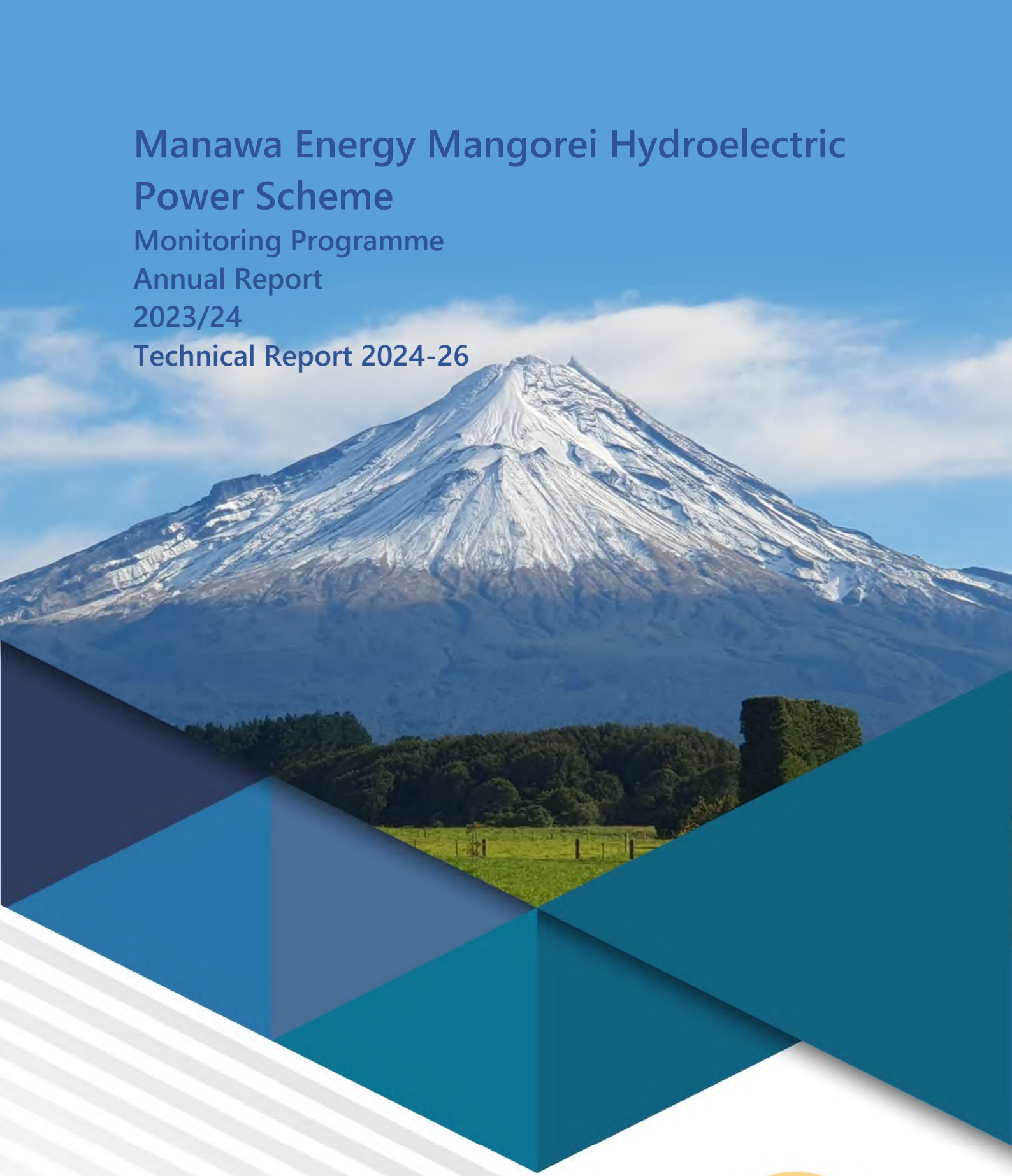
Manawa Energy Mangorei Hydroelectric Power Scheme

Monitoring Programme Annual Report 2023/24

Technical Report 2024-26



Taranaki Regional Council

Manawa Energy Mangorei Hydroelectric Power Scheme

Monitoring Programme
Annual Report
2023/24
Technical Report 2024-26

Taranaki Regional Council
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Executive summary

Manawa Energy Ltd (the Company) operates the Mangorei Hydroelectric Power Scheme (HEPS) in the Waiwhakaiho River Catchment to the south of New Plymouth. The Company diverts water from the Waiwhakaiho River into Lake Mangamahoe, from where it is directed through penstocks to the Mangorei Power Station, located on Hydro Road. The water is returned to the Waiwhakaiho River at the Meeting of the Waters, 6km downstream of the original diversion.

This report for the period July 2023 to June 2024 describes the monitoring programme implemented by Taranaki Regional Council (the Council) to assess the Company's environmental and consent compliance performance during the period under review. The report also details the results of the monitoring undertaken and assesses the environmental effects of the Company's activities.

During the monitoring period, the Company demonstrated an overall high level of environmental and high administrative performance.

The Company holds six resource consents, which include a total of 31 conditions setting out the requirements that the Company must satisfy. The Company holds three consents to allow it to divert, use and discharge water and three consents for various structures, including to dam the Mangamahoe Stream, the Waiwhakaiho River intake weir, and an access culvert related to this site. One consent expired in June 2020, and the remaining consents in June 2021. The Company applied to renew these consents, and the consenting process is in progress. In the meantime, the Company continues to exercise the consents under the protection of section 124 of the Resource Management Act 1991.

The Council's monitoring programme for the year under review included 11 hydrological inspections (which included a gauging of the residual flow on each occasion), two macroinvertebrate surveys, the auditing of data provided by the Company, and water temperature monitoring of the Waiwhakaiho River.

Gauging of the residual flow recorded a compliant flow on all occasions assessed. The fish passage was maintained in good condition throughout the monitoring year. Data provided by the Company showed good compliance with lake level restrictions and residual flow requirements, and the requirement to generate at least 950L/s during the day to provide adequate flow downstream of the scheme.

The number of elvers transferred from the Mangorei Power Station to the Waiwhakaiho River during the period under review was slightly lower than the long-term average. Downstream migratory adult eel passage was also provided by the Company by manual trapping and transfer. A total of 47 adult eels were transferred in the reported period, which is above the long-term average.

Overall, there was a general decrease in macroinvertebrate community health in a downstream direction. There was a slight improvement during the March 2024 survey compared to the December 2023 survey. These reductions could potentially indicate a negative impact on the macroinvertebrate communities of the Waiwhakaiho River due to the Mangorei HEPS abstraction. However, due to the distance between sampling sites and other inflows and discharges that enter the Waiwhakaiho River within the residual reach, it is difficult to determine the extent to which the Mangorei HEPS activities have affected macroinvertebrate communities. It is likely that any stressors affecting the macroinvertebrate communities on the Waiwhakaiho River are exacerbated by abstraction activities.

During this monitoring period, water temperatures in the residual reach did not present excessive levels for any extended period, although there is a clear relationship between the activity and increased water temperatures. Water temperature results indicated a typical change in water temperature in a downstream direction attributable to the HEPS. This monitoring continues to demonstrate how the variability in diurnal ranges and climatic conditions can influence temperatures within the river at any given period.

For reference, in the 2023/24 year, consent holders were found to achieve a high level of environmental performance and compliance for 864 (89%) of a total of 967 consents monitored through the Taranaki tailored monitoring programmes, while for another 75 (8%) of the consents a good level of environmental performance and compliance was achieved. A further 26 (3%) of consents monitored required improvement in their performance, while the remaining two (<1%) achieved a rating of poor.

In terms of overall environmental and compliance performance by the consent holder over the last several years, this report shows that the consent holder's performance has remained at a high level.

This report includes recommendations for the 2024/25 year.

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1. Introduction

1.1 Compliance monitoring programme reports and the Resource Management Act 1991

1.1.1 Introduction

This report is for the period July 2023 to June 2024 by Taranaki Regional Council (the Council) on the monitoring programme associated with resource consents held by Manawa Energy Limited (the Company) in relation to the Mangorei hydroelectric power scheme (HEPS). The scheme diverts water from the Waiwhakaiho River to Lake Mangamahoe, and then on to the Mangorei Power Station, located on Hydro Road.

The report includes the results and findings of the monitoring programme implemented by the Council in respect of the consents held by the Company that relate to diversions of water and related in-stream structures within the Waiwhakaiho Catchment.

1.1.2 Structure of this report

Section 1 of this report is a background section. It sets out general information about:

- consent compliance monitoring under the *Resource Management Act 1991* (RMA) and the Council's obligations;
- the Council's approach to monitoring sites though annual programmes;
- the resource consents held by the Company in the Waiwhakaiho Catchment;
- the nature of the monitoring programme in place for the period under review; and
- a description of the activities and operations conducted in the Company's site/catchment.

Section 2 presents the results of monitoring during the period under review, including scientific and technical data.

Section 3 discusses the results, their interpretations, and their significance for the environment.

Section 4 presents recommendations to be implemented in the 2024/25 monitoring year.

A glossary of common abbreviations and scientific terms, and a bibliography, are presented at the end of the report.

1.1.3 The Resource Management Act 1991 and monitoring

The RMA primarily addresses environmental 'effects' which are defined as positive or adverse, temporary or permanent, past, present or future, or cumulative. Effects may arise in relation to:

a. the neighbourhood or the wider community around an activity, and may include cultural and social-economic effects;
b. physical effects on the locality, including landscape, amenity and visual effects;
c. ecosystems, including effects on plants, animals, or habitats, whether aquatic or terrestrial;
d. natural and physical resources having special significance (for example recreational, cultural, or aesthetic); and
e. risks to the neighbourhood or environment.

In drafting and reviewing conditions on discharge permits, and in implementing monitoring programmes, the Council is recognising the comprehensive meaning of 'effects' in as much as is appropriate for each activity. Monitoring programmes are not only based on existing permit conditions, but also on the obligations of the RMA to assess the effects of the exercise of consents. In accordance with Section 35 of the RMA, the Council undertakes compliance monitoring for consents and rules in regional plans, and maintains an overview of the performance of resource users and consent holders. Compliance monitoring, including both activity and impact monitoring, enables the Council to continually re-evaluate its approach and that of consent holders to resource management and, ultimately, through the refinement of methods and considered responsible resource utilisation, to move closer to achieving sustainable development of the region's resources.

1.1.4 Evaluation of environmental performance

Besides discussing the various details of the performance and extent of compliance by the consent holders, this report also assigns a rating as to each Company's environmental and administrative performance during the period under review. The rating categories are high, good, improvement required and poor for both environmental and administrative performance. The interpretations for these ratings are found in Appendix II.

For reference, in the 2023/24 year, consent holders were found to achieve a high level of environmental performance and compliance for 864 (89%) of a total of 967 consents monitored through the Taranaki tailored monitoring programmes, while for another 75 (8%) of the consents a good level of environmental performance and compliance was achieved. A further 26 (3%) of consents monitored required improvement in their performance, while the remaining two (<1%) achieved a rating of poor.[1]

1.2 Process description

The Mangorei HEPS diverts water from the Waiwhakaiho River to Lake Mangamahoe via an intake weir and tunnel (Figure 1). Water is taken from the lake for the Mangorei Power Station and returned to the Waiwhakaiho River approximately 6km downstream of the intake weir. The New Plymouth Water Treatment Plant also takes water from Lake Mangamahoe for the New Plymouth and Waitara water supplies.

When the Mangorei HEPS consents were renewed in 1996, the main areas of concern related to the flow in the reach between the intake weir and the Meeting of the Waters, known as the residual flow reach, and fish passage at the intake weir. These concerns were addressed by specifying a residual flow regime, with flows ranging from 400L/s to 700L/s depending on the time of year, and by requiring modifications to the fish pass, to ensure trout and native fish species were able to migrate upstream past the weir.

Historical points of note are discussed in previous reports, listed in the bibliography and references section.

[1] The Council has used these compliance grading criteria for more than 20 years. They align closely with the 4 compliance grades in the MfE Best Practice Guidelines for Compliance, Monitoring and Enforcement, 2018

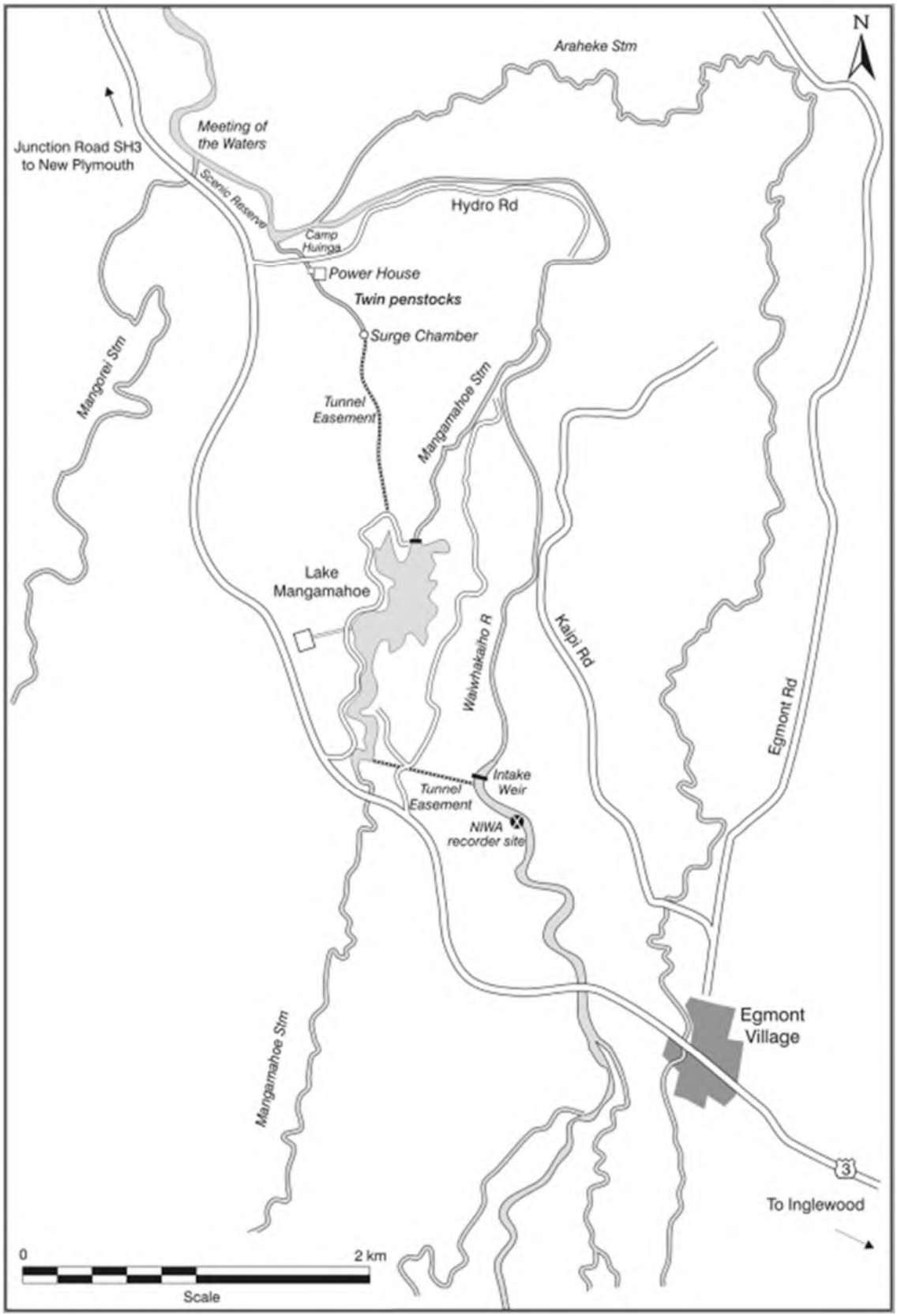


Figure 1 Lake Mangamahoe environs showing the Waiwhakaiho diversion, community water supply, and the Company's HEPS

1.3 Resource consents

The Company holds six resource consents, the details of which are summarised in the table below. Summaries of the conditions attached to each permit are set out in Section 3 of this report. All the remaining relevant consents are now under Section 124 protection under the RMA as they go through the renewal phase.

