



# WATER QUALITY AND QUANTITY

## 1 ACTIVITY OVERVIEW

The Water Quality and Quantity Activity of the Annual Plan includes the work programmes of Horizons Freshwater & Partnerships, and Science & Innovation teams.

the Freshwater & Partnerships Team works closely with other Horizons teams, as well as external people and organisations, to implement water quality and aquatic habitat improvement works. This work draws on monitoring and research undertaken by our Science & Innovation and Environmental Data teams, along with that of other agencies, to prioritise and focus implementation efforts.

Both programmes actively seek funding from other sources to provide external science advice and facilitate the acceleration of works. These include the **Freshwater Improvement Fund (FIF)** for the Manawatū and Lake Waipu/Rātana catchments, **Public Waterways Ecosystem Restoration (PWER)** for the Regional Stream Fencing and Riparian Planting programme, enhancing fish populations through the Fish Barrier Remediation programme, Horowhenua water quality interventions projects, and the **Community Environmental Fund (CEF)** for the Waikawa Catchment. These are all administered through the **Ministry for the Environment (MfE)**. The Ngā Wai Ora o te Whangaehu/Whangaehu FIF programme ran from 1 July 2018 to 30 June 2021.

Funding of science advice through the **Ministry of Innovation, Business and Employment's (MBIE)** Envirolink fund totals approximately \$120,000 per year.

Implementation activities include riparian fencing and planting for water quality improvement and fish habitat enhancement; identification and enhancement of whitebait spawning habitat and fish passage improvement; sewage treatment plant upgrades; work with horticulture growers; and harvesting of lake weed.

Science activities include monitoring and reporting of water quantity for both surface water and groundwater, and the quality of groundwater, rivers, lakes, estuaries, and the coast. More than 80 popular swim spots are monitored weekly throughout the swimming season from November to April. In addition to guiding implementation programmes, science and research also informs consent decision-making, and policy development and implementation.

Communication of science data and information is primarily covered in the Environmental Reporting and Air Quality Monitoring section of this report.

This item presents the Water Quality and Quantity Activity regionally where appropriate and/or for each of the **Freshwater Management Units (FMUs)** that make up the Manawatū-

Whanganui region. It integrates the implementation work of the Freshwater & Partnerships Team, and the water quality and quantity activities of the Science and Innovation & Environmental Data teams. This includes the:

- Regional Water Quality and Quantity Programme;
- Whanganui & Kai Iwi;
- Whangaehu – including the Whangaehu FIF projects;
- Rangitīkei-Turakina – including the Lake Waipu (Rātana) FIF project;
- Manawatū – including the Manawatū River Accord and FIF project;
- Waiopēhu – including the Lake Horowhenua Accord and PWER project, as well as freshwater improvement work with horticulture growers; and
- Puketoi ki Tai – coastal Tararua area.

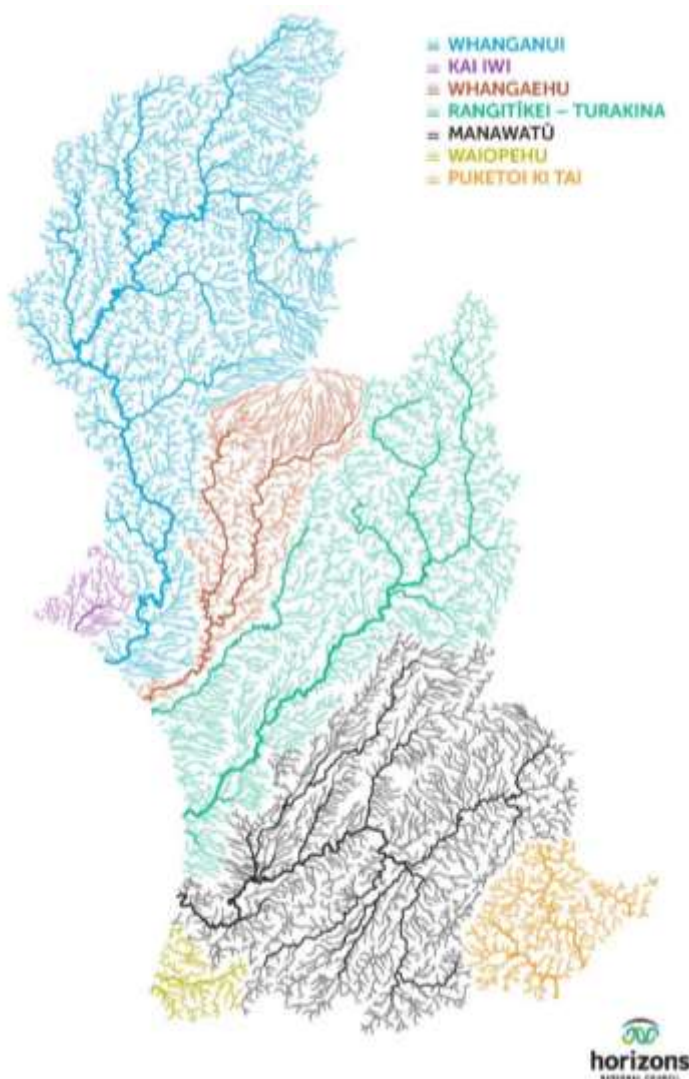


Figure 1: Freshwater Management Units in the Horizons region

The September 2021 Environment Committee report presents information for the period 1 May to 31 July 2021 in the context of delivery of the programme for the financial year 1 July 2020 to 30 June 2021, and including an annual summary of the 2020-21 science monitoring and research activity completed. Due to the timing of this report, some reports are still to be finalised but all will be made available once they are completed.

## 2 REGIONAL WATER QUALITY AND QUANTITY PROGRAMME

### 2.1 Regional Freshwater & Partnerships Overview

#### **PROGRESS AGAINST ANNUAL PLAN TARGETS**

2.1.1 The Freshwater & Partnerships programme links with a range of national and regional policies and strategies. The programme aims to deliver freshwater enhancement work in partnership with others to improve water quality and aquatic health outcomes, and to facilitate community involvement. Some of the work also informs restoration options and seeks to build capacity. The programme delivers work across six key components, each of which includes funding from Central Government. They are:

- Regional freshwater programme, outside the Manawatū and Whangaehu Catchments (includes the Jobs for Nature stream-fencing and riparian-planting programme);
- Manawatū Accord and Freshwater Improvement Fund project;
- Whangaehu Catchment Freshwater Improvement Fund project (concluded on 30 June 2021);
- Enhancing fish populations through fish barrier remediation Jobs for Nature project;
- Waipu Catchment Freshwater Improvement Fund project to remove the Rātana waste water treatment plant (WWTP) discharge from Lake Waipu and irrigate to land, while also developing a restoration plan for Lake Waipu; and
- Lake Horowhenua Accord and Horowhenua Freshwater Management Unit Water Quality Interventions Jobs for Nature project.

2.1.2 A summary of progress against Annual Plan targets is presented in this section of the report, and project updates on specific works are presented in the relevant FMU summary.

2.1.3 Overall, the Freshwater and Partnerships programme completed:

- 162 km of riparian fencing, 62% more than the target of 102 km;
- 182,914 riparian plants planted, 133% more than the target 78,333;
- 20 fish passage repairs, 185% more than the target of 7;
- 20 community projects, 53% more than the target of 13; and
- Other activity as outlined in the summaries below.

2.1.4 The Land programme completed 96 km of stream fencing and 41,290 riparian plants, in addition to the Freshwater and Partnerships programme. Horizons combined programme (freshwater and land) completed 258 km of stream fencing and 224,204 riparian plants in the 2020-21 year. Including the stream fencing and planting, the land programme completed 4,107 ha of erosion control works and 24,676 ha of farm plans.

Table 1: Freshwater & Partnerships programme progress against the 2020-21 Annual Plan targets as at 30 June 2021.

Riparian fencing (km)					Riparian planting			
	Target	Allocated	Complete	% complete	Target	Allocated	Complete	% complete
<b>Regional</b>	12		2.316	331% <sup>1</sup>	20,000		15,241	310%
<b>Jobs for Nature<sup>2</sup></b>	35		37.430	107%	35,000		46,755	134%
<b>Manawatū</b>	50		83.2	166%	40,000		114,515	286%
<b>Whangaehu</b>	17		39.984	235%	3,333		6,403	192%
<b>Total<sup>3</sup></b>	102		162.93	160%	78,333		182,914	233%
Fish passes					Community projects			
	Target	Allocated	Complete	% complete	Target	Allocated	Complete	% complete
<b>Regional</b>	1		0	0% <sup>4</sup>	1		2	200%
<b>Jobs for Nature</b>	5		5	100%	n/a		n/a	n/a
<b>Manawatū</b>	4		8	200%	9		10	111%
<b>Whangaehu</b>	2		7	350%	3		8	267%
<b>Total<sup>3</sup></b>	7		20	285%	13		20	153%

## JOBS FOR NATURE PROJECTS

2.1.5 Council resolved to enter into three Jobs for Nature “Quick-start” projects -in July 2020. These projects are funded through the broad Jobs for Nature Fund, and more specifically are referred to by MfE as Public Waterway Ecosystem Restoration Fund projects.

2.1.6 Deeds of Funding for the Stream Fencing and Riparian Planting programme, and enhancing fish populations through fish barrier remediation, were signed and the governance groups first met during October 2020. The Deed of Funding for the Horowhenua FMU project was signed in February and the first Governance Group meeting was in March 2021.

2.1.7 During the reporting period the following positions were added to the team as a result of the additional funding:

- A Freshwater Coordinator – Horowhenua FMU has joined the team and the two monitoring roles have been appointed. The monitoring roles will sit within the Environmental Data team;

<sup>1</sup> Percentage is based on works completed in both the Regional and Jobs for Nature programmes.

<sup>2</sup> Currently not an annual plan target however, both the Regional and Jobs for Nature projects count towards the Annual Plan targets for the Regional Freshwater Programme.

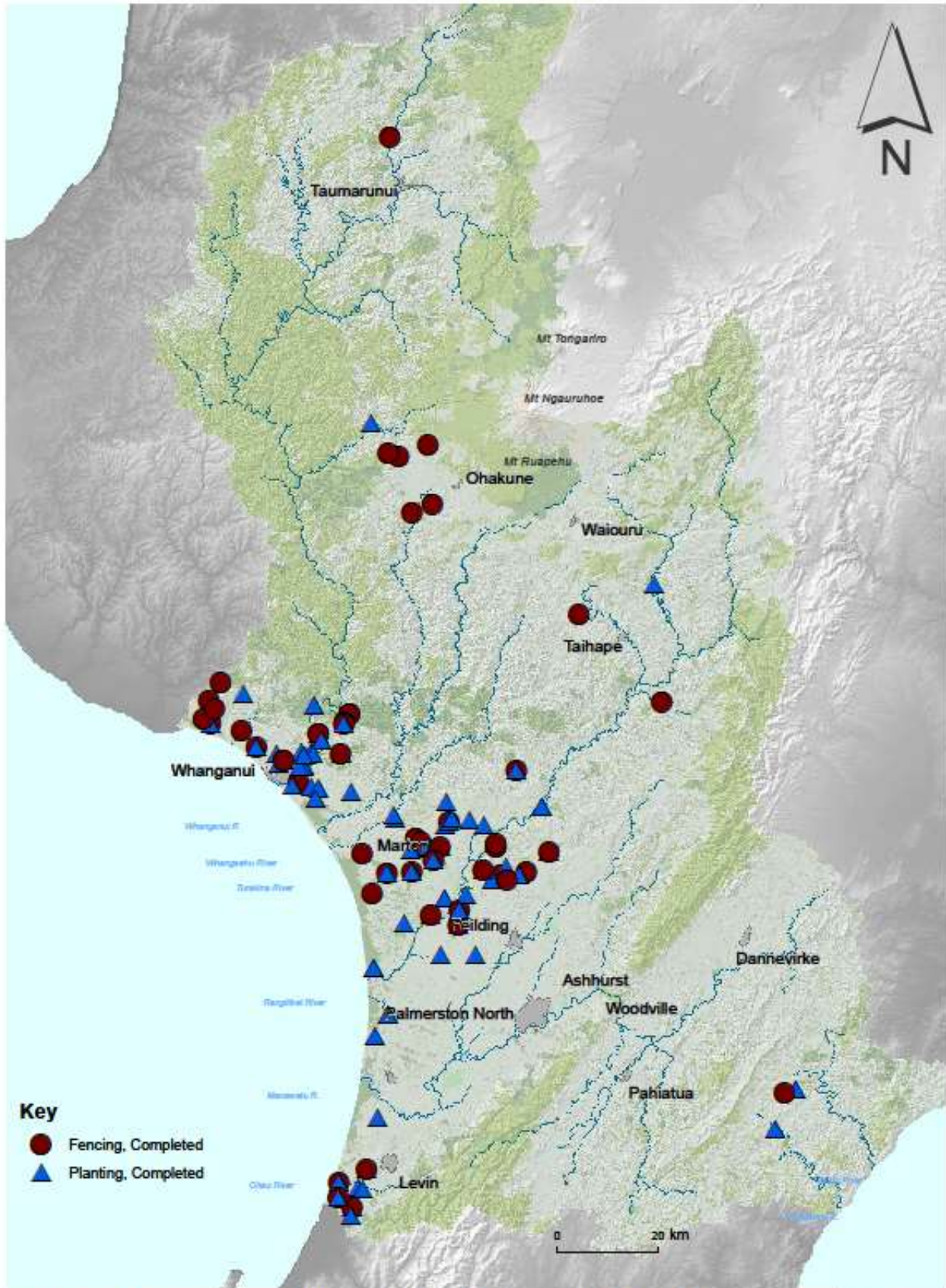
<sup>3</sup> NB: The totals in these target tables represent an overall total and achieving these totals does not necessarily mean all targets have been met, as it is the individual targets that are in the Annual Plan.

