological variation is uniform, forming a run with occasionally deeper pools, partial shading and with stable banks. There is some, but variable, connectivity between the stream and the riparian vegetation, and variable connectivity with the floodplain. The riparian vegetation comprised a mix of native shrubs and trees including nikau (*Rhopalostylis sapida*), māhoe (*Melicytus ramiflorus*) and occasional kahikatea (*Dacrycarpus dacrydioides*), and exotic weed species (arum lilly, *Zantedeschia aethiopica*; privet, *Ligustrum lucidum*, *L. sinense*), which provided moderate, but patchy, shading to the stream. Macrophytes, mainly curly pond weed and the macroalgae Nitella, formed a patch coverage in the stream, at times dominant in the watercourse and at times absent. (Photo 2 and Photo 3).



Photo 2. Rangitopuni Stream Site 1, with dense macroalgae and macrophytes. View downstream



Photo 3. Rangitopuni Stream Site 1. View upstream of bridge.

Site 2

Site 2 is located on Rangitopuni Stream north-east of the Site, at the Horseshoe Bush Road bridge crossing. The site is located downstream of the first stormwater discharges from the Site.

The stream is wide and deep at this point, averaging 6m wide in Spring and 4.5m wide in Autumn, and greater than 1.5m deep through most of the width of the reach. The stream was not wadeable at this point and biomonitoring data was collected using a kayak. The stream reach formed a uniform run with no hydrological variation. There was no effective shading to the stream, with wide sloping banks. The riparian vegetation was comprised of a mix of exotic weed species (privet; brush wattle, *Paraserianthes lophantha*) and pasture species, with an occasional native shrub (karamu, *Coprosma robusta*). Connectivity between the stream and the riparian vegetation was good, but it is unlikely the stream regularly connects with the floodplain due to the height and slope of the banks. (Photo 4 and Photo 5) Macrophytes, mainly curly pond weed and the macroalgae Nitella, formed a patchy coverage in the stream, at times dominant in the watercourse and at times absent.



Photo 4. Rangitopuni Stream Site 2.



Photo 5. Rangitopuni Stream Site 2.

Site 3

Site 3 is located on Rangitopuni Stream east of the Site, on Landfill Access Road and downstream of the storm-water discharges from WMNZ site.

In spring the stream averaged 2.8m wide reducing to 1.3m in early autumn. The stream was generally wide and shallow, averaging 0.23m and 0.11m in spring and autumn respectively. The stream was mostly stable, dominated by silty sand with occasional small gravels. It was well shaded, and drying out after the summer drought. The stream reach formed a run with occasional deep pools. The riparian vegetation was comprised of a mix of native and exotic shrubs, weed species and pasture species. Connectivity between the stream and the riparian vegetation was good, but it is unlikely the stream regularly connects with the floodplain due to the height and slope of the banks. (Photo 6 and Photo 7). Macrophytes were patchy with occasional areas of high coverage dominated by curly pond weed.



Photo 6. Site 3 with fyke net set



Photo 7. Site 3, deep pool in foreground, shallow on true left bank background.

Site 4

Site 4 is located on a tributary of the Rangitopuni Stream that flows from near the entrance to the Site towards the Rangitopuni Stream. The site was mainly shallow with occasional deeper pools, and flowed near the WMNZ fenceline, mainly forming a stream channel but occasionally braiding to flow through willows. (Photo 8 and Photo 9). The riparian vegetation was comprised of willows and pasture grasses and weeds.

The stream was flowing in Spring with an average width of 2.7m and an average depth of 0.14m (ranging from 0.01m to 0.49m deep). During the Autumn 2025 monitoring round the stream was dry, after the sustained dry summer period.



Photo 8. Site 4 – Rangitopuni Tributary



Photo 9. Site 4 Rangitopuni Tributary

Site 5

Site 5 is located on Rangitopuni Stream south of the Site, at the bridge crossing at Richards Road and downstream of the stormwater discharges from the WMNZ site. The downstream freshwater site assessments were carried out in the Rangitopuni at Landfill Access Road, instead of Richards Road in the Spring / Summer monitoring round. This was corrected in the Autumn sampling round, increasing the number of sampling sites in the Rangitopuni from four to five.

The stream is wide with variable depths, averaging 2.45m wide, with variable depths from dry mounds to deep water (0.77m) near the true right bank. The stream was wadeable through most areas. The stream reach was not flowing in Autumn after a dry summer period and formed a series of long runs in mostly deep pools, separated by dry stream bed or mounded gravel bars. The stream was well shaded with vertical banks. The riparian vegetation was dominated by well-established trees, dominantly exotic (privet, oaks, willow) and shrubs downstream of the bridge with a line of oaks and pasture grass upstream of the bridge. Connectivity between the stream and the riparian vegetation was poor, and it is likely that the stream reach only connects with the floodplain occasionally due to the height and vertical banks. (Photo 10 and Photo 11). Macrophytes, were limited to the macroalgae Nitella, formed a patchy coverage in one of the long downstream pools.



Photo 10. Site 5 – Rangitopuni Stream, view downstream from Richards Road Bridge



Photo 11. Site 5 – Long pool upstream of bridge.

2.2.10 On-site Ponds

Within the Site, seven constructed ponds have been established throughout the outer margins of the site. These ponds *do not* receive leachate which is generated on the active fill area. Ponds 1 - 4 are utilised for stormwater treatment and sediment retention using a series of ponds, each containing two to four individual ponds. All water received in these four constructed ponds is stormwater generated from hardstand roading and additional impervious surfaces throughout the site. Pond 6 is an offline pond which was used to treat stormwater run-off from the now decommissioned Managed Fill area and contains a consented dam and water take. The Office Pond is located between the offices and the workshop areas, and does not appear to have a function in relation to stormwater management. Pond 5 is now an offline pond and is used to treat stormwater from Stockpile 4, and a natural wetland area part of which appears as a pond, is located on the south-western side of the Site.

The ponds applicable to this assessment (Pond 1-4, 6 and the Office Pond), were of overall **low freshwater ecological value**. The ponds provided limited aquatic habitat diversity, had minimal shading with elevated turbidity. The ponds contained minimal riparian margins or in-stream vegetation, including macrophytes, emergent vegetation or bankside vegetation as it related to freshwater values and habitat.



Photo 12. Cell of Pond 1



Photo 13. Pond 3



Photo 14. Pond 4



Photo 15. Office Pond

3 SURVEY RESULTS

3.1 Vegetation

Four vegetation types occur on site as shown in Table 5 and Figure 9, which includes; planted native vegetation, mixed native and exotic vegetation, exotic vegetation and exotic managed (mowed or grazed) grassland. A Significant Ecological Area (SEA_T_2194) exists along the southwest boundary of the property, encompassing approximately 3ha of vegetation, which was described as 'mixed native exotic' during the site survey.

Table 5. Broad vegetation categories identified within the site, including a brief description of the categories.

Vegetation category	Value	Category description
Planted native vegetation	Low	Native plantings appear along the pond margins, and on the hill slopes of the northern margin alongside the road. Several TAR species are found here including kauri, kāpuka, makaka and ngaio; and common native species such as harakeke, cabbage tree and Coprosma sp. The plantings are young (~10 years old), patchily distributed, and occur in narrow strips with weedy vegetation growing within the understory.
Mixed native and exotic vegetation	Low	This vegetation type consists of areas of native forest with an understory of naturally regenerated native shrubs, ferns, or young trees interspersed throughout (e.g., mānuka, kānuka, kumarahoe, large-leaved māhoe, red mapou), and weedy species such as Chinese privet, blackberry, Japanese honeysuckle, pampas) throughout the edges and understory.
Exotic vegetation	Negligible	Stands of planted Pinus radiata which dominate the canopy and species composition. Some native and exotic vegetation has naturally regenerated in the subcanopy.
Exotic managed grassland	Negligible	Occurs where historic vegetation clearance and subsequent reseeding of grass have occurred; the majority of which is along the hillslopes of the landfill surrounding the landfill. The majority of grass on the landfill hill slope is managed (mowed or grazed), and comprises exotic grasses with weedy pasture species throughout.

Twelve 'Threatened' or 'At-Risk' (TAR) plant species were recorded on-site as shown in Table 6, however only two TAR species were found to be naturally occurring (i.e., not planted) on-site. These include; kumarahou (*Pomaderris kumeraho*) and large-leaved māhoe (*Melycitus macrophyllus*). A full list of flora observed within the site area can be found in Table 20, Appendix A.

The conservation status of floral species found on site reflect the most recent iterations of the National and Regional conservation status reports (Simpkins et al, 2025 and de Lange et al, 2023). Specifically, mānuka (*Leptospermum scoparium*) and kānuka (*Kunzea robusta*) have been reclassified during the writing of this report from 'Threatened' to 'Not Threatened' both regionally and nationally (Simpkins et al, 2025) after assessments concluded the species were less susceptible to myrtle rust compared to other Myrtaceae species, and less than previously indicated.

Most native vegetation on site has been planted in accordance with the requirements of the existing resource consent conditions and is further described in the Landscape and Visual Assessment, prepared to support this application. Several of these planted species shown in Table 6 are not indigenous to the Auckland region, resulting in genetic diversity that is not representative of the local area and consequently, these native plantings are assessed as having low floristic value.

As many of the vegetated habitats on site comprise of highly modified, non-naturally occurring habitat types and contain a limited number of naturally occurring native plant species, they were considered to be of **Negligible - Low** botanic value, as shown in Table 5.

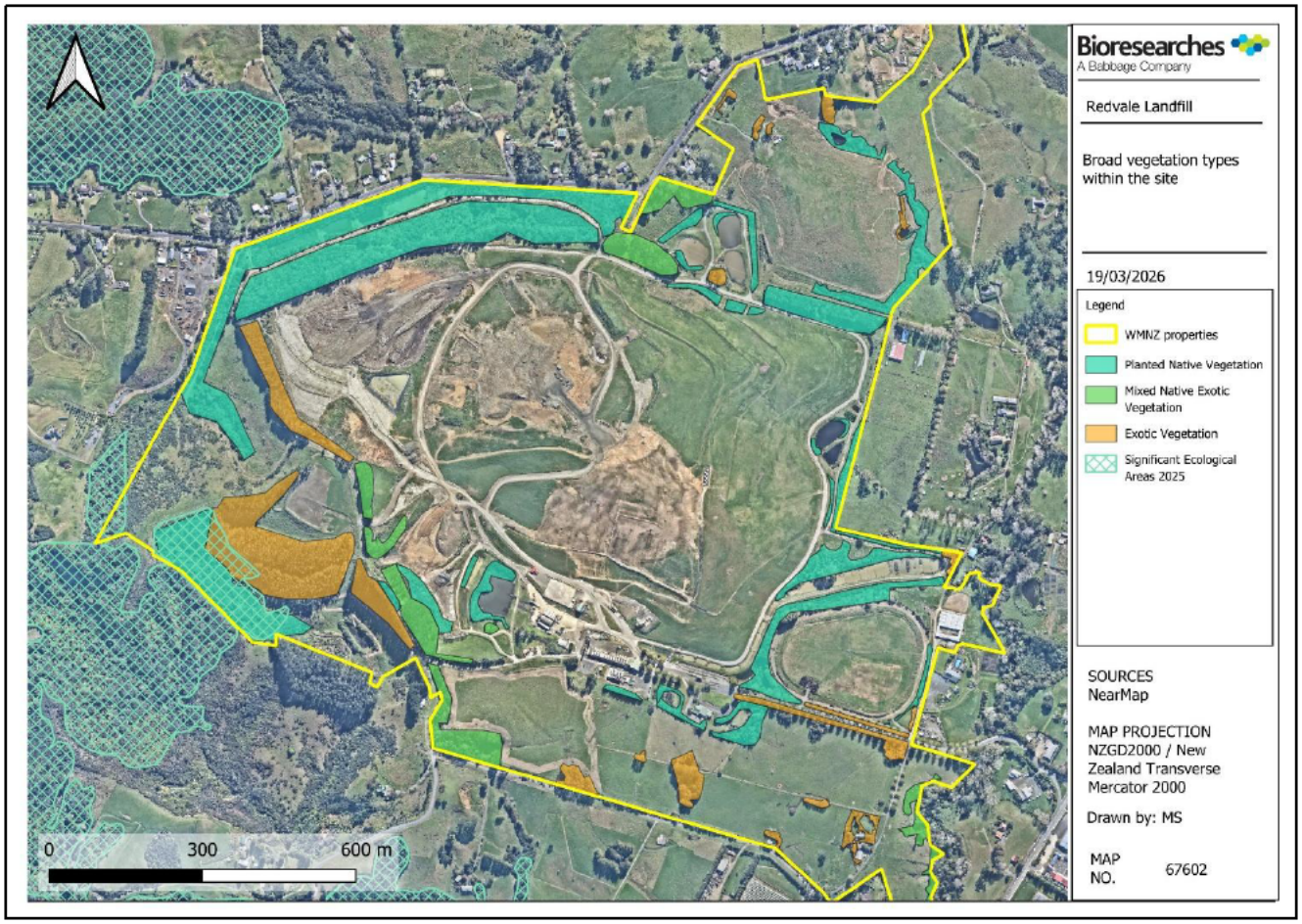


Figure 9. Extent of vegetation types across the site. Note: the remainder of vegetation on site not highlighted comprises managed (grazed or mowed) grassland. SEA_T_2194 is shown in the southwest corner of the site.

Table 6. At-Risk and Threatened plants recorded during the vegetation surveys on site

Scientific name	Common name	Regional conservation status *	National Conservation Status *, **	Notes
Griselinia littoralis	Kāpuka	Endangered	Not Threatened	Planted
Agathis australis	Kauri	Declining	Threatened – Vulnerable	Planted
Pomaderris kumeraho	Kumarahou	Declining	Not Threatened	Natural
Melycitus macrophyllus	Large-leaved māhoe	Naturally uncommon	Not Threatened	Natural
Olearia lineata cv. 'Dartonii'	Long-leaved tree daisy	None***	Declining	Planted
Myoporum laetum	Ngaio	Declining	Not Threatened	Planted
Metrosideros excelsa	Pōhutukawa	Declining	Threatened – Vulnerable	Planted

Plagianthus regius	Ribbonwood	Endangered	Not Threatened	Planted
Pittosporum eugenioides	Tarata	Data deficient	Not Threatened	Planted
Coprosma repens	Taupata	Declining	Not Threatened	Planted
Austroderia fulvida	Toetoe	Endangered	Naturally uncommon	Planted
Melicope ternata	Wharangi	Vulnerable	Not Threatened	Planted

*Notes: Species highlighted in blue were found naturally occurring within the Site, and have a conservation threat status *Simpkins et al, 2025; **de Lange et al, 2023; *** this species is endemic to the bottom two-thirds of the south island and it is likely that the plants observed at site are a commercial cultivar 'Dartonii'.*

3.2 Fauna

3.2.1 Avifauna

Desktop Assessment

Thirty-three avifauna species were detected within a 10km radius from the Site, nineteen of which may potentially breed on site within suitable habitat (Table 7). Habitat specific species were omitted from the results based on the lack of suitable habitat available on site (i.e., dense reeds, coastal habitat), or if nesting preferences were not supported or recorded (i.e., colonial nesters). Of these, one threatened species was recorded within the desktop assessment with the potential to breed on site; dabchick (*Poliocephalus rufopectus*) which has a national conservation status of Threatened – increasing (Robertson et al., 2021), and a regional threat status of Regionally Critical (Woolly et al, 2024).

On Site Assessment

The Avifauna species recorded at the site are included in Table 7. Of those recorded on site four threatened or at risk species were recorded over the first and second survey periods; dabchick, little black shag (*Phalacrocorax sulcirostris*), black shag (*Phalacrocorax carbo*) and red-billed gulls (*Chroicocephalus novaehollandiae*) (Appendix A, Table 21, Table 23, Table 24). No other TAR avifauna were detected during the acoustic lure playback surveys, pond observations, acoustic recorder surveys or 5MBCs.

Table 7. Avifauna species recorded within 10km from Site, and recorded during on-site surveys (2024-2025). Species highlighted in blue are those with the potential to breed within suitable habitat on site.