A summary of the various consent types issued by the Council is included in Appendix I, as are copies of all permits held by the Company during the period under review.

Table 1 Resource consents held by the Company in relation to the Mangorei HEPS

Consent number	Purpose	Granted	Review	Expires
Water abstraction permits				
2053-3.2	To divert up to 10m^3/s of water from the Waiwhakaiho River via a diversion weir and associated intake structures into Lake Mangamahoe through the Mangorei HEPS and back into the river approximately six kilometres downstream of the diversion point	4 September 1996 Varied 1 August 2017	-	Expired 1 June 2021 s.124 protection
2056-3.1	To use up to 864,000m^3/day of water from Lake Mangamahoe in the Waiwhakaiho Catchment for hydroelectric power generation purposes	4 September 1996 Varied 16 June 2016	-	Expired 1 June 2021 s.124 protection
Water discharge permits				
4888-1	To discharge up to 150,00L/s of water from Lake Mangamahoe via a spillway into the Mangamahoe Stream in the Waiwhakaiho Catchment under emergency conditions associated with hydroelectric generation purposes	4 September 1996	-	Expired 1 June 2021 s.124 protection
Land use permits				
2054-3	To dam the Mangamahoe Stream in the Waiwhakaiho Catchment to form Lake Mangamahoe to act as a reservoir of water for hydroelectric power generation purposes	4 September 1996	-	Expired 1 June 2021 s.124 protection
4886-1	To erect and maintain structures in the Mangamahoe Stream in the Waiwhakaiho Catchment to dam the stream to form Lake Mangamahoe for hydroelectric power generation purposes	4 September 1996	-	Expired 1 June 2021 s.124 protection
6810-1	To erect, place and maintain a culvert in an unnamed tributary of the Waiwhakaiho River for access purposes	6 March 2006	-	Expired 1 June 2020 s.124 protection

1.4 Monitoring programme

1.4.1 Introduction

Section 35 of the RMA sets obligations upon the Council to gather information, monitor and conduct research on the exercise of resource consents within the Taranaki region. The Council is also required to assess the effects arising from the exercising of these consents and report upon them.

The Council may therefore make and record measurements of physical and chemical parameters, take samples for analysis, carry out surveys and inspections, conduct investigations and seek information from consent holders.

The monitoring programme for the Mangorei HEPS site consisted of five primary components.

1.4.2 Programme liaison and management

There is generally a significant investment of time and resources by the Council in:

- ongoing liaison with resource consent holders over consent conditions and their interpretation and application;
- discussion over monitoring requirements;
- preparation for any consent reviews, renewals or new consent applications;
- advice on the Council's environmental management strategies and content of regional plans; and
- consultation on associated matters.

1.4.3 Site inspections

The Mangorei HEPS was visited 11 times during the monitoring period for routine hydrological inspections. These focused largely on hydrological aspects of the scheme, with a gauging of the residual flow reach undertaken on each occasion and some water level readings also taken. The fish pass was inspected, as was the access culvert.

Separate informal inspections of the culvert entrance/exit to the Waiwhakaiho River were carried out in liaison with Company staff to ensure that the best practical option was obtained for fish passage.

1.4.4 Data audit

The Company provided the Council with data on generation, flow from the power station, residual flow below the weir and the water level of Lake Mangamahoe. This data was assessed by the Council to determine whether consented generation and lake level requirements were complied with.

1.4.5 Water temperature monitoring

Water temperature was monitored at two locations, to assess the impacts of the reduced flow through the residual flow reach, and the release of water through generation on water temperatures of the middle and lower reaches of the river. The details of these sites are provided in Table 2 and Figure 5. As a result of vandalism previously, the Rimu Street site was decommissioned and replaced with the Vickers Road Site, approximately 2.5km downstream. Water temperatures were being obtained through a Sidelooker Acoustic Doppler Current Profiler instrument, which unfortunately was high and dry for a period when flows were low. Since January 2024 a Pressure Transducer has been installed with water temperature on board which should remain submerged year round. Therefore, this has resulted in a reduction of temperature data at this site for the monitoring period under review.

Table 2 Water temperature monitoring sites in the Waiwhakaiho River

Site	Location	GPS Location	Site code
W1	State Highway 3 (approximately 2km upstream of weir)	E1698297 N5666893	WKH000500
W5	Hydro Road (within residual flow reach, approximately 5km downstream of weir)	E1697474 N5671435	WKH000650
W7	Rimu Street track extension (approximately 13km downstream of weir)	E1696149 N5675261	WKH000820
-	Vickers Road (approximately 15.5km downstream of weir)	E1696377 N5677621	-

1.4.6 Biological inspection and surveys

The programme includes an annual biological inspection. This includes an inspection of the river channel and various structures to assess continuing suitability for fish passage. Monitoring of the elver trap at the

station is difficult to access especially as the station is continuously operating. Part of the elver trap is located underneath the power station, and the tank is located in the locked building of the station. Due to these logistical issues the elver trap was not inspected this monitoring year. Furthermore, due to time constraints, Council staff availability and logistical issues, a biological inspection of the residual flow reach was not undertaken during this monitoring period either. However, inspection of the access culvert was completed and so too was the fish passage.

Macroinvertebrate monitoring was undertaken at four different sites during the 2023/24 monitoring period. There were two surveys during the monitoring year.

Fish monitoring has been undertaken previously, with the results presented in an earlier report (TRC Technical Report 2009-39). Fish monitoring continues to be provisionally included in the current programme however, it was decided previously to consider the occurrence of fish monitoring once the consent renewal process is complete.

2. Results

2.1 Water

2.1.1 Hydrological Inspections

The primary purpose of the hydrological inspections was to gauge the flow downstream of the intake weir, to determine whether the residual flow provided by the Company met the requirements of the consent. A full historical context of residual flow compliance can be found in previous monitoring reports.

The gaugings undertaken in the 2023/24 period are summarised in Table 3. This table shows that the residual flow was compliant on all occasions but one, during April 2024 when the flow was not assessed. During high flows on the Waiwhakaiho during April, the Council was advised by the Company that the outlet pipe on the headworks diversion weir was blocked by a 600mm diameter round piece of timber. It was agreed at the time by the Company and the Council that more time would be needed to rectify the issue onsite and that a residual flow gauging for April would not be relevant/worthwhile as the residual flow from the weir was not being accurately controlled due to the blockage. Since April, residual flow gauging recommenced at the request of the Company, despite the blocked outlet, with the purpose to check that there was enough residual flow passing through the reach.

Initially it had not been possible to remove the piece of timber, as it was firmly jammed in the outlet. The Company tried on several occasions to shift the timber, and eventually were successful in the removal of the blockage during August 2024. The Company regularly kept the Council updated on any progress with this matter.

Table 3 Results of gaugings undertaken in relation to the Mangorei HEPS 2023/24

Date	Time	Gauged flow downstream of weir (L/s)	Residual flow required at this time	Compliant?
18/07/2023	13:56:00	533	400	Yes
23/08/2023	12:58:00	647	400	Yes
19/09/2023	11:37:00	530	400	Yes
13/10/2023	11:36:00	508	400	Yes
13/11/2023	09:54:00	712	600	Yes
15/12/2023	13:10:00	619	600	Yes
18/01/2023	11:34:00	633	700	Yes[a]
08/02/2024	14:16:00	751	700	Yes
13/03/2024	09:22:00	803	700	Yes
18/04/2024	-	-	600	Not assessed[b]
31/05/2024	12:30:00	469	400	Yes
24/06/2024	11:40:00	736	400	Yes

Note: [a] With the uncertainty of +/- 0.067m^3/s the gauged flow is 0.700m^3/s (700L/s) which is compliant.
[b] Due to initial timber jam in pipe at headworks diversion weir – further information see above.

2.1.2 Fish passage inspection

During the regular hydrological inspections, some notes were also made regarding the condition of the fish pass. On all inspections the fish passage was clear, flowing and undamaged.

A full biological inspection was not completed during this monitoring period due to time constraints and Council staff changes and availability.

During other monitoring activities related to this consent (biomonitoring and hydrological inspections) and informal monitoring activities, there were no obvious changes to the key features observed previously.

With regard to condition 5 of Consent 2053-3.2, which requires the Company to maintain the river channel in the residual flow reach to enhance fish habitat and passage, there were no obvious maintenance works required.

2.1.3 Provision of consent holder data

Resource Consent 2053-3.2 requires the Company to maintain a device capable of measuring the residual flow downstream of the intake weir, and to provide these records to the Council upon request. This condition outlines that the device be installed and operated to the satisfaction of the Council. The data provided by the Company in fulfilment of this condition is shown in Figure 2. This data shows that water level was recorded throughout the monitoring period, except for a few occasions that the Company provided an explanation for.

The new staff gauge installed during June 2023 has been placed at a different level to the previous staff gauge. Consequently, there is a consistent difference of 100mm, this figure needs to be added to the recorded data in order to determine the correct data. Table 4 compares the results of spot readings made during site visits with the recorded data provided by the Company. This shows that the accuracy of the meter has varied marginally over the reported period, ranging from 3 to 13mm. All of these readings were within well within 10% of each other. This data was largely used by the Company to guide management of the residual flow. This has been successful, as demonstrated by the results of the gaugings undertaken (Table 3). The data was also compared against indicative water levels, above which adequate residual flow is provided for the majority of the monitoring period (Figure 3).

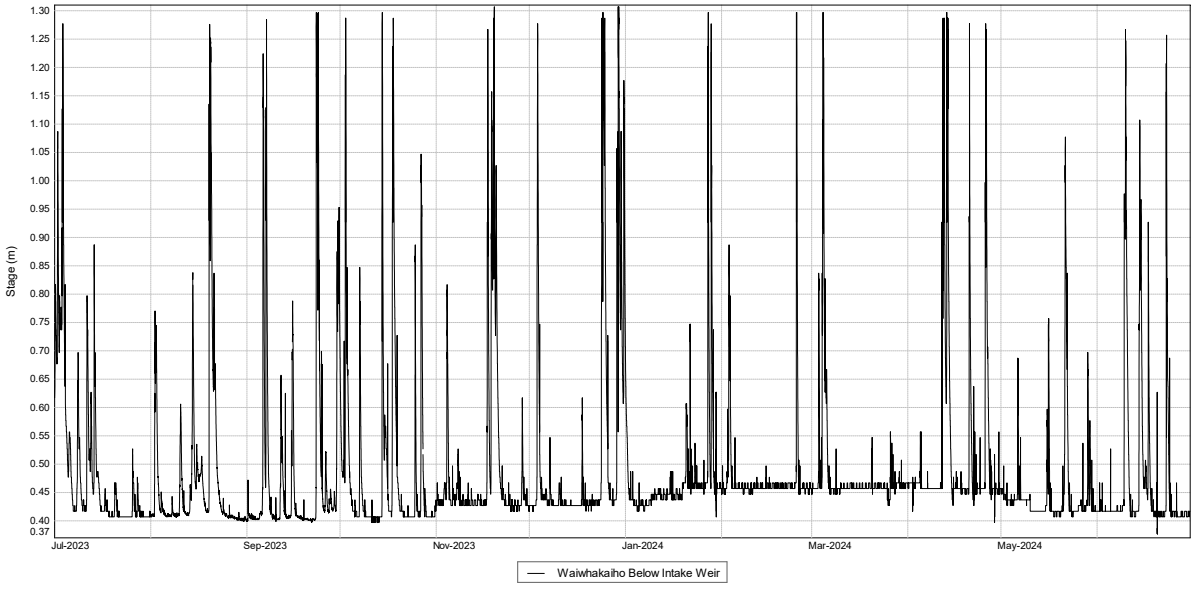


Figure 2 Water level data recorded by the Company, downstream of the intake weir

Although the relevant consent condition requires the provision of residual flow data, the Company only provides water level data. This is done with the agreement of the Council, as the maintenance of a rating curve in the Waiwhakaiho River at this location is problematic because the riverbed cross section can change with every flood. This makes maintaining a rating curve at this location impractical. The Council undertakes monthly gaugings at this location to not only assess compliance with the residual flow requirements, but also to provide flow versus water level data to the Company, which they use to manage their residual flow.

Table 4 The results of spot calibration checks made of the Company's flow recorder located downstream of the intake weir

Date	Time	Manual reading from hydrological inspection (mm)	Recorded reading (mm)	Adjusted recorded reading (mm)	Difference (mm)	Difference as % of manual reading
18/07/2023	13:56	520	407	507	13	2.5
23/08/2023	12:58	530	425	525	5	0.9
19/09/2023	11:37	506	403	503	3	0.6
13/10/2023	11:36	510	407	507	3	0.6
13/11/2023	09:54	550	437	537	13	2.4
15/12/2023	13:10	530	427	527	3	0.6
18/01/2023	11:34	550	447	547	3	0.5
08/02/2024	14:16	565	467	567	2	0.4
13/03/2024	09:22	560	467	567	7	1.25
18/04/2024	-	No reading[a]	-	-	-	-
31/05/2024	12:30	510	417	517	7	1.4
24/06/2024	11:40	510	417	517	7	1.4

Note: [a] Due to initial timber jam in pipe at headworks diversion weir – further information see Section 2.1.1

As can been seen in Figure 3 there are no significant periods where water levels are below both indicative lines (margin of error at 10%). There were three short term dips below both indicative water levels, seen on 30 January 2024 at 06:30, 28 April 2024 at 23:15 and on 20 June 2024 from 09:45 to 11:00. It is not expected that these very brief dips would result in any adverse effects. Therefore, this has not been seen as a compliance issue. Overall, the Company is continuing to show a good level of compliance with residual flow conditions.