<sup>4</sup> Captured in the Jobs for Nature reporting for fish passage.

- A recruitment process has commenced for two Research Assistants - Fish Passage with one resignation from the team and another team member being seconded into the Science and Innovation Team for 12 months; and
- The two Riparian Assistant roles will end during September/October and the recruitment process for summer roles will commence during the next few months.

## **REGIONAL STREAM FENCING AND RIPARIAN PLANTING**

- 2.1.8 This project commenced October 2020 following the signing of the Deed of Funding with the **Ministry for the Environment (MfE)**. This project is to fast-track the amount of stream fencing, riparian planting and employment opportunities within the Horizons Region. The increase in stream fencing aligns with the recently gazetted regulations for stock exclusion from streams on low slope land and certain stock types.
- 2.1.9 This four-year project started in October 2020 and delivered on all targets in its first year targeting 35 km of stream fencing and delivering 37.430 km. The riparian planting component target was 35,000 riparian plants planted and achieved 46,755 plants planted. The direct employment component targeted direct employment of 2.5 FTEs and overall employment of 11.5 FTEs across the entire year 1 programme. The project employed 2.5 FTEs internally and 11.9 FTEs, including the internal employment, across the entire programme.
- 2.1.10 The total budget for the project is \$11.345 million (MfE \$4.681 million, Horizons \$2.698 million, landowners \$3.966 million). The 2020-21 budget was \$1.232 million (MfE \$528,000, Horizons \$354,000, landowners \$350,000). Over the shortened first year, which started in October, the actual spend was \$939,851.15 (MfE \$358,211.65, Horizons \$218,471.12, landowners \$363,168.23). The primary reason for the Horizons and MfE under-expenditure was increased landowner contributions. This has enabled Horizons and Central Government to contribute to more overall fencing and planting. Both the MfE and Horizons funds have been requested to be carried forward into year 2 of the project.
- 2.1.11 Reporting for this project includes quarterly reports and an annual report to a governance group and MfE on project progress, budgets, risk, and health and safety. Horizons Councillors receive reporting via the Environment Committee and the Audit and Risk Committee. The project is audited via Horizons annual audit processes and a separate independent annual audit. Locations of the works are shown in Figure 2.



### Regional Freshwater and Jobs for Nature Projects 2021



Figure 2: Stream fencing and riparian planting completed through the Regional Stream Fencing and Riparian Planting Jobs for Nature project.

## ENHANCING FISH POPULATIONS THROUGH FISH BARRIER REMEDIATION

2.1.12 This project, which commenced in October 2020 following the signing of the Deed of Funding with the Ministry for the Environment (MfE), aims to enhance understanding of fish and kākahi (freshwater mussel) populations in the region, identify and assess barriers to remediation, and to remediate high priority barriers. This aligns with new requirements of Regional Councils through the **National Policy Statement for Freshwater Management (NPS-FW)**.

2.1.13 This four-year project started in October 2020 and delivered on all targets in its first year. It focussed on assessing in-stream structures as potential barriers in the Ōhau/Waikawa catchments in year one (Figure 3) and moved into the Manawatū catchment (Figure 4) once the Ōhau/Waikawa was completed. More than 745 km of stream length has been assessed for the presence of in-stream structures, 687 in-stream structures have been assessed, and the target of five remediated was met (Figure 5). Fish monitoring targeted 12 sites and 47 sites were completed (Figure 6). The stocktake report on knowledge of native fish populations was drafted and is now being peer reviewed. The employment stage gate test that required 8 FTEs per \$1 million spent was met and the project has been approved to proceed into year 2 and beyond.

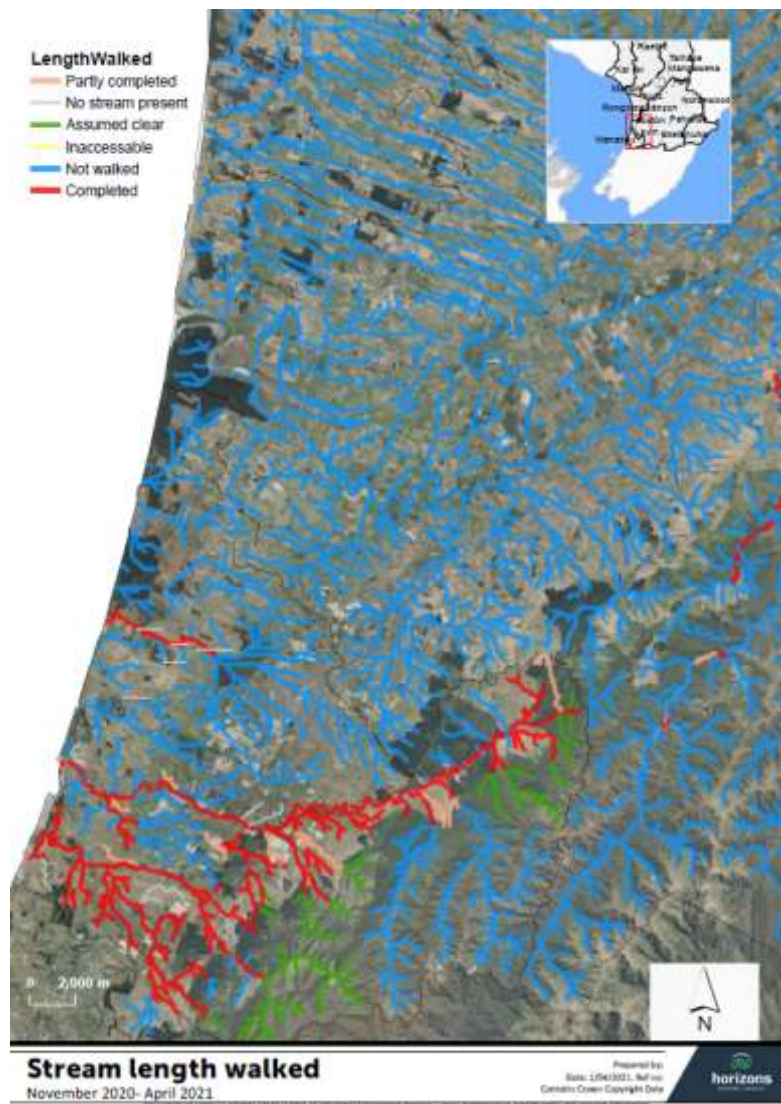


Figure 3: Stream length walked in Ōhau and Waikawa Catchments.

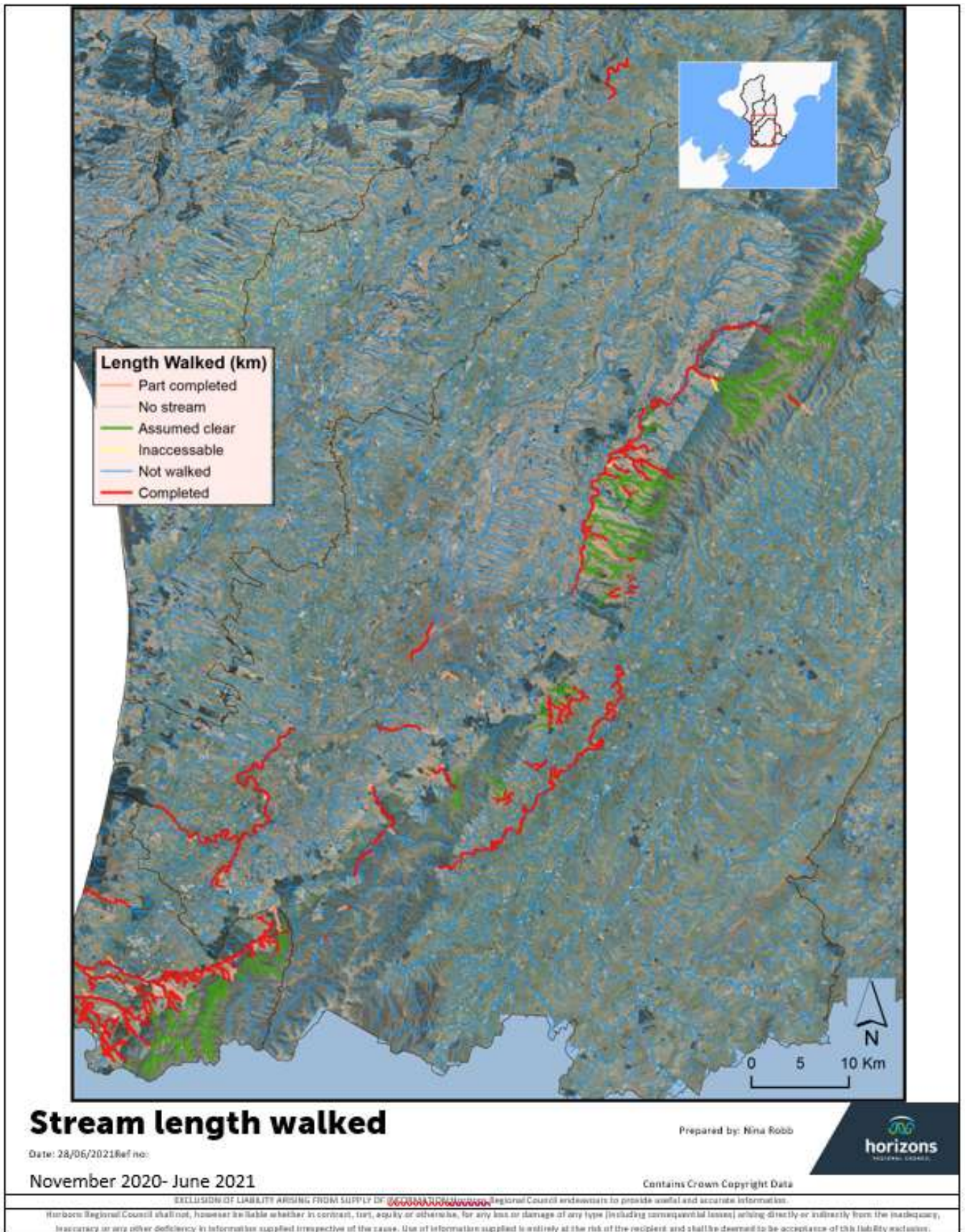


Figure 4: Total stream length walked across the Horizons region.