Species		Recorded in desktop assessments (10km)		Recorded on Site during surveys	Potential to breed in suitable habitat on Site
Common name	Scientific Name	eBird	iNaturalist		
Australasian Bittern	*Botaurus poiciloptilus*		✓		
Australasian Coot	*Fulica atra australis*		✓		✓
Australasian Harrier	*Circus approximans*	✓	✓	✓	✓

Australasian Shoveler	*Spatula rhynchotis*		✓		✓
Banded Rail	*Gallirallus philippensis*		✓		
Black backed gull	*Larus dominicanus*	✓	✓	✓	
Black Shag	*Phalacrocorax carbo*	✓	✓	✓	
Brown Teal	*Anas chlorotis*		✓		
Dabchick	*Poliocephalus rufopectus*		✓	✓	✓
Fantail	*Rhipidura fuliginosa*	✓	✓	✓	✓
Grey Teal	*Anas gracilis*	✓	✓		✓
Grey Warbler	*Gerygone igata*		✓	✓	✓
Kereru	*Hemiphaga novaeseelandiae*	✓	✓		✓
Kingfisher	*Todiramphus sanctus*	✓	✓	✓	✓
Little Black Shag	*Phalacrocorax sulcirostris*		✓	✓	
Little Shag	*Microcarbo melanoleucos*		✓		
Mallard	*Anas platyrhynchos*	✓	✓	✓	✓
Morepork	*Ninox novaeseelandiae*	✓	✓		✓
New Zealand Kaka	*Nestor meridionalis*	✓	✓		
New Zealand Pipit	*Anthus novaeseelandiae*	✓	✓		
North Island Robin	*Petroica longipes*		✓		
North Island Tomtit	*Petroica macrocephala*		✓		
Paradise Shelduck	*Tadorna variegata*	✓	✓	✓	✓
Pied Shag	*Phalacrocorax varius*	✓	✓		
Pied Stilt	*Himantopus leucocephalus*	✓	✓		
Pukeko	*Porphyrio melanotus*	✓	✓	✓	✓
Red Billed Gull	*Chroicocephalus novaehollandiae*	✓	✓	✓	
Reef Heron	*Egretta sacra*		✓		
Royal Spoonbill	*Platalea regia*		✓		
Shining Bronze-Cuckoo	*Chalcites lucidus*		✓		✓
Silvereye	*Zosterops lateralis*	✓	✓	✓	✓
Spur-winged Plover	*Vanellus miles*		✓	✓	✓
Tui	*Prosthemadera novaeseelandiae*	✓	✓	✓	✓
Welcome Swallow	*Hirundo neoxena*	✓	✓	✓	✓
White-faced Heron	*Egretta novaehollandiae*		✓		✓

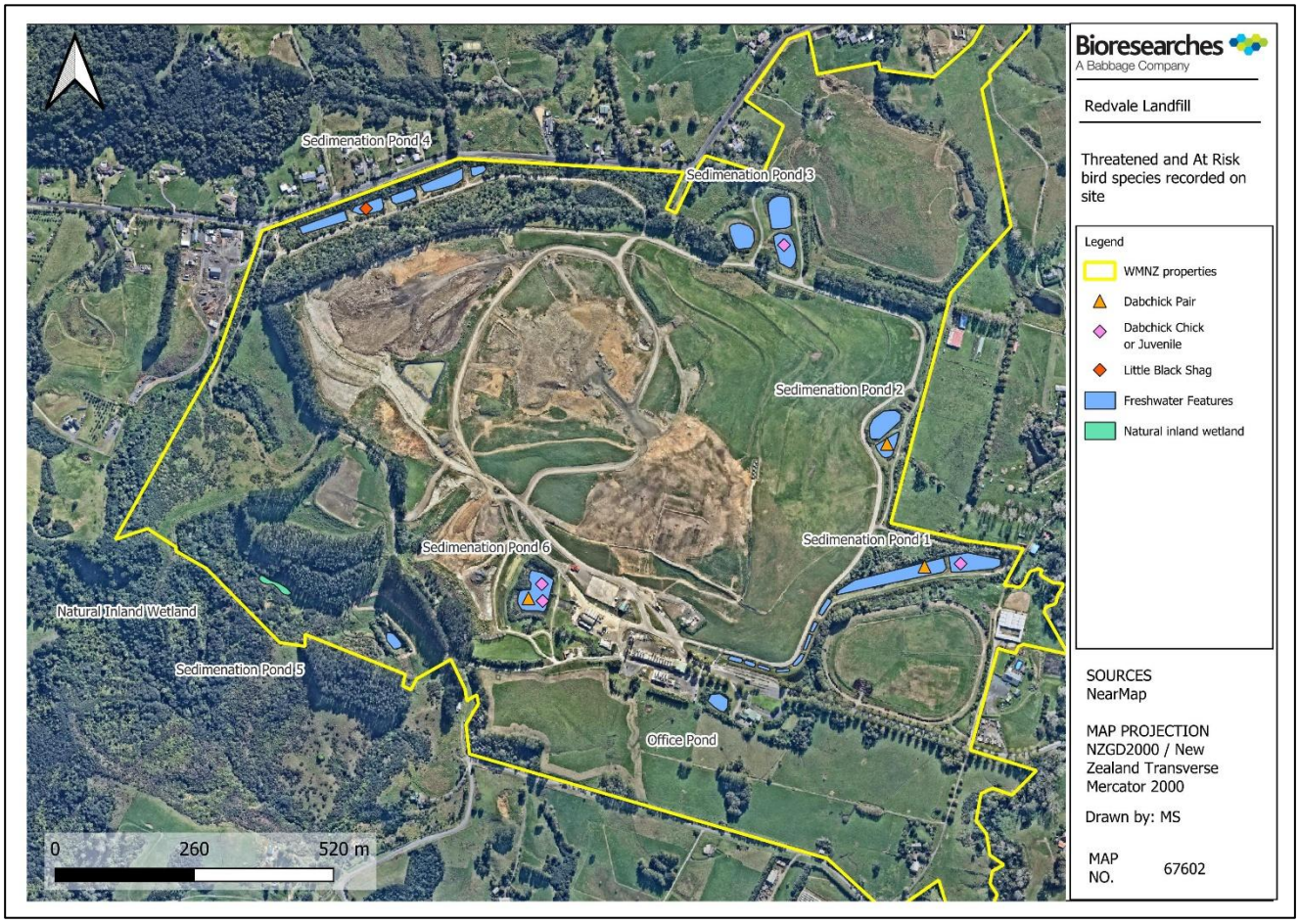


Figure 10. Threatened and At Risk Avifauna; presence and distribution across the ponds on-Site. Note: Individual records and counts over the survey period are provided in Table 21.

3.2.1.1 Dabchicks

During breeding season surveys (Table 21), three pairs of dabchicks were recorded using Ponds 1, 2 and 6 (Figure 10). These birds successfully bred on Ponds 1 and 6 (Photo 16). Two solitary juveniles were recorded at Pond 1 (the second of a series of two) and Pond 3 (one of a series of three ponds), indicating these may serve as dispersal habitats for young birds after fledging. No dabchicks were observed on any ponds on site during the June survey, however during the July survey, one immature dabchick was recorded on Pond 3 (Photo 16).

Dabchicks have a sparse distribution throughout Auckland, and are known to favour shallow freshwater ponds, with dense vegetation (Szabo, 2013). They typically inhabit artificial freshwater environments (such as amenity, farm and stormwater ponds) as alternatives to their historically lost natural habitats- particularly where such environments support dense edge vegetation.

During the breeding season, dabchick form monogamous pairs that actively defend their territories, producing offspring that typically remain within the parental territory for 2-3 months before dispersing between Autumn and early Winter[2]. Total records of dabchick over the survey period can be found in Appendix A, Table 22.

In consideration of the above, and due to dabchicks regional conservation status (Threatened – Regionally Critical), the dabchick value on site is considered to be **very high**.

[2] https://www.nzbirdsonline.org.nz/assets/95597/1691725054-036_new-20zealand-20dabchick.pdf

3.2.1.1.1 Dabchick pond habitat

Aside from Ponds 1, 2 and 6, where adult pairs were established during the breeding season surveys, at least five other ponds within the site support suitable potential habitat for dabchick pairs, including other ponds within the Pond 1, 2 and 4 series (each of these Ponds consist of a series of two to four individual ponds), and Office Pond. While Pond 3 supported a single juvenile during surveys, this series of three ponds generally lacked edge vegetation that dabchicks favour for protection from predators and nesting (e.g. undercut banks, floating platforms). Pond 3 could support a breeding pair; however this would be less likely than other available ponds identified.

Table 8 summarises a description of the ponds and number of smaller series of ponds on site, and habitat features present that can support breeding dabchick. Habitat features include: edge vegetation where dabchick can nest and where it provides shelter; emergent vegetation which can provide habitat and shelter; and a moderate to high level of macrophytes which provides additional habitat complexity to support invertebrate communities, and thus, provides a resource for dabchick. However, as the density of macrophytes may limit the ability of dabchicks to forage within the ponds efficiently, this was considered to attribute to a lower habitat value.

The pond value is ranked from low to high, based on several considerations; the habitat features present (i.e., edge vegetation, emergent vegetation and macrophytes) and whether dabchick have been recorded breeding or present as pairs on site. A total of 12 of 16 pond series are considered suitable to support breeding dabchick, which are ranked as **moderate to high** in value, and shown in Figure 11. Ponds evaluated as low, are not considered suitable to support breeding dabchick.

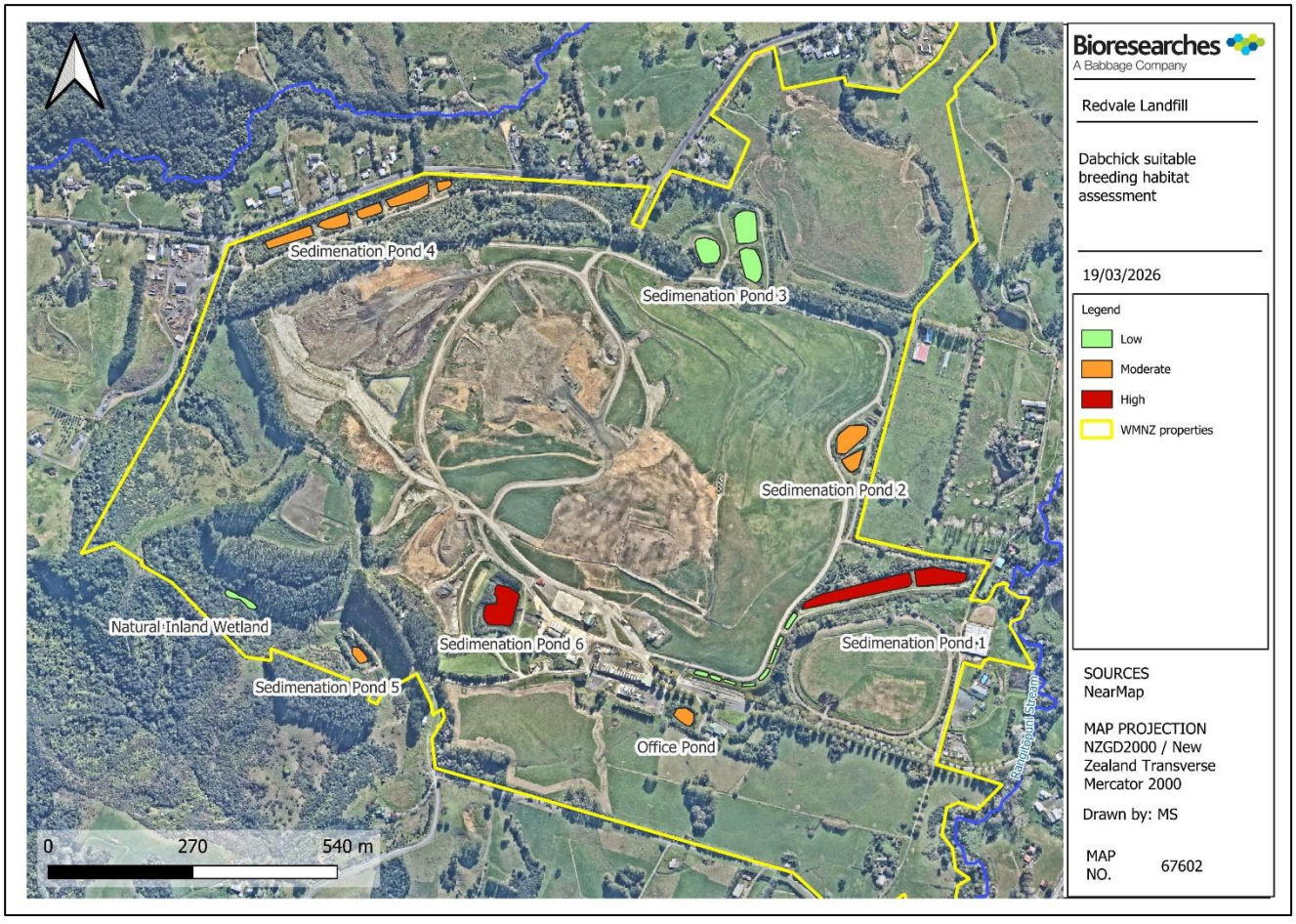


Figure 11. Assessment of ponds as suitable potential breeding habitat for Dabchicks.

Table 8. Habitat value to dabchicks, of constructed ponds at the Site

Pond number	Series within each pond	Habitat Features that provide suitable breeding habitat*			Recorded breeding / pairs present on pond	Considered suitable potential breeding habitat	Pond value for breeding dabchick	Number of ponds suitable for breeding
		Edge vegetation	Emergent vegetation (i.e., reeds)	Macrophytes				
1	2	High	High	High	Yes	Likely	High	2
2	2	Moderate	Low	Moderate	Yes	Likely	Moderate	2
3	3	Low	Low	Low	No	Unlikely	Low	0
4	5	Moderate	Low	Low	No	Possible	Moderate	5
5	1	Moderate	Low	Low	No	Possible	Moderate	1
6	1	High	Low	High	Yes	Likely	High	1
7	1	High	Low	Dense	No	Unlikely	Low	0
8	1	High	Low	Dense	No	Possible	Moderate	1
							Total	**12**

Note: Pond numbers correspond to those indicated in Figure 11.

3.2.1.2 Other avifauna

Other species recorded during the pond surveys included common, non-threatened species such as pūkeko (*Porphyrio melanotus*) welcome swallow (*Hirundo neoxena*), and paradise shelduck (*Tadorna variegata*), with a high abundance of introduced waterfowl, the majority of which comprised mallard (*Anas platyrhynchos*) and Canada geese (*Branta canadensis*) (Table 21, Figure 16).

The wetland bird surveys did not detect any Australasian bittern, spotless crake or banded rail on site, and due to the small size, fragmentation and low structural complexity of vegetated habitat surrounding the ponds, it is considered highly unlikely for TAR avifauna such as Australasian bittern, spotless crake and banded rail to occur any more than intermittently, using the site for limited feeding opportunities.

The 5MBC survey results show terrestrial avifauna on site primarily consist of common forest, edge adapted species (i.e., fantail (*Rhipidura fuliginosa*), tūī (*Prosthemadera novaeseelandiae*), kingfisher (*Todiramphus sanctus*), silvereye (*Zosterops lateralis*), grey warbler (*Gerygone igata*), and species that readily colonise modified landscapes (i.e., spur-winged plover (*Vanellus miles*), pūkeko) – all of which are abundant throughout the Auckland region and nationally. Native species were detected in low densities, as documented in Appendix A, Table 23 and Figure 17. Due to the lack of mature native vegetation on site and the lack of sufficiently complex forest habitat in the surrounding landscape, the site is highly unlikely to support TAR forest bird species such as fernbird.

Opportunistic observations (outside of the targeted surveys) on site detected red-bill gulls and black back gulls (*Larus dominicanus*) in high densities; one black shag and one little black shag. The gulls congregated around areas of landfill, or were found roosting on man-made structures such as roofs, and platforms and are not likely to be present within the terrestrial vegetation or the freshwater pond habitats. The black shag was observed flying overhead, whilst the little black shag was observed using an overhanging branch for roosting. Shags may potentially utilise overhanging branches or large trees adjacent to ponds on site for limited roosting opportunities, but are unlikely to be found breeding on site as they are typically colonial nesters, and only one individual of each species was observed, on separate occasions.

In consideration of the above, the avifauna value on site is considered to be **low**.



Photo 16. (L) Dabchick on Pond six, accompanied by two chicks (approximately 2-4 weeks old) recorded during 2024-2025 breeding season; (R) immature dabchick recorded on Pond three during a July 2025 survey.

3.2.2 Lizards

Copper skinks (*Oligosoma aeneum* - At Risk - Declining) were detected within vegetated, edge habitat during the ACO survey (Photo 17). Using photographic identification, one individual (gravid female) captured twice under the same ACO, was identified as the same individual based on the facial markings, regenerated tail, size, age and gender, shown in Figure 12. Diurnal lizard survey effort over the survey period is shown in Table 9, nocturnal survey effort is shown in Table 10.