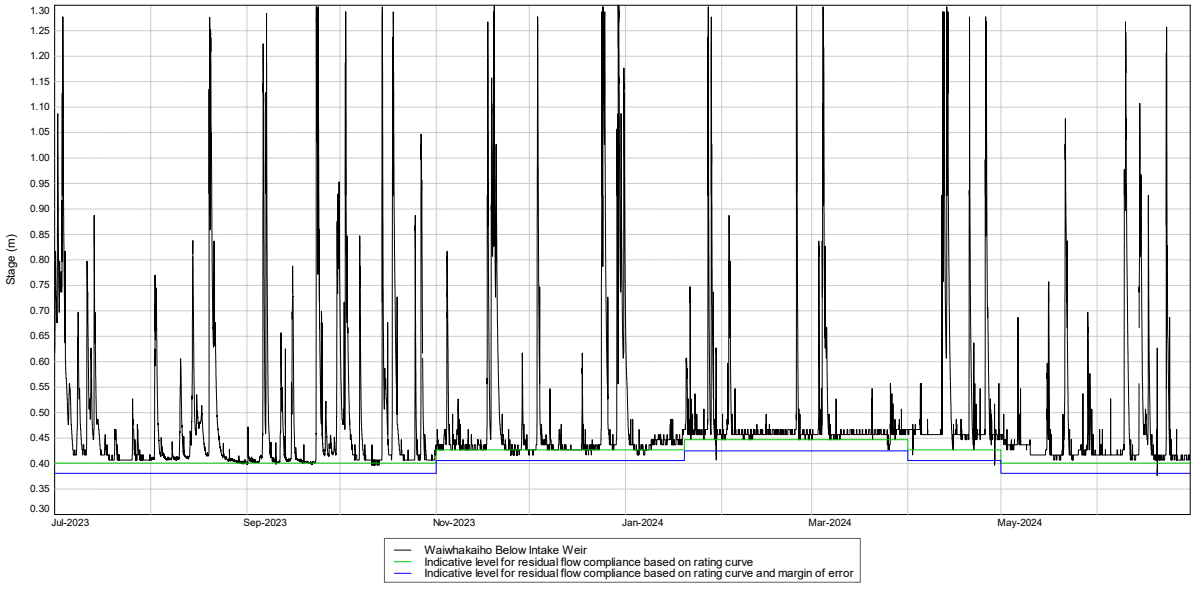


Figure 3 Water level downstream of the intake weir, compared with indicative water level required to ensure residual flow compliance and the indicative water level to ensure flow compliance with a margin of error allowance

The Company has also provided lake level data to the Council. This data is presented in Figure 4, and shows that management with the minimum lake level was good, with no breaches recorded. The one instance where the lake level exceeded the spillway level was associated with floods in the contributing catchments.

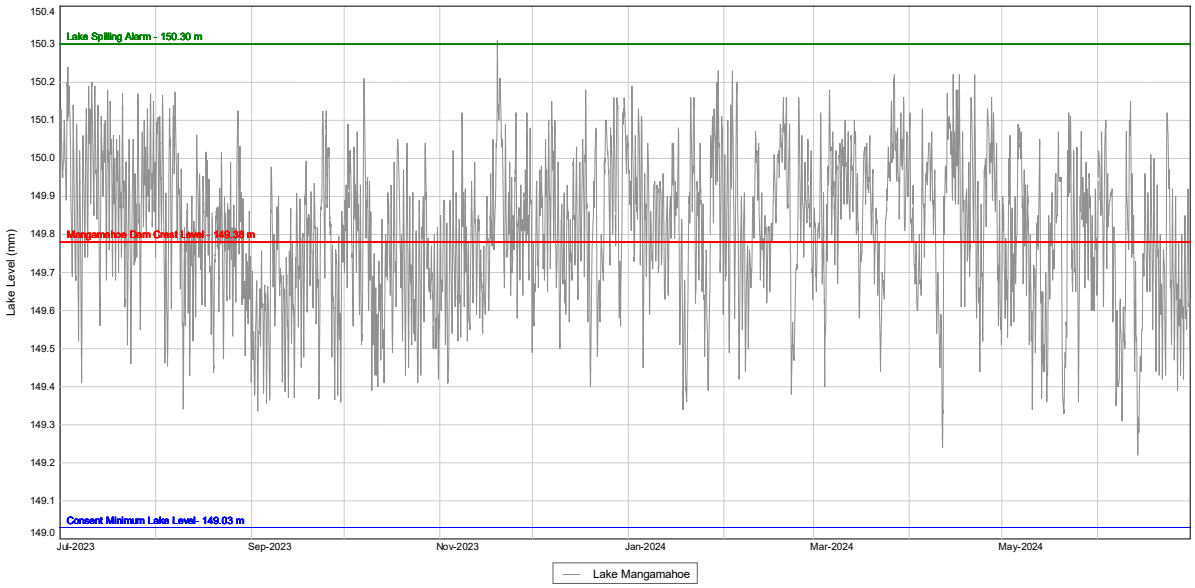


Figure 4 Lake Mangamahoe water level as recorded by the Company (2023/24)

The Company also provides the Council with generation data, and this allows an assessment of compliance with condition 1 of consent 2053-3.2, which requires that a continuous generation flow release of at least 950L/s be maintained between 8am and 6pm each day. This requirement is intended to mitigate for the low flows and high water temperatures that can occur in mid to late summer, while also providing recreational opportunities, and maintaining water and habitat quality in general.

A generation rate of 0.575MW approximately equates to a flow of 950L/s, and this generation rate was exceeded over 99% of the time between 8am and 6pm during the 2023/24 period. For those times between 8am and 6pm when the generation flow does not exceed 950L/s, the Company has historically notified the Council beforehand (for planned generation changes only) or afterwards (in relation to an unforeseeable event etc.) that a compensation flow would be provided. Compensation flows are provided by reducing the abstraction of water from the Waiwhakaiho River at the intake weir or by using the bypass valve at the station; when the bypass valve is in operation the intake weir is closed. During this monitoring period the Council was notified on several occasions when generation flows were not provided, which were predominantly related to network issues, either planned or unplanned.

Condition 3 of Consent 2053-3.2 requires the diversion of water to cease when flows exceed 85 cumecs. This consent does not include a requirement to record the rate that water is diverted from the river, and as such it is not possible to monitor this condition through the assessment of data. Therefore, the Council will continue to liaise with the Company to ensure that this consent condition is adhered to.

2.1.4 Results of receiving environment monitoring

2.1.4.1 River water temperatures

Continuous river water temperature measurements have been performed throughout the term of the consents at three sites on the Waiwhakaiho River. Temperatures are monitored at one site upstream (W1) of the abstraction point, one site within the residual flow reach of the river between the abstraction point and the power station outlet (W5), and one site below the power station outlet (W7). These locations are illustrated in Figure 5.

As a result of vandalism during the previous monitoring period, Rimu Street (W7) was decommissioned on 23 March 2022. Vickers Road Site, approximately 2.5km downstream of the Rimu Street site, has been active

since 19 December 2019. However, during a flood event the Vickers Road Site lost its sensor subsequently resulting in no temperature data for the 2022/23 monitoring year from this site. Water temperature monitoring at a site below the Meetings of the Water was also previously in place however, as a result of a major weather event, this site was washed away, and no data has been obtained since.

The Vickers Road Site was re-instated during August 2023. Water temperatures were being obtained through a Sidelooker Acoustic Doppler Current Profiler instrument, which unfortunately was high and dry for a period when flows were low. Since January 2024 a Pressure Transducer has been installed with water temperature on board which should remain submerged year-round. Therefore, this has resulted in a reduction of temperature data at this site for the monitoring period under review.

No logger was installed at the Meeting of the Waters over the summer of 2023/24 due to staff logistics together with lack of available capital costs. As an interim solution it was planned that a temporary water temperature logger will be installed during the latter part of 2024. This has now been recently installed.

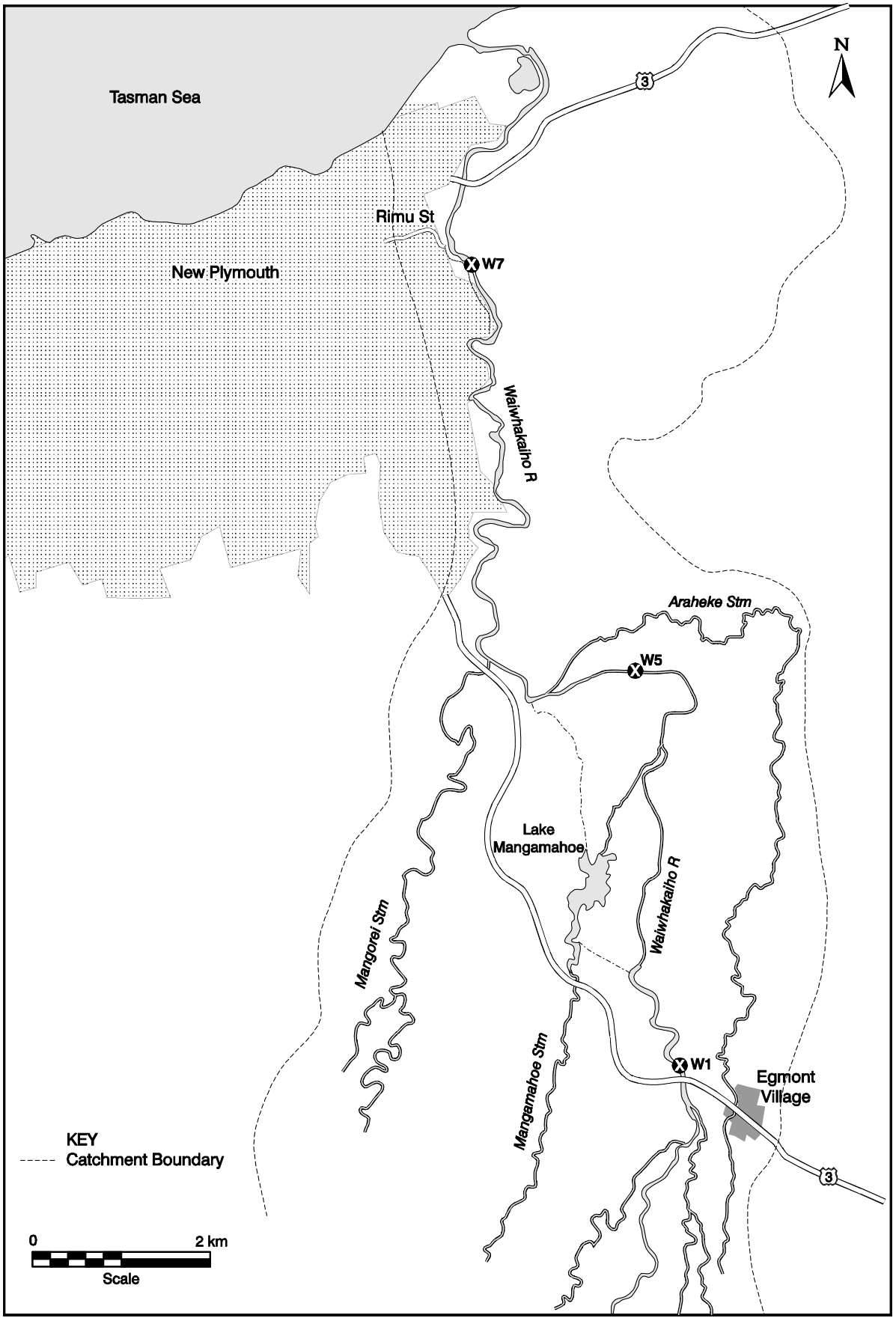


Figure 5 Water temperature monitoring sites (W1, W5, and W7) in the lower Waiwhakaiho River Catchment.
Note: (W1 – Egmont Village, W5 - Hydro Road and W7 – Rimu Street)

The Waiwhakaiho River exhibited average daily water temperatures throughout 2023/24 typical of the long-term daily average (Figure 6). There were a few select warmer than average periods during September, and January; and a few select cooler than average periods during February and May. Figure 6 shows the average daily water temperatures for the current monitoring period as red; the historic average daily water temperatures (1992-2024) in green; and the blue shows the maximum and minimum historic temperature range for 1992-2024.

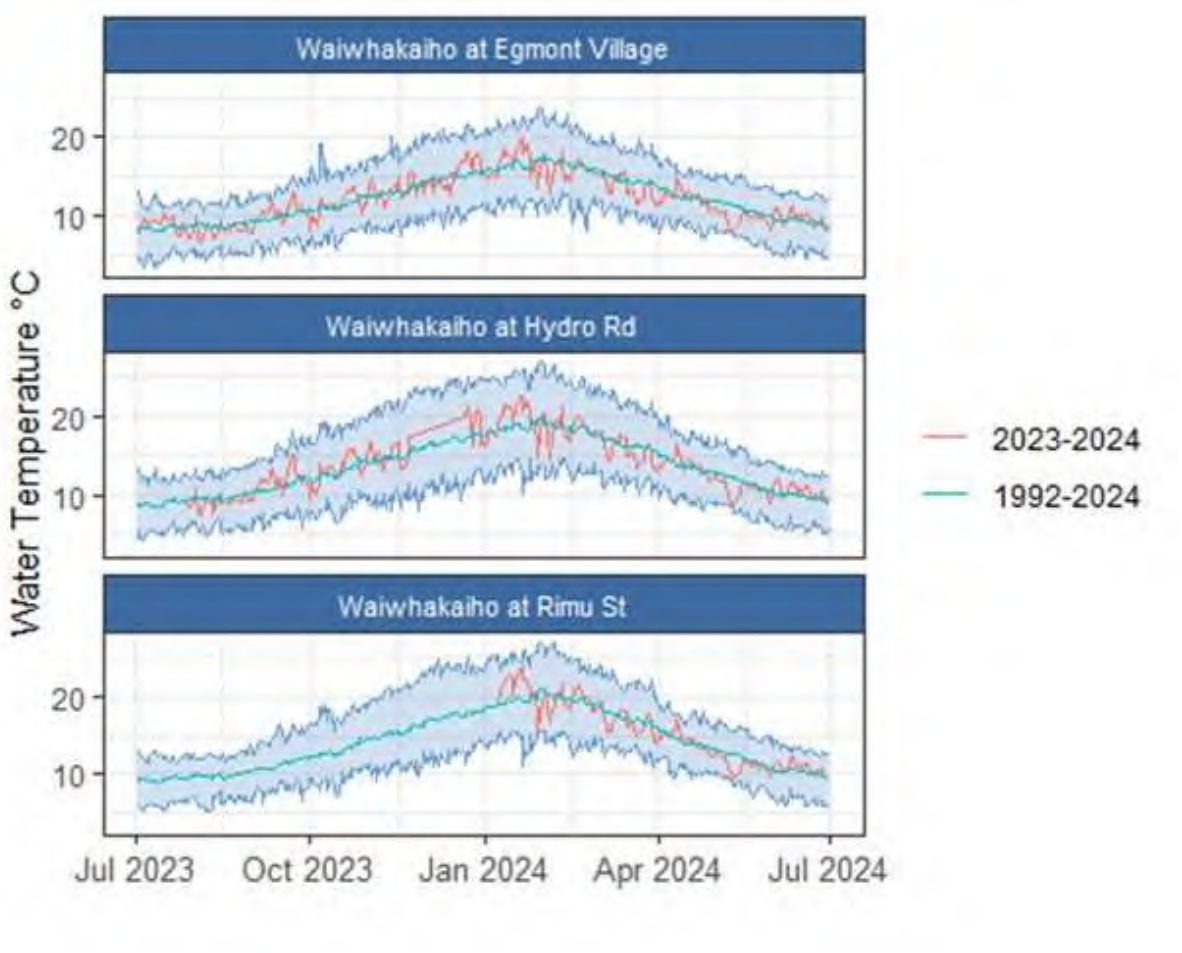


Figure 6 Average daily water temperature at the Waiwhakaiho River sites for the monitoring period. Shaded range is the historical data for comparison.
(Note that the 2023/24 data within Rimu Street is from Vickers Road)

When considering the impact of abstraction on aquatic life, it is biologically relevant to consider the difference in temperature between sites above the abstraction point and sites below the abstraction point. To determine potential impact on aquatic life, both the maximum temperature reached as well as the proportion of time water temperature exceeds the thermal preference and tolerance of aquatic life is considered. Table 5 shows the proportion of days when maximum temperature fell within the denoted temperature range. These proportions are compared with historical data and the previous monitoring years' data. The river upstream of the intake at Egmont Village has never exceeded 25˚C; however, downstream at Hydro Road, 25˚C is occasionally exceeded, with 1.2% of the total temperature record being above 25˚C. At Rimu Street, 25˚C is also exceeded occasionally, with 0.8% of the total record being above 25˚C, despite being much further downstream than Hydro Road.