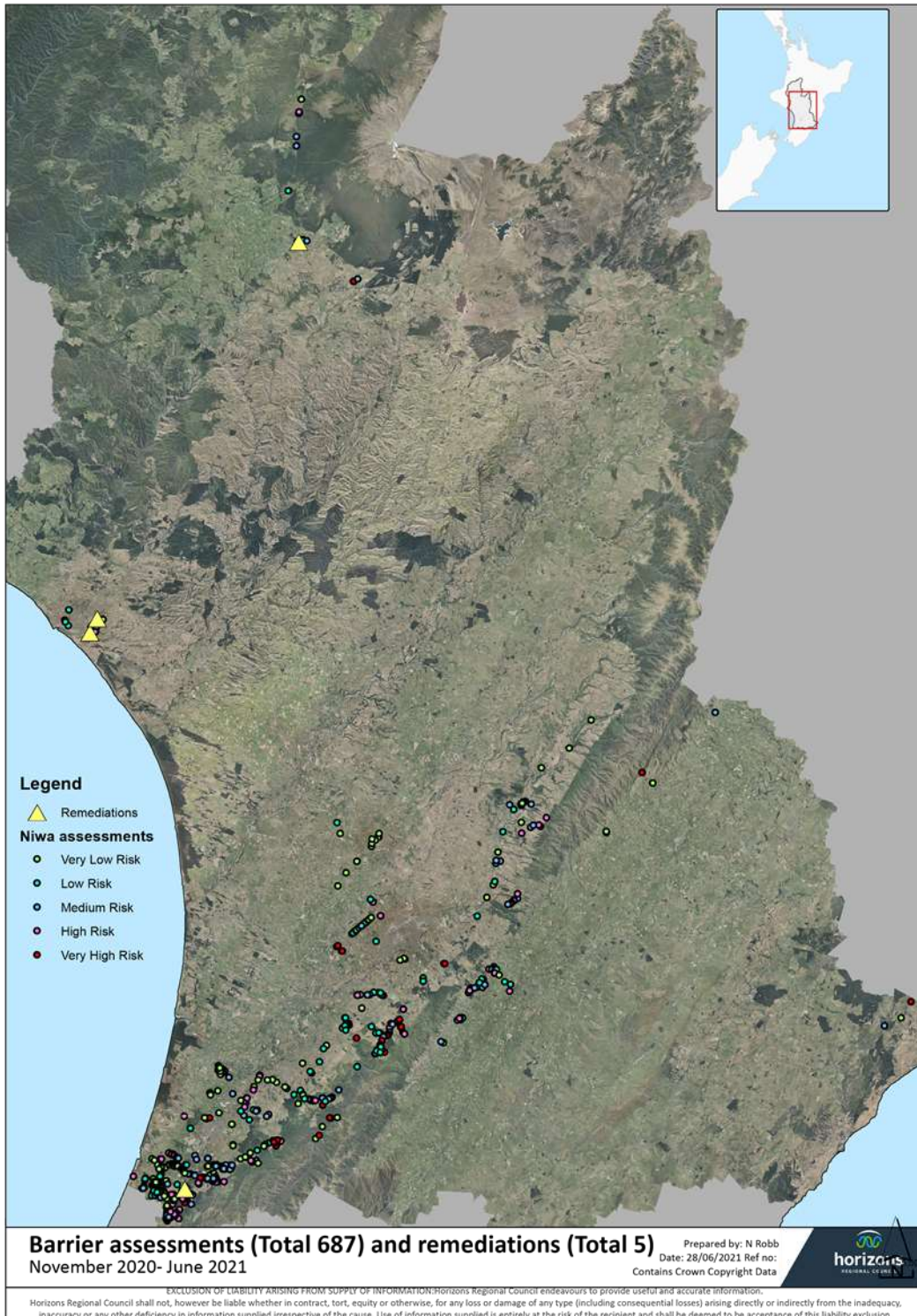
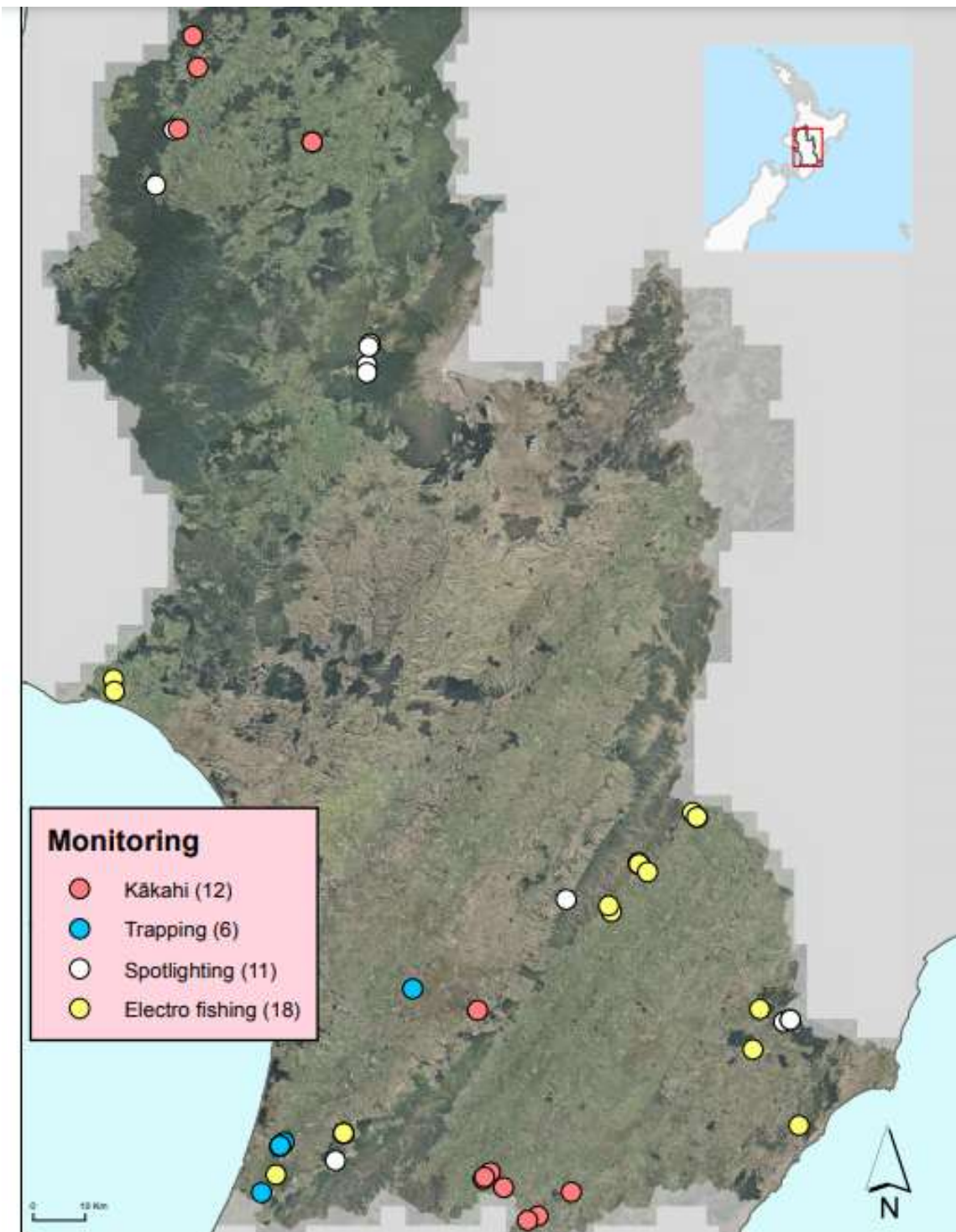


Figure 5: Total instream structure assessments across the region. Note: Two remediations took place in Ohakune but, due to scale, the map shows only one.



<b>Monitoring sites</b> November 2020- June 2021	Prepared by: N Robb Date: 28/06/2021, Ref no: Contains Crown Copyright Data	
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Figure 6: Monitoring sites completed through to the end of Q3. Note: Eleven electrofishing sites have been surveyed on the eastern side of the Manawātū (clumped yellow dots)

## 2.2 Regional Water Quality & Quantity Science Programme Overview

### MONITORING PROGRAMMES

2.2.1 Water quality and quantity monitoring is overseen by Horizons Science & Innovation team, but delivered in partnership with the Environmental Data, Consents Monitoring and Freshwater & Partnerships teams. Much of this activity focusses on improving knowledge and understanding of the region's freshwater and coastal environments by monitoring the state of the environment, tracking changes over time and identifying areas of emerging pressure. Water quantity, quality monitoring and biomonitoring programmes encompass:

- River flow at 65 sites, groundwater levels at 192 sites and measurement of water use at more than 350 sites across the region;
- River water quality at 90 SoE sites, 32 discharges and 52 sites located upstream and downstream of discharges;
- Water quality at four coastal and seven estuary sites, and ecological condition and/or sedimentation of five estuaries;
- Groundwater quality at 35 sites;
- Water quality in 17 lakes and submerged plants in approximately eight lakes annually;
- 81 popular swim spots throughout the swimming season from November to April; and
- Macroinvertebrates at 95 sites and periphyton at 63 sites.

### ENVIROLINK RESEARCH

2.2.2 Horizons is one of a number of smaller regional councils that can access funding through the MBIE Envirolink Fund. Approximately \$120,000 of Horizons' applications are successful each year. A number of potential projects have been identified and five advice grants totalling \$110,830 were secured for 2020-21, as shown in Table 1. Further details and links to these reports, where available, can be found in the body of this report.

Table 2: Envirolink-funded projects for Horizons Regional Council in 2020-21.

Envirolink Project	Provider	Value	Deliverable
<b>National Environmental Monitoring Standards (NEMS)</b> macroinvertebrate review	NIWA	\$5,460	Technical advice
Riparian and freshwater plant identification	NIWA	\$10,000	Workshop
Paired laboratory nutrient analysis	NIWA	\$10,000	Technical report
<b>Coastal Marine Area (CMA)</b> mapping of the Horizons Region	NIWA	\$38,737.50	Technical report
Trend analysis and reporting guidance	NIWA	\$46,632.50	Technical report
<b>TOTAL</b>		<b>\$110,830</b>	

## **Trend Analysis**

- 2.2.3 This project around trend analysis is the largest grant for the year and is a good example of what the Envirolink fund seeks to do i.e., transfer knowledge from science providers to the applied work of regional councils.
- 2.2.4 Practical guidance for the analysis and reporting of temporal trends in environmental data has been prepared for Horizons on behalf of the regional sector, via an MBIE Envirolink advice grant. The primary purpose of this guidance is to facilitate more consistent and transparent assessment and reporting of trends in freshwater and other environmental data. The emphasis of the work is on freshwater physico-chemical and biological variables. However, the methods are applicable to other environmental variables and domains e.g., lakes, groundwaters, estuaries and coastal waters, for which a suitable time-series record exists.
- 2.2.5 Trend assessments serve multiple purposes including informing the public about changes in environmental state, assessing the effectiveness of management actions and policies, evaluating relationships between environmental conditions and the factors that influence them (i.e., driver or explanatory variables), and providing early warning of environmental problems. Trend assessments are used in New Zealand for regional and national environmental reporting, reflecting regional council responsibilities under Section 35 (2) of the Resource Management Act. Recently, the requirement for trend analysis has been made explicit in the NPS-FM.
- 2.2.6 These guidelines start by describing three types of application of trend analysis: local, regional and national. Local applications are concerned with maximising information about trends at a single site whereas regional and national applications are concerned about obtaining consistent assessments over many sites. The details of trend analysis and reporting processes vary to some extent depending on the type of application.
- 2.2.7 The guidance describes trend analysis in four main steps:
1. acquiring and compiling data,
  2. accounting for confounding factors,
  3. assessing trend direction, rate and confidence in these determinations, and
  4. reporting the results.
- 2.2.8 Trend assessment is a process of building a statistical model of the behaviour of a variable at a site over a time period of interest, based on a series of observations. The guidelines describe methods for detecting and quantifying the two most fundamental aspects of the relationship between the variable and time: the direction of the trend (i.e., increasing or decreasing) and the rate of change (e.g., change in concentration per year). In addition, because the observations are subject to random fluctuations and only comprise a sample of the variable's behaviour over the time period, the guidelines also describe methods for quantifying the uncertainties associated with the assessment of trend direction and rate.
- 2.2.9 This guidance is directly applicable for the requirement in Section 3.19(1) of the NPS-FM to characterise trends. However, NPS-FM Sections 3.19(2) and 3.19(3)

concern the causes of trends i.e., trend attribution, which was out of scope for this guidance.

#### 2.2.10 Reports

Snelder, T., Fraser, C., Larned, S., Whitehead, A. (2021). Guidance for the analysis of temporal trends in environmental data. NIWA Client Report 2021017WN, April 2021.

### STATE OF THE REGIONAL WATER RESOURCE

2.2.11 Autumn 2021 was the tenth warmest autumn in 112 years of records and no region in New Zealand experienced below average temperatures, according to NIWA. Rainfall was also below normal for many parts of the North Island including the Manawatū-Whanganui. The Ruapehu, Whanganui, Rangitikei and Manawatū Districts experienced below average rainfall (Figure 7) while Tararua District was even further below average and Horowhenua was about average.