Copper skinks are a robust species, capable of recolonising heavily modified and degraded environments, utilising rubbish and anthropogenic debris as refuge and habitat. While adaptable to disturbed areas, they also naturally inhabit areas with dense ground cover, logs or other debris within forested or rank grassland habitats. Copper skinks have a conservation status of 'At Risk Declining' nationally and regionally (Melzer et al, 2022) and are threatened by environmental pressures such as predation (i.e., cats, stoats) and habitat loss. Due to the presence of a gravid female found during the survey, these detections likely represent a larger population of copper skinks on site. Copper skinks are likely present across the site within areas of suitable habitat, particularly in areas with adequate groundcover vegetation combined with surface debris that provides shelter.

No native geckos were found on site over 9.7 nocturnal VES search person hours. Much of the vegetation within the Site is considered highly unlikely to support geckos because it comprises young plantings, disconnected from existing, more stable habitats. Therefore, native geckos are not considered to be present within the Site. Although the nocturnal searches did not detect geckos within suitable potential habitats on Site, they may persist in the surrounding environment at low population densities in areas where the vegetation is more established and connected to the wider landscape. These habitat types are not found within the works footprint however, and so occurrence within the Site is considered unlikely.

Due to the likelihood of there being a low-density of copper skinks on site within suitable habitat, the value for herpetofauna is conservatively assessed as **high**.



Photo 17. One of the copper skinks found on site, and ACO placement; within rank grass along a margin of vegetation.



Figure 12. Locations of copper skink found during ACO surveys

Table 9. Survey effort for lizards (refer to Figure 6 for locations).

Dates	No. ACOs	ACO Inspections
December 24 to February 25	116	464

Table 10. Nocturnal survey effort for native geckos along native and scrub forest edges (refer to Figure 7 for locations and coverage).

Date	Habitat	Number of searchers	Time spent spotlighting (hours)	Nocturnal VES (person search hours)
20/03/25	Kānuka Forest SW path	3	1.7	5.1
20/03/25	Kānuka Forest Northern path	2	0.3	0.6
24/03/25	Kānuka Forest SW path	2	1.7	3.4
24/03/25	Kānuka Forest Northern path	2	0.3	0.6
Total			**4**	**9.7**

3.2.3 Long Tailed Bat

Following the extensive acoustic monitoring program (described in Section 2.1.2.3), no evidence of long-tailed bat (*Chalinolobus tuberculatus*) or short-tailed bat (*Mystacina tuberculata*) activity was detected within the Site or broader landscape.

The survey results indicate that:

- No bat calls were recorded during any of the three monitoring periods
- The site characteristics are not conducive to long-tailed bat occupation

No long-tailed bats were detected during the comprehensive monitoring program. Their highly mobile nature means they could potentially utilise the area in the future.

In consideration of the above factors, the value for long tailed bats on Site is considered **negligible**.

3.3 Freshwater – Rangitopuni Stream and Rangitopuni Site 4 Tributary

The freshwater habitats, streams, ponds and wetland are illustrated in Figure 13 and Figure 15. Though the Rangitoopuni stream is highly degraded through surrounding land-use practices, the stream provides habitat for At Risk aquatic fauna, and important ecological connectivity within the landscape. It is therefore assigned an ecological value of **moderate**. As site 4 tributary is an intermittent stream with limited habitat variability and hosts pollutant tolerant taxa the ecological value of this stream has been assessed as **low**.

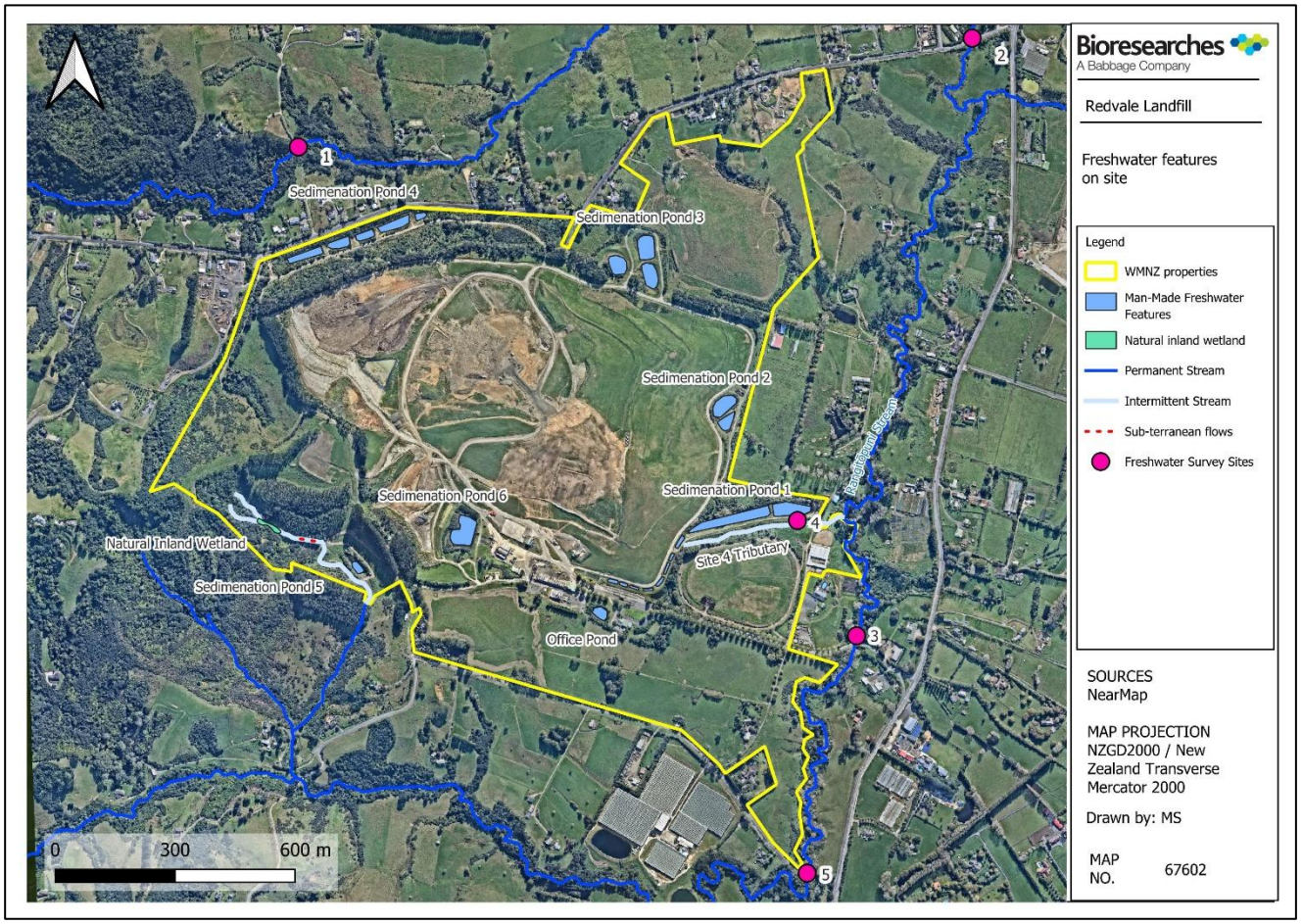


Figure 13. Freshwater features observed within the WMNZ site.

3.3.1 Stream Habitats

Summary habitat and fauna data from the Spring and Autumn sampling are presented as Table 13 and Table 14, with habitat descriptions provided in Section 2.2.6, and additional data provided in Appendices B – D.

3.3.2 Macroinvertebrates

Freshwater macroinvertebrate communities at all Rangitopuni Stream survey sites showed poor diversity. The highest taxonomic richness was recorded at the most upstream freshwater survey site (Site 1) during Spring, but this declined substantially from 22 taxa to 10 taxa by Autumn. The remaining freshwater survey sites exhibited moderate to low taxonomic diversity, with all freshwater survey sites showing a decrease in number of taxa between Spring and Autumn.

The Macroinvertebrate Community Index (MCI) and the Semi-Quantitative Macroinvertebrate Community Index (SQMCI) results were all indicative of "poor" quality habitat, i.e. with scores of less than 80 and 4 respectively (Section 2.2.6; Table 13).

With the exception of Site 2, the macroinvertebrate samples were dominated by low scoring snails (*Potamopyrgus antipodarum, Physella fontinalis*), oligochaetes or mosquito larvae. At Site 2, the macroinvertebrate fauna was dominated by damselfly larvae *Xanthocnemis zealandica,* which were abundant on aquatic macrophytes at this location.

The %EPT taxa was also very low, with minimal representation (2.7% and 0.2%) at Site 1 and absence at all other freshwater survey sites.

3.3.3 Native Fish

Netting and trapping for native fish was carried out at four freshwater survey sites in the Rangitopuni Stream, a tributary to the Rangitopuni Stream, and WMNZ site Ponds 1, 2, 3, 4 and 6 (Figure 13). In addition, longfin eel (*Anguilla dieffenbachia, At Risk declining*), common bully (*Gobiomorphus cotidianus*), were observed when working in the Rangitopuni Stream (Photo 18). The native fish population in the ponds was exclusively shortfin eel (*Anguilla australis*), with the highest numbers recorded in Pond 1. Native fish caught in the Rangitopuni Stream were shortfin and longfin eel, common bully, Crans bully (*Gobiomorphus basalis, At Risk – Regionally Declining*) and banded kokopu (*Galaxias fasciatus*) (Photo 19 to Photo 21).

The eels in the pond ranged from elvers (180mm) to large adults (800mm). Both juvenile and adult eels were caught in the Rangitopuni Stream, with larger eels reaching one metre long. The bullies ranged in size from 31 – 90 mm, and most were considered common bullies. It should be noted that distinguishing between common and Crans bullies is very difficult, as there are no clear distinguishing features, unless the bullies are large adult males.



Photo 18. Longfin eel at Site 1.



Photo 19. Common bullies caught at Site 2.

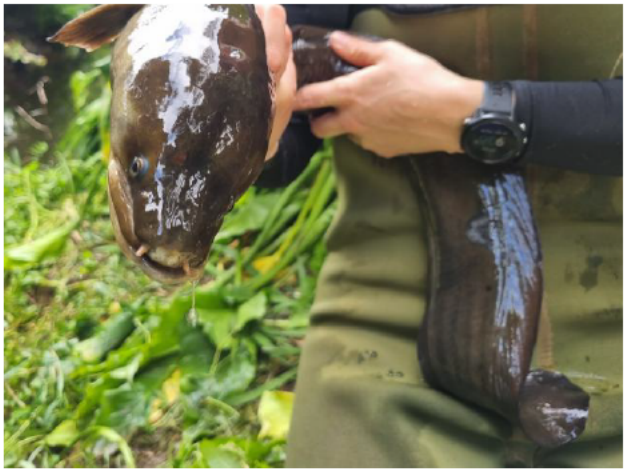


Photo 20. Longfin eel caught in Rangitopuni Stream.



Photo 21. Shortfin eel caught in Pond 1.

Table 11. Native fish summary data from the Rangitopuni Stream and tributary

Stream						
		Site 1	Site 2	Site 3	Site 4	Site 5
Species	**Parameter**	**Nov/Dec**	**Nov/Dec**	**Nov/Dec**	**Nov/Dec**	**April**
Shortfin eel (*Anguilla australis*)	Abundance	1	6	76	1	82
	Size range (mm)	390	300 - 650	200 - 850	300	210-780
Longfin eel (*Anguilla dieffenbachii*)	Abundance	10	-	-	-	4
	Size range (mm)	590 - 1000	-	-	-	710-870
Common bully (*Gobiomorphus cotidianus*)	Abundance	24	50	-	-	2
	Size range	31 - 66	35 - 90	-	-	30-50
Crans bully (*Gobiomorphus basalis*)	Abundance	-	-	1	--	1
	Size range (mm)	-	-	68	-	70
Banded kokopu (*Galaxias fasciatus*)	Abundance	-	-	1	--	1
	Size range (mm)	-	-	34	-	50

Table 12. Native fish summary data from WMNZ site ponds

Ponds						
		Pond 1	Pond 2*	Pond 3	Pond 4	Pond 6
Species	**Parameter**	**Nov/Dec**	**Nov/Dec**	**March**	**March**	**Nov/Dec**

Shortfin eel (*Anguilla australis*)	Abundance	330	4	12	58	89
	Size range (mm)	100 - 800	200 - 300	100 - adult	100 - adult	100 - 800
* Only GMTs set, not fyke nets, due to presence of dabchicks						

Table 13. Summary of physical and habitat characteristics Rangitopuni Stream and tributary

Summary of the physical characteristics and biological survey results									
Site	**1**		**2**		**3**		**4**		**5**
Date	27/11/2024 (Spring)	25/03/2025 (Autumn)	27/11/2024 (Spring)	25/03/2025 (Autumn)	27/11/2024 (Spring)	25/03/2025 (Autumn)	28/11/2024 (Spring)	25/03/2025 (Autumn)	2/04/2025 (Autumn)
Habitat									
Average Width (m)	3.575	2.868	5.98	4.51	2.8	1.327	2.17	Dry	2.45
Average Depth (m)	0.6095	0.82	1.11	1.02	0.23	0.11	0.14	Dry	0.36
Flow (L/s)									
Dominant substrate	Silt & Wood	Silt & Wood	Silt, Boulder & Wood	Silt	Silt, Wood & Small - Medium Gravel	Silt & Small - Medium Gravel	Silt & Wood	N/A	Silt and Small gravel
Fish Cover	Macrophytes, bank vegetation		Macrophytes, in-stream debris, undercut banks, bank vegetation		Macrophytes, in-stream debris, bank vegetation		Macrophytes, in-stream debris, bank vegetation	N/A	Bank vegetation, wood
Macrophytes and Algae									
No. of Taxa	6	6	9	6	6	3	4	N/A	1
Average Percent Cover	70.58	29.80	52.50	51.21	34.57	34.21	34.84	N/A	0.83
Species Recorded	Duckweed, Curly pondweed, Water purslane, Nitella, Green mat, Green filamentous.	Willow weed, Watercress, Duckweed, Water celery, Curly pondweed, Nitella	Willow weed, Watercress, Curly pondweed, Water purslane, Blunt Pondweed, Nitella, Green filamentous, Brown mat.	Willow weed, Watercress, Starwort, Water celery, Curly pondweed, Nitella	Starwort, Water celery, Curly pondweed, Water purslane, Nitella.	Water celery, Curly pondweed, Nitella	Willow weed, Watercress, Buttercup, Mercer grass, Iron Flocc.	N/A	Nitella
Macroinvertebrates									
No. of Taxa	23	10	14	4	11	6	18	7	11
Dominant taxon	*Potamopyrgus*	*Potamopyrgus*	*Xanthocnemis*	*Xanthocnemis*	*Potamopyrgus Paracalliope*	*Physella*	*Potamopyrgus*	*Oligochaeta Culex*	*Culex*
%EPT	2.7	0.2	0	0	0	0	0	0	0
MCI	72 Poor	60 Poor	58 Poor	36 Poor	50 Poor	52 Poor	54 Poor	54 Poor	62 Poor
SQMCI	1.74 Poor	1.83 Poor	1.99 Poor	3.44 Poor	1.27 Poor	1.97 Poor	2.08 Poor	2.30 Poor	1.74 Poor
Fish (Streams fished in one occasion only)									

No. of species	3		2		3		1		5
No. of fish	35		56		78		1		90
Fish IBI	38 Good		26 Poor		44 Very Good		22 Poor		54 Excellent
Species recorded	Common bully, Shortfin Eel, Long-fin Eel.		Common bully, Shortfin Eel		Banded kokopu, Crans bully, Short-fin Eel.		Shortfin eel		Crans bully, Common bully, Shortfin eel, Longfin eel, Banded kokopu

Table 14. Habitat Characteristics

	Site 1		Site 2		Site 3		Site 4		Site 5
Parameter	**Nov**	**March**	**Nov**	**March**	**Nov**	**March**	**Nov**	**March**	**April**
Water depth (m)	0.08 - >1	0.01 - >1.5	0.2 - 2	0 - >1.5	0.02 - 0.56	0 - 0.48	**0.05 - 0.49**	N/A	0.1 - 0.75
Water width (m)	2.1 - 5.1	1.67 - 3.84	5.2 - 6.5	1.62 - 6.9	1.9 - 3.8	0.63 - 2.6	0.55 - 5.1	N/A	1.47 -3.72
Run (%)	100	90	100	100	70	80	95	N/A	95
Riffle (%)	0	0	0	0	5	0	0	N/A	0
Pool (%)	0	10	0	0	25	20	5	N/A	5
Chute (%)	0	0	0	0	0	0	0	N/A	0
Shading	Partial	Partial	Open	Open	Shaded	Shaded	Partial	N/A	Shaded
TLB stability	Mostly stable	Stable	Mostly stable	Stable	Mostly stable	Mostly stable	Stable	N/A	Unstable
TRB stability	Mostly stable	Stable	Mostly stable	Stable	Mostly stable	Mostly stable	Stable	N/A	Mostly stable

3.3.4 Water Quality

The in-situ spot measurements of water quality showed the temperature at stream sampling sites were reflective of season, with slightly warmer temperatures in late Spring / early Summer and slightly cooler temperatures in Autumn. The temperatures were mostly below 20°C, at levels to cause only minor stress to more sensitive aquatic fauna (Biggs *et al*., 2002). Dissolved oxygen was generally low, with Sites 1, 3, 4 and 5 recording dissolved below the NPS-FM National bottom line for the 1-day minimum (i.e. <4.0 mg/L). Conductivity was variable and indicative of enriched water, with this increasing in Autumn at all freshwater survey sites, after the long dry summer and reduced or lack of flow in the streams.