During the 2023/24 monitoring period, water temperature did not exceed 25˚C at either of the two sites with relevant data (Egmont Village and Hydro Road), nor at Vickers Road from January through to June 2024. The temperature trends were in line with the historic data, and all data following a similar pattern.

Maximum daily temperatures in the range of 20-25°C at Hydro Road consisted of a higher proportion of days (56%) in comparison to Egmont Village (7.5%), and lower in the mid-range 15-20°C, (44% compared to 74% respectively) (Table 5). This follows the same pattern to previous years and continues to indicate that there are differences in characteristics of the residual flow compared to upstream of the intake.

Table 5 Summary of maximum daily water temperatures in the Waiwhakaiho River between 1 December and 31 March inclusive

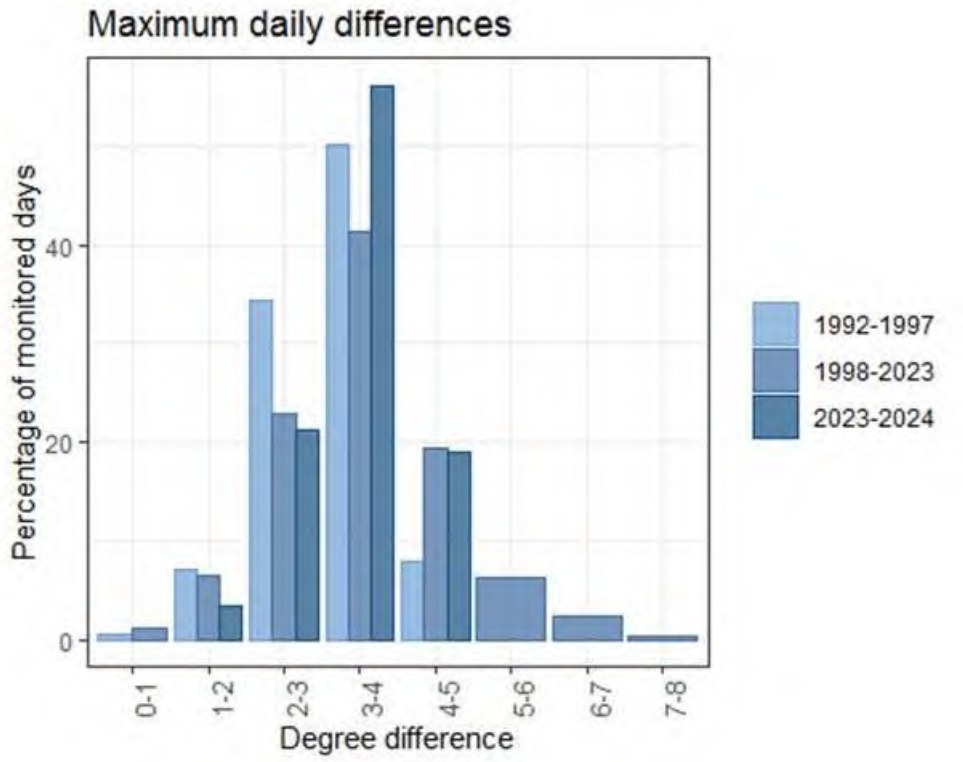
Monitoring site	Years	No. of days monitored	% of daily maxima in band (no. of days)			
			10-15˚C	15-20˚C	20-25˚C	>=25˚C
Egmont Village	1992-2024	3,172	12.2 (388)	78.7 (2,496)	9.1 (288)	0.0
	2023/24	120	18.3 (22)	74.2 (89)	7.5 (9)	0.0
	2022/23	119	8.4 (10)	89.1 (106)	2.5 (3)	0.0
Hydro Road	1992-2024	3,005	1.5 (44)	47.1 (1,416)	50.2 (1,508)	1.2 (37)
	2023/24	100	0.0	44 (46)	56 (56)	0.0
	2022/23	119	1.7 (2)	48.7 (58)	49.6 (59)	0.0
Rimu Street/ Vickers Road	1992-2024	3,184	0.9 (28)	50.9 (1,619)	47.4 (1,510)	0.9 (27)
	2023/24	66	0.0	48.5 (32)	47.0 (31)	4.6 (3)
	2022/23	No data				

*Historical values may differ slightly from those published previously due to new calculation methods and rounding levels

In terms of temperature differences between Egmont Village and Hydro Road (Figure 7), there has been a slight decrease in the frequency of maximum daily differences between 2˚C and 4˚C and an increase between 4°C and 5°C in a downstream direction since the higher residual flow has been implemented.

During the 2023/24 period, the majority of recorded differences were in the range of 3-4˚C, then 2-3˚C followed closely by 4-5°C range. Although following a similar historical pattern during 2023/24, there was a slight shift with a higher percentage in the 3-4°C range and a lower percentage in the 1-2°C range. The pattern remained similar for the other temperature ranges. This demonstrates that temperature differences vary from year to year, depending on meteorological conditions and river flow levels throughout the catchment.

It has been determined previously that during a low flow there is a clear diurnal variation, but when flows increase, the water temperature does not change significantly as it flows downstream. This is likely to be because of the volume of water, but also the speed of flow, meaning that the water has less time to warm as it flows downstream.



Note: 600L/s residual flow at Hydro Road: 1992-97 and 700L/s residual flow at Hydro Road: 1998-2022

Figure 7 The distribution of maximum daily temperature differences (Hydro Road minus Egmont Village), displayed as a percentage of total days monitored

Table 6 shows the difference in hourly mean temperature (˚C) throughout the month of January 2024 at Hydro Road, illustrating the heating and cooling variation throughout a range of climatic conditions over one day and a month. Note that the colour scheme is based on an unspecified gradient and is used as a visualisation tool only.

Table 7 shows the differences in hourly mean temperature (˚C) for the month of January 2024 between Egmont Village site and Hydro Road site, with positive values representing a hotter water temperature at Hydro Road. The mean daily temperature is higher at Hydro Road throughout the month, ranging from 1.3°C-3.7°C. The maximum hourly difference was 4.5°C, and the minimum was 0.4°C. This is similar to January 2023. There is a clear correlation between the actual temperatures of the river and the temperature differences between sites, this can be seen by comparing the two tables together. There are diurnal patterns which generally show an increase in temperatures and temperature differences between 16:00 and 19:00 hours, correlating to air temperature and previous data. The data also shows that whilst a daily average temperature is a useful tool for comparison and assessing effects, it can hinder the detection of potential effects on a waterway in the absence of finer scale temperature data, particularly for residual flow reaches.

In summary, the water temperature results for the 2023/24 monitoring period indicated the effect of a slightly warmer than average summer, with lower river flows (marginally lower than average rainfall), together with a typical change in water temperature in a downstream direction attributable to the HEPS.

Table 6 Hourly mean water temperature (˚C) data for January 2024 at Hydro Road

Red represents higher water temperature and blue represents lower temperature with white being mid-range temperature relative to data set.

Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean	Min	Max	Range
Day																												
1	16.1	15.9	15.7	15.5	15.3	15.1	15.0	15.0	15.1	15.5	16.2	16.9	17.6	18.3	18.9	19.3	19.5	19.4	19.1	18.6	18.0	17.5	17.2	16.9	17.0	15.0	19.5	4.5
2	16.7	16.5	16.3	16.1	15.9	15.7	15.7	15.8	16.0	16.1	16.3	16.6	17.1	17.7	18.3	18.9	19.2	19.4	19.3	19.0	18.6	18.2	17.9	17.6	17.3	15.7	19.4	3.8
3	17.3	17.1	16.9	16.8	16.7	16.5	16.5	16.5	16.6	17.0	17.6	18.4	19.2	19.6	20.1	20.6	20.9	21.0	20.9	20.5	20.0	19.6	19.1	18.6	18.5	16.5	21.0	4.6
4	18.1	17.7	17.5	17.2	17.0	16.8	16.6	16.6	16.7	16.8	17.1	17.3	17.6	18.2	18.8	19.4	19.5	19.3	19.1	18.7	18.4	18.1	17.8	17.5	17.8	16.6	19.5	2.9
5	17.4	17.2	16.9	16.8	16.6	16.5	16.4	16.5	16.7	17.0	17.4	17.6	17.9	18.2	18.3	18.4	18.4	18.4	18.3	18.1	17.9	17.7	17.5	17.3	17.5	16.4	18.4	2.0
6	17.1	17.0	16.8	16.6	16.5	16.3	16.2	16.3	16.7	17.2	17.4	17.3	17.8	18.5	18.9	19.8	20.1	20.1	20.1	19.8	19.3	18.9	18.4	17.9	18.0	16.2	20.1	3.9
7	17.5	17.2	16.9	16.6	16.3	16.1	16.0	16.1	16.4	17.0	17.7	18.4	19.0	19.8	20.6	21.5	21.8	22.0	21.9	21.5	20.9	20.3	19.6	19.1	18.8	16.0	22.0	6.0
8	18.6	18.3	18.0	17.7	17.5	17.3	17.2	17.3	17.5	17.9	18.4	19.1	19.7	20.3	20.8	21.3	21.6	21.8	21.7	21.4	21.0	20.6	20.3	19.9	19.4	17.2	21.8	4.6
9	19.5	19.1	18.8	18.5	18.3	18.2	18.1	18.1	18.3	18.6	19.0	19.6	20.0	20.4	21.1	21.7	21.8	22.0	22.1	21.9	21.6	21.3	20.9	20.5	20.0	18.1	22.1	4.0
10	20.1	19.8	19.5	19.3	19.1	18.8	18.6	18.6	19.0	19.4	19.9	20.4	21.0	21.7	22.4	23.2	23.4	23.6	23.6	23.3	22.9	22.5	22.1	21.7	21.0	18.6	23.6	5.0
11	21.3	21.0	20.8	20.6	20.4	20.2	20.1	20.1	20.2	20.4	20.6	20.9	21.3	21.9	22.5	23.0	23.2	23.3	23.2	22.9	22.5	22.0	21.6	21.1	21.5	20.1	23.3	3.3
12	20.7	20.4	20.0	19.7	19.5	19.2	19.1	19.0	19.3	19.7	20.1	20.6	21.2	21.7	22.2	23.0	23.2	23.4	23.4	23.1	22.8	22.5	22.2	21.8	21.2	19.0	23.4	4.4
13	21.4	21.0	20.7	20.4	20.0	19.8	19.5	19.5	19.6	20.0	20.4	20.7	21.1	21.7	22.5	23.0	23.1	23.2	23.0	22.8	22.3	21.9	21.6	21.3	21.3	19.5	23.2	3.7
14	21.0	20.7	20.4	20.2	20.0	19.8	19.6	19.5	19.7	20.0	20.5	21.0	21.2	21.4	21.7	21.9	22.1	22.2	22.1	21.9	21.7	21.4	21.2	20.9	20.9	19.5	22.2	2.7
15	20.7	20.5	20.3	20.1	19.9	19.8	19.7	19.6	19.5	19.6	19.8	20.1	20.4	20.5	20.4	20.5	20.6	20.5	20.5	20.3	20.1	19.8	19.6	19.3	20.1	19.3	20.7	1.4
16	19.0	18.8	18.5	18.2	18.0	17.7	17.5	17.4	17.7	18.1	18.7	19.4	19.8	20.4	21.0	21.9	22.1	22.4	22.5	22.4	22.2	21.9	21.6	21.3	19.9	17.4	22.5	5.1
17	21.0	20.8	20.5	20.3	20.1	19.9	19.8	19.7	19.9	20.1	20.4	20.6	21.0	21.4	21.9	22.3	22.5	22.6	22.7	22.6	22.4	22.1	21.9	21.6	21.2	19.7	22.7	3.0
18	21.4	21.2	21.0	20.8	20.7	20.5	20.5	20.4	20.4	20.6	21.0	21.7	22.1	22.6	22.9	23.8	24.1	24.3	24.1	23.9	23.7	23.4	23.1	22.7	22.1	20.4	24.3	3.9
19	22.4	22.2	22.0	21.8	21.6	21.4	21.3	21.2	21.4	21.6	22.1	22.5	22.8	23.1	23.5	23.9	24.0	23.8	23.7	23.6	23.3	23.0	22.8	22.6	22.6	21.2	24.0	2.8
20	22.4	22.2	22.1	21.9	21.8	21.7	21.6	21.5	21.5	21.5	21.5	21.6	21.8	21.8	21.9	22.1	22.1	21.9	21.6	21.3	21.1	20.8	20.6	20.5	21.6	20.5	22.4	1.9
21	20.3	20.2	20.1	20.0	19.9	19.9	19.8	19.9	19.9	20.1	20.6	21.0	21.3	21.8	22.3	22.6	22.9	23.1	23.0	22.7	22.4	21.7	20.9	20.6	21.1	19.8	23.1	3.3
22	20.4	20.3	20.2	20.1	20.1	20.0	20.0	20.0	20.2	20.6	21.1	21.5	21.8	22.3	23.0	23.3	23.5	23.7	23.5	23.2	22.9	22.5	22.2	21.9	21.6	20.0	23.7	3.7
23	21.6	21.3	21.1	21.0	20.8	20.7	20.6	20.5	20.5	20.6	20.8	21.0	21.3	21.8	22.2	22.5	22.6	22.5	22.4	22.1	21.6	21.2	20.8	20.5	21.3	20.5	22.6	2.2
24	20.1	19.8	19.4	19.1	18.8	18.6	18.3	18.3	18.4	18.6	18.7	19.1	19.5	19.9	20.3	20.4	20.4	20.4	20.3	20.1	19.6	19.3	18.9	18.5	19.4	18.3	20.4	2.2
25	18.1	17.8	17.4	17.1	16.8	16.6	16.4	16.3	16.5	16.9	17.5	18.1	18.8	20.1	21.2	22.0	22.4	22.3	22.0	21.3	20.5	19.9	19.2	18.7	18.9	16.3	22.4	6.1
26	18.3	17.9	17.5	17.3	17.0	16.8	16.6	16.6	17.0	17.6	18.1	18.5	19.2	20.3	21.3	21.9	22.2	22.3	22.0	21.4	20.8	20.3	19.8	19.3	19.2	16.6	22.3	5.7
27	18.9	18.6	18.4	18.2	18.1	17.9	17.8	17.8	17.7	17.7	17.8	17.8	18.0	18.2	17.2	16.5	16.7	16.8	16.7	16.6	16.4	16.2	16.1	15.9	17.4	15.9	18.9	3.0
28	15.7	15.4	15.1	14.9	14.7	14.5	14.4	14.5	14.5	14.6	14.7	14.9	15.1	15.1	15.1	15.5	14.9	15.0	15.2	15.3	15.2	15.0	14.8	14.5	14.9	14.4	15.7	1.3
29	14.4	14.2	14.1	14.0	14.0	14.0	13.9	14.0	14.3	14.9	15.5	16.4	17.6	18.5	19.4	20.2	20.7	20.7	20.3	19.7	19.1	18.6	18.1	17.5	16.8	13.9	20.7	6.8
30	17.2	16.9	16.7	16.5	16.4	16.2	16.0	15.8	16.2	16.9	17.7	18.4	19.2	20.4	21.6	22.4	23.0	23.1	22.8	22.2	21.6	21.0	20.3	19.8	19.1	15.8	23.1	7.3
31	19.3	18.9	18.6	18.2	17.9	17.7	17.5	17.5	17.8	18.4	19.1	19.7	20.4	21.5	22.5	23.4	23.8	23.6	23.3	22.9	22.1	21.5	21.0	20.5	20.3	17.5	23.8	6.3
Mean	19.2	18.9	18.7	18.4	18.2	18.1	17.9	17.9	18.1	18.4	18.8	19.3	19.7	20.3	20.8	21.3	21.5	21.6	21.4	21.1	20.7	20.4	20.0	19.6	19.59			
Min	14.4	14.2	14.1	14.0	14.0	14.0	13.9	14.0	14.3	14.6	14.7	14.9	15.1	15.1	15.1	15.5	14.9	15.0	15.2	15.3	15.2	15.0	14.8	14.5				
Max	22.4	22.2	22.1	21.9	21.8	21.7	21.6	21.5	21.5	21.6	22.1	22.5	22.8	23.1	23.5	23.9	24.1	24.3	24.1	23.9	23.7	23.4	23.1	22.7				
Range	8.1	8.0	8.0	7.9	7.8	7.7	7.7	7.5	7.2	7.0	7.4	7.6	7.7	8.0	8.4	8.5	9.3	9.3	8.9	8.6	8.5	8.4	8.3	8.2				

Table 7 Difference in mean hourly water temperature (˚C) data for January 2024 between Hydro Road and Egmont Village

Positive values represent hotter temperatures at Hydro Road (coloured red).

Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Mean	Min	Max	Range
Day																												
1	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.7	1.9	1.8	1.7	1.8	1.8	1.8	1.9	2.0	2.0	1.8	1.7	1.8	1.9	1.6	1.2	2.0	0.8
2	2.0	2.2	2.4	2.5	2.6	2.6	2.6	2.7	2.7	2.5	2.5	2.4	2.5	2.6	2.5	2.5	2.7	2.9	3.1	3.2	3.3	3.2	3.0	2.9	2.7	2.0	3.3	1.2
3	2.8	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.9	3.2	3.5	3.3	3.1	3.5	3.7	3.8	4.0	4.0	3.8	3.5	3.3	3.1	3.2	2.6	4.0	1.4
4	3.0	3.0	3.1	3.2	3.2	3.2	3.1	3.1	3.1	2.9	2.8	2.8	2.9	3.3	3.3	3.5	3.4	3.0	2.9	2.6	2.4	2.2	2.0	1.9	2.9	1.9	3.5	1.6
5	2.0	2.1	2.2	2.3	2.5	2.5	2.5	2.6	2.6	2.6	2.7	2.7	2.6	2.8	2.9	2.8	2.8	2.7	2.6	2.5	2.5	2.4	2.5	2.5	2.5	2.0	2.9	0.9
6	2.5	2.5	2.4	2.4	2.4	2.4	2.5	2.5	2.7	2.9	3.0	2.6	2.9	3.4	3.0	3.2	3.2	3.1	3.4	3.4	3.2	3.0	2.7	2.5	2.8	2.4	3.4	1.0
7	2.4	2.3	2.3	2.3	2.4	2.4	2.5	2.5	2.7	2.8	2.8	2.7	2.6	2.6	2.8	3.2	3.2	3.3	3.4	3.3	3.0	2.7	2.5	2.3	2.7	2.3	3.4	1.1
8	2.2	2.2	2.3	2.4	2.5	2.6	2.6	2.7	2.8	2.9	2.9	3.2	3.2	3.4	3.6	3.6	3.5	3.4	3.5	3.4	3.1	2.9	2.7	2.6	2.9	2.2	3.6	1.4
9	2.4	2.3	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.8	2.7	2.5	2.5	2.3	2.2	2.4	2.0	2.1	2.4	2.4	2.1	2.0	1.8	1.7	2.3	1.7	2.8	1.1
10	1.8	1.9	2.0	2.2	2.4	2.4	2.4	2.5	2.6	2.9	3.0	3.0	2.9	2.9	2.9	3.2	3.2	3.3	3.5	3.5	3.2	3.0	2.8	2.6	2.8	1.8	3.5	1.8
11	2.5	2.4	2.4	2.5	2.6	2.7	2.8	2.8	3.0	3.1	3.2	3.4	3.5	3.5	3.7	3.8	3.6	3.8	4.0	4.1	3.9	3.8	3.5	3.3	3.2	2.4	4.1	1.7
12	3.1	3.1	3.0	3.1	3.2	3.3	3.5	3.6	3.7	3.9	3.8	3.6	3.3	3.0	2.8	3.3	3.4	3.3	3.4	3.3	3.2	3.2	3.1	3.0	3.3	2.8	3.9	1.0
13	3.0	3.1	3.2	3.3	3.5	3.6	3.6	3.7	3.7	3.8	3.5	3.5	3.7	3.8	4.2	4.4	4.0	4.0	4.3	4.3	4.0	3.7	3.5	3.4	3.7	3.0	4.4	1.4
14	3.2	3.2	3.2	3.3	3.5	3.6	3.6	3.6	3.6	3.6	3.7	3.8	3.6	3.6	3.7	3.7	3.7	3.8	3.8	3.6	3.5	3.4	3.3	3.2	3.5	3.2	3.8	0.7
15	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.0	2.8	3.0	3.0	3.0	3.1	3.2	3.2	3.1	3.1	3.2	3.2	3.2	3.1	2.8	3.2	0.4
16	3.2	3.3	3.4	3.4	3.5	3.6	3.5	3.4	3.4	3.4	3.3	3.1	2.8	2.6	2.5	2.7	2.6	2.7	3.0	3.0	2.9	2.7	2.5	2.4	3.0	2.4	3.6	1.2
17	2.3	2.2	2.2	2.4	2.5	2.6	2.7	2.8	2.8	2.9	2.8	2.6	2.6	2.6	2.7	2.8	2.7	2.9	3.2	3.2	3.2	3.2	3.1	3.0	2.7	2.2	3.2	1.0
18	2.9	2.9	2.9	3.0	3.1	3.1	3.2	3.2	3.2	3.0	2.9	3.0	2.7	2.6	2.3	2.8	3.0	3.2	3.3	3.3	3.2	3.1	2.9	2.8	3.0	2.3	3.3	1.0
19	2.7	2.7	2.7	2.8	2.9	3.1	3.1	3.2	3.4	3.4	3.4	3.2	3.0	2.8	2.5	2.8	3.2	3.3	3.3	3.2	3.0	2.7	2.6	2.5	3.0	2.5	3.4	0.9
20	2.5	2.6	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.8	2.9	2.9	2.9	3.0	2.9	2.8	2.7	2.6	2.7	2.7	2.7	2.8	2.8	2.5	3.0	0.5
21	2.7	2.7	2.8	2.8	2.8	2.8	2.9	2.8	2.8	2.7	2.5	2.1	2.2	2.6	2.8	3.1	2.9	3.0	2.9	2.9	3.2	2.8	2.2	2.0	2.7	2.0	3.2	1.2
22	2.0	2.1	2.3	2.4	2.6	2.7	2.7	2.8	2.7	2.7	2.7	2.5	2.4	2.6	2.7	2.7	2.6	2.7	2.5	2.4	2.3	2.2	2.2	2.2	2.5	2.0	2.8	0.7
23	2.3	2.4	2.4	2.5	2.6	2.7	2.8	2.8	2.9	3.0	2.9	3.0	3.0	3.0	3.0	3.0	2.9	3.0	3.2	3.3	3.2	3.2	3.1	3.1	2.9	2.3	3.3	1.0
24	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.8	3.8	3.7	4.0	4.1	3.7	3.8	4.0	3.9	3.8	3.8	3.9	3.7	3.6	3.6	3.5	3.7	3.1	4.1	1.0
25	3.4	3.3	3.4	3.5	3.5	3.5	3.5	3.5	3.4	3.4	3.4	3.2	3.1	3.4	3.8	4.3	4.5	4.5	4.3	3.9	3.3	2.8	2.4	2.1	3.5	2.1	4.5	2.4
26	1.9	1.8	1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.9	3.0	3.1	3.2	3.6	3.9	4.0	4.0	4.0	3.9	3.5	3.1	2.8	2.4	2.1	2.9	1.8	4.0	2.2
27	2.0	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.4	1.5	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.2	1.7	0.8	2.4	1.6
28	1.4	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.6	1.7	1.8	1.8	1.7	1.7	0.5	0.4	0.6	0.8	1.1	1.2	1.1	1.0	1.3	0.4	1.8	1.4
29	1.0	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.3	1.3	1.5	1.9	2.1	2.3	2.6	2.8	2.8	2.9	2.7	2.4	2.2	2.0	1.8	1.7	0.9	2.9	2.0
30	1.7	1.7	1.7	1.8	1.8	1.8	1.6	1.4	1.5	1.9	2.0	2.0	2.0	2.4	2.9	3.1	3.4	3.4	3.3	3.0	2.6	2.3	2.0	1.8	2.2	1.4	3.4	2.0
31	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.9	2.2	2.4	2.5	2.5	2.5	2.9	3.3	3.6	3.6	3.4	3.2	3.0	2.5	2.2	2.0	1.9	2.4	1.7	3.6	1.9
Mean	2.4	2.4	2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.9	2.9	3.1	3.0	3.0	3.1	3.1	2.9	2.7	2.6	2.5	2.75			
Min	1.0	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.3	1.3	1.5	1.8	1.7	1.5	0.8	0.5	0.4	0.6	0.8	0.9	0.9	1.0	1.0				
Max	3.4	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.8	3.9	3.8	4.0	4.1	3.8	4.2	4.4	4.5	4.5	4.3	4.3	4.0	3.8	3.6	3.5				
Range	2.4	2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.7	2.6	2.5	2.5	2.3	2.1	2.7	3.6	4.0	4.1	3.8	3.5	3.1	2.8	2.5	2.4				

2.1.4.2 Macroinvertebrate monitoring

Two biomonitoring surveys were conducted during the period under review, on 18 December 2023 and 21 March 2024. The results and conclusions of these surveys are summarised in this report. Full copies of the biomonitoring reports are available from the Council upon request.

The Council's standard 'kick-sampling' technique was used at four established sites (Hydro Road, SH3, DD1, and RR1) to collect streambed macroinvertebrates from the Waiwhakaiho River on each sampling occasion (Figure 8 and Figure 9). Samples were processed to provide number of taxa (richness), MCI and SQMCI scores for each site.

The MCI is a measure of the overall sensitivity of the macroinvertebrate community to the effects of organic pollution in stony streams. It is based on the presence/absence of taxa with varying degrees of sensitivity to environmental conditions. The SQMCI takes into account taxa abundances as well as sensitivity to pollution. It may indicate subtle changes in communities, and therefore be the more relevant index if non-organic impacts are occurring. Significant differences in either the MCI or the SQMCI between sites indicate the degree of adverse effects (if any).

For the December survey, macroinvertebrate taxa richness was moderate and ranged from 20 to 29 taxa. A decrease of five taxa was recorded between the 'control' site (SH3) and site RR1 (below the abstraction point), which is potentially a reflection of habitat limitation caused by water abstraction. There continued to be a decrease in taxa richness further downstream; the 'control' site (SH3) recorded 29 taxa, while the impact sites recorded 24 taxa (site RR1), 23 taxa (Hydro Road) and 20 taxa (site DD1). Taxa richness was higher to that recorded by the previous survey at all sites. When compared to their historical site medians, all sites recorded more than their respective site median. Several taxa were dominant at all four sites, many of which were 'tolerant'. The number of EPT taxa and % EPT abundance also decreased in a downstream direction.

MCI scores were 103 units, 99 units, 89 units, and 84 units at sites SH3, RR1, Hydro Road, and DD1 respectively. These scores categorised site SH3 as having 'good' macroinvertebrate community health, while the three downstream sites had 'fair' health. There was no significant difference in MCI scores recorded at the 'control' site SH3 and that recorded at site RR1 below the abstraction point, although there was a slight decrease by four units. However, there was a significant difference in MCI scores between the 'control' SH3 site and the two further most downstream sites, Hydro Road and DD1. It is likely that the deterioration in scores is due to a decrease in taxa richness and the absence of numerous 'sensitive' taxa. All sites scored similarly to their respective site median, with no significant differences recorded.

SQMCI scores categorised site SH3 as having 'poor' macroinvertebrate community health, while the three downstream sites had 'very poor' health. Sites RR1 and DD1 recorded the lowest SQMCI scores at their respective sites to date, and the Hydro Road site recorded the same as the lowest score to date. There was a general decrease in SQMCI scores in a downstream direction, with the 'control' site SH3 recording significantly more than all three downstream sites. Examination of taxa results suggest this could be attributed to large changes in abundance categories, particularly in relation to Oligochaetes and the *Deleatidium* mayfly. All sites recorded less than their respective historic site medians, with sites SH3, RR1, and DD1 recording significantly less.

For the March survey, macroinvertebrate taxa richness was 20 taxa at SH3, 17 taxa at RR1, 13 taxa at Hydro Road, and 15 taxa at DD1. A decrease of three taxa was recorded between the 'control' site (SH3) and site RR1 (below the abstraction point), which is potentially a reflection of habitat limitation caused by water abstraction. All sites had lower taxa richness compared to the previous survey, and all but one site recorded less than their respective medians. Three 'tolerant' taxa were dominant at all four sites (*Hydropsyche (Aoteapsyche),* Orthocladiinae and Tanytarsini). The number of EPT taxa and % EPT abundance also decreased in a downstream direction.

MCI scores were 94 units, 101 units, 94 units, and 68 units at sites SH3, RR1, Hydro Road, and DD1 respectively. These scores categorised site RR1 as having 'good' macroinvertebrate community health, sites SH3 and Hydro Rd as having 'fair' health, and site DD1 as having 'poor' health. Site DD1, located downstream of the discharge point, recorded an MCI score significantly less than the three upstream sites. This lower score at DD1 is reflected in the community composition, where 12 of the 15 taxa were 'tolerant' and no 'highly sensitive' taxa were present.

SQMCI scores categorised sites SH3, Hydro Road, and DD1 as having 'poor' macroinvertebrate community health, while site RR1 was categorised as having 'fair' health. There was a significant increase in SQMCI health from the 'control' site SH3 to site RR1, which is located just below the abstraction intake. However, SQMCI scores then decreased downstream, with sites Hydro Road and DD1 showing scores significantly less than site RR1.

Examination of taxa results suggest this could be attributed to large changes in abundance categories, particularly in relation to Orthocladiinae and Tanytarsini midge larvae. All sites recorded more than their respective historic site medians, with the exception of the 'control' site SH3 which recorded significantly less.

Overall, there was a general decrease in macroinvertebrate community health in a downstream direction. There was a slight improvement during the March survey compared to the December survey. These reductions could potentially indicate a negative impact on the macroinvertebrate communities of the Waiwhakaiho River due to the Mangorei HEPS abstraction. However, due to the distance between sampling sites and other inflows and discharges that enter the Waiwhakaiho River within the residual reach, it is difficult to determine the extent to which the Mangorei HEPS activities have affected macroinvertebrate communities. It is likely that any stressors affecting the macroinvertebrate communities on the Waiwhakaiho River are exacerbated by abstraction activities.