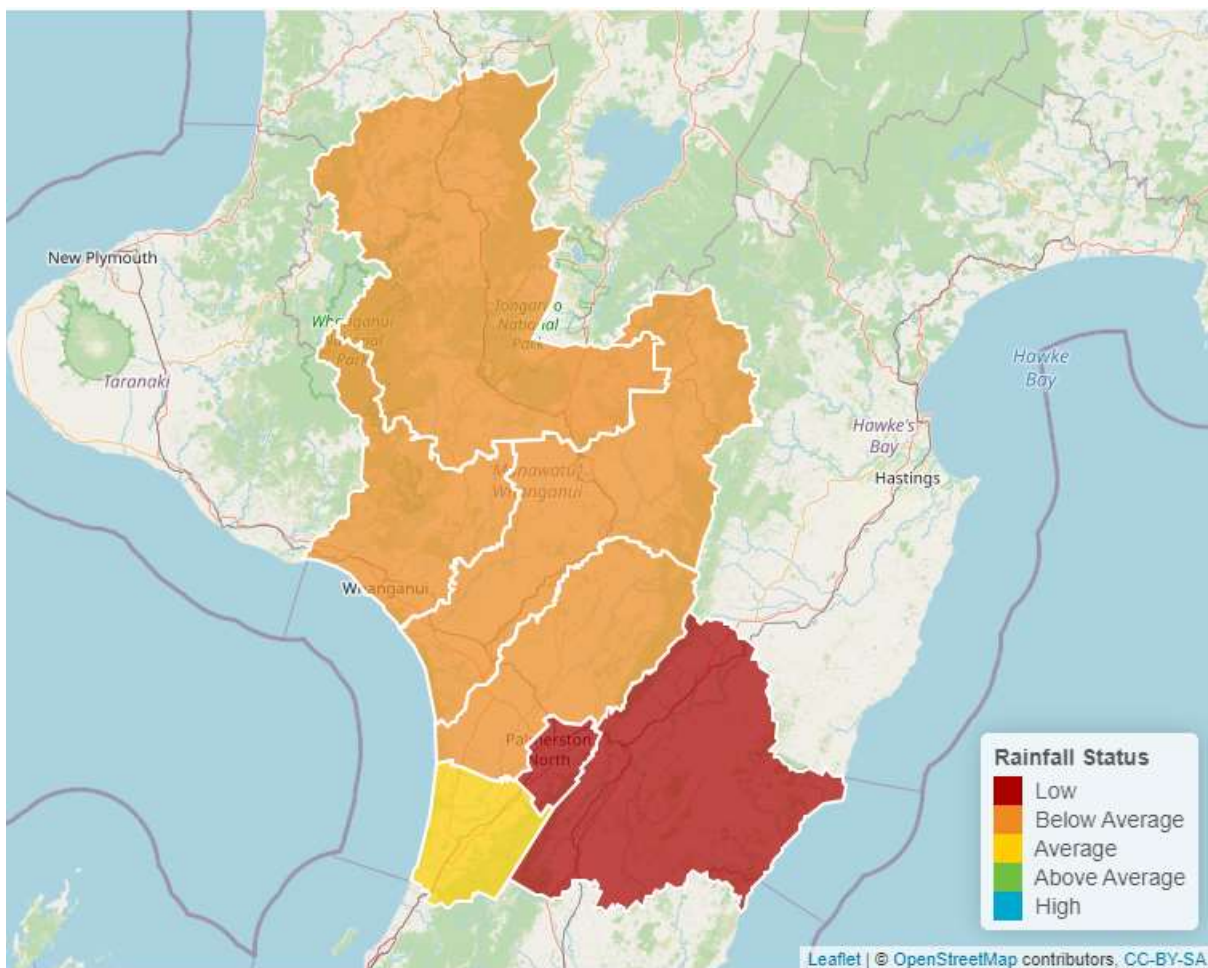


Figure 7: Hydrological status as determined by rainfall quantities during the preceding four months at 7 representative sites, August 2021.

2.2.12 The below-average autumn rainfall had some impact on groundwater levels going into winter. In August 2021, about 60% of the bores Horizons monitors were at average, above average or high level while about 40% were low or below average (Figure 8). Manawatū has the highest proportion of low and below average groundwater levels, with particularly low levels around the Ashhurst, Whakarongo and Karere areas.

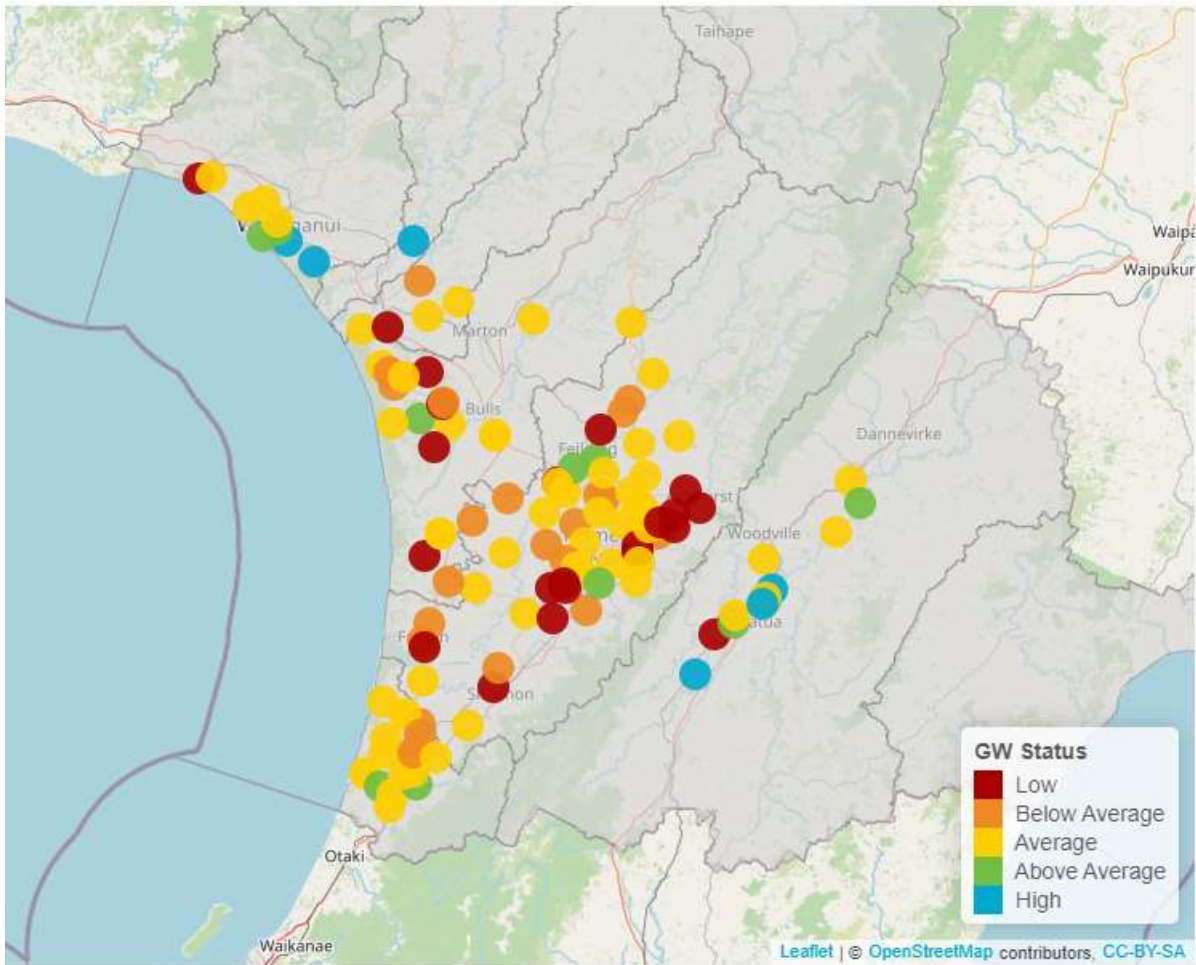


Figure 8: Groundwater level status as determined by monthly monitoring at 130 bores, August 2021.

2.2.13 Summer river flows reached limits in parts of the region. Lowest levels were reached in late March or early April, as is seasonally typical. During summer 2021 flow limits were reached later in the season than flows in summer 2020. Between July 2020 and June 2021 river flows across the region were generally higher than for the period July 2019 to June 2020. Figure 9 shows the river flow status at 30 June 2021 compared to the same date in 2020.

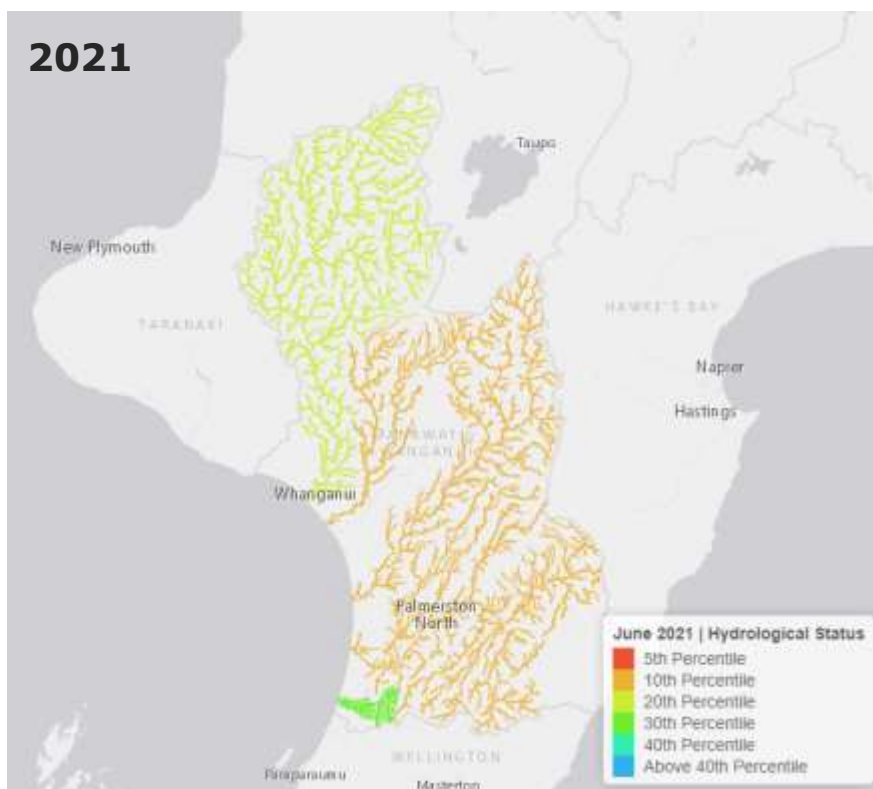
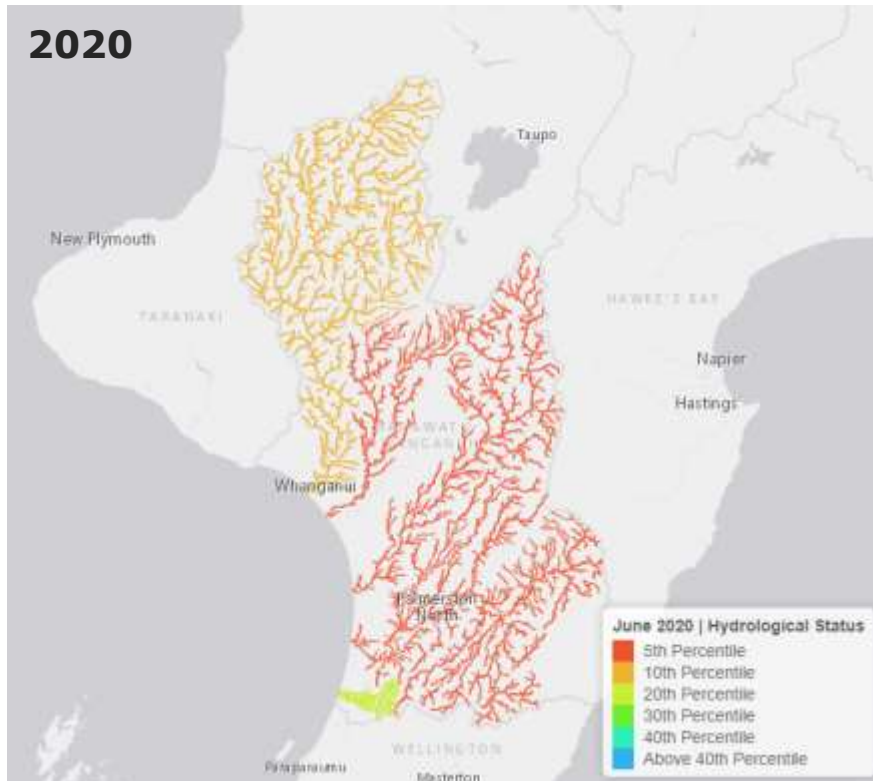


Figure 9: Hydrological status as determined by river flow at representative sites on 30 June 2021 (bottom image), compared to the same date in 2020 (top image). Flow bands are calculated on a daily scale based on every year in the dataset for 1 January 2000 to 31 December 2018) e.g., the 5<sup>th</sup> percentile flow represents the lowest 5 percent of flows for every 30 June in the dataset.