Results of the comprehensive water quality analysis carried out by Hill Labs (Table 16) were compared to the ANZG (2018) 95% and 80% protection levels for aquatic ecosystems. Values exceeding either protection threshold are highlighted in red in Table 16 below. The results showed that total suspended solids (TSS) and total ammoniacal-N (TAN) exceeded the guidelines at Site 4 in Spring, and Sites 1, 3, 4 and 5 in Autumn. The higher TSS and TAN in Autumn were likely due to drought and low or lack of flow in the river.

While no formal trigger values exist for Chemical Oxygen Demand (COD) or Oil and Grease (see notes below Table 16), COD levels were greater than those typical of clean water at all sampling locations. Additionally, Oil and Grease were detected in small but measurable quantities at all freshwater survey sites during at least one sampling event.

All heavy metals tested for, except potentially Arsenic, were either below detection limits or below the established Guideline values. The Guidelines for Arsenic apply to As III and are set at concentrations lower than the detection limit for dissolved Arsenic. Further investigation will be necessary to determine whether the guideline for As III is appropriate in this context.

Table 15. Physico-chemical parameters in Rangitopuni Stream sites in Spring (2024) and Autumn (2025).

	Site 1		Site 2		Site 3		Site 4		Site 5
Site	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Spring**	**Autumn**	**Autumn**
Date	5/12/24	25/3/25	5/12/24	26/3/25	5/12/24	25/3/25	5/12/24	25/3/25	3/4/25
Time NZDT	10:45	10:05	14:00	12:20	12:00	11:00	11:30	11:15	15:40
Temperature °C	17.1	15.3	22.7	18.1	18.5	15.7	16.6	14.9	17.9
DO%	45	27	55	87	39	36	70	37	36
DO mg/L	4.4	2.6	4.7	8.3	3.7	3.4	7.2	3.4	3.42
Conductivity uS/cm	182	245	206	300	239	480	317	343	509

Table 16. Water quality and laboratory analysis results (Guideline values - blue, exceedances of the 80% values - red, exceedance of 95% - bold)

Sample Type: Aqueous		Spring				Autumn					ANZG (2018) 95% & 80% Protection Level	
		Site 1	Site 2	Site 3	Site 4	Site1	Site 2	Site 3	Site 4	Site 5	95%	80%
Total Alkalinity	g/m³ as $CaCO^3$	49	59	70	300	95	134	250	450	151	-	-
Total Suspended Solids	g/m³	< 3	5	4	25	9	6	12	25	27	-	8.8
Chloride	g/m³	29	27	27	28	35	26	38	36	51	150	280
Total Ammoniacal-N	g/m³	< 0.010	0.019	0.022	**0.062**	**0.084**	< 0.010	0.38	2.2	1.62	0.05	0.4
Chemical Oxygen Demand	g O2/m³	21	28	26	38	24	36	56	80	54	A	A
Oil and Grease	g/m³	< 4	5	5	< 4	6	< 5	6	4	10	B	B
Heavy metals, dissolved												
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.0011	< 0.0010	0.0015	0.0015	0.0019	0.00013	0.00042
Dissolved Cadmium**	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.000008	0.0000025
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001	0.0044
Dissolved Copper	g/m³	**0.0006**	**0.0006**	**0.0008**	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0014*	0.0025*
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	0.0009*	0.0034*
Dissolved Nickel	g/m³	**0.0012**	**0.0011**	**0.0011**	**0.0011**	**0.001**	**0.0007**	**0.0019**	**0.0009**	**0.0016**	0.011*	0.03*
Dissolved Zinc	g/m³	< 0.0010	**0.0013**	**0.0011**	**0.0019**	< 0.0010	< 0.0010	**0.0012**	**0.0013**	**0.0018**	0.008*	0.023*

*Metals marked with * are hardness-modified — values depend on calcium/magnesium levels in the water. ** analytical limit of cadmium is above the guideline values (Appendix E)
Dissolved As criteria are for As III. Dissolved Cr criteria are for Cr VI.
A= There are no formal ecological trigger values for COD in ANZG (2018) or NPS-FM. However, a COD value < 20 mg/L is typically considered low and indicative of clean water.
B= There are no formal ecological trigger values for oil and grease in ANZG (2018) or NPS-FM. However, typical consent limits are ≤ 5–15 mg/L in treated stormwater discharges, and no visible oil sheen on water surface (aesthetic/visual standard)

3.3.5 Sediment Quality

Sediments collected from the Rangitopuni Stream for metal analysis in spring 2024 and autumn 2025 surveys are provided in Table 17 were compared to the ANZG (2018) Sediment Quality Guidelines for metals in sediments.

Default guideline values (DGVs) for toxicants in sediment are listed in Table 17. As per the DGVs for toxicants in water, the sediment DGVs indicate the concentrations below which there is a low risk of unacceptable effects occurring, and should be used, with other lines of evidence, to protect aquatic ecosystems. In contrast, the 'upper' guideline values (GV-high), provide an indication of concentrations at which you might already expect to observe toxicity-related adverse effects. As such, the GV-high value should only be used as an indicator of potential high-level toxicity problems, not as a guideline value to ensure protection of ecosystems.

The results show slightly elevated concentrations at Site 4 (the minor tributary to the Rangitopuni Stream) of arsenic, cadmium, copper, and lead, and high concentrations of zinc (above the Probable Effect Level) in both Spring and Autumn. No other freshwater survey sites exhibiting metal concentrations exceeding DGVs, and only Site 3 during the Autumn sampling period, which showed slightly elevated zinc concentrations (but below the DGV values).

Site 4 is in the intermittent stream, located outside of the works area, which includes road run-off from part of Landfill Access Road, and would include contaminants from tyre wear, brake pads and heavy vehicle wear, which contain zinc, copper, iron, lead and cadmium, as well as trace amounts of other metals.

Table 17. Sediment and laboratory analysis results (Guideline values in blue, exceedances of the GV-High values in red, exceedance of DGV in bold font)

		Spring 2024			Autumn 2025				ANZG	
Heavy metal, trace level		Site 1	Site 3	Site 4	Site 1	Site 3	Site 4	Site 5	DGV	GV-high
Total Recoverable Arsenic	mg/kg dry wt	3.3	2.4	10.3	4.8	4.6	7.2	2.3	20	70
Total Recoverable Cadmium	mg/kg dry wt	0.19	0.141	0.56	0.181	0.36	0.73	0.21	1.5	10
Total Recoverable Chromium	mg/kg dry wt	10.2	5.8	18	9.2	9.2	12.9	6.6	80	370
Total Recoverable Copper	mg/kg dry wt	14.3	16.9	37	15.2	19.9	36	13.6	65	270
Total Recoverable Lead	mg/kg dry wt	8.6	8.7	41	9.3	12.6	32	10.2	50	220
Total Recoverable Nickel	mg/kg dry wt	9.4	5.6	15.8	8.2	10.1	13.8	5.9	21	52
Total Recoverable Zinc	mg/kg dry wt	76	49	580	66	128	510	75	200	410

(refer Appendix F Water Quality and Sediment Guidelines for details on applying guideline values).

3.4 Freshwater – Landfill Operational Area

The operational area of the landfill includes the areas where active operations are taking place including the placement of waste and the ancillary activities. The operational area as surveyed for freshwater is shown as Figure 14.

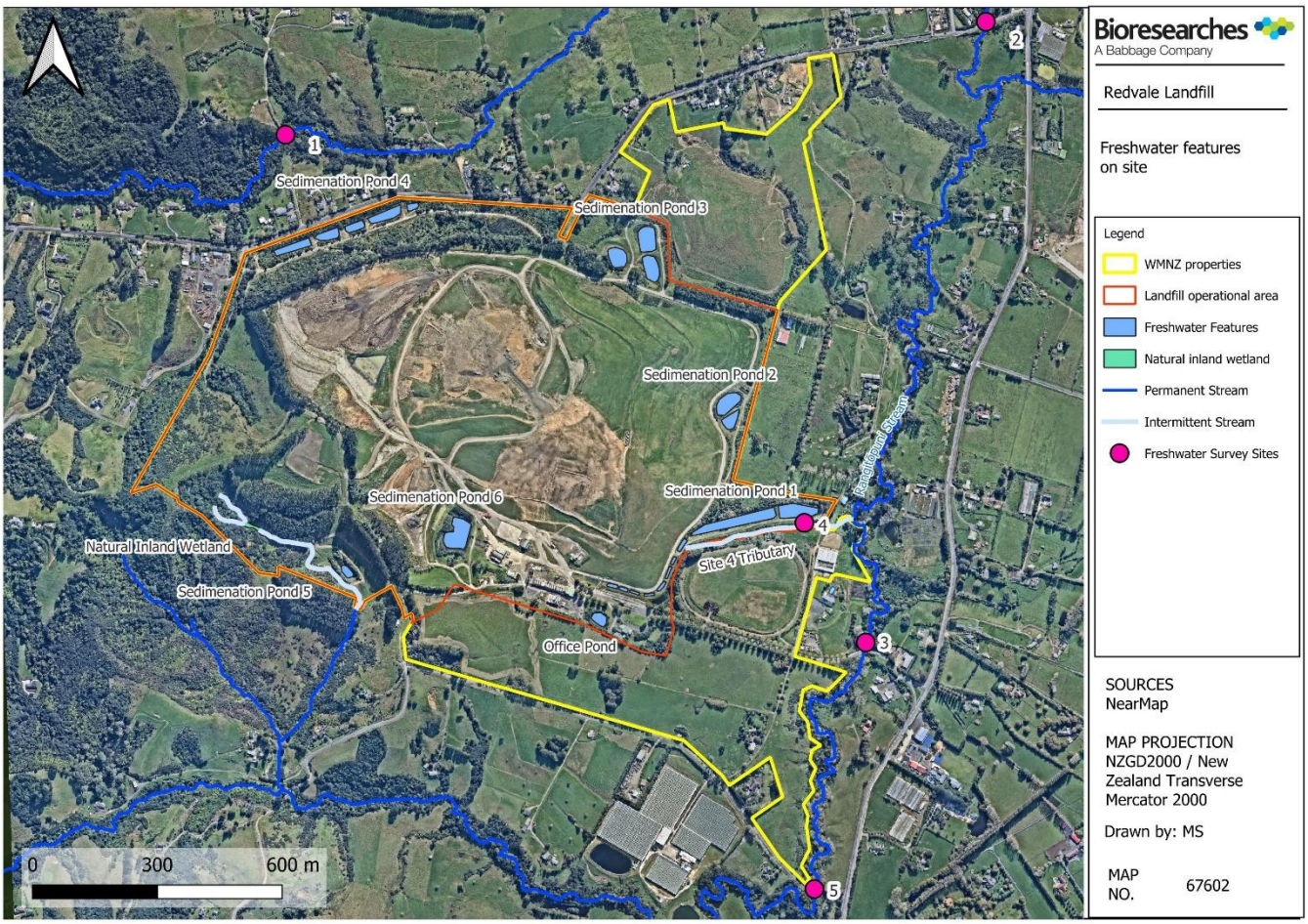


Figure 14. Landfill Operational Area Surveyed for Freshwater Habitats.

3.4.1 Streams

Although the WMNZ site has several flow paths modelled on the Auckland Council GIS viewer as potential streams, no natural permanent or intermittent streams are present within the operational area (as indicated in Figure 14) , including the north-western corner of the site. The surface water within the operational areas is diverted and collected into the sediment ponds on the site, prior to discharge to the drains constructed around the site boundary or to a flow path to the Rangitopuni Stream.

No intermittent or permanent streams were observed within the operational area of the WMNZ site. No natural inland wetlands, or areas indicative of natural inland wetlands were observed within the operational area of WMNZ site

3.4.2 Sedimentation Ponds

Five ponds / pond series were investigated (Figure 13) (Ponds 1 to 4 and 6), and fyke nets and Gees minnow traps were deployed to provide information on the presence of native fish in the ponds (refer Section 3.3.3).

All of the ponds are constructed waterbodies, open with either a band of native amenity plantings or grass as riparian vegetation. Spot measurements of Ponds 1, 2 and 6 water quality were collected prior to deploying the fish nets and traps. The water quality data showed the ponds were warm, ranging from 24 – 26°C, with moderate to high conductivity (333 – 468 µS/cm) and moderate to good, dissolved oxygen concentrations (56 -80%) (Table 18).

In consideration of the findings in this report relevant to ponds 1 to 4 and pond 6, the ponds are assigned an ecological value of **low**.

Table 18. Spot water quality measurements in the WMNZ Site Ponds

Site	Pond 1 Flow btw cells	Pond 1 Last cell bank	Pond 2 South	Pond 2 North	Pond 6
Date	16/12/2024	16/12/2024	16/12/2024	16/12/2024	16/12/2024
Time	11:30	11:30	13:15	13:15	12:45
Temperature	24.6	23.7	26	24.8	25.6
Conductivity (µS/cm)	410.5	419.7	335.8	333	468
D.O. *(g/m³*	5.8	4.6	5	4.4	6.4
D.O. *(%sat)*	69	56	71	56	80



Photo 22. Pond Series 1



Photo 23. Pond 6

3.5 Freshwater – Non Operational Area

3.5.1 Natural Inland Wetland

A natural inland wetland exists within a gully system West of the WMNZ Site (shown in Figure 13). This wetland is characterised by a predominance of obligate and facultative wetland plant species, thereby satisfying the

Rapid Test for a natural inland wetland classification. The wetland is situated in a modified environment at the base of Stockpile 4 currently covered with pines to be utilised for the use of ongoing landfilling activities (i.e. liner and stockpiling). The wetland is approximately 320m² in extent, and discharges to a narrow, incised (likely constructed) stream channel. The upper reach of the wetland was formed in the confluence with forested overland flow paths, open pooling, and channelised flow paths within the wetland. (Photo 24 and Photo 25). The vegetation observed included pūrei (*Carex secta*), lotus (*Lotus pedunculatus)* within the pool, and reed sweet grass (*Glyceria maxima*) on the outer edges. As the wetland flowed downstream, it became channelised with wetland hydrology consisting of saturated soils and shallow pooling water. Within these channelised reaches, vegetation included mercer grass (*Paspalum distichum*), reed sweetgrass and watercress (*Nasturtium officinale)* The stream channel is approximately 75m long before disappearing at the fence line, and discharging further downstream into a highly modified, lined storm water channel directing water flows to a slipway on the downstream extent of a stormwater pond (Figure 15). In consideration of the above, the value of this wetland is considered to be **low**.



Photo 24. Natural inland wetland in base of gully west of the managed fill site.



Photo 25. Narrow incised stream from wetland.