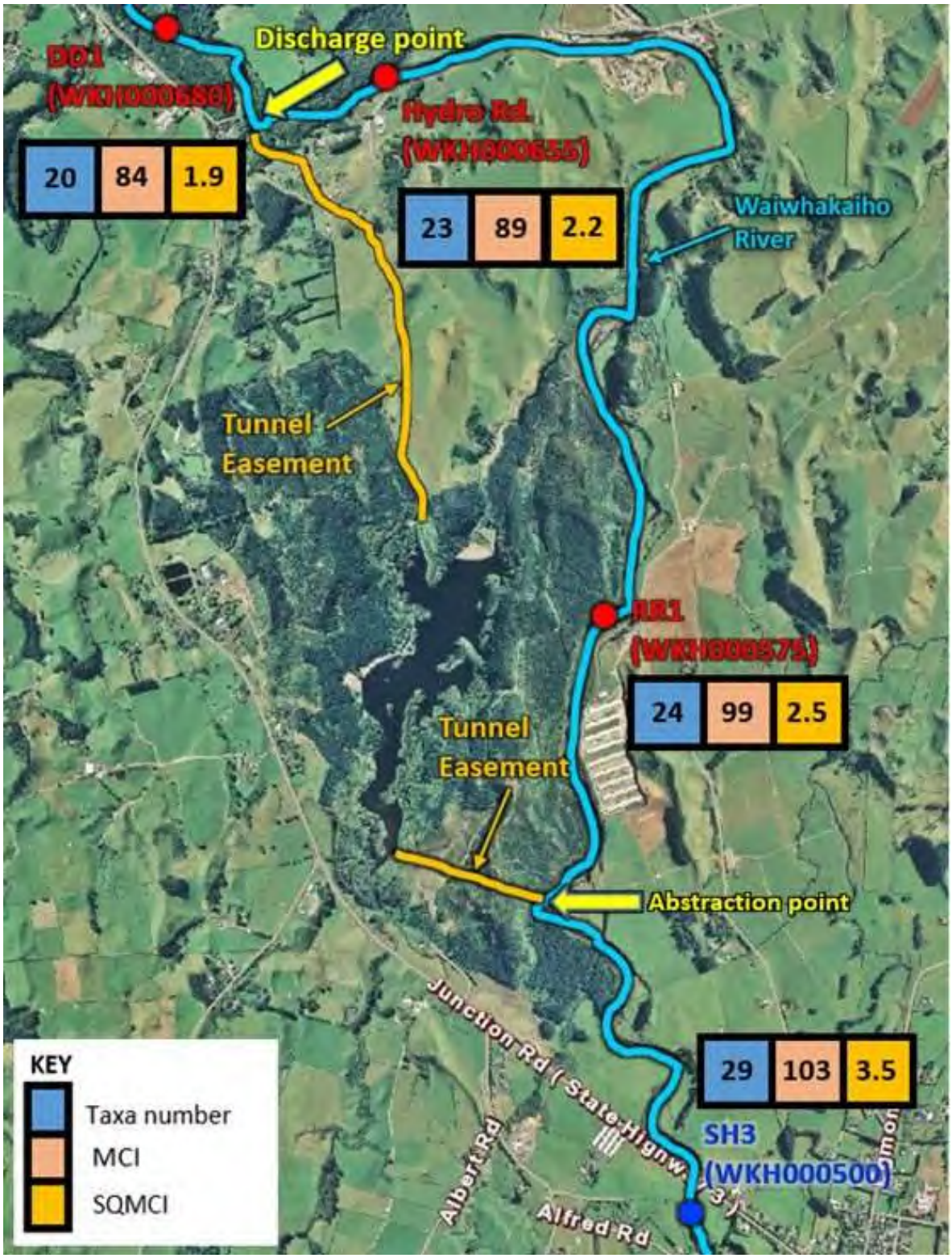


Figure 8 Biological monitoring sites in the Waiwhakaiho River in relation to the Mangorei Power Scheme with survey results, 18 December 2023

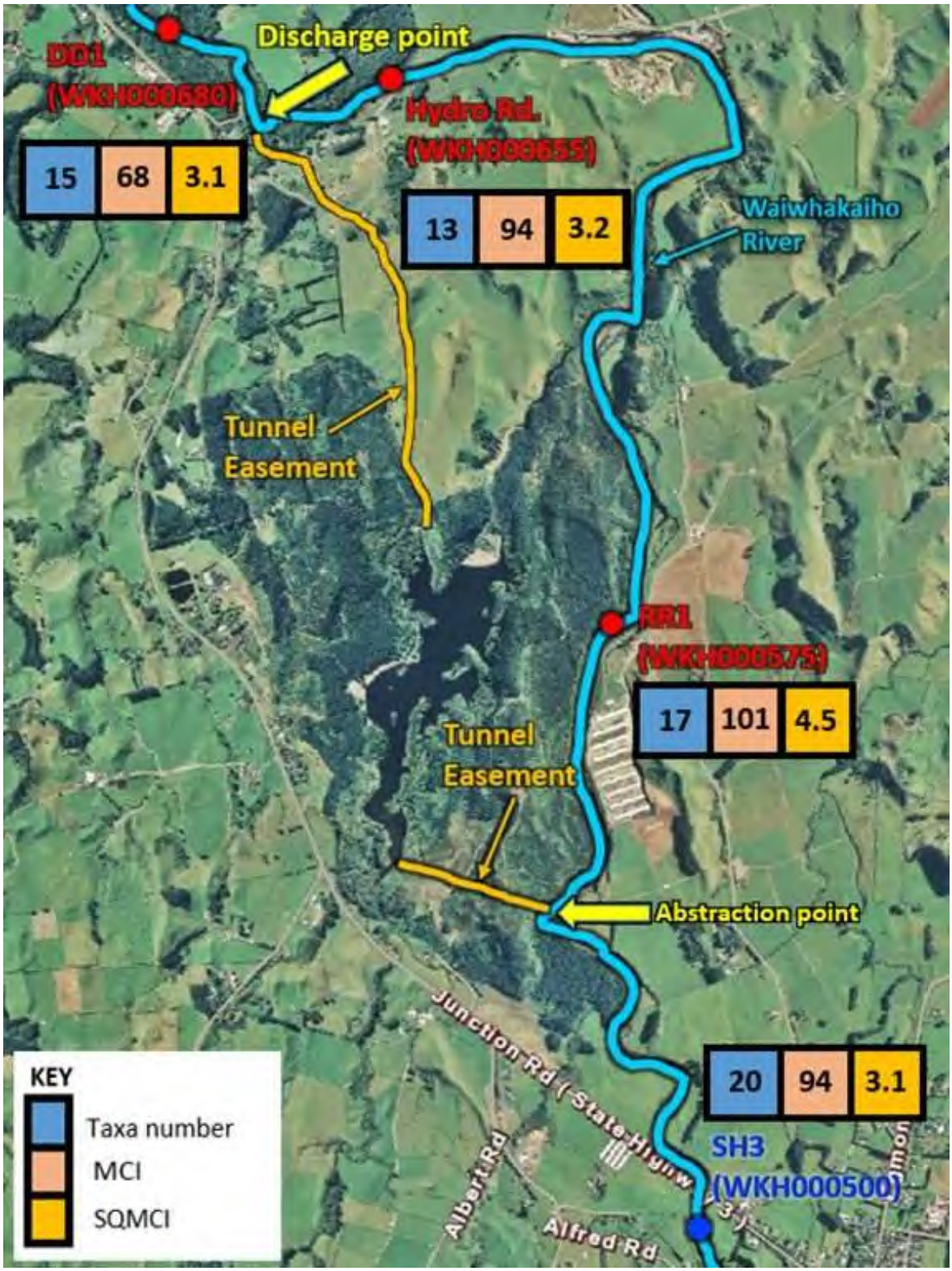


Figure 9 Biological monitoring sites in the Waiwhakaiho River in relation to the Mangorei Power Scheme with survey results, 21 March 2024

2.1.4.3 Fish monitoring

As the Company had undertaken its own fish monitoring as part of their re-consenting process in previous monitoring periods, it was decided that the Council would not undertake any additional monitoring during this period. Consideration of fish monitoring will be given once the consenting renewal process is complete.

2.1.4.4 Adult eel and elver transfers

Every year, the Company transfers adult eels that are attempting to migrate downstream through Lake Mangamahoe, so that they can continue their migration downstream of the HEPS. These eels tend to accumulate where water is taken from the lake for generation purposes and can be captured using nets set in this location. This system has been employed each autumn since 2009, with the number of eels transferred varying significantly each year. The numbers transferred during 2023/24 are presented in Table 8. A total of 47 adult eels were transferred in the reported period. This included 21 longfin eels and 26 shortfin eels. There were also four eel mortalities recorded due to turbine strike.

Overall, the number of eels transferred in the 2023/24 period was higher than average for this transfer programme, and higher than both 2022 and 2023. However, the numbers continue to fluctuate widely over the years. It is understood that commercial eeling does occur within the lake, which likely influences the number of migrating adult eels caught within the lake from year to year.

Table 8 Numbers of adult eels transferred at the Mangorei HEPS

Year	Number of longfin eels transferred	Number of shortfin eels transferred	Total number of eels transferred
2024	26	21	47
2023	6	16	22
2022	11	4	15
2009-2023 Mean	-	-	35
2014-2023 Mean	14	13	32

In early summer, juvenile eels, known as elvers, migrate up the Waiwhakaiho River. Some of these elvers are attracted by the generation flow from the station and move up the powerhouse outlet canal and into the power station. In 2002, a trap was installed within the power station. Elvers are collected from this trap, weighed and then transferred to the Waiwhakaiho River residual flow reach upstream of the Meeting of the Waters. The elver trap was not visited during this period largely due to logistical restrictions and the location of the trap.

This trapping and transfer programme commenced in the 2002/03 monitoring period with the numbers of elver trapped and transferred summarised in Table 9. The data is collected and supplied by the Company. Numbers of elvers were calculated from a calibration exercise performed at the trap (January 2003) when it was determined that 1kg equated to 1,200 elvers.

Table 9 Estimated numbers of elvers trapped and transferred at the Mangorei HEPS 2002-2024

Monitoring year	Transfer period	Total number of elvers (calculated using 1200 per kg)	Peak daily number	Peak month
2002/03	9 Jan 03-25 Apr 03	18,160	1,020	Jan 2003
2003/04	4 Dec 03-25 Mar 04	19,445	1,715	Jan 2004
2004/05	14 Jan 04-21 Mar 05	9,780	600	Jan 2005
2005/06	30 Nov 05-20 Mar 06	19,965	1,140	Feb 2006
2006/07	3 Jan 07-26 Apr 07	25,230	1,910	Jan 2007
2007/09	30 Nov 07-26 Mar 08	29,668	940	Jan 2008
2008/09	2 Dec 08-16 Mar 09	38,040	1,140	Jan 2009
2009/10	18 Dec 09-25 Feb 10	8,566	237	Jan 2010
2010/11	8 Nov 10-28 Feb 11	18,776	525	Dec 2010
2011/12	21 Jan 12-31 Mar 12	640	96	Feb 2012
2012/13	14 Dec 12-12 Apr 13	15,972	270	Jan 2013

Monitoring year	Transfer period	Total number of elvers (calculated using 1200 per kg)	Peak daily number	Peak month
2013/14	20 Dec 13-28 Mar 14	19,680	566	Jan 2014
2014/15	1 Nov 14-30 Apr 15	13,200	471	Jan 2015
2015/16	11 Dec 15-24 Mar 16	24,588	906	Jan 2016
2016/17	16 Dec 16-7 Apr 17	18,696	411	Feb 2017
2017/18	8 Dec 17-5 Apr 18	15,828	1,200	Dec 2017
2018/19	7 Dec 18-15 Mar 19	37,176	2,256	Jan 2019
2019/20	6 Dec 19-30 Apr 20	35,532	777	Jan 2020
2020/21	20 Nov 20-12 Apr 21	34,284	1244	Jan 2021
2021/22	25 Nov 21-25 Mar 22	45,660	1310	Jan 2022
2022/23	16 Dec 22-06 Apr 23	34,380	879	Jan 2023
2023/24	19 Dec 23-5 Apr 24	28,200	715	Jan 2024
Mean 2002-2023		**23,013**		

The traps are typically operative at the start of December each year, with elvers usually arriving mid-December. In the monitoring period the first elvers were transferred on 19 December 2023. The last few elvers passed through the trap during early April 2024. The majority of numbers were recorded during January 2024, with approximately 12kg being transferred. This is consistent with the migrating season, as January is often the month with the highest numbers transferred. Table 10 details the weekly figures of elver transfers for the season.

Table 10 Numbers of elvers transferred during the 2023/24 period

Date	Elver			Cumulative total of estimated elvers
	Interval (days)	Elver weight (kg)	Estimated number of elvers transferred (1kg = 1,200 elvers)	
19/12/2023		1.12	1,344	1,344
22/12/2023	3	1.63	1,956	3,300
28/12/2023	6	1.3	1,560	4,860
4/01/2024	7	1.27	1,524	6,384
12/01/2024	8	3.10	3,720	10,104
19/01/2024	7	3.02	3,624	13,728
26/01/2024	7	4.17	5,004	18,732
2/02/2024	7	1.67	2,004	20,736
9/02/2024	7	1.54	1,848	22,584
16/02/2024	7	1.22	1,464	24,048
23/02/2024	7	1.12	1,344	25,392
1/03/2024	7	0.45	540	25,932
8/03/2024	7	0.69	828	26,760
15/03/2024	7	0.57	684	27,444
22/03/2024	7	0.42	504	27,948
28/03/2024	6	0.19	228	28,176
5/04/2024	8	0.02	24	28,200
Total	**108 days**	**23.50kg**	**28,200**	

2.2 Incidents, investigations, and interventions

The monitoring programme for the year was based on what was considered to be an appropriate level of monitoring, review of data, and liaison with the Company. During the year matters may arise which require additional activity by the Council, for example provision of advice and information, or investigation of potential or actual causes of non-compliance or failure to maintain good practices. A pro-active approach, that in the first instance avoids issues occurring, is favoured.

For all significant compliance issues, as well as complaints from the public, the Council maintains a database record. The record includes events where the individual/organisation concerned has itself notified the Council. Details of any investigation and corrective action taken are recorded for non-compliant events.

Complaints may be alleged to be associated with a particular site. If there is potentially an issue of legal liability, the Council must be able to prove by investigation that the identified individual/organisation is indeed the source of the incident (or that the allegation cannot be proven).

In the 2023/24 period, the Council was not required to undertake significant additional investigations and interventions, or record incidents, in association with the Company's conditions in resource consents or provisions in Regional Plans.

2.3 Riparian planting

As per special condition 8 of Consent 2053-3.2, the Company makes a financial contribution to the Council each year ($5,000-adjusted to the consumer price index; this year $4496.75) for the purpose of providing riparian planting and management in the Waiwhakaiho River Catchment.

For the year 2023/24 seven landholders in the Waiwhakaiho Catchment had applied to receive the 50% plant cost subsidy, and one for some fencing, with approximately $18,500 funds available at the start of the period. It is expected that there will be approximately $15,000 available for the 2024/25 period following the Company's next contribution.

2.4 Stakeholders' meeting

As a requirement under a special condition in various Mangorei HEPS consents, an annual meeting of interested stakeholders is held to discuss any matters relating to the exercise of these consents, but particularly monitoring programme design, implementation and interpretation, in order to facilitate ongoing consultation.