2.2.14 Table 3 provides an end-of-season summary of the days of low-flow restrictions experienced at flow sites across the region and the number of consent holders who were affected.

Table 3: End-of-season summary of flow restriction. Days in restriction calculated from 1 November 2020 to 1 May 2021.

Site Name	No. of Consents linked to site	Days in Restriction
Hautapu at Alabasters	2	47
Kai Iwi at Handley Road	1	26
Kumeti at Te Rehunga	1	73
Makakahi at Hamua	1	30
Makino at Boness Road	2	0
Makotuku at Raetihi	1	37
Manakau at SH 1 bridge	3	0
Manawatū at Hopelands	11	46
Manawatū at Teachers College	17	8
Manawatū at Upper Gorge	4	6
Manawatū at Weber Road	6	82
Mangahao at Ballance	1	3
Mangapapa at Troup Rd	1	38
Mangatainoka at Pahiatua Town Bridge	6	0
Mangatoro at Mangahei Road	1	65
Mangawhero at Pakihi Rd Bridge	11	0
Ōhau at Rongomatane	6	0
Oroua at Almadale Slackline	8	14
Oruakeretaki at S.H.2 Napier	3	14
Pohangina at Mai's Reach	5	3
Rangitikei at Mangaweka	6	25
Rangitikei at McKelvies	14	0
Rangitikei at Onepuhi	11	0
Rangitikei at Pukeokahu	1	13
Raparapawai at Jackson Rd	1	13
Tamaki at Stephensons	4	53
Tamaki at Water Supply Weir	1	79
Tiraumea at Ngaturi	4	7
Tokiahuru at Junction	10	0
Tokomaru at Riverland Farm	4	0
Turakina at Otairi	1	15
Waikawa at North Manakau Road	1	0
Waitangi at Tangiwai	1	48
Whangaehu at Kauangaroa	3	19
Whanganui at Te Maire	4	26

2.2.15 Of the 157 surface-water consents across the region with low-flow restriction conditions, 57% (89) experienced some period of restriction over the low-flow season from 1 November 2020 to 30 April 2021. Thirty of these consent holders experienced 30 or more days in restriction, meaning they had to either cease or substantially decrease their abstraction volumes. The flow site with the largest number of days with flows below minimum was Manawatū at Weber Road, recording 82 day of restriction. Six consents are linked to this site.

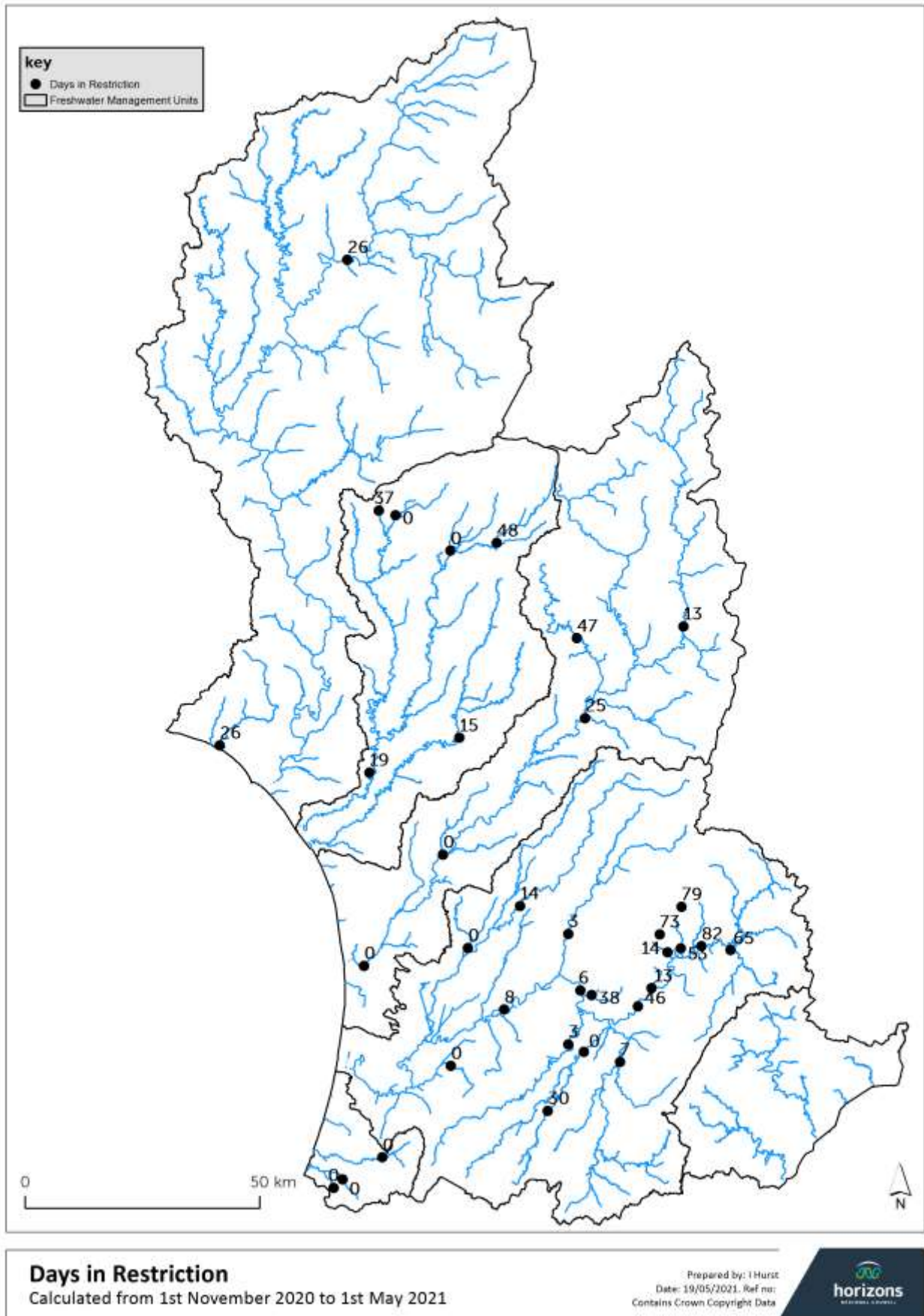


Figure 10: End-of-season summary of flow restriction displayed by location of sites (from Table 3) and the number of days in restriction.

2.2.16 The telemetered water-use programme continues with the programme of annual inspections progressing well. At the time of writing 358 were completed (81 more than last year's total) and 82 more than last year at the same time. Work was to continue with a further 189 assessments, many of which are industrial, to be completed. New sites are prioritised over those which power-off over winter. Eighty-three sites have been upgraded to the new equipment and a further nine require telemetry to be installed, six of which are challenging due to limited network availability and some involving portable pumps. However, the team will endeavour to have them installed before next summer. Spark have recently made some changes to their cell tower network, making greater coverage available in remote areas for use of the new telemetry equipment.

2.2.17 Council received a paper on the emerging issue where new national stock exclusion requirements are in some locations challenging to implement as the subsequent requirement to reticulate water requires resource consents and the water allocation framework in the One Plan is fully allocated, does not have a numerically defined water allocation limit, or the water allocation limit is zero allocation.

2.2.18 Reports

Mercer, R., Mitchell, J., Brown, L., Peet, N., and Roygard, J. (2021). [\*National Environmental Standard for Stock Exclusion – Implications for Consenting of Water Abstractions\*](#). Report No 20-158 to the Horizons Regional Council Strategy and Policy Committee, 10 November 2020.

## LAKES MONITORING

### State of the Environment Monitoring

2.2.19 **State of the Environment (SoE)** monitoring of the coastal dune lakes continued at four lakes monthly and a further 11 on a quarterly basis. Sampling of Lake Waiwiri (Papaitonga) at the staff gauge was reinstated in December as well as sampling of the Hokowhitu Lagoon at the footbridge; both lakes are now sampled monthly. Work on an expanded monitoring programme for lakes was undertaken during the year and was fed into the **Long-term Plan (LTP)** process.

### LakeSPI

2.2.20 The ecological condition of eight lakes was assessed during December 2020 using the **Lake Submerged Plant Indicators (LakeSPI)** survey method (Photo 1). Rotokawau (aka Virginia Lake) in Whanganui and Hokowhitu (Centennial Lagoon in Palmerston North, were surveyed for the first time while the remaining six lakes (Alice, Dudding, Namunamu, Pauri, Pukepuke Lagoon, and Wiritoa) were last surveyed in 2015-16.

2.2.21 Of the two new lakes, Hokowhitu Lagoon was categorised in excellent condition and Lake Rotokawau as moderate. The Hokowhitu Lagoon, while shallow at approximately 2.4 metres, maintained a native plant community extending across the bottom and no impact from invasive weed species. Lake Rotokawau retained elements of native vegetation while also being impacted by the invasive

weed *Egeria densa*, and an extensive algae bloom was also present at the time of the December survey.

2.2.22 All six lakes re-surveyed in 2020 remained in a stable condition. However, New Zealand's worst submerged weed species, hornwort (*Ceratophyllum demersum*), was recorded at Lake Namunamu near Hunterville, as it continues to spread around the lake.

2.2.23 This monitoring forms part of a longer-term monitoring programme. LakeSPI has been used to assess the condition of 47 lakes in the Manawatū-Whanganui region with LakeSPI indices for lakes ranging from 0% (heavily impacted) to 97% (pristine, unimpacted). Eleven lakes were categorised in excellent condition, five in high condition, 18 in moderate condition, eight in poor condition and five as being non-vegetated (Figure 11). The final report has been completed. This monitoring will inform assessment of lake state against new water quality attributes required under the 2020 NPS-FM.



Photo 1: Photo montage of LakeSPI field sampling (December 2020) in Horizons Region.

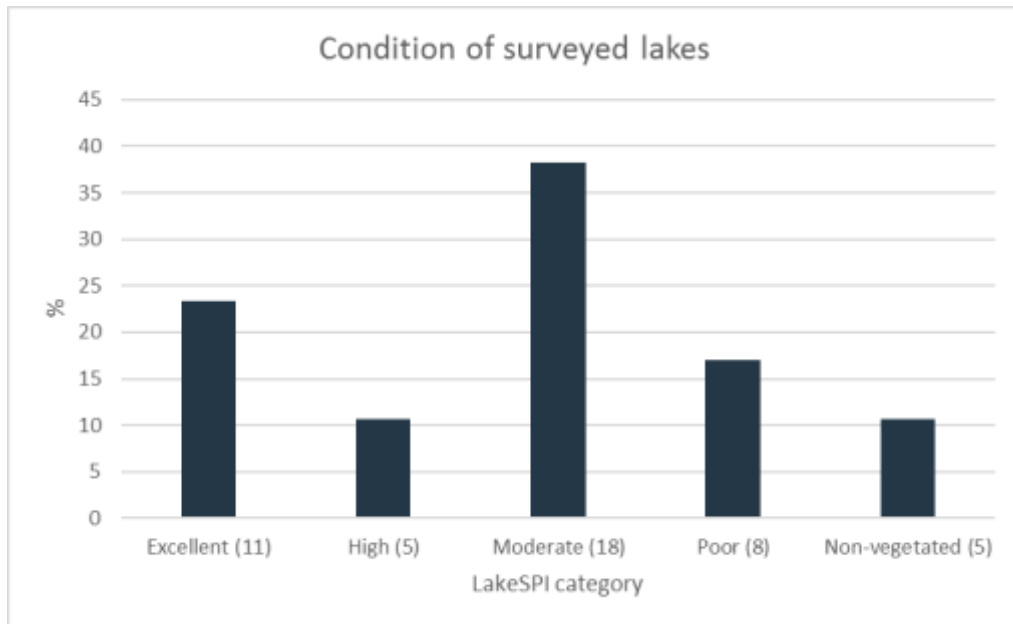


Figure 11: The percentage of the 47 surveyed lakes that fall into each of the five LakeSPI categories. Numbers in brackets show the number of lakes in each category.