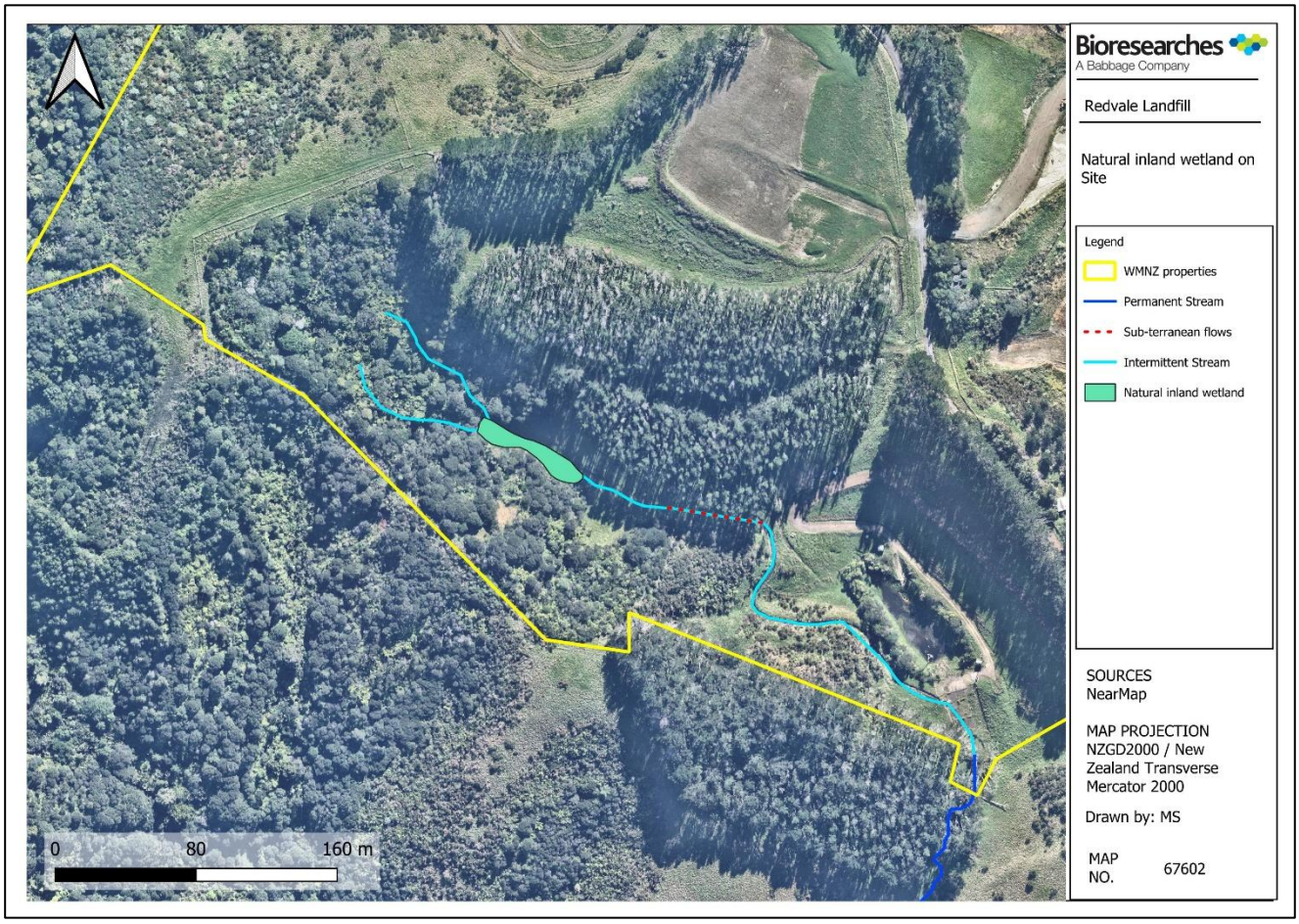


Figure 15. Wetland (green polygon) and streams west of the Site. Note constructed ponds and flow paths exist south-east of the wetland and stream.

3.6 Summary of Values

The freshwater and terrestrial ecological values, including fauna and habitats as discussed in this report are summarised in Table 19.

Table 19. A summary of the freshwater and terrestrial values discussed within this report

Habitat / Taxa	Value	Justification
Taxa		
Avifauna - Dabchick	**Very High**	Three pairs of regionally threatened dabchicks (EIANZ value = very high) were recorded breeding on ponds within the Site, and fledged individuals were recorded using ponds as dispersal habitats.
Avifauna – All other species	**Low**	Only common, Not Threatened and exotic terrestrial birds were observed on site during the surveys. The site is considered unlikely to be important habitat as it highly modified, providing limited foraging and nesting habitats. Little black shag and black shag were recorded roosting on site (EIANZ value = moderate) however the site is not considered to provide any more than intermittent roosting opportunities.
Lizards	**High**	Some weedy and planted vegetation and refugia on-site supports a likely low-density population of 'At Risk' copper skinks.
Long Tailed Bats	**Negligible**	Given the absence of any activity recorded within the Site across three survey periods totalling 2,007 survey nights, the Site is considered unlikely to provide important habitat to native bats.
Native Fish	**Low-Moderate**	Presence of an 'At Risk' species within the Rangitopuni Stream, however onsite waterbodies only host tolerant species.
Habitats		
Dabchick breeding ponds	**Moderate - High**	A total of 12 of 16 pond series are considered suitable to support breeding dabchick.
Natural inland wetland	**Low**	Pest infested wetland confined to single flow path with no functional riparian buffer.
Pond s 1-4, 6 & Office Pond	**Low**	Not natural aquatic ecosystems, contain high turbidity and host tolerant aquatic fauna
Rangitopuni stream (Sites 1, 2, 3 and 5)	**Moderate**	Large permanent stream, albeit highly degraded through surrounding land-use practices. Rangitopuni contains At Risk aquatic fauna
Site tributary (Site 4)	**Low**	Intermittent stream with limited habitat variability and hosts pollutant tolerant taxa.
Terrestrial vegetation	**Negligible - Low**	Highly modified habitats which contain a limited number of naturally occurring native plant species.

** Does not include sediment treatment Pond 1, 2, 3, 4*

4 SUMMARY

In summary, several freshwater and terrestrial fauna species with a conservation status of 'Threatened' or 'At Risk' were recorded during the surveys, as shown in Table 19. These species and their detections are briefly summarised here:

1. Some weedy and planted vegetation and refugia on-site supports a likely low-density population of At-Risk copper skinks.
2. Three pairs of regionally threatened dabchicks were recorded breeding on ponds within the Site. Although all ponds are constructed (predominantly sedimentation ponds), these environments have value in provision of breeding, roosting and dispersal habitat for dabchicks. A total of 12 of 16 pond series are considered suitable to support breeding dabchick, which are ranked as moderate to high in value. Ponds evaluated as low, are not considered suitable to support breeding dabchick.
3. Little black shag and black shag were recorded visiting the site, but are not expected to use the site any more than an intermittent basis for roosting.
4. **'**At Risk' fish species, on a national scale (longfin eel, At risk - Declining) or regional scale (Cran's bully, At Risk – Regionally Declining) were detected during the freshwater surveys, however these were only found in the Rangitopuni Stream, outside the Site.

The freshwater ecological values indicated a degraded system overall, as per the below:

1. Aquatic habitats were overall of low quality with very little variation in habitat diversity, including hydrological features, substrates, organic features, and a low to moderate degree of aquatic plant cover.
2. Macroinvertebrate communities indicated tolerant communities with sensitive specimens either absent, or at very low numbers
    a. Whilst TAR fish species were present within the Rangitopuni Stream, fish communities within the Site were restricted to the on-site ponds and only the tolerant shortfin eel was captured
3. Water quality of the Rangitopuni Stream indicated poor dissolved oxygen, and slightly elevated temperatures and conductivity; however, heavy metal concentrations were overall acceptable based on the findings set out in Section 3.3.4 and 3.3.5. Pressures from ammoniacal nitrogen and chemical oxygen demand are present.
4. *In situ* water quality of the ponds indicates high temperatures and conductivity, and low oxygen levels, limiting aquatic fauna that may reside within them.
5. Sediment quality throughout the Rangitopuni Stream indicates accumulation of heavy metals is not occurring in the in-stream sediments.

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APPLICABILITY AND LIMITATIONS

Restrictions of Intended Purpose

This report has been prepared solely for the benefit of Waste Management New Zealand as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on, they should be independently verified with appropriate legal advice.

Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Bioresearches.

Appendix A Terrestrial Survey Data

Vegetation

Table 20. Species recorded on-site during the vegetation surveys

Scientific name	Common name	Regional Conservation status	National Conservation Status	Notes
Griselinia littoralis	kāpuka	Threatened - Endangered	Not Threatened	Planted
Kunzea robusta	kānuka	Not threatened	Not Threatened	Planted and natural
Agathis australis	kauri	At Risk - Declining	Threatened - Vulnerable	Planted
Pomaderris kumeraho	kumarahou	At Risk - Declining	Not Threatened	Natural
Melycitus macrophyllus	large-leaved mahoe	At Risk - Naturally uncommon	Not Threatened	Natural
Olearia lineata cv. 'Dartonii'	long-leaved tree daisy	None	At Risk - Declining	Planted*
Leptospermum scoparium	mānuka	Not threatened	Not Threatened	Planted and natural
Myoporum laetum	ngaio	At Risk - Declining	Not Threatened	Planted
Metrosideros excelsa	pōhutukawa	At Risk - Declining	Threatened - Vulnerable	Planted
Plagianthus regius	ribbonwood	Threatened - Endangered	Not threatened	Planted
Coprosma repens	taupata	At Risk - Declining	Not Threatened	Planted
Austroderia fulvida	toetoe	Threatened - Endangered	At Risk - Naturally uncommon	Planted
Melicope ternata	wharangi	Threatened - Vulnerable	Not Threatened	Planted
Ptychomnion aciculare	pipecleaner moss	None	None	
Dodonaea viscosa	akeake	Not Threatened	Not Threatened	
Oplismenus hirtellus subsp. *imbecillis*	basket grass	Not Threatened	Not Threatened	
Pteridium esculentum	bracken	Not Threatened	Not Threatened	
Pakau pennigera	gully fern	Not Threatened	Not Threatened	
Geniostoma ligustrifolium	hangehange	Not Threatened	Not Threatened	
Phormium tenax	harakeke, flax	Not Threatened	Not Threatened	
Veronica stricta	hebe	Not Threatened	Not Threatened	
Hoheria populnea	houhere	Not Threatened	Not Threatened	
Machaerina articulata	jointed baumea	Not Threatened	Not Threatened	
Dacrycarpus dacrydioides	kahikatea	Not Threatened	Not Threatened	
Corynocarpus laevigatus	karaka	Not Threatened	Not Threatened	

Coprosma robusta	karamū	Not Threatened	Not Threatened	
Pittosporum crassifolium	karo	Not Threatened	Not Threatened	
Piper excelsum	kawakawa	Not Threatened	Not Threatened	
Parablechnum novae-zelandiae	kiokio	Not Threatened	Not Threatened	
Pittosporum tenuifolium	kōhūhū	Not Threatened	Not Threatened	
Sophora tetraptera	kōwhai	None	Not Threatened	
Pseudopanax crassifolius	lancewood	Not Threatened	Not Threatened	
Melycitus ramiflorus	mahoe	Not Threatened	Not Threatened	
Carex maorica	Māori sedge	Not Threatened	Not Threatened	
Myrsine australis	mapou	Not Threatened	Not Threatened	
Bolboschoenus fluviatilis	marsh clubrush	Not Threatened	Not Threatened	
Lobelia anceps	New Zealand lobelia	Not Threatened	Not Threatened	
Rhopalostylis sapida	nīkau	Not Threatened	Not Threatened	
Apodasmia similis	oioi	Not Threatened	Not Threatened	
Microtis unifolia	onion-leaved orchid	Not Threatened	Not Threatened	
Hedycarya arborea	pigeonwood	Not Threatened	Not Threatened	
Carex secta	purei	Not Threatened	Not Threatened	
Vitex lucens	pūriri	Not Threatened	Not Threatened	
Carpodetus serratus	putaputawētā	Not Threatened	Not Threatened	
Typha orientalis	raupō	Not Threatened	Not Threatened	
Carex lessoniana	rautahi	Not Threatened	Not Threatened	
Knightia excelsa	rewarewa	Not Threatened	Not Threatened	
Dacrydium cupressinum	rimu	Not Threatened	Not Threatened	
Pteris tremula	shaking brake	Not Threatened	Not Threatened	
Alsophila tricolour	silver fern	Not Threatened	Not Threatened	
Leucopogon fasciculatus	soft mingimingi	Not Threatened	Not Threatened	
Phyllocladus trichomanoides	tanekaha	Not Threatened	Not Threatened	
Pittosporum eugenioides	tarata	Data deficient	Not Threatened	Planted
Coprosma areolata	thin-leaved coprosma	Not Threatened	Not Threatened	
Cordyline australis	tī kōuka, cabbage tree	Not Threatened	Not Threatened	

Haloragis erecta	toatoa	Not Threatened	Not Threatened	
Podocarpus totara	tōtara	Not Threatened	Not Threatened	
Coprosma rhamnoides	twiggy coprosma	Not Threatened	Not Threatened	
Coprosma macrocarpa var. minor		Not Threatened	Not Threatened	
Malus x domestica	apple	Exotic	Exotic	
Aristea ecklonii	aristea	Exotic	Exotic	
Zantedeschia aethiopica	arum lily	Exotic	Exotic	
Banksia integrifolia	banksia	Exotic	Exotic	
Lauris nobilis	bay tree	Exotic	Exotic	
Calystegia silvatica subsp. *disjuncta*	bindweed	Exotic	Exotic	
Calystegia silvatica	bindweed	Exotic	Exotic	
Calystegia sepium x silvatica	bindweed hybrid	Exotic	Exotic	
Rubus fruticosus agg.	blackberry	Exotic	Exotic	
Acacia melanoxylon	blackwood	Exotic	Exotic	
Melaleuca citrina	bottlebrush	Exotic	Exotic	
Rumex obtusifolius	broad-leaved dock	Exotic	Exotic	
Plantago major	broad-leaved plantain	Exotic	Exotic	
Paraserianthes lophantha	brush wattle	Exotic	Exotic	
Ranunculus repens	buttercup	Exotic	Exotic	
Physalis peruviana	Cape gooseberry	Exotic	Exotic	
Hypochaeris radicata	catsear	Exotic	Exotic	
Ligustrum sinense	Chinese privet	Exotic	Exotic	
Galium aparine	cleavers	Exotic	Exotic	
Trifolium repens	clover	Exotic	Exotic	
Dactylis glomerata	cocksfoot	Exotic	Exotic	
Salix fagilis x S. euxina	crack willow	Exotic	Exotic	
Malva pseudolavatera	Cretan mallow	Exotic	Exotic	
Eucalyptus sp.	eucalyptus	Exotic	Exotic	
Foeniculum vulgare	fennel	Exotic	Exotic	
Myosotis arvensis	field forget-me-not	Exotic	Exotic	

Pilosela caespitosa	field hawkweed	Exotic	Exotic	
Erigeron bilbaoanus	Fleabane	Exotic	Exotic	
Glyceria maxima	floating sweetgrass	Exotic	Exotic	
Ulex europaeus	gorse	Exotic	Exotic	
Senecio skirrhodon	gravel groundsel	Exotic	Exotic	
Carex divulsa	grey sedge	Exotic	Exotic	
Lagurus ovatus	hare's tail	Exotic	Exotic	
Leontodon saxatilis	hawkbit	Exotic	Exotic	
Crataegus monogyna	hawthorn	Exotic	Exotic	
Potentilla indica	Indian strawberry	Exotic	Exotic	
Lonicera japonica	Japanese honeysuckle	Exotic	Exotic	
Cenchrus clandestinus	kikuyu	Exotic	Exotic	
Bellis perennis	lawn daisy	Exotic	Exotic	
Lotus pedunculatus	lotus	Exotic	Exotic	
Hesperocyparis macrocarpa	macrocarpa	Exotic	Exotic	
Paspalum distichum	mercer grass	Exotic	Exotic	
Crocosmia x crocosmiiflora	montbretia	Exotic	Exotic	
Plantago lanceolata	narrow-leaf plantain	Exotic	Exotic	
Plantago lanceolata	narrow-leaved plantain	Exotic	Exotic	
Populus deltoides	necklace poplar	Exotic	Exotic	
Araucaria heterophylla	Norfolk island pine	Exotic	Exotic	
Leucanthemum vulgare	oxeye daisy	Exotic	Exotic	
Helminthotheca echioides	oxtongue	Exotic	Exotic	
Linum bienne	pale flax	Exotic	Exotic	
Cortaderia selloana	pampas	Exotic	Exotic	
Oenanthe pimpinelloides	parsley dropwort	Exotic	Exotic	
Paspalum dilatatum	paspalum	Exotic	Exotic	
Mentha pulegium	penny royal	Exotic	Exotic	
Lysimachia arvenisis	pimpernel	Exotic	Exotic	
Pinus sp.	pine	Exotic	Exotic	

Verbena bonariensis	purple-top	Exotic	Exotic	
Pinus radiata	radiata pine	Exotic	Exotic	
Trifolium praetense	red clover	Exotic	Exotic	
Casuarina cumminghamiana	river she-oak	Exotic	Exotic	
Lolium perenne	rye grass	Exotic	Exotic	
Cirsium vulgare	Scotch thistle	Exotic	Exotic	
Eucalyptus cinerea	silver dollar gum	Exotic	Exotic	
Juncus effusus var. *effusus*	soft rush	Exotic	Exotic	
Sison amomum	stone parsley	Exotic	Exotic	
Anthoxanthus odoratum	sweet vernal	Exotic	Exotic	
Acacia longifolia	Sydney golden wattle	Exotic	Exotic	
Lolium arundinaceum subsp. *arundinaeceum*	tall fescue	Exotic	Exotic	
Ligustrum lucidum	tree privet	Exotic	Exotic	
Salix matsudana	twisted willow	Exotic	Exotic	
Cyperus eragrostis	umbrella sedge	Exotic	Exotic	
Vicia sativa	vetch	Exotic	Exotic	
Myosotis laxa subsp. *caespitosa*	water forget-me-not	Exotic	Exotic	
Persicaria hydropiper	water pepper	Exotic	Exotic	
Nasturtium officinale	watercress	Exotic	Exotic	
Daucus carota	wild carrot	Exotic	Exotic	
Hedychium gardinerianum	wild ginger	Exotic	Exotic	
Avena fatua	wild oat	Exotic	Exotic	
Agonis flexuosa	willow myrtle	Exotic	Exotic	
Holcus lanatus	Yorkshire fog	Exotic	Exotic	
Gamochaeta americana		Exotic	Exotic	

Notes: *this species is endemic to the bottom two-thirds of the south island and it is likely that the plants observed at site are a commercial cultivar 'Dartonii'; **This species is endemic to the south-eastern portion of the North Island and does not naturally occur in the Auckland region, where it is considered a pest species due to hybridisation risks with native kōwhai



Photo 26. Vegetation types found on Site; (left) mixed native exotic vegetation, (middle) exotic vegetation, (right) planted native vegetation.