Previously, stakeholders' meetings have only been held when particular issues warranted it. No such issues were raised during the reported period. The Company has informed the Council that they have continued to engage with stakeholders as part of the ongoing consenting process for the scheme during this period and they have considered that a stakeholder meeting has therefore not been necessary. The Council has not been approached by stakeholders with queries during this period or with requests for a stakeholder meeting. Should any stakeholder have any issues or wish to have a meeting they can formally request it.

3. Discussion

3.1 Discussion of site performance

Monitoring undertaken over the 2023/24 period has concentrated on the provision and maintenance of appropriate residual flow releases below the intake weir, maintenance of lake levels and discharge flows, provision of fish passage, and the provision of data from the Company as required.

The station is largely controlled automatically, with the river intake gates opening or closing dependent on flows in the Waiwhakaiho River. The data recorded by the Company's water level recorder located downstream of the intake weir is used in this control system and has resulted in a good standard of compliance with the required residual flows.

Compliance with the residual flow requirements was determined through monthly gaugings, which found residual flow requirements were being complied with. On one occasion it was decided not to complete a gauging due to a piece of timber which had got jammed in the outlet pipe on the headworks diversion weir (see Section 2.1.1). Despite the presence of telemetered water level monitoring immediately downstream of the intake weir, these gaugings continue to retain their importance, as maintaining the accuracy of flow rates calculated with level data from this recorder is often difficult, given the frequent changes in the riverbed cross section at the monitoring location.

Daily minimum powerhouse generation releases of 950L/s during daylight hours were largely maintained by the Company. The automatic compensation valve at the powerhouse, which removed the need for spillages via the intake weir during power station outages was required on several occasions, mostly due to short power outages.

Compliance with Lake Mangamahoe minimum lake levels was also achieved throughout the period. The one instance where the lake level exceeded the spillway level was associated with floods in the contributing catchments.

The fish pass was maintained and operated successfully for the monitoring period.

During the previous monitoring year, there were discussions held on site between Council staff and Company staff with regard to the lower culvert and allowing for easier fish passage. During the latter part of the 2023/24 summer work was carried out by the Company on the culvert, and easy fish passage was established.

Overall, in terms of compliance with the Mangorei HEPS consent conditions, the performance of the Company was of a good standard throughout this monitoring period.

3.2 Environmental effects of exercise of consents

The primary impact of the Mangorei HEPS is the reduced flow in the Waiwhakaiho River. This reduced flow is largely limited to the residual flow reach, as the release of at least 950L/s during the day from the station results in higher flows in the river downstream of the scheme. In addition, the variable residual flow requirements ensures that the scheme can make good use of winter flows, while providing a higher residual flow in the summer.

River water temperature records illustrate the impacts of residual flow releases on the lower river reaches. The records also indicate a general trend of a rise in water temperatures along the length of the river in more recent years, despite the increase in the summer residual flow release. The increasing temperature trends are also evident upstream of the scheme and are therefore due, at least in part, to warmer weather, possibly related to climate change. There continues to be variation in temperatures year to year.

Temperatures in excess of 25˚C can be lethal to some fish, including sportfish such as rainbow and brown trout. Temperatures in excess of 20˚C for extended periods may also negatively impact fish through stress. Over extended periods, this can make fish more susceptible to infection, can cause fish to lose body condition, and can even lead to fish death. This kind of warming can cause fish to change behaviours, including seeking cooler tributary flows. The residual reach is the only fish passage to the upper Waiwhakaiho and its tributaries, therefore active management of the temperature in the residual reach is imperative.

In terms of the warming of waters in a downstream direction, the abstraction of water results in less buffering of the temperature, and consequently can result in much warmer waters than would occur naturally. This was acknowledged previously, resulting in a higher residual flow requirement during the summer.

The macroinvertebrate surveys concluded that there continues to be a general decrease in macroinvertebrate community health in a downstream direction. These reductions could potentially indicate a negative impact on the macroinvertebrate communities of the Waiwhakaiho River due to the Mangorei HEPS abstraction. However, due to the distance between sampling sites, other inflows and discharges that enter the Waiwhakaiho River within the residual reach, it is difficult to determine the extent to which the Mangorei HEPS activities have affected macroinvertebrate communities. It is likely that any stressors affecting the macroinvertebrate communities on the Waiwhakaiho River are exacerbated by abstraction activities.

The fish pass is considered adequate to provide for the passage of all fish species expected to migrate up to and beyond the weir. This includes all native migratory species recorded as present in the residual flow reach, and adult trout, which have been shown to be capable of negotiating the pass. Maintenance continues to be required on a regular basis to maintain this passage.

The Company also transferred elvers that were trapped at the power station for release in the residual flow reach and transferred migrating adult eels from Lake Mangamahoe into the lower Waiwhakaiho River. A higher than average number of adult eels and a slightly above average number of elvers were transferred during the 2023/24 period.

The Company is required to provide some mitigation for the effects of the diversion of the river flow by financially contributing to riparian management elsewhere in the Waiwhakaiho Catchment. This is done by subsidising the cost of plants sold to landowners in the catchments and was utilised by several landowners this monitoring year.

The bathymetric survey report of Lake Mangamahoe submitted in 2021 concluded that the magnitude of effects of sediment entering Lake Mangamahoe through the Waiwhakaiho diversion tunnel was very low and that remedial or mitigation actions were generally not required. However, it has been previously outlined that should the New Plymouth District Council and/or the Company in the future deem the loss of storage volume in the lake to be a significant issue for the purposes of water supply or hydro-electric power generation, that low impact sediment removal could be considered as an appropriate sediment management tool in Lake Mangamahoe.

3.3 Evaluation of performance

A tabular summary of the consent holder's compliance record for the year under review is set out in Tables 11 to 17.

Table 11 Summary of performance for Consent 2053-3.2

Purpose: To divert water from the river into Lake Mangamahoe		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Continuous daily generation of 950L/s between 8am and 6pm	Supply of data by consent holder	Yes
2. Seasonal residual flows released over the weir	Inspections, gaugings (Council), and automatic flow recording (Company)	Yes
3. Cessation of diversion when Waiwhakaiho River ≥85 cumecs	Liaison with consent holder	Yes
4. Maintenance of residual flow recording device and supply of records	Supply of levels by consent holder	Yes
5. Provision of suitable fish passage in residual flow channel	Inspections	Yes
6. Provision of sediment/lake bathymetry monitoring programme by the Company	Consent holder to undertake and provide data. Report provided 2021.	Yes
7. Provision of public safety notices	Liaison with consent holder and inspections	Yes
8. Mitigation by riparian management	TRC Land Management records	Yes
9. Stakeholders bi-annual meetings	Consent holder liaison	Yes
10. Optional review provision	No reviews remaining	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 12 Summary of performance for Consent 2054-3

Purpose: To dam the Mangamahoe Stream for HEPS generation purposes		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Operation and maintenance of dam to satisfaction of the Council	Liaison with consent holder	Yes
2. Maintenance of minimum level in Lake Mangamahoe	Supply of data by consent holder	Yes
3. Notification if lake level to be lowered for weed maintenance purposes	Liaison with consent holder	N/A
4. Optional review provision	No reviews remaining	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 13 Summary of performance for Consent 2056-3

Purpose: To use up to 750,000m^3 per day of water from Lake Mangamahoe for HEPS generation purposes		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Spread generation during daylight hours as far as reasonably practical	Review of data	Yes
2. Optional review provision	No reviews remaining	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 14 Summary of performance for Consent 4886-1

Purpose: To erect and maintain structures in, and dam, the Mangamahoe Stream for the formation of Lake Mangamahoe for HEPS generation purposes		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Operation and maintenance of structures to satisfaction of the Council	Liaison with consent holder	Yes
2. Optional review provision	No reviews remaining	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 15 Summary of performance for Consent 4888-1

Purpose: Emergency discharge of Lake Mangamahoe water to the Mangamahoe Stream		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Optional review provision	No reviews remaining	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 16 Summary of performance for Consent 6810-1

Purpose: To erect, place and maintain a culvert for access purposes, in an unnamed tributary of the Waiwhakaiho River		
Condition requirement	**Means of monitoring during period under review**	**Compliance achieved?**
1. Silt discharge and riverbed disturbance minimisation	Liaison with the Council by consent holder	N/A
2. Exercise in accordance with documentation	Inspections	N/A
3. Notification of installation and maintenance works	Notification by consent holder	N/A
4. Timing of works	Inspections	N/A
5. Riverbed disturbance limits	Inspections	N/A
6. Limits to effects on receiving waters	Inspections	N/A
7. Removal of structure if no longer required	Liaison with consent holder	Yes
8. Flow and fish passage restrictions	Inspections	Yes
9. Ponding restrictions	Inspections	Yes
10. Erosion and sediment control plan	Provision by consent holder	N/A
11. Lapse of consent	Consent exercised	N/A
12. Optional review provision	No reviews remaining	N/A
Overall assessment of consent compliance and environmental performance in respect of this consent Overall assessment of administrative performance in respect of this consent		**High** **High**

N/A = not applicable

Table 17 Evaluation of environmental performance over time

Year	Consent numbers	High	Good	Improvement req	Poor
2019/20	2053-3, 2054-3, 2056-3, 4886-1, 4887-1, 4888-1, 6810-1	5	2	-	-
2020/21	2053-3, 2054-3, 2056-3, 4886-1, 4887-1, 4888-1, 6810-1	6	1	-	-
2021/22	2053-3, 2054-3, 2056-3, 4886-1, 4887-1, 4888-1, 6810-1	7	-	-	-

Year	Consent numbers	High	Good	Improvement req	Poor
2022/23	2053-3, 2054-3, 2056-3, 4886-1, 4888-1, 6810-1	5	1	-	-
2023/24	2053-3, 2054-3, 2056-3, 4886-1, 4888-1, 6810-1	6	-	-	-

During the year, the Company demonstrated a high level of environmental and administrative performance with the resource consents as defined in Appendix II. Most components of the Mangorei HEPS were operated well, with the Company maintaining the fish passage at the weir and assisting with the migration of both adult and juvenile eels when these fish congregate at the scheme.

3.4 Recommendations from the 2022/23 Annual Report

In the 2022/23 Annual Report, it was recommended:

1. THAT all monitoring of consented activities at Mangorei HEPS in the 2023/24 year continue at the same level as in 2022/23.
2. THAT should there be issues with environmental or administrative performance in 2023/24, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Recommendation one was implemented while it was not considered necessary to undertake recommendation two.

3.5 Alterations to monitoring programmes for 2024/25

In designing and implementing the monitoring programmes for air/water discharges in the region, the Council has taken into account:

- the extent of information already made available through monitoring or other means to date;
- its relevance under the RMA;
- the Council's obligations to monitor consented activities and their effects under the RMA;
- the record of administrative and environmental performances of the consent holder; and
- reporting to the regional community.

The Council also takes into account the scope of assessments required at the time of renewal of permits, and the need to maintain a sound understanding of industrial processes within Taranaki exercising resource consents.

It is proposed that for the 2024/25 monitoring of the Mangorei HEPS continues at the same level as in 2023/24.

It should be noted that the proposed programme represents a reasonable and risk-based level of monitoring for the site(s) in question. The Council reserves the right to subsequently adjust the programme from that initially prepared, should the need arise if potential or actual non-compliance is determined at any time during 2024/25.

4. Recommendations

1. THAT all monitoring of consented activities at Mangorei HEPS in the 2024/25 year continue at the same level as in 2023/24.
2. THAT should there be issues with environmental or administrative performance in 2024/25, monitoring may be adjusted to reflect any additional investigation or intervention as found necessary.

Glossary of common terms and abbreviations

Biomonitoring	Assessing the health of the environment using aquatic organisms.
Cumec	A volumetric measure of flow- 1 cubic metre per second ($1m^3s^{-1}$).
Diadromous	A fish with life cycles encompassing fresh and salt water stages.
Elver	Juvenile eel(s) that has entered freshwater from the sea.
Fresh	Elevated flow in a stream, such as after heavy rainfall.
HEPS	Hydroelectric power scheme.
Incident	An event that is alleged or is found to have occurred that may have actual or potential environmental consequences or may involve non-compliance with a consent or rule in a regional plan. Registration of an incident by the Council does not automatically mean such an outcome had actually occurred.
Intervention	Action/s taken by Council to instruct or direct actions be taken to avoid or reduce the likelihood of an incident occurring.
Investigation	Action taken by Council to establish what were the circumstances/events surrounding an incident including any allegations of an incident.
Incident Register	The Incident Register contains a list of events recorded by the Council on the basis that they may have the potential or actual environmental consequences that may represent a breach of a consent or provision in a Regional Plan.
L/s	Litres per second.
MCI	Macroinvertebrate community index; a numerical indication of the state of biological life in a stream that takes into account the sensitivity of the taxa present to organic pollution in stony habitats.
Mixing zone	The zone below a discharge point where the discharge is not fully mixed with the receiving environment. For a stream, conventionally taken as a length equivalent to 7 times the width of the stream at the discharge point.
Physicochemical	Measurement of both physical properties (e.g. temperature, clarity, density) and chemical determinants (e.g. metals and nutrients) to characterise the state of an environment.
Residual flow	Flow required to maintain fish passage and/or aquatic habitat.
Resource consent	Refer Section 87 of the RMA. Resource consents include land use consents (refer Sections 9 and 13 of the RMA), coastal permits (Sections 12, 14 and 15), water permits (Section 14) and discharge permits (Section 15).
RFWP	Regional Fresh Water Plan for Taranaki.
RMA	*Resource Management Act 1991* and including all subsequent amendments.
SQMCI	Semi quantitative macroinvertebrate community index.
Temp	Temperature, measured in °C (degrees Celsius).

For further information on analytical methods, contact an Environment Quality Manager.

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Appendix I

Resource consents held by Manawa Energy Ltd

(For a copy of the signed resource consent please contact the TRC Consents department)

Water abstraction permits

Section 14 of the RMA stipulates that no person may take, use, dam or divert any water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or it falls within some particular categories set out in Section 14. Permits authorising the abstraction of water are issued by the Council under Section 87(d) of the RMA.

Water discharge permits

Section 15(1)(a) of the RMA stipulates that no person may discharge any contaminant into water, unless the activity is expressly allowed for by a resource consent or a rule in a regional plan, or by national regulations. Permits authorising discharges to water are issued by the Council under Section 87(e) of the RMA.

Air discharge permits

Section 15(1)(c) of the RMA stipulates that no person may discharge any contaminant from any industrial or trade premises into air, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising discharges to air are issued by the Council under Section 87(e) of the RMA.

Discharges of wastes to land

Sections 15(1)(b) and (d) of the RMA stipulate that no person may discharge any contaminant onto land if it may then enter water, or from any industrial or trade premises onto land under any circumstances, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Permits authorising the discharge of wastes to land are issued by the Council under Section 87(e) of the RMA.

Land use permits

Section 13(1)(a) of the RMA stipulates that no person may in relation to the bed of any lake or river use, erect, reconstruct, place, alter, extend, remove, or demolish any structure or part of any structure in, on, under, or over the bed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Land use permits are issued by the Council under Section 87(a) of the RMA.

Coastal permits

Section 12(1)(b) of the RMA stipulates that no person may erect, reconstruct, place, alter, extend, remove, or demolish any structure that is fixed in, on, under, or over any foreshore or seabed, unless the activity is expressly allowed for by a resource consent, a rule in a regional plan, or by national regulations. Coastal permits are issued by the Council under Section 87(c) of the RMA.