## Microplastics Monitoring

2.2.24 Microplastics are among contaminants of emerging concern for aquatic systems. The **Global Lake Ecological Observatory Network (GLEON)** has begun a study named **Global Lake Microplastics (GALACTIC)**, and Horizons participated by sampling Lake Wiritoa and Lake Pauri, both near Whanganui, in November 2020. The objective is to sample lakes worldwide to identify the occurrence of microplastics in surface water of different freshwater systems based on watershed and lake features e.g., land-use, population and catchment area. Samples were sent to the University of Milano-Bicocca in Italy for processing free of charge. Fifty-seven lakes are now included in the project and 18 analysed with techniques ranging from visual identification to Raman Spectroscopy, and analysis was planned to conclude within months. This will lead to a collective research paper drafted by the end of the year, helping to advance global research around microplastics in freshwater systems.

### 2.2.25 Reports

Burton, T. (2021). *Assessment of 47 lakes in the Manawatū-Whanganui Region using LakeSPI*. NIWA Client Report prepared for Horizons Regional Council.

## ESTUARY ECOLOGICAL CONDITION MONITORING

2.2.26 Horizons region contains 40 estuaries with 25 on the west coast and 15 on the east coast. Five of these estuaries have been identified as moderately to highly vulnerable to excess nutrient and sediment (Wainui and Tutane on the east coast and Kai iwi, Hōkio and Waikawa on the west coast). Horizons monitors seven estuaries for water quality indicators and undertakes ecological condition monitoring on a 10-year rotational work programme.

2.2.27 Ecological condition and/or sedimentation monitoring of five estuaries across four FMUs was conducted by Salt Ecology in December 2020.

- 2.2.28 Fine-scale intertidal monitoring of Whanganui Estuary (Whanganui Kai Iwi FMU) was the culmination of a baseline of three annual ecological surveys undertaken between January 2019 and December 2020. One of the questions raised in the January 2020 survey report was whether the significant sedimentation measured at Site A in January 2020 was a reflection of a change in the catchment e.g., land disturbance, a climatic event that delivered a large pulse of sediment, and/or simply reflected a highly dynamic sedimentary environment. The present survey, which revealed a variable macrofauna community at Site A, coupled with the loss of sediment plates and pegs, suggest that the estuary environment is relatively dynamic and experiences naturally-driven temporal variability consistent with its river-dominated nature.
- 2.2.29 Annual sediment monitoring in the Whangaehu Estuary (Whangaehu FMU) has been undertaken since January 2018 to assess trends in the deposition rate, mud content and oxygenation of intertidal sediments. There are not enough data to calculate the five-year mean sedimentation rate, however the annual changes show the Whangaehu Estuary is highly dynamic and remains under pressure from fine sediments in catchment run-off.
- 2.2.30 Annual sediment monitoring in the Manawatū Estuary (Manawatū FMU) has been undertaken since January 2017 to assess trends in the deposition rate, mud content and oxygenation of intertidal sediments. There are not yet enough data to calculate a five-year mean sedimentation rate but this is due in 2022. The results to date indicate that despite observed erosion, the estuary remains under pressure from sediment impacts, with a macrofaunal community likely dominated by mud-tolerant species – a common situation in New Zealand tidal river estuaries.
- 2.2.31 Synoptic surveys of Ōhau Estuary and Waikawa Estuary (Waiopahu FMU) were conducted in December 2020 to quantify the ecological condition of the subtidal reaches. The survey targeted locations that showed symptoms of nutrient enrichment i.e., algal blooms and depleted oxygen in stratified areas when previously surveyed in January 2020. The results from December 2020 show some improvement in sediment condition and water quality in both the Ōhau and Waikawa estuaries compared to January 2020, likely as a consequence of recent flushing following heavy rainfall in the week prior to the most recent sampling. The results show that the estuaries remain under pressure from nutrient and sediment loads and continue to express signs of eutrophication. As recommended in the report, Horizons is undertaking bathymetric surveys of the estuaries to enable accurate delineation of areas likely to stratify, and to inform the development of hydrodynamic models. These models will be used to estimate nutrient concentrations and predict ecological outcomes of future nutrient and sediment management in the catchment, and have been commissioned via the Jobs for Nature Project.

#### 2.2.32 Reports

Whanganui and Kai Iwi FMU:

Forrest BM, Roberts KL, Stevens LM. 2021. [Fine Scale Intertidal Monitoring of Whanganui Estuary](#). Salt Ecology Report 065, prepared for Horizons Regional Council, March 2021. 31p.

Whangaehu FMU:

Roberts KL. 2021. [Whangaehu Estuary Sediment Monitoring Short Report](#). Salt Ecology Short Report 004, prepared for Horizons Regional Council, March 2021. 2p.

Manawatū FMU:

Roberts KL. 2021. [Manawatū Estuary Sediment Monitoring Short Report](#). Salt Ecology Short Report 003, prepared for Horizons Regional Council, March 2021. 2p.

Waiopēhu FMU:

Roberts KL, Stevens LM, Forrest BM. 2021. [Synoptic Subtidal Monitoring of Ōhau Estuary, Manawatū](#). Salt Ecology Report 064, prepared for Horizons Regional Council, April 2021. 37p.

Roberts KL, Stevens LM, Forrest BM. 2021. [Synoptic Subtidal Monitoring of Waikawa Estuary, Manawatū](#). Salt Ecology Report 063, prepared for Horizons Regional Council, March 2021. 39p.

## COASTAL MARINE AREA MAPPING

2.2.33 The **Costal Marine Area (CMA)** of Horizons region encompasses approximately 3,000 km<sup>2</sup> of territorial sea comprising distinct and separate western and eastern coastlines. Horizons manages the CMA in accordance with its combined Regional Policy Statement and the One Plan, a key objective being to ensure that the natural character and ecosystem processes are maintained while still allowing activities and development. Funded through an MBIE Envirolink Advice Grant, NIWA was commissioned by Horizons to report information on three CMA priority areas identified during a previous Envirolink project:

- Seafloor biota information for the western and eastern CMAs to describe the likely distribution of biogenic habitat<sup>5</sup>-forming species and the distribution of corals and other vulnerable benthic<sup>6</sup> species.
- Threatened marine mammal and marine invertebrate distribution information for the western and eastern CMAs.
- Predicted distribution of reef and demersal<sup>7</sup> (living near the sea floor) fish species in the eastern CMA.

2.2.34 The habitat suitability and species occurrence modelling maps provide important information on the potential distribution of vulnerable marine invertebrates (corals), marine mammals, and reef and demersal fish, which allows the identification of important habitats and areas for protection and conservation. In comparison to much of the rest of New Zealand's coastal marine regions there are few data and datasets available on the habitats, fauna and flora of the Horizons CMAs. Considerably more information was available for the western than the eastern CMA, which appears to have a paucity of data on both marine habitat types and associated species diversity.

2.2.35 Horizons has a commitment within its Regional Policy Statement and Regional Plan (One Plan) to ensure that the natural character and ecosystem processes are maintained. This includes maintaining the life-supporting capacity and social

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<sup>5</sup> Biogenic habitats are habitats produced by living organisms.

<sup>6</sup> The benthic zone is the ecological region at the lowest level of a body of water such as an ocean, lake, or stream, including the sediment surface and some sub-surface layers.

<sup>7</sup> The demersal zone is the part of the sea or ocean (or deep lake) consisting of the part of the water column near to (and significantly affected by) the seabed and the benthos.

and economic values of the region's CMA. This project will inform future policy development e.g., through identification of probable significant or vulnerable habitats/species that may require specific management; assessment of resource consent applications; and Horizons' SOE reporting for the CMA. It will also build on our existing baseline knowledge of the CMA for the further development of our coastal monitoring programme, which provides the most efficient use of limited resources.

#### 2.2.36 Reports produced

Hale, R., Wadhwa, S., Anderson, T., Anderson, O., Hupman, K., Stephenson, F., Lundquist, C., Schnabel, K., and Neil, K. (2021). [\*Seafloor habitats and fish, invertebrate and marine mammal diversity in the Horizons Region coastal marine area\*](#). NIWA Client Report 2021069NE prepared for Horizons Regional Council, March 2021.

### **CONTACT RECREATION WATER QUALITY MONITORING**

2.2.37 Monitoring of 81 popular swim spots around the region (Figure 12) began on 1 November 2020. The programme is delivered in collaboration with MidCentral Public Health Service, local councils and Ngā Waihua o Paerangi Trust (formerly Ngāti Rangi Trust). Monitoring results are reported weekly, as they become available, via both Horizons (<http://www.horizons.govt.nz>) and the LAWA (<http://www.LAWA.org.nz>) websites. The 2020-21 contact recreation season ended on 27 April 2021.

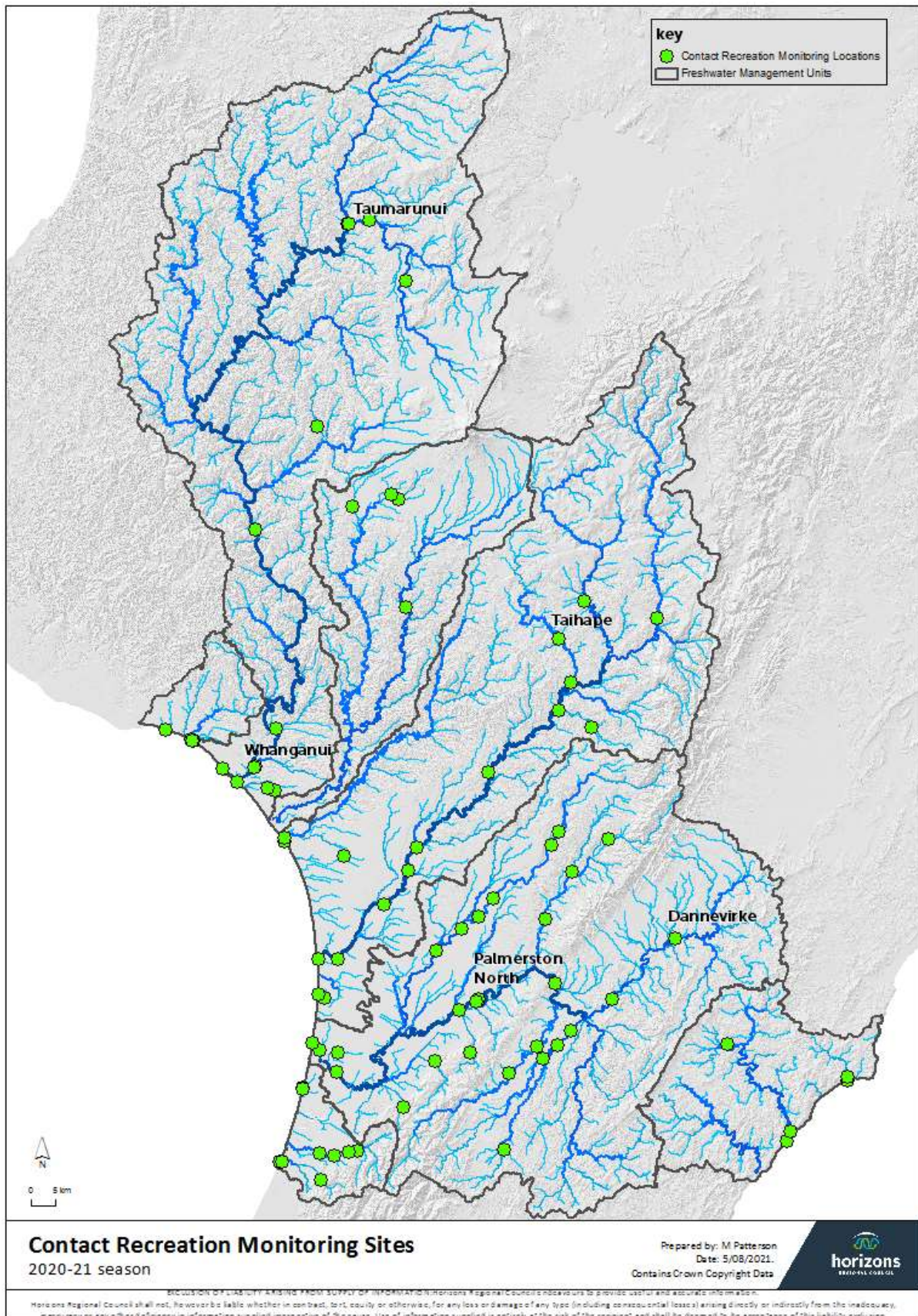


Figure 12: Map of all contact recreation monitoring locations in the 2020-21 monitoring season

2.2.38 The 2020-21 contact recreation data has been finalised and quality coded, and the results have been disseminated to territorial authorities. As this is the fifth year of the extended contact recreation programme (at the majority of the 81 sites as opposed to the earlier approximate 17 sites), a five-year dataset has now been captured. This will allow for an analysis against the requirements of the NPS-FM (2020) and will allow classification of sites into their appropriate attribute bands. This work is programmed for the 2021-22 financial year.