Avifauna

Table 21. Pond Counts: Combined species abundance and detection rate over survey periods; 14/11/2024 to 5/3/2025

Species	Native/ Introduced	Pond Number								# sites (n=8) detected	Detection Rate	Individual total	Average abundance (Mean/count)	Standard dev.	St. Error
		1	2	3	4	5	6	7	8						
Mallard	Introduced	38		43	67	18	78	4	4	7	88%	252	36.00	29.30	10.36
Canada Goose	Introduced	73				6	18			3	38%	97	32.33	35.73	12.63
Dabchick	Native	3	3				8			3	38%	14	4.67	2.89	1.02
Pukeko	Native	3	3	2	6	2	10		12	7	88%	38	5.43	4.08	1.44
Paradise Shelduck	Native	26		19	2		2			4	50%	49	12.25	12.18	4.30
Welcome Swallow	Native	3		19	4		25			4	50%	51	12.75	10.97	3.88
Black Swan	Native		1							1	13%	1	1.00	0.00	0.00
Little Black Shag	Native				1					1	13%	1	1.00	0.00	0.00
Spur Winged Plover	Native				3					1	13%	3	3.00	0.00	0.00

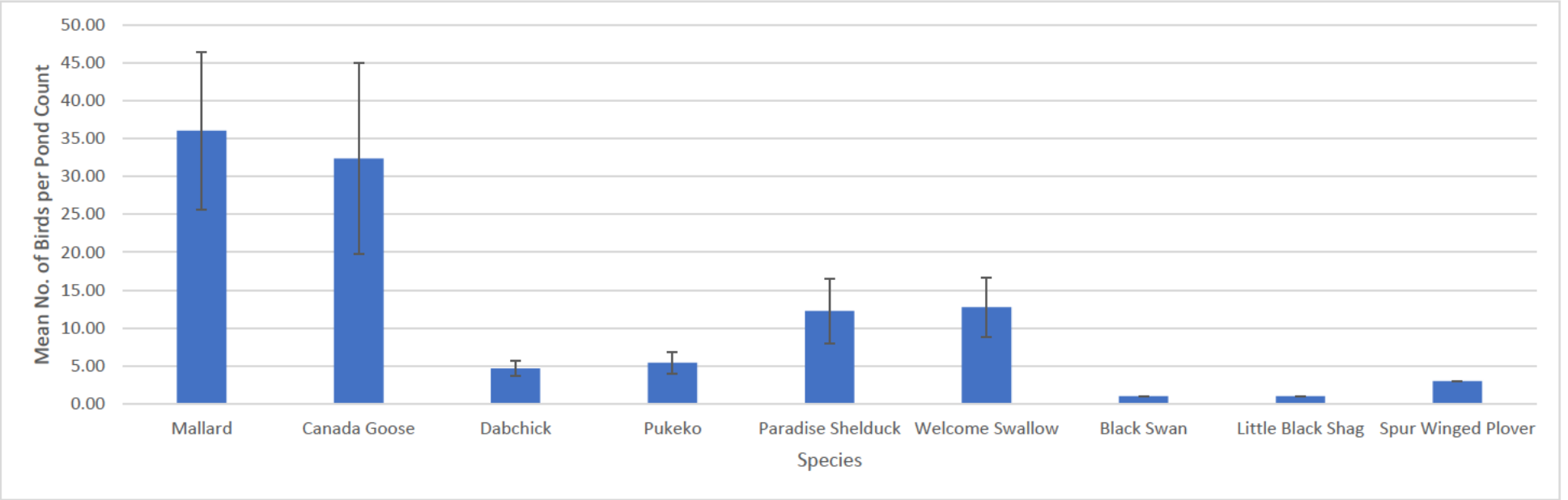


Figure 16. Mean number of birds (with standard error) per pond count over the survey period; 14/11/2024 to 5/3/2025

Table 22. Dabchick Records over the survey period; 14/11/2024 to 5/3/2025

Pond ID Number	Observer	Date (dd/mm/yy)	Start time (24 hr clock)	Species (If no species are recorded select this off the drop down list)	Adults	Chicks / Juve-niles	Pair? Yes / no	Total
1	MS and MA	9/12/2024	14:28:00	Dabchick, NZ	2		Yes	2
1	MS	5/03/2025	12:25:00	Dabchick, NZ		1		1
2	MS	9/12/2024	14:02:00	Dabchick, NZ	2		Yes	2
2	MS and MA	14/11/2024	11:30:00	Dabchick, NZ	1			1
6	MA	9/12/2024	10:00:00	Dabchick, NZ	2	2	Yes	4
6	MS and MA	14/11/2024	10:30:00	Dabchick, NZ	2	2	Yes	4

3	CW	03/03/2025	09:30:00	Dabchick, NZ		1		

Table 23. 5MBC data: combined species abundance and detection rates over two survey periods; 9/12/2024 to 5/3/2025

Species	Native/ Introduced	5MBC Sites				# sites (n=10) detected						Detection Rate	Individual total	Average abundance (Mean/count)		St. Error
		1	2	3	4	6	7	8	9	10	11					
Australasian Harrier	Native										1	1	10.0%	1	1.00	0.00
Fantail	Native	1	1	0		1	1		1			6	60.0%	5	0.83	0.13
Grey Warbler	Native			2		2			1	1	2	5	50.0%	8	1.60	0.17
Kingfisher	Native	3	2	0			1		1		1	6	60.0%	8	1.33	0.33
Paradise Shelduck	Native				2					2		2	20.0%	4	2.00	0.00
Pukeko	Native			1	2	1	4	1	1	2		7	70.0%	12	1.71	0.35
Silvereye	Native			2		2		1	3		4	5	50.0%	12	2.40	0.36
Spur Winged Plover	Native				2	1	6			1	1	5	50.0%	11	2.20	0.69
Tui	Native			1		1			2		2	4	40.0%	6	1.50	0.18
Blackbird	Introduced	1	1	0	2			1			2	6	60.0%	7	1.17	0.24
Canada Goose	Introduced									1		1	10.0%	1	1.00	0.00
Chaffinch	Introduced	3	1	3	4		2	1	2	2	4	9	90.0%	22	2.44	0.36
Goldfinch	Introduced							1				1	10.0%	1	1.00	0.00

Greenfinch	Introduced								1		1	2	20.0%	2	1.00	0.00
Magpie	Introduced							3	1			2	20.0%	4	2.00	0.45
Myna	Introduced	20	17	24	31	26	15	6	12	15	14	10	100.0%	180	18.00	2.33
Pheasant	Introduced			1	1		1			1		4	40.0%	4	1.00	0.00
Rosella	Introduced										1	1	10.0%	1	1.00	0.00
Skylark	Introduced						1			1		2	20.0%	2	1.00	0.00
Song Thrush	Introduced			1								1	10.0%	1	1.00	0.00
Sparrow	Introduced		6	8	9	7	8		5	4		7	70.0%	47	6.71	0.57

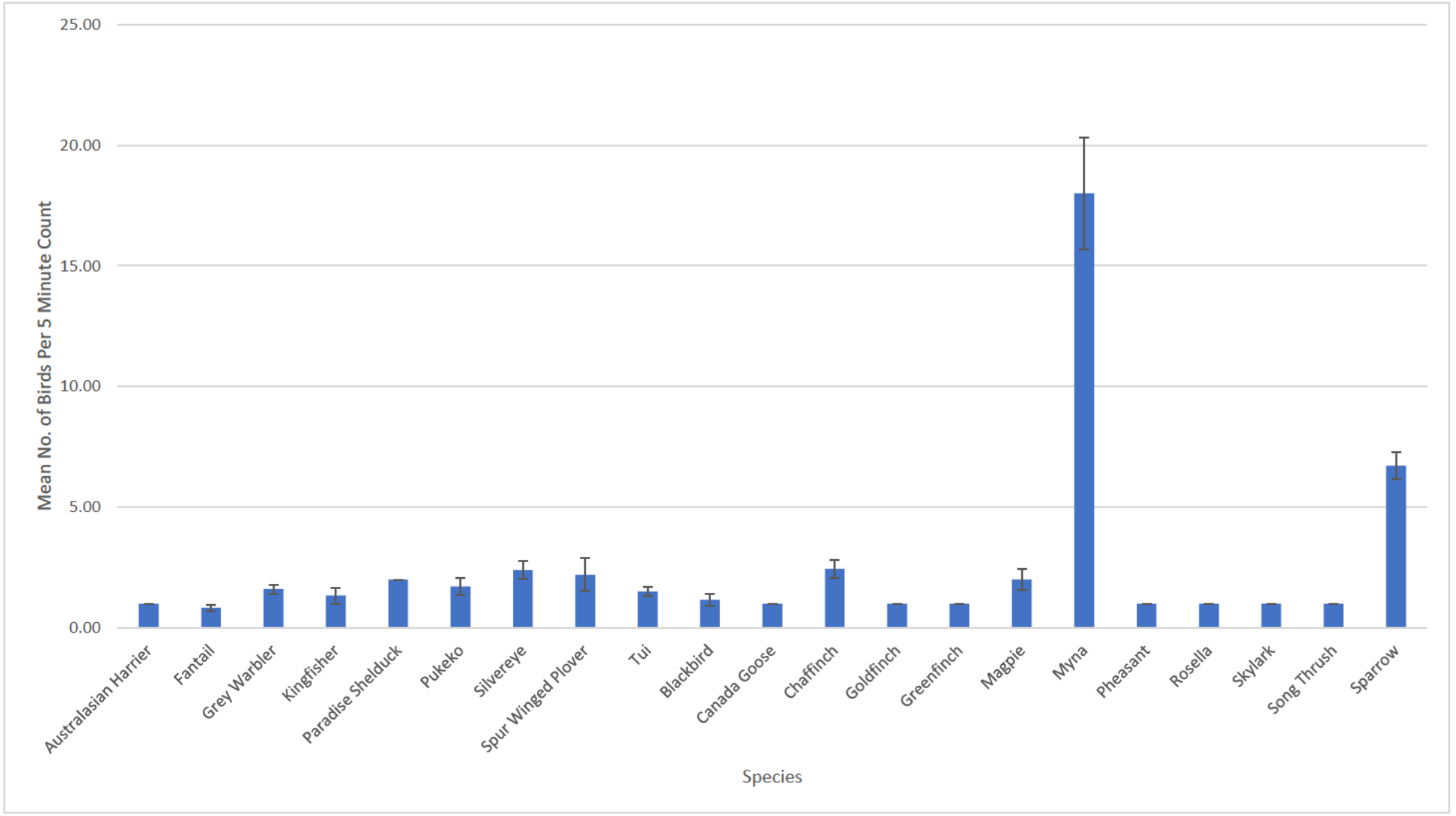


Figure 17. 5MBC: combined species abundance and detection rates (with standard error) over two survey periods; 9/12/2024 to 5/3/2025

Table 24. Species recorded on-site during opportunistic observations, not otherwise detected during targeted surveys

Common Name	Scientific Name	Native/ Introduced	Regional Threat Status	National Threat Status
Black backed gull	*Larus dominicanus*	Native	Not threatened	Not threatened
Black shag	*Phalacrocorax carbo*	Native	Threatened – Critical	At Risk - Relict
Red billed gull	*Chroicocephalus novaehollandiae*	Native	Threatened - Vulnerable	At Risk – Declining

Appendix B Macrophyte Survey Data

Site 1		Spring												Mean	S.E
Transect		1	2	3	4	5	6	7	8	9	10	11	12		
Width (m)		5.1	4.4	3.8	5	3.8	4.4	5.2	4.1	2.6	2.1	2.4	4.6		
Macrophytes (%)															
Willow weed	*Persicaria sp.*	0	0	0	0	0	0	0	0	0	1	2	0	0.25	0.18
Watercress	*Nasturtium officinale*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Duckweed	*Lemna minor*	0	0	0	0	8	0	0	0	0	0	0	0	0.67	0.67
Cape pondweed	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Water Celery	*Apium nodiflorum*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Oxygen weed	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pondweed	*Potamogeton ochreatus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Curly pondweed	*Potamogeton crispus*	0	0	0	0	0	0	80	85	60	98	95	65	40.25	12.50
Buttercup	*Ranunculus repens*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Other macrophytes	*Ludwigia palustris*	0	10	0	0	5	0	0	10	3	1	0	10	3.25	1.26
	Mercel	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Iron flocc		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Nitella	*Nitella hookeri*	1	60	15	0	75	0	0	0	25	0	0	15	15.92	7.42
Green mat		0	3	0	0	0	0	0	0	0	0	0	0	0.25	0.25
Green filamentous		0	0	0	0	0	0	60	60	0	0	0	0	10.00	6.74
Brown mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Macrophytes (%)		0	10	0	0	13	0	80	95	63	100	97	75	44.42	12.62
Total Algae (%)		1	63	15	0	75	0	60	60	25	0	0	15	26.17	8.55
Bare Substrate (%)		99	27	85	100	12	100	-40	-55	12	0	3	10	29.42	15.67

Site 2		Spring												Mean	S.E
Transect		1	2	3	4	5	6	7	8	9	10	11	12		
Width (m)		6.5	6.4	6.2	6.1	6.2	6	6	6	6	5.8	5.9	5.2		
Macrophytes (%)															
Willow weed	*Persicaria sp.*	10	5	20	2	0	10	0	0	2	0	10	20	6.58	2.15
Watercress	*Nasturtium officinale*	0	5	0	0	0	0	0	0	0	0	0	0	0.42	0.42
Duckweed	*Lemna minor*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Cape pondweed	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Water Celery	*Apium nodiflorum*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Oxygen weed	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pondweed	*Potamogeton ochreatus*	70	0	0	0	50	0	0	0	0	0	0	0	10.00	6.85
Curly pondweed	*Potamogeton crispus*	10	0	0	0	0	0	0	30	0	0	90	60	15.83	8.57
Buttercup	*Ranunculus repens*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Other macrophytes	*Ludwigia palustris*	0	0	0	0	0	0	1	0	0	0	0	20	1.75	1.66
	Mercel	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Iron flocc		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Nitella	*Nitella hookeri*	0	0	0	20	0	0	0	0	0	0	0	0	1.67	1.67
Green mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green filamentous		0	0	0	0	0	5	5	5	0	0	0	0	1.25	0.65
Brown mat		0	0	0	0	0	35	35	55	50	0	0	0	14.58	6.41
Brown filamentous		0	0	0	0	0	0	0	0	5	0	0	0	0.42	0.42
Total Macrophytes (%)		90	10	20	2	50	10	1	30	2	0	100	100	34.58	11.60
Total Algae (%)		0	0	0	20	0	40	40	60	55	0	0	0	17.92	6.95
Bare Substrate (%)		10	90	80	78	50	50	59	10	43	100	0	0	47.50	10.31

Site 3		Spring												Mean	S.E
Transect		1	2	3	4	5	6	7	8	9	10	11	12		
Width (m)		2.8	3.5	4.1	1.9	2.4	2.4	1.8	3.4	2.5	2.9	2.2	4.6		
Macrophytes (%)															
Willow weed	*Persicaria sp.*	0	0	0	0	0	0	0	0	0.5	15	0	10	2.13	1.43
Watercress	*Nasturtium officinale*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Duckweed	*Lemna minor*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Cape pondweed	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0.2	0	0	0	0	0	0	0.5	0	0	0	0	0.06	0.04
Water Celery	*Apium nodiflorum*	0.1	3	0	0	0	0	2	1	0	5	0	0	0.93	0.47
Oxygen weed	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pondweed	*Potamogeton ochreatus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Curly pondweed	*Potamogeton crispus*	2	25	0	0	0	0	1	1	1	40	80	60	17.50	8.05
Buttercup	*Ranunculus repens*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Other macrophytes	*Ludwigia palustris*	0	0	0.5	0	0	0.5	0.5	0.5	0.5	0	0	0	0.21	0.07
	Mercel	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Iron flocc		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Nitella	*Nitella hookeri*	0	5	5	30	5	5	5	20	25	40	20	5	13.75	3.70
Green mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Macrophytes (%)		2.3	28	0.5	0	0	0.5	3.5	3	2	60	80	70	20.82	8.93
Total Algae (%)		0	5	5	30	5	5	5	20	25	40	20	5	13.75	3.70
Bare Substrate (%)		97.7	67	94.5	70	95	94.5	91.5	77	73	0	0	25	65.43	10.55