Water Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Trustpower Limited Private Bag 12023 Tauranga 3143	
Decision Date (Change):	01 August 2017	
Commencement Date (Change):	01 August 2017	(Granted Date: 01 August 2017)

Conditions of Consent

Consent Granted:	To divert up to 10 cubic metres per second of water from the Waiwhakaiho River via a diversion weir and associated intake structures into Lake Mangamahoe through the Mangorei Hydroelectric Power Scheme and back into the river approximately six kilometres downstream of the diversion point
Expiry Date:	01 June 2021
Site Location:	Lake Mangamahoe, Junction Road, New Plymouth
Grid Reference (NZTM)	1697720E - 5668050N
Catchment:	Waiwhakaiho
Tributary:	Lake Mangamahoe

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General condition

a. The consent holder shall pay to the Taranaki Regional Council all the administration, monitoring and supervision costs of this consent, fixed in accordance with section 36 of the Resource Management Act 1991.

Special conditions

1. That the consent holder shall maintain a continuous generation flow release of at least 950 litres/second between 8:00 am and 6:00 pm each day.

2. That the consent holder shall maintain, each 12-month period, the following minimum residual flows in the Waiwhakaiho River below the diversion weir:

    i) at least 700 litres/second between 1 January and 31 March, effective from 1 January 1998;

    ii) at least 600 litres/second between 1 January and 31 March, until 31 December 1997;

    iii) at least 600 litres/second between 1 November and 31 December and during April; and

    iv) at least 400 litres/second between 1 May and 31 October.

3. No water shall be diverted when the flow in the Waiwhakaiho River is greater than or equal to 85 cubic metres per second.

4. That the consent holder shall install and operate, to the satisfaction of the Chief Executive, Taranaki Regional Council, a measuring device capable of measuring the residual flow to be maintained in the Waiwhakaiho River downstream of the diversion weir, and shall provide records of such measurements to the Chief Executive, Taranaki Regional Council, upon request.

5. That the consent holder shall maintain, as far as reasonably practicable, the river channel below the diversion weir to the `Meeting of Waters' for the purpose of enhancing available fish passage and habitat, to the satisfaction of the Chief Executive, Taranaki Regional Council; and, the Taranaki Regional Council will inspect the fish passage device and river channel for compliance after any significant river fresh.

6. The consent holder shall ensure a monitoring programme is undertaken that includes:

    a) sediment sampling that relates the flow in the Waiwhakaiho River to the rate of sediment entering Lake Mangamahoe via the diversion;
    b) bathymetric surveys that record the change in bathymetry of Lake Mangamahoe between winter 2013 and 31 December 2020; and
    c) a report assessing the effects of this application and any significant change in bathymetry.

7. That the consent holder shall erect and maintain notices and other warnings as may be required, to the satisfaction of the Chief Executive, Taranaki Regional Council, for adequate protection of public safety to warn the public using the river downstream of the scheme of fluctuations in river flow and of the extent of those fluctuations.

8. The consent holder shall mitigate the environmental effects of the diversion by making annual payments of $5,000 (GST exclusive) to the Taranaki Regional Council as a financial contribution for the purpose of providing riparian planting and management in the Waiwhakaiho River catchment. The amount to be paid shall be adjusted annually according to the consumer price index, or similar index, to account for the effects of inflation, and be made no later than 1 September each year.

9. That the consent holder and staff of the Taranaki Regional Council shall meet as appropriate, and at least once every two years, with submitters to the consent to discuss any matter relating to the exercise of this resource consent.

10. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, June 2006, June 2011 and/or June 2016 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the diversion on the environment.

Signed at Stratford on 01 August 2017

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Trustpower Limited Private Bag 12023 Tauranga 3143
Decision Date:	4 September 1996
Commencement Date:	4 September 1996

Conditions of Consent

Consent Granted:	To dam the Mangamahoe Stream in the Waiwhakaiho Catchment to form Lake Mangamahoe to act as a reservoir of water for hydroelectric power generation purposes
Expiry Date:	1 June 2021
Site Location:	Lake Mangamahoe Junction Road New Plymouth
Grid Reference (NZTM)	1697320E-5669450N
Catchment:	Waiwhakaiho
Tributary:	Mangamahoe

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

(a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

(b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

(c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

(i) the administration, monitoring and supervision of this consent;
(ii) charges for the carrying out of the Council's functions under section 35 in relation to this consent; and
(iii) charges authorised by regulations.

Special conditions

1. That the consent holder shall maintain and operate the dam and associated structures, to the satisfaction of the Chief Executive, Taranaki Regional Council.

2. That the consent holder shall maintain a minimum lake level of 750 mm below the crest of the Mangamahoe spillway except during lake weed maintenance periods.

3. That the consent holder shall notify the Chief Executive, Taranaki Regional Council, of its intention to temporarily lower Lake Mangamahoe for weed management purposes at least seven days prior to commencing lake dewatering.

4. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, June 2006, June 2011 and/or June 2016 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the dam on the environment.

Transferred at Stratford on 31 October 2016

For and on behalf of
Taranaki Regional Council

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A D McLay
Director - Resource Management

Water Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Trustpower Limited Private Bag 12023 Tauranga 3143
Decision Date (Change):	16 June 2016
Commencement Date (Change):	16 June 2016

Conditions of Consent

Consent Granted:	To use up to 864,000 cubic metres/day of water from Lake Mangamahoe in the Waiwhakaiho catchment for hydroelectric power generation purposes
Expiry Date:	1 June 2021
Site Location:	Lake Mangamahoe, Junction Road, New Plymouth
Grid Reference (NZTM)	1697220E-5669450N
Catchment:	Waiwhakaiho
Tributary:	Mangamahoe Lake Mangamahoe

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

(a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

(b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

(c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

(i) the administration, monitoring and supervision of this consent;
(ii) charges for the carrying out of the Council's functions under section 35 in relation to this consent; and
(iii) charges authorised by regulations.

Special conditions

1. That the consent holder shall, as far as reasonably practicable, spread its generation during daylight hours in order to maximise the beneficial effect of artificial flows in the lower Waiwhakaiho River.

2. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, June 2006, June 2011 and/or June 2016 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the water use on the environment.

Transferred at Stratford on 31 October 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Trustpower Limited Private Bag 12023 Tauranga 3143
Decision Date:	4 September 1996
Commencement Date:	4 September 1996

Conditions of Consent

Consent Granted:	To erect and maintain structures in the Mangamahoe Stream in the Waiwhakaiho Catchment to dam the stream to form Lake Mangamahoe for hydroelectric power generation purposes
Expiry Date:	1 June 2021
Site Location:	Lake Mangamahoe, Junction Road, New Plymouth
Grid Reference (NZTM)	1697318E-5669451N
Catchment:	Waiwhakaiho
Tributary:	Mangamahoe Lake Mangamahoe

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

(a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

(b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

(c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

(i) the administration, monitoring and supervision of this consent;
(ii) charges for the carrying out of the Council's functions under section 35 in relation to this consent; and
(iii) charges authorised by regulations.

Special conditions

1. That the consent holder shall maintain and operate the structures, to the satisfaction of the Chief Executive, Taranaki Regional Council.

2. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, June 2006, June 2011 and/or June 2016 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the structures on the environment.

Transferred at Stratford on 31 October 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Discharge Permit

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Trustpower Limited Private Bag 12023 Tauranga 3143
Decision Date:	4 September 1996
Commencement Date:	4 September 1996

Conditions of Consent

Consent Granted:	To discharge up to 150,000 litres/second of water from Lake Mangamahoe via a spillway into the Mangamahoe Stream in the Waiwhakaiho Catchment under emergency conditions associated with hydroelectric generation purposes
Expiry Date:	1 June 2021
Site Location:	Lake Mangamahoe, Junction Road, New Plymouth
Grid Reference (NZTM)	1697318E-5669451N
Catchment:	Waiwhakaiho
Tributary:	Mangamahoe Lake Mangamahoe

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

(a) That on receipt of a requirement from the Chief Executive, Taranaki Regional Council (hereinafter the Chief Executive), the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

(b) That unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

(c) That the consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

(i) the administration, monitoring and supervision of this consent;
(ii) charges for the carrying out of the Council's functions under section 35 in relation to this consent; and
(iii) charges authorised by regulations.

Special condition

1. That the Taranaki Regional Council may review any or all of the conditions of this consent by giving notice of review during June 2001, June 2006, June 2011 and/or June 2016 for the purpose of ensuring that the conditions are adequate to deal with any adverse effects of the discharge on the environment.

Transferred at Stratford on 31 October 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Land Use Consent

Pursuant to the Resource Management Act 1991
a resource consent is hereby granted by the
Taranaki Regional Council

Name of Consent Holder:	Trustpower Limited Private Bag 12023 Tauranga 3143
Decision Date:	6 March 2006
Commencement Date:	6 March 2006

Conditions of Consent

Consent Granted:	To erect, place and maintain a culvert in an unnamed tributary of the Waiwhakaiho River for access purposes
Expiry Date:	1 June 2020
Site Location:	Lake Mangamahoe, Junction Road, New Plymouth
Grid Reference (NZTM)	1697023E-5668380N
Catchment:	Waiwhakaiho

For General, Standard and Special conditions
pertaining to this consent please see reverse side of this document

General conditions

a) On receipt of a requirement from the Chief Executive, Taranaki Regional Council the consent holder shall, within the time specified in the requirement, supply the information required relating to the exercise of this consent.

b) Unless it is otherwise specified in the conditions of this consent, compliance with any monitoring requirement imposed by this consent must be at the consent holder's own expense.

c) The consent holder shall pay to the Council all required administrative charges fixed by the Council pursuant to section 36 in relation to:

i) the administration, monitoring and supervision of this consent; and
ii) charges authorised by regulations.

Special conditions

1. The consent holder shall adopt the best practicable option, as defined in section 2 of the Resource Management Act 1991, to avoid or minimise the discharge of silt or other contaminants into water or onto the riverbed and to avoid or minimise the disturbance of the riverbed and any adverse effects on water quality.

2. The exercise of this consent shall be undertaken generally in accordance with the documentation submitted in support of application 4114. In the case of any contradiction between the documentation submitted in support of application 4114 and the conditions of this consent, the conditions of this consent shall prevail.

3. The consent holder shall notify the Chief Executive, Taranaki Regional Council, in writing at least 48 hours prior to the commencement and upon completion of the initial installation and again at least 48 hours prior to and upon completion of any subsequent maintenance works which would involve disturbance of or deposition to the riverbed or discharges to water.

4. Any instream works shall take place only between 1 November and 30 April inclusive, except where this requirement is waived in writing by the Chief Executive, Taranaki Regional Council.

5. The consent holder shall ensure that the area and volume of riverbed disturbance shall, so far as practicable, be minimised and any areas which are disturbed shall, so far as practicable, be reinstated.

6. After allowing for reasonable mixing, being a mixing zone extending seven times the width of the surface water body at the point of discharge, the discharge shall not give rise to any of the following effects in any surface water body:

a) the production of any conspicuous oil or grease films, scums or foams, or floatable or suspended materials;
b) any conspicuous change in the colour or visual clarity;
c) any emission of objectionable odour;
d) the rendering of fresh water unsuitable for consumption by farm animals;
e) any significant adverse effects on aquatic life.

7. Except with the written agreement of the Chief Executive, Taranaki Regional Council, the structure[s] authorised by this consent shall be removed and the area reinstated, if and when the structure[s] are no longer required. The consent holder shall notify the Taranaki Regional Council at least 48 hours prior to structure[s] removal and reinstatement.

8. The exercise of this consent shall not alter the natural flow of the river or restrict the passage of fish.

9. The exercise of this consent shall not result in the significant ponding of water upstream of the culvert.

10. Prior to the exercise of this consent, the consent holder shall provide for the written approval of the Chief Executive, Taranaki Regional Council, a site erosion and sediment control management plan.

11. This consent shall lapse on the expiry of five years after the date of issue of this consent, unless the consent is given effect to before the end of that period or the Taranaki Regional Council fixes a longer period pursuant to section 125(1)(b) of the Resource Management Act 1991.

12. In accordance with section 128 and section 129 of the Resource Management Act 1991, the Taranaki Regional Council may serve notice of its intention to review, amend, delete or add to the conditions of this resource consent by giving notice of review during the month of June 2008 and/or June 2014, for the purpose of ensuring that the conditions are adequate to deal with any adverse effects on the environment arising from the exercise of this resource consent, which were either not foreseen at the time the application was considered or which it was not appropriate to deal with at the time.

Transferred at Stratford on 31 October 2016

For and on behalf of
Taranaki Regional Council

_____

A D McLay
Director - Resource Management

Appendix II

Categories used to evaluate environmental and administrative performance

Categories used to evaluate environmental and administrative performance

Environmental performance is concerned with actual or likely effects on the receiving environment from the activities during the monitoring year. Administrative performance is concerned with the Company's approach to demonstrating consent compliance in site operations and management including the timely provision of information to Council (such as contingency plans and water take data) in accordance with consent conditions.

Events that were beyond the control of the consent holder and unforeseeable (that is a defence under the provisions of the RMA can be established) may be excluded with regard to the performance rating applied. For example loss of data due to a flood destroying deployed field equipment.

The categories used by the Council for this monitoring period, and their interpretation, are as follows:

Environmental Performance

High: No or inconsequential (short-term duration, less than minor in severity) breaches of consent or regional plan parameters resulting from the activity; no adverse effects of significance noted or likely in the receiving environment. The Council did not record any verified unauthorised incidents involving environmental impacts and was not obliged to issue any abatement notices or infringement notices in relation to such impacts.

Good: Likely or actual adverse effects of activities on the receiving environment were negligible or minor at most. There were some such issues noted during monitoring, from self-reports, or during investigations of incidents reported to the Council by a third party but these items were not critical, and follow-up inspections showed they have been dealt with. These minor issues were resolved positively, co-operatively, and quickly. The Council was not obliged to issue any abatement notices or infringement notices in relation to the minor non-compliant effects however, abatement notices may have been issued to mitigate an identified potential for an environmental effect to occur.

For example:

- High suspended solid values recorded in discharge samples however, the discharge was to land or to receiving waters that were in high flow at the time;
- Strong odour beyond boundary but no residential properties or other recipient nearby.

Improvement required: Likely or actual adverse effects of activities on the receiving environment were more than minor, but not substantial. There were some issues noted during monitoring, from self-reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent minor non-compliant activity could elevate a minor issue to this level. Abatement notices and infringement notices may have been issued in respect of effects.

Poor: Likely or actual adverse effects of activities on the receiving environment were significant. There were some items noted during monitoring, from self-reports, or during investigations of incidents reported to the Council by a third party. Cumulative adverse effects of a persistent moderate non-compliant activity could elevate an 'improvement required' issue to this level. Typically there were grounds for either a prosecution or an infringement notice in respect of effects.

Administrative performance

High: The administrative requirements of the resource consents were met, or any failure to do this had trivial consequences and were addressed promptly and co-operatively.

Good: Perhaps some administrative requirements of the resource consents were not met at a particular time however, this was addressed without repeated interventions from the Council staff. Alternatively adequate reason was provided for matters such as the no or late provision of information, interpretation of 'best practical option' for avoiding potential effects, etc.

Improvement required: Repeated interventions to meet the administrative requirements of the resource consents were made by Council staff. These matters took some time to resolve, or remained unresolved at the end of the period under review. The Council may have issued an abatement notice to attain compliance.

Poor: Material failings to meet the administrative requirements of the resource consents. Significant intervention by the Council was required. Typically there were grounds for an infringement notice.