### **Summary of Swimmability in the 2020-21 season**

2.2.39 Below is a regional summary of swimmability as measured against relevant national guidelines for contact recreation. River and lake sites are measured for both microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. Coastal sites are measured for *Enterococci* only. The first graph below provides a composite of these three measures and takes the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed.

2.2.40 Figure 14 is a graph displaying regional measures for *E. coli* only; cyanobacteria only are displayed in Figure 15; and *Enterococci* only are displayed in Figure 16. These allow for a more detailed explanation of drivers of the swimmability results seen at a site.

2.2.41 A summary of the season's results for each FMU, as measured against relevant national guidelines for contact recreation, are displayed later in the report in their relevant FMU. These are ranked by worst to best performing sites, top to bottom for each FMU, and for the sake of brevity are displayed as an overall score only.

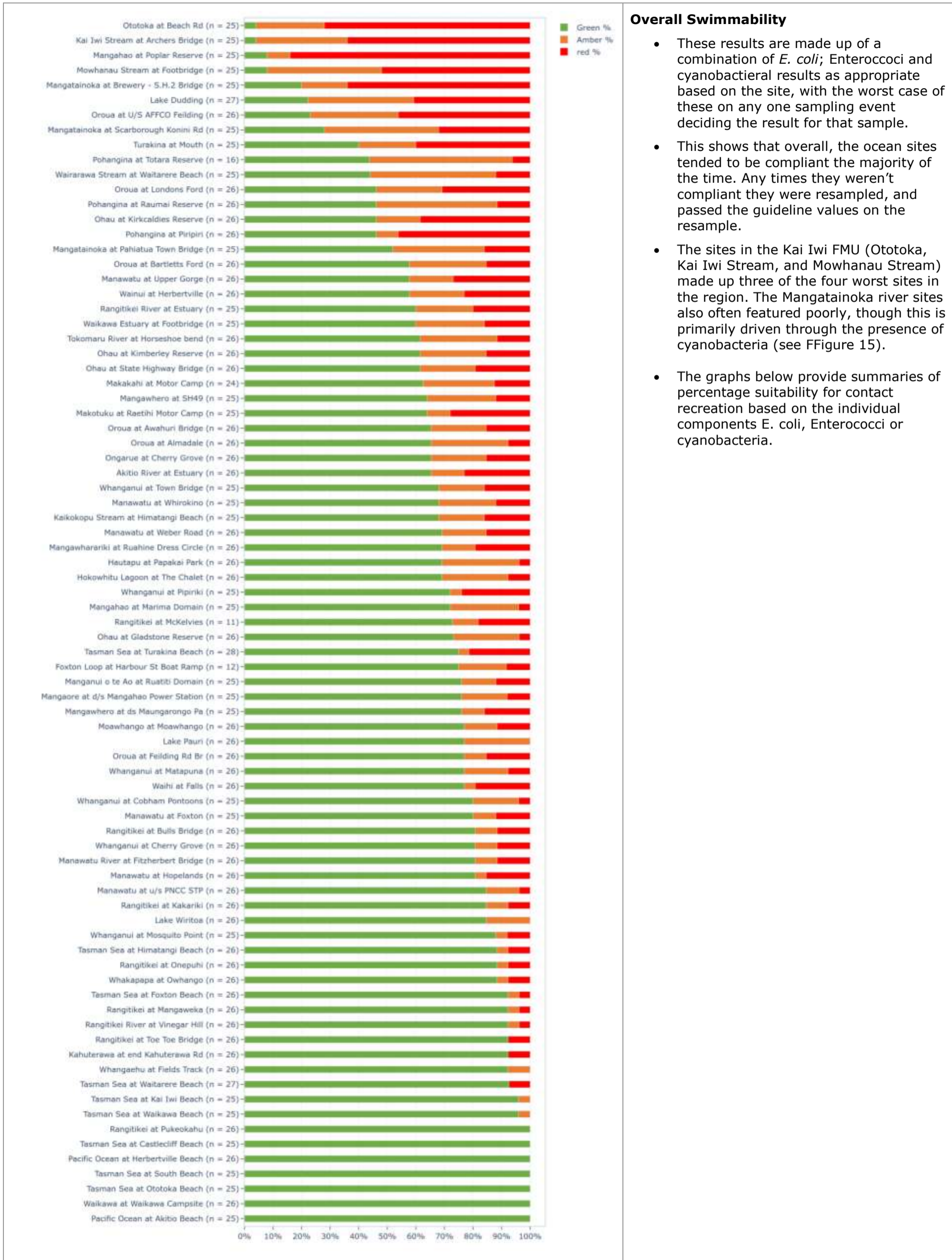
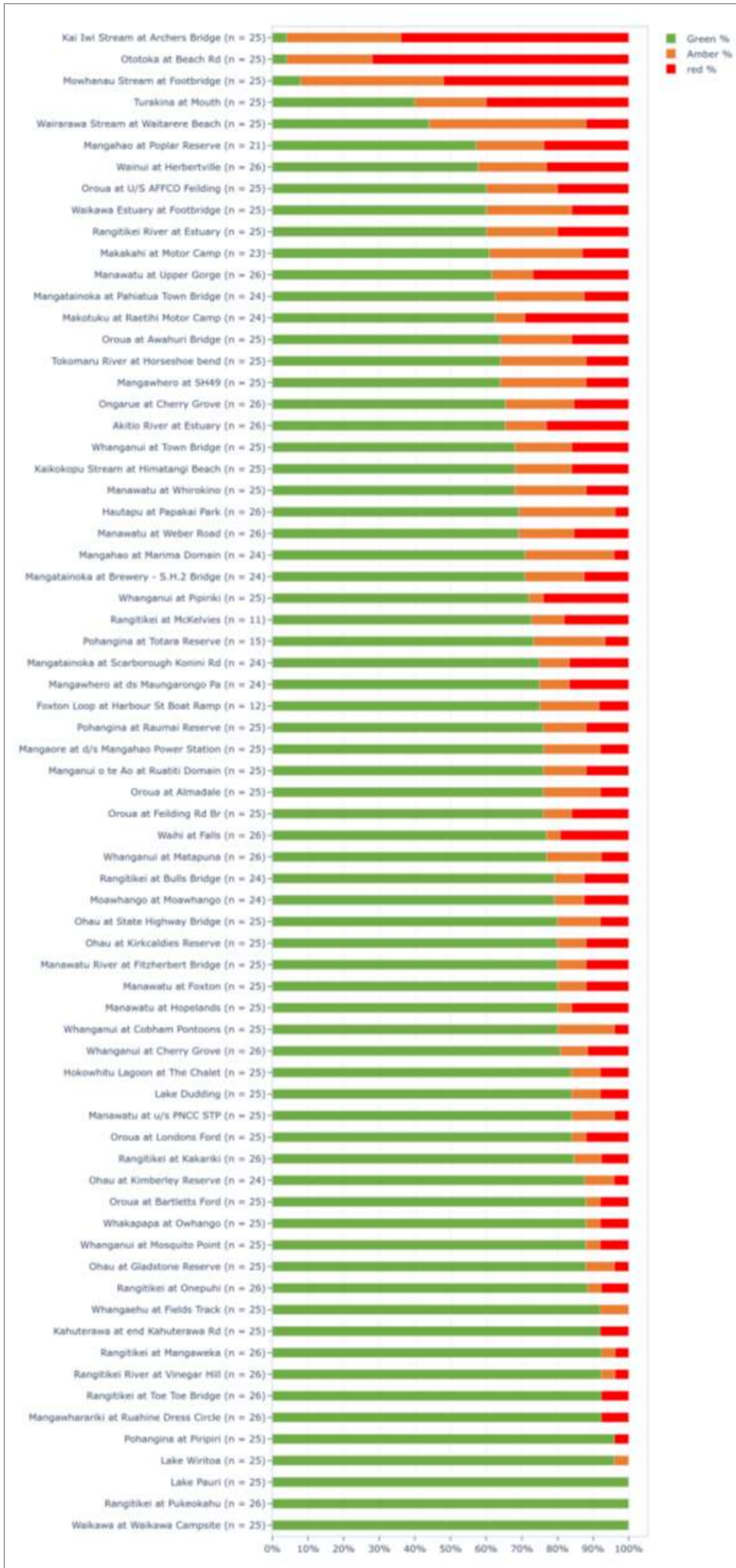


Figure 13: Overall swimmability at bathing sites during the 2020-21 monitoring Season



### E. coli only results

- High *E. coli* results indicate a high incidence of faecal contamination, and suggest it is more likely that someone would get a stomach bug or similar gastrointestinal infection if they were to swim or engage in contact recreation at these sites.
- The three freshwater and estuarine Kai Iwi FMU sites feature as the three worst sites in the region (discussed further in the Kai Iwi FMU).
- Lake Wairua and Lake Pauri feature as some of the best performing sites in this region for this measure.
- Typically sites higher up in catchments performed better than those lower in catchments, though this is not always the case.

Figure 14: Proportion of samples in the different *E. coli* alert levels at monitored freshwater and estuarine bathing sites during the 2020-21 monitoring season

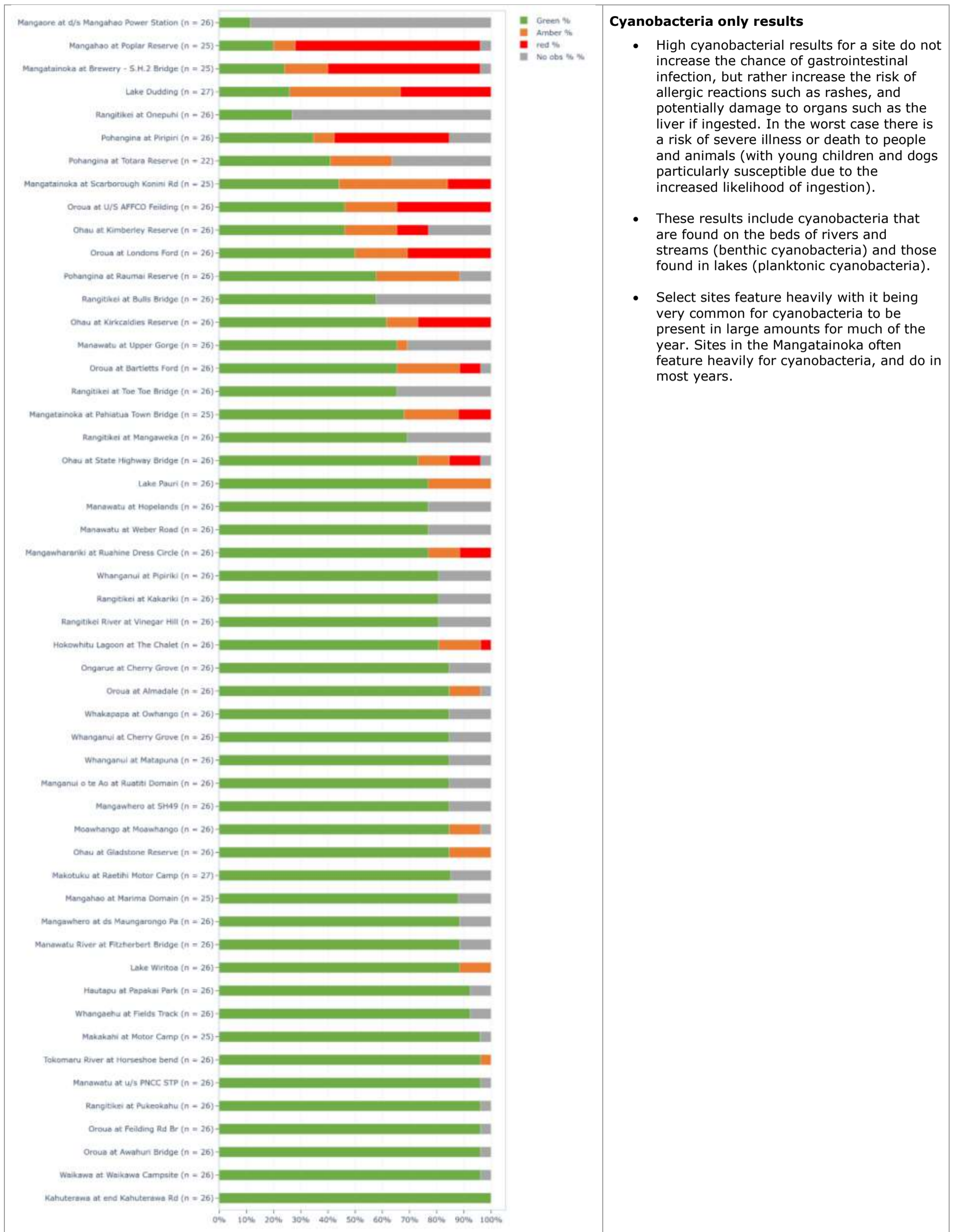


Figure 15: Proportion of samples in the different cyanobacteria alert levels at monitored freshwater bathing sites during the 2020-21 monitoring season