Site 4		Spring												Mean	S.E
Transect		1	2	3	4	5	6	7	8	9	10	11	12		
Width (m)		1.1	2.7	1.1	1.7	3.3	2.4	1.4	2.4	0.55	0.81	5.1	4.6		
Macrophytes (%)															
Willow weed	*Persicaria sp.*	20	0	3	5	0	0.1	5	25	20	0	0	40	9.84	3.82
Watercress	*Nasturtium officinale*	0	0	0	0	0	0	70	3	35	10	0	0	9.83	6.20
Duckweed	*Lemna minor*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Cape pondweed	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Water Celery	*Apium nodiflorum*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Oxygen weed	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pondweed	*Potamogeton ochreatus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Curly pondweed	*Potamogeton crispus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Buttercup	*Ranunculus repens*	1	0	91	70	0	0	3	0	5	1	0	10	15.08	8.96
Other macrophytes	*Ludwigia palustris*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
	Mercel	0	0	1	0	0	0	0	0	0	0	0	0	0.08	0.08
Iron flocc		0	10	0	5	0	70	0	0	0	0	0	0	7.08	5.79
Nitella	*Nitella hookeri*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Macrophytes (%)		21	0	95	75	0	0.1	78	28	60	11	0	50	34.84	10.16
Total Algae (%)		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Bare Substrate (%)		79	100	5	25	100	99.9	22	72	40	89	100	50	65.16	10.16

Site 1		Autumn												Mean	S.E
Transect		1	2	3	4	5	6	7	8	9	10	11	12		
Width (m)		3.84	3.28	2.75	4.56	3	3.13	3.64	3.71	1.67	1.81	2.09	2.61		
Macrophytes (%)															
Willow wee	*Persicaria sp.*	0	0	0	0	0	0	0	1	0	0	5	0	0.50	0.42
Watercres	*Nasturtium officinale*	0	0	0	0	0	0	0.5	0	0	0	7	0	0.63	0.58
Duckweed	*Lemna minor*	0.5	0.5	5	3	0.5	2	0.5	0	0	0.1	0	0	1.01	0.45
Cape pond	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Water Cele	*Apium nodiflorum*	0	0	0	0	0	2	0	0	0	0	0	15	1.42	1.25
Oxygen we	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pond	*Potamogeton ochreatus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Curly pond	*Potamogeton crispus*	0	0	0	0	0	0	35	0	0	10	50	0	7.92	4.82
Buttercup	*Ranunculus repens*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Other macrophytes		0	0	5	0	0	2	0	15	25	0	0	3	4.17	2.27
Iron flocc		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Nitella	*Nitella hookeri*	0	0	30	15	65	60	0	0	0	0	0	0	14.17	7.04
Green mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Macrophytes (%)		0.5	0.5	10	3	0.5	6	36	16	25	10.1	62	18	15.63	5.27
Total Algae (%)		0	0	30	15	65	60	0	0	0	0	0	0	14.17	7.04
Bare Substrate (%)		99.5	99.5	60	82	34.5	34	64	84	75	89.9	38	82	70.20	6.94

Site 2		Autumn												Mean	S.E
Transect		1	2	3	4	5	6	7	8	9	10	11	12		
Width (m)		1.62	1.94	3.42	4.81	4.63	6.2	5.8	5.7	6.9	4.3	2.56	2.35		
Macrophytes (%)															
Willow wee	*Persicaria sp.*	90	25	10	0	3	0	0	0	5	5	15	10	13.58	7.28
Watercres	*Nasturtium officinale*	5	5	0	0	0	0	0	0	0	0	0	0	0.83	0.56
Duckweed	*Lemna minor*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Cape pond	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0	0	0	0	0	0	0	0	0	0	0.5	0	0.04	0.04
Water Cele	*Apium nodiflorum*	0	70	0	0	0	0	0	0	0	0	0	0	5.83	5.83
Oxygen we	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pond	*Potamogeton ochreatus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Curly pond	*Potamogeton crispus*	0	0	95	0	15	70	5	0	0	30	25	0	20.00	9.09
Buttercup	*Ranunculus repens*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Other macrophytes		0	0	5	2	2	2	5	0	0	0	0	0	1.33	0.56
Iron flocc		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Nitella	*Nitella hookeri*	0	0	0	5	30	0	20	0	0	60	0	0	9.58	5.38
Green mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Macrophytes (%)		95	100	110	2	20	72	10	0	5	35	40.5	10	41.63	12.00
Total Algae (%)		0	0	0	5	30	0	20	0	0	60	0	0	9.58	5.38
Bare Substrate (%)		5	0	-10	93	50	28	70	100	95	5	59.5	90	48.79	12.02

Site 3		Autumn													
Transect		1	2	3	4	5	6	7	8	9	10	11	12	Mean	S.E
Width (m)		2.6	0.89	0.63	1.07	0.78	1.02	0.86	2.07	0.89	2.54	1.96	0.61		
Macrophytes (%)															
Willow wee	*Persicaria sp.*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Watercres	*Nasturtium officinale*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Duckweed	*Lemna minor*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Cape pond	*Aponogeton distachyus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Starwort	*Callitriche stagnalis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Water Cele	*Apium nodiflorum*	0	0	0	0.5	0	0	0	0	0	0	0	0	0.04	0.04
Oxygen we	*Elodea canadensis*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Blunt pond	*Potamogeton ochreatus*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Curly pond	*Potamogeton crispus*	0	0	0	0	70	0	15	0	90	80	100	0	29.58	12.04
Buttercup	*Ranunculus repens*	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Other macrophytes		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Iron flocc		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Nitella	*Nitella hookeri*	0	20	0	0	0	0	0	0	0	0	0	0	1.67	1.67
Green mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Green filamentous		0	0	0	0	0	0	0	0	0	35	0	0	2.92	2.92
Brown mat		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Brown filamentous		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Macrophytes (%)		0	0	0	0.5	70	0	15	0	90	80	100	0	29.63	12.03
Total Algae (%)		0	20	0	0	0	0	0	0	0	35	0	0	4.58	3.23
Bare Substrate (%)		100	80	100	99.5	30	100	85	100	10	-15	0	100	65.79	13.14

Site 4		Autumn													
Transect		1	2	3	4	5	6	7	8	9	10	11	12	Mean	S.E
Width (m)															
Macrophytes (%)		Intermittent Steam Dry - No instream data collected.													
Total Macrophytes (%)		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Total Algae (%)		0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00
Bare Substrate (%)		100	100	100	100	100	100	100	100	100	100	100	100	100.00	0.00

Appendix C Macroinvertebrate Data

					Spring 2024				Autumn 2025				
PHYLUM	CLASS: Order	Family	Taxa	Taxa MCI sb	Site 1	Site 2	Site 3	Site 4	Site 1	Site 2	Site 3	Site 4	Site 5
ANNELIDA	OLIGOCHAETA		Oligochaeta	3.8				16		8		28	28
	HIRUDINEA		*Glossiphonia* sp.	1.2	4	3	2	24		8		20	4
PLATYHELMINTHES			Platyhelminthes	0.9		1	4			2			4
NEMERTEA			Nematoda	3.1				2				4	
MOLLUSCA	GASTROPODA	Hydrobiidae	*Potamopyrgus antipodarum*	2.1	1292	17	782	4424	1556		60	16	
		Planorbidae	*Gyraulus sp.*	1.7	56		10		80				
		Physidae	*Physella fontinalis*	0.1	104	18	110	128	156		268		8
		Lymneaidae	*Lymnaea columella*	1.2	4	3	2						
		Ancylidae	*Gundlachia* sp.	2.4	8								
	BIVALVIA	Sphaeriidae	*Pisidium hodgkini*	2.9					76				
ARTHROPODA	Araneae		*Dolomedes* sp.	6.2	8	1						4	
	CRUSTACEA: Cladocera		Cladocera	0.7				8					
	Ostracoda		Ostracoda	1.9	76	5	2	32					
	Amphipoda		*Paraleptamphopus subterraneus*	5.5	4				4				
			Paracalliope fluviatilis	5.5			852						76
	INSECTA: Odonata	Zygoptera	*Xanthocnemis zealandica*	1.2	160	51	5	1	108	10		8	4
		Anisoptera	*Antipodochlora braueri*	6.3					4				
			Hemicordulia australiae	0.4				1					
	Ephemeroptera	Leptophlebiidae	*Zephlebia* spp	8.8	12								
	Trichoptera	Hydroptilidae	*Oxyethira albiceps*	1.2	16	3							
			Paroxyethira hendersoni	3.7	8	2							
		Polycentropodidae	*Polyplectropus puerilis*	8.1	8								
		Leptoceridae	*Triplectides obsoleta*	5.7	32				4				
	Hemiptera	Veliidae	*Microvelia* sp.	4.6	108			8					
		Corixidae	*Sigara* sp.	2.4	12	8							
			Anisops sp.	2.2	16	4					120		
	Coleoptera	Hydrophilidae	Hydrophilidae	8				8					
			Enochrus tritus	2.6				48			4		8
		Dytiscidae	*Rhantus suturalis*	1				16					
	Diptera	Tipulidae	*Zelandotipula* sp.	3.6	4			8					
		Hexatomini	*Paralimnophila skusei*	7.4							4		
		Simuliidae	*Austrosimulium australense* gp	3.9	4		10						
		Chironomidae	*Chironomus*	3.4				32					16
			Polypedilum	8	8	1	2						
			Orthcladiinae	3.2	4				4				
		Tanyderidae	*Mischoderus* sp.	5.9				8					12
		Culicidae	*Culex* sp.	1.2				8	4		12	24	152
		Dixidae	*Paradixa* sp.	8.5	8	1		16					4
		TOTALS:	NO. TAXA		23	14	11	18	10	4	6	7	11
			NO. EPT TAXA		5	2	0	0	1	0	0	0	0
			NO. INDIVIDUALS		1956	118	1781	4788	1996	28	468	104	316

Appendix D Fish Survey Data

Site 1						
Species		Gear Type	Total (n)	Length (mm)		
				Average	Min	Max
Common Bully	*Gobiomorphus cotidianus*	G. Minnow & Fyke	20	43.4	31	58
Cran's Bully	*Gobiomorphus basalis*	Fyke	4	51.25	38	66
Shortfin Eel	*Anguilla australis*	Fyke	1	390	390	390
Longfin Eel	*Anguilla dieffenbachii*	Fyke	10	818	590	1000

Site 2						
Species		Gear Type	Total (n)	Length (mm)		
				Average	Min	Max
Common Bully	*Gobiomorphus cotidianus*	G. Minnow & Fyke	50	51.2	35	90
Shortfin Eel	*Anguilla australis*	Fyke	6	533	300	650

Site 3						
Species		Gear Type	Total (n)	Length (mm)		
				Average	Min	Max
Banded kokopu	*Galaxias fasciatus*	Fyke	1	34	34	34
Cran's Bully	*Gobiomorphus cotidianus*	Fyke	1	68	68	68
Shortfin Eel	*Anguilla australis*	G. Minnow & Fyke	76	477	200	850

Site 4						
Species		Gear Type	Total (n)	Length (mm)		
				Average	Min	Max
Shortfin Eel	*Anguilla australis*	G. Minnow	1	300	300	300

Pond 1						
Species		Life stage	Gear	Total (n)	Length (mm)	
					Min	Max
Shortfin Eel	*Anguilla australis*	Elvers	Fyke	12	60	100
Shortfin Eel	*Anguilla australis*	Juvenile	Fyke	249	100	300

Shortfin Eel	*Anguilla australis*	Adult	Fyke	201	300	800

Pond 2						
Species		Life Stage	Gear Type	Total (n)	Length (mm)	
					Min	Max
Shortfin Eel	*Anguilla australis*	Juvenile	Fyke	4	100	300

Pond 6						
Species		Life Stage	Gear Type	Total (n)	Length (mm)	
					Min	Max
Shortfin Eel	*Anguilla australis*	Elvers	Fyke	4	80	100
Shortfin Eel	*Anguilla australis*	Juvenile	Fyke	27	100	300
Shortfin Eel	*Anguilla australis*	Adult	Fyke	23	300	800

Appendix E Hill Labs Sediment and Water Quality Data

HillLabs

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

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+64 7 858 2000
mail@hill-labs.co.nz
www.hill-labs.co.nz

Certificate of Analysis

Client:	Bioresearches	**Lab No:**	3733761	SPv1
Contact:	Treff Barnett	**Date Received:**	06-Dec-2024	
	C/- Bioresearches	**Date Reported:**	13-Dec-2024	
	PO Box 2828	**Quote No:**	135038	
	Auckland 1140	**Order No:**		
		Client Reference:	67602	
		Submitted By:	Treff Barnett	

Sample Type: Sediment

Sample Name:		Site 1 [Sediment]	Site 3 [Sediment]	Site 4 [Sediment]
Lab Number:		3733761.5	3733761.6	3733761.7
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Recoverable Arsenic	mg/kg dry wt	3.3	2.4	10.3
Total Recoverable Cadmium	mg/kg dry wt	0.190	0.141	0.56
Total Recoverable Chromium	mg/kg dry wt	10.2	5.6	16.0
Total Recoverable Copper	mg/kg dry wt	14.3	16.9	37
Total Recoverable Lead	mg/kg dry wt	6.6	6.7	41
Total Recoverable Nickel	mg/kg dry wt	9.4	5.6	15.6
Total Recoverable Zinc	mg/kg dry wt	76	49	560

Sample Type: Aqueous

Sample Name:		Site 1 [Water]	Site 2 [Water]	Site 3 [Water]	Site 4 [Water]
Lab Number:		3733761.1	3733761.2	3733761.3	3733761.4
Individual Tests					
Total Alkalinity	g/m³ as $CaCO_3$	49	59	70	300
Total Suspended Solids	g/m³	< 3	5	4	25
Chloride	g/m³	29	27	27	26
Total Ammoniacal-N	g/m³	< 0.010	0.019	0.022	0.062
Chemical Oxygen Demand (COD)	g O_2/m³	21	26	26	36
Oil and Grease	g/m³	< 4	5	5	< 4
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn					
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dissolved Copper	g/m³	0.0006	0.0006	0.0006	< 0.0005
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Dissolved Nickel	g/m³	0.0012	0.0011 #1	0.0011	0.0011
Dissolved Zinc	g/m³	< 0.0010	0.0013	0.0011 #1	0.0019
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Arsenic	g/m³	< 0.0011	0.0011	< 0.0011	0.0015
Total Cadmium	g/m³	< 0.000053	< 0.000053	< 0.000053	< 0.000053
Total Chromium	g/m³	< 0.00053	< 0.00053	0.00077	< 0.00053
Total Copper	g/m³	0.00092	0.00060	0.00101	0.00095
Total Lead	g/m³	< 0.00011	0.00014	< 0.00011	0.00022
Total Nickel	g/m³	0.00116	0.00105 #1	0.00113	0.00132
Total Zinc	g/m³	0.0013	0.0015	< 0.0011 #1	0.0072

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

Sample Type: Aqueous					
Sample Name:		Site 1 [Water]	Site 2 [Water]	Site 3 [Water]	Site 4 [Water]
Lab Number:		3733761.1	3733761.2	3733761.3	3733761.4
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m³	< 0.10	< 0.10	< 0.10	< 0.10
C10 - C14	g/m³	< 0.2	< 0.2	< 0.2	< 0.2
C15 - C36	g/m³	< 0.4	< 0.4	< 0.4	< 0.4
Total hydrocarbons (C7 - C36)	g/m³	< 0.7	< 0.7	< 0.7	< 0.7

Analyst's Comments

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

Summary of Methods

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

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed).	-	5-7
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation May contain a residual moisture content of 2-5%. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed).	-	5-7
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	5-7
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.8 mg/kg dry wt	5-7

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-4
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1-4
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m³ as $CaCO_3$	1-4
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/m³	1-4
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1-4
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m³	1-4
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/m³	1-4
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D : Online Edition.	6 g O_2/m³	1-4
Oil and Grease	Sample filtration through filter aid, Soxhlet extraction, gravimetric determination of extracted Oil & Grease. APHA 5520 D (modified) : Online Edition.	4 g/m³	1-4
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m³	1-4
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B (modified) : Online Edition / US EPA 200.8.	0.000053 - 0.0011 g/m³	1-4
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.10 g/m³	1-4
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m³	1-4
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m³	1-4

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m^3	1-4

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

Testing was completed between 06-Dec-2024 and 13-Dec-2024. For completion dates of individual analyses please contact the laboratory.

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

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Ara Heron BSc (Tech)
Client Services Manager - Environmental

Lab No: 3733761-SPv1 Hill Labs Page 3 of 3

Hill Labs

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Certificate of Analysis

Client:	Bioresearches	**Lab No:**	3832177	SUPv1
Contact:	Treff Barnett	**Date Received:**	26-Mar-2025	
	C/- Bioresearches	**Date Reported:**	01-Apr-2025	
	PO Box 2828	**Quote No:**	135038	
	Auckland 1140	**Order No:**		
		Client Reference:	67602	
		Submitted By:	Treff Barnett	

Sample Type: Sediment

Sample Name:		Site 1 26-Mar-2025	Site 3 26-Mar-2025	Site 4 26-Mar-2025
Lab Number:		3832177.2	3832177.5	3832177.7
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn				
Total Recoverable Arsenic	mg/kg dry wt	4.79 ± 0.50	4.56 ± 0.46	7.23 ± 0.74
Total Recoverable Cadmium	mg/kg dry wt	0.161 ± 0.023	0.364 ± 0.045	0.731 ± 0.088
Total Recoverable Chromium	mg/kg dry wt	9.2 ± 1.2	9.2 ± 1.2	12.9 ± 1.6
Total Recoverable Copper	mg/kg dry wt	15.2 ± 2.2	19.9 ± 2.8	36.0 ± 5.1
Total Recoverable Lead	mg/kg dry wt	9.3 ± 1.2	12.6 ± 1.6	31.6 ± 3.8
Total Recoverable Nickel	mg/kg dry wt	5.19 ± 0.83	10.1 ± 1.1	13.8 ± 1.4
Total Recoverable Zinc	mg/kg dry wt	66 ± 11	126 ± 21	511 ± 82

Sample Type: Aqueous

Sample Name:		Site 1 26-Mar-2025	Site 2 26-Mar-2025	Site 3 26-Mar-2025	Site 4 26-Mar-2025
Lab Number:		3832177.1	3832177.3	3832177.4	3832177.6
Individual Tests					
Total Alkalinity	g/m³ as $CaCO_3$	95.5 ± 3.9	133.5 ± 5.4	245 ± 10	451 ± 19
Total Suspended Solids	g/m³	6.6 ± 2.4	5.9 ± 2.2	12.3 ± 2.7	24.9 ± 4.1
Chloride	g/m³	34.9 ± 2.2	26.3 ± 1.7	37.6 ± 2.3	36.2 ± 2.2
Total Ammoniacal-N	g/m³	0.0542 ± 0.0073	< 0.010 ± 0.0067	0.379 ± 0.016	2.236 ± 0.081
Chemical Oxygen Demand (COD)	g O_2/m³	23.5 ± 6.6	36.5 ± 9.6	56 ± 14	60 ± 20
Oil and Grease	g/m³	6.4 ± 2.9	< 5 ± 2.7 #1	6.0 ± 2.9	4.4 ± 2.7
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn					
Dissolved Arsenic	g/m³	0.00105 ± 0.00067	< 0.0010 ± 0.00067	0.00145 ± 0.00067	0.00147 ± 0.00067
Dissolved Cadmium	g/m³	< 0.00005 ± 0.000034	< 0.00005 ± 0.000034	< 0.00005 ± 0.000034	< 0.00005 ± 0.000034
Dissolved Chromium	g/m³	< 0.0005 ± 0.00034	< 0.0005 ± 0.00034	< 0.0005 ± 0.00034	< 0.0005 ± 0.00034
Dissolved Copper	g/m³	< 0.0005 ± 0.00034	< 0.0005 ± 0.00034	< 0.0005 ± 0.00034	< 0.0005 ± 0.00034
Dissolved Lead	g/m³	< 0.00010 ± 0.000067	< 0.00010 ± 0.000067	< 0.00010 ± 0.000067	< 0.00010 ± 0.000067
Dissolved Nickel	g/m³	0.00095 ± 0.00034	0.00073 ± 0.00034	0.00155 ± 0.00034	0.00090 ± 0.00034
Dissolved Zinc	g/m³	< 0.0010 ± 0.00067	< 0.0010 ± 0.00067	0.00125 ± 0.00066	0.00134 ± 0.00066
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn					
Total Arsenic	g/m³	0.00155 ± 0.00074	0.00155 ± 0.00074	0.00212 ± 0.00075	0.00197 ± 0.00074
Total Cadmium	g/m³	< 0.000053 ± 0.000036	< 0.000053 ± 0.000036	< 0.000053 ± 0.000036	< 0.000053 ± 0.000036
Total Chromium	g/m³	0.00059 ± 0.00036	< 0.00053 ± 0.00036	0.00075 ± 0.00036	0.00100 ± 0.00036
Total Copper	g/m³	< 0.00053 ± 0.00036	< 0.00053 ± 0.00036	< 0.00053 ± 0.00036	0.00076 ± 0.00036
Total Lead	g/m³	< 0.00011 ± 0.000074	< 0.00011 ± 0.000074	< 0.00011 ± 0.000074	0.000474 ± 0.000079
Total Nickel	g/m³	0.00109 ± 0.00036	0.00066 ± 0.00037	0.00220 ± 0.00044	0.00120 ± 0.00036
Total Zinc	g/m³	< 0.0011 ± 0.00074	0.00120 ± 0.00074	0.00202 ± 0.00075	0.00611 ± 0.00066

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

Sample Type: Aqueous					
Sample Name:		Site 1 26-Mar-2025	Site 2 26-Mar-2025	Site 3 26-Mar-2025	Site 4 26-Mar-2025
Lab Number:		3832177.1	3832177.3	3832177.4	3832177.6
Total Petroleum Hydrocarbons in Water					
C7 - C9	g/m³	< 0.10 ± 0.067	< 0.10 ± 0.067	< 0.10 ± 0.067	< 0.10 ± 0.067
C10 - C14	g/m³	< 0.2 ± 0.095	< 0.2 ± 0.095	< 0.2 ± 0.095	< 0.2 ± 0.095
C15 - C36	g/m³	< 0.4 ± 0.12	< 0.4 ± 0.12	< 0.4 ± 0.12	< 0.4 ± 0.12
Total hydrocarbons (C7 - C36)	g/m³	< 0.7 ± 0.17	< 0.7 ± 0.17	< 0.7 ± 0.17	< 0.7 ± 0.17

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

Analyst's Comments

#1 There was insufficient sample left to filter the usual amount for the Oil and Grease analysis, so the detection limit achieved is greater 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: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed).	-	2, 5, 7
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation May contain a residual moisture content of 2-5%. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed).	-	2, 5, 7
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	2, 5, 7
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.8 mg/kg dry wt	2, 5, 7

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1, 3-4, 6
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1, 3-4, 6
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m³ as $CaCO_3$	1, 3-4, 6
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/m³	1, 3-4, 6
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1, 3-4, 6
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m³	1, 3-4, 6
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/m³	1, 3-4, 6
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D : Online Edition.	6 g O_2/m³	1, 3-4, 6
Oil and Grease	Sample filtration through filter aid, Soxhlet extraction, gravimetric determination of extracted Oil & Grease. APHA 5520 D (modified) : Online Edition.	4 g/m³	1, 3-4, 6
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m³	1, 3-4, 6
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.000053 - 0.0011 g/m³	1, 3-4, 6

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 5015.	0.10 g/m^3	1, 3-4, 6
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 5015.	0.2 g/m^3	1, 3-4, 6
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 5015.	0.4 g/m^3	1, 3-4, 6
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 5015.	0.7 g/m^3	1, 3-4, 6

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

Testing was completed between 27-Mar-2025 and 01-Apr-2025. For completion dates of individual analyses please contact the laboratory.

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

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Ara Heron BSc (Tech)
Client Services Manager - Environmental

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Certificate of Analysis

Client:	Bioresearches	**Lab No:**	3843178	SUPv1
Contact:	Treff Barnett	**Date Received:**	03-Apr-2025	
	C/- Bioresearches	**Date Reported:**	14-Apr-2025	
	PO Box 2828	**Quote No:**	135038	
	Auckland 1140	**Order No:**		
		Client Reference:	67602	
		Submitted By:	Treff Barnett	

Sample Type: Sediment

Sample Name:		Site 5 [Sediment] 03-Apr-2025 2:45 pm
Lab Number:		3843178.2
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn		
Total Recoverable Arsenic	mg/kg dry wt	2.28 ± 0.27
Total Recoverable Cadmium	mg/kg dry wt	0.215 ± 0.027
Total Recoverable Chromium	mg/kg dry wt	6.64 ± 0.81
Total Recoverable Copper	mg/kg dry wt	13.6 ± 2.0
Total Recoverable Lead	mg/kg dry wt	10.2 ± 1.3
Total Recoverable Nickel	mg/kg dry wt	5.67 ± 0.61
Total Recoverable Zinc	mg/kg dry wt	75 ± 13

Sample Type: Aqueous

Sample Name:		Site 5 03-Apr-2025 9:30 am
Lab Number:		3843178.1
Individual Tests		
Total Alkalinity	g/m³ as $CaCO_3$	151.2 ± 6.1
Total Suspended Solids	g/m³	26.6 ± 4.3
Chloride	g/m³	51.3 ± 3.1
Total Ammoniacal-N	g/m³	1.621 ± 0.059
Chemical Oxygen Demand (COD)	g O_2/m³	54 ± 14
Oil and Grease	g/m³	10.2 ± 3.3
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn		
Dissolved Arsenic	g/m³	0.00195 ± 0.00066
Dissolved Cadmium	g/m³	< 0.00005 ± 0.000034
Dissolved Chromium	g/m³	< 0.0005 ± 0.00034
Dissolved Copper	g/m³	< 0.0005 ± 0.00034
Dissolved Lead	g/m³	< 0.00010 ± 0.000067
Dissolved Nickel	g/m³	0.00164 ± 0.00034
Dissolved Zinc	g/m³	0.00176 ± 0.00069
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn		
Total Arsenic	g/m³	0.00356 ± 0.00077
Total Cadmium	g/m³	< 0.000053 ± 0.000036
Total Chromium	g/m³	< 0.00053 ± 0.00036
Total Copper	g/m³	0.00056 ± 0.00037
Total Lead	g/m³	0.000351 ± 0.000077
Total Nickel	g/m³	0.00197 ± 0.00043
Total Zinc	g/m³	0.00631 ± 0.00069

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

Sample Type: Aqueous		
Sample Name:		Site 5 03-Apr-2025 9:30 am
Lab Number:		3843178.1
Total Petroleum Hydrocarbons in Water		
C7 - C9	g/m³	< 0.10 ± 0.067
C10 - C14	g/m³	< 0.2 ± 0.095
C15 - C36	g/m³	< 0.4 ± 0.12
Total hydrocarbons (C7 - C36)	g/m³	< 0.7 ± 0.17

The reported uncertainty is an expanded uncertainty with a level of confidence of approximately 95 percent (i.e. two standard deviations, calculated using a coverage factor of 2). Reported uncertainties are calculated from the performance of typical matrices, and do not include variation due to sampling.

For further information on uncertainty of measurement at Hill Laboratories, refer to the technical note on our website: www.hill-laboratories.com/files/Intro_To_UOM.pdf, or contact the laboratory.

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: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed).	-	2
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation May contain a residual moisture content of 2-5%. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed).	-	2
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2 (modified).	-	2
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.8 mg/kg dry wt	2

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) : Online Edition.	-	1
Total Alkalinity	Titration to pH 4.5 (M-alkalinity), autotitrator. APHA 2320 B (modified for Alkalinity <20) : Online Edition.	1.0 g/m³ as $CaCO_3$	1
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/m³	1
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.	-	1
Chloride	Filtered sample. Ion Chromatography. APHA 4110 B (modified) : Online Edition.	0.5 g/m³	1
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/m³	1
Chemical Oxygen Demand (COD), trace level	Dichromate/sulphuric acid digestion in Hach tubes, colorimetry. Trace Level method. APHA 5220 D : Online Edition.	6 g O_2/m³	1
Oil and Grease	Sample filtration through filter aid, Soxhlet extraction, gravimetric determination of extracted Oil & Grease. APHA 5520 D (modified) : Online Edition.	4 g/m³	1
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.00005 - 0.0010 g/m³	1
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.	0.000053 - 0.0011 g/m³	1
Total Petroleum Hydrocarbons in Water			
C7 - C9	Solvent extraction, GC-FID analysis. In-house based on US EPA 5015.	0.10 g/m³	1

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
C10 - C14	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.2 g/m^3	1
C15 - C36	Solvent extraction, GC-FID analysis. In-house based on US EPA 8015.	0.4 g/m^3	1
Total hydrocarbons (C7 - C36)	Calculation: Sum of carbon bands from C7 to C36. In-house based on US EPA 8015.	0.7 g/m^3	1

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

Testing was completed between 08-Apr-2025 and 14-Apr-2025. For completion dates of individual analyses please contact the laboratory.

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

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

Ara Heron BSc (Tech)
Client Services Manager - Environmental

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Appendix F Water Quality and Sediment Guidelines

Water Quality Guidelines (for metals dissolved in water)

These are concentration thresholds for metals in freshwater, designed to protect aquatic life (fish, invertebrates, algae).

New Zealand uses the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) https://www.waterquality.gov.au/anz-guidelines

These provide trigger values for dissolved metals in water.

Trigger values vary by species protection level (e.g. 95%, 99%, 80%).

Metal	99% Protection	95% Protection	80% Protection	Units (µg/L)	
	Arsenic (As III)	0.024	0.13	0.42	µg/L
Cadmium (Cd)	0.0002	0.0008	0.0025	µg/L	
	Chromium (Cr VI)	0.06	1	4.4	µg/L
Copper (Cu)	~0.5*	~1.4*	~2.5*	µg/L	
	Lead (Pb)	~0.9*	~3.4*	~9.4*	µg/L
Nickel (Ni)	~2*	~11*	~30*	µg/L	
	Zinc (Zn)	~2.4*	~8.0*	~23*	µg/L

*Metals marked with ~ are hardness-modified — values depend on calcium/magnesium levels in the water.

Sediment Quality Guidelines (for metals in stream/riverbed sediment)

The Toxicant Default Guideline Values (DGVs) for sediment quality from the ANZG (Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2018) are applicable to New Zealand freshwater streams, but with important caveats. These values are intended as interim, screening-level thresholds and should be used as part of a broader weight-of-evidence approach in ecological risk assessments.

The ANZG sediment DGVs are explicitly designed for use in both Australia and New Zealand, as they are regionally developed from the original ANZECC/ARMCANZ 2000 Guidelines.

They are routinely used by NIWA, regional councils, and the Ministry for the Environment in freshwater sediment quality assessments, and have been applied in freshwater ecosystems, including lowland rivers, urban streams, and estuarine environments throughout New Zealand.

While initially developed with more marine/estuarine data, the ISQG-Low and ISQG-High sediment thresholds (still used under the DGV framework) have been adopted in the absence of more specific NZ freshwater thresholds. They act as a first-tier screening tool—if sediment concentrations exceed DGVs, further site-specific investigation is typically triggered.

Note / Caveats

1. Not Ecosystem-Specific. The DGVs are not tailored to specific New Zealand stream types, such as upland or volcanic catchments. Natural background levels (e.g., for arsenic or nickel in geothermal or ultramafic regions) may exceed DGVs without anthropogenic contamination.

2. Total Metals, Not Bioavailable Fraction. DGVs apply to total recoverable concentrations in fine sediments (generally <63 µm). i.e. They do not account for bioavailability, which may vary significantly with redox, organic content, or sulphide binding (e.g., using SEM-AVS methods).

3. DGVs Are Not Regulatory Limits. These are guidelines, not legal standards. Regulatory decisions in NZ often rely on site-specific assessments, ecological surveys, and council monitoring frameworks in addition to the DGVs.

Type of toxicant	Toxicant	DGV	GV-high
Metals (mg/kg dry weight)[a]	Antimony	2.0	25
	Cadmium	1.5	10
	Chromium	80	370
	Copper	65	270
	Lead	50	220
	Mercury (Inorganic)	0.15	1.0
	Nickel	21	52
	Silver	1.0	4.0
	Zinc	200	410
Metalloids (mg/kg dry weight)[a]	Arsenic	20	70

Guideline References:

ANZG. (2018). *Australian and New Zealand guidelines for fresh and marine water quality*. Australian and New Zealand Governments and the Australian state and territory governments.
https://www.waterquality.gov.au/anz-guidelines

and Toxicology, 39, 20–31.
https://doi.org/10.1007/s002440010075