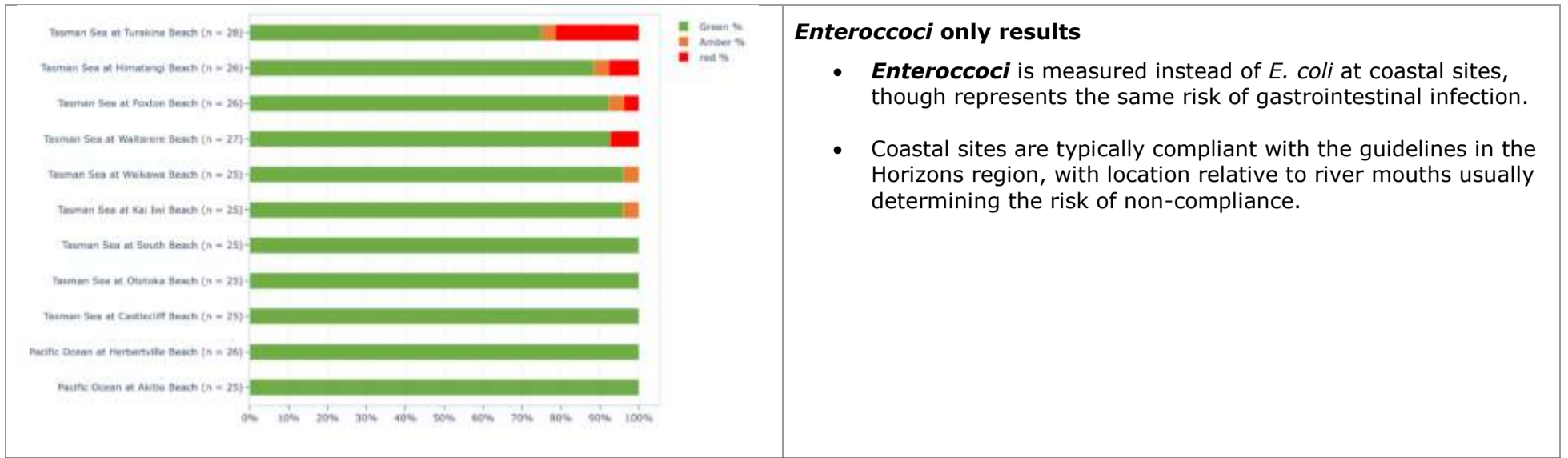


Figure 16: Proportion of samples in the different *Enterococci* alert levels at monitored coastal bathing sites during the 2020-21 monitoring season

2.2.42 Faecal source tracking was planned for last season but had to be delayed because of Covid-19. During the 2020-21 season, samples were taken at all lakes monitored for contact recreation, as well as a number of sites along the Wainui Stream in coastal Tararua. Samples were tested for E.coli concentrations and those that exceeded the amber alert level for contact recreation (greater than 260 MPN/100 mL), or close to this threshold, were further analysed for human, avian, ruminant markers and a general DNA marker. A summary of results for sites that were able to progress to faecal source tracking can be seen below in Table 4 (lakes) and Table 5 (Wainui Stream). NB: the threshold for the red alert level is 550 MPN/100 mL.

Table 4: Faecal-source tracking results for lake samples during the 2020-21 season

Site	<i>E.coli</i> (MPN/100 mL)	Conclusion
Stormwater drain at Lake Pauri	140	Species-specific faecal source not identified
Lake Dudding	620	Faecal source – avian
Hokowhitu Lagoon at Outlet	1,900	Species-specific faecal source not identified

Table 5: Faecal source-tracking results for Wainui Stream during the 2020-21 season

Site	<i>E.coli</i> (MPN/100 mL)	Conclusion
Wainui u/s Wimbledon Stream	1,700	Faecal source – ruminant (50 - 100%)
Wainui d/s Wimbledon Stream	210	Faecal source – ruminant (50 - 100%) plus avian
Wainui u/s Waikopiro Stream	230	Faecal source – ruminant (10 - 50%)
Wainui d/s Waikopiro Stream	340	Faecal source – ruminant (10 - 50%)
Wainui u/s Mangaone Stream	130	Faecal source – ruminant (10 - 50%)
Wainui d/s Mangaone Stream	760	Faecal source – ruminant (50 - 100%)
Wainui u/s Herbertville Town	130	Faecal source – avian plus possibly low level ruminant

2.2.43 Other work underway includes a review of all of the contact recreation signage across the region and the 'Can I Swim Here?' campaign, ahead of the 2021-22 season. This will include additional information on the risk of drowning, following a coroner's report into a drowning in the region.

## PLAN CHANGE 2 SUPPORT

2.2.44 Plan Change 2 was focussed on amending implementation issues with the nutrient management framework in the One Plan, including changes to Overseer and the inability to apply for consent for leaching in excess of One Plan Table 14.2.

2.2.45 A team of science staff and external consultants provided support as technical experts to the Plan Change 2 process. Much of the work in the lead up to the plan change was carried out in the 2019-20 financial year. Preparation of

evidence, caucusing and appearance before the hearing panel took place during the 2020-21 financial year.

2.2.46 Scientific evidence covered the impact on water quality from proposed changes to the table; modelling for outcomes as a result of the new rule framework being implemented; soil science and Overseer changes; on-farm management practices; good management practice; and economics.

2.2.47 Reports produced

Technical reports related to this process can be found on the Horizons website:  
<http://www.horizons.govt.nz/publications-feedback/publications/plan-change-2-documents>

## ESSENTIAL FRESHWATER IMPLEMENTATION

2.2.48 On 28 May 2020 the Government released the essential freshwater package, which included an amended **National Policy Statement for Freshwater Management (NPS-FM)** 2020 and a **National Environmental Standard for Freshwater (NES-FW)**. Oranga Wai - Our Freshwater Future is the way Horizons has chosen to represent the Essential Freshwater package and to allow for cohesion across the freshwater work we undertake.

2.2.49 Science staff have been undertaking a gap analysis of requirements of regional councils under both the NES-FW and NPS-FM and are subsequently developing a detailed science work programme for the next four years to support the Oranga Wai process.

2.2.50 Part of this development included commissioning LWP to lead a think-piece around the role of science in the process and how it can best support the policy team to deliver Oranga Wai. This report was finalised in May 2021 and is available to council.

2.2.51 LWP (Land Water People) Ltd were commissioned to work on nutrient load estimates and nutrient load reduction assessments for the Region. The end goal of this work is to understand the reduction in nutrient load required to meet periphyton outcomes in the One Plan and to meet periphyton bands SET OUT IN in the NPS-FM. This builds on the work programmes that have been completed in partnership with NIWA and DairyNZ in previous years, exploring the drivers of periphyton.

2.2.52 This analysis will eventually underpin the recalibration of the CASM model that was developed during the Plan Change 2 (PC2) process to further inform limit setting under the NPS.

2.2.53 There are two outputs for this work. The first is a report, now complete, and the calculation of updated contaminant loads (to December 2019) for water quality monitoring sites in the Manawatū-Whanganui region. The second is a report providing an estimate of reductions required to achieve the different periphyton biomass targets in the region. A draft of this piece of work is currently being internally reviewed.

2.2.54 Reports

Snelder, T., Harris, S., Norton, N., Robson-Williams, M., Roygard, J., and Matthews, A. (2021). [Horizons Regional Council science plan](#). LWP (landwaterpeople) Client Report 2019-10 prepared for Horizons Regional Council, May 2021.

Fraser, C., (2021) [Load calculations for rivers of the Manawatū-Whanganui Region to 31 December 2019](#). LWP (landwaterpeople) Client Report 2021-09 prepared for Horizons Regional Council, June 2021.

## STATE AND TRENDS OF WATER QUALITY

- 2.2.55 As part of the Oranga Wai process, stocktake documents for each of the identified Freshwater Management Units are being compiled by the policy team. Science staff have been involved in the compilation of scientific information about the catchments, which included updating the state and trends of river water quality at both state of the environment and impact (downstream of major point source discharges) for the period ending December 2019.
- 2.2.56 LWP were commissioned to undertake this analysis as an update to the 2019 SoE report, which presented the results to 1 July 2017. The data from the SoE river physico-chemical and biological monitoring programmes were collated to December 2019 and provided to facilitate this update.
- 2.2.57 The outputs of the analysis were completed by LWP in February 2021 alongside a short technical report outlining the methods used and a brief summary of results.
- 2.2.58 A regional summary of the results is presented below and a summary of the results for each of the FMUs is included in the specific FMU section later in the report. The analysis calculated the state of water quality as compared to the NPS-FM 2020 **National Objectives Framework (NOF)** for a five-year period and the confidence of an improving trend in water quality and biological indicators for both a 10-year and a 20-year period ending in December 2019. The trend analysis is using raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.
- 2.2.59 The state of water quality at state of the environment sites is presented in Figure 17. Most sites were in the A or B band for nitrate and ammonia toxicity. Of the 50 sites analysed for periphyton many were band A; however, two (Moawhango at Waiouru and Makuri at Tuscan Hills) are below the national bottom line (band D). Grades for DRP and MCI/QMCI are mixed with 40 and 23 sites respectively below the national bottom line. Three of the sites below the bottom line for DRP are reference sites (sites that are predominantly in native cover). Across the different statistics for *E. coli*, sites are mostly in bands D and E.
- 2.2.60 The state of water quality at impact sites is presented in Figure 18. Generally, water quality state is poorer immediately downstream of the point-source discharges than the state of the environment sites. Three sites are below the bottom line for **Invertebrate Community Indices (ICIs)** and 18 for DRP.

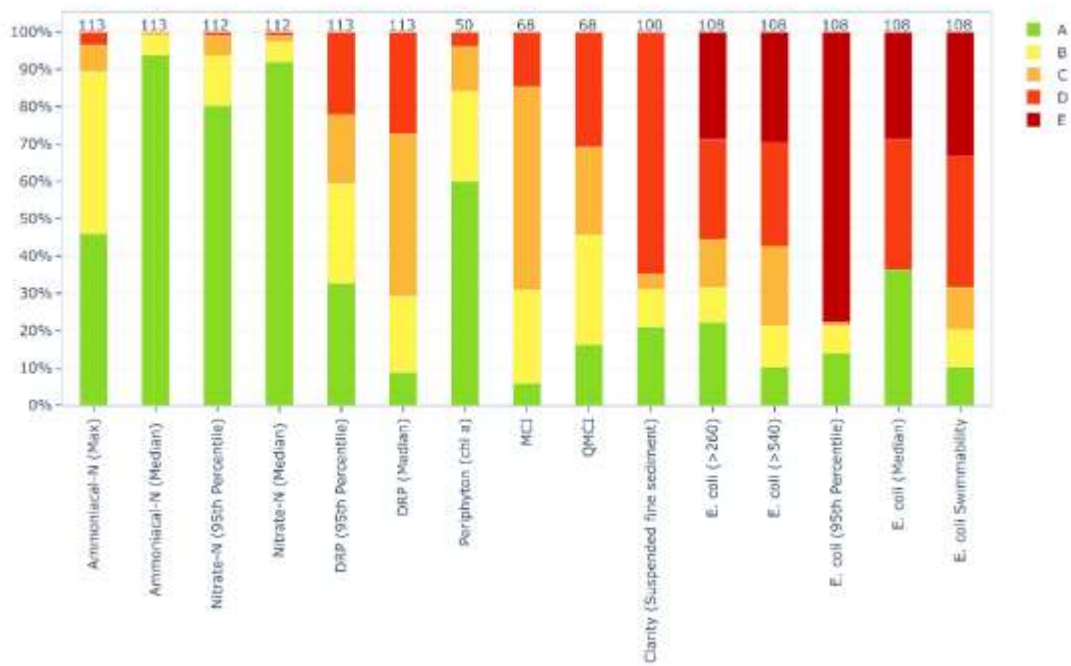


Figure 17: State of water quality in the Manawatū-Whanganui Region at state of the environment sites compared to NOF 2020 attributes for the five-year period ending December 2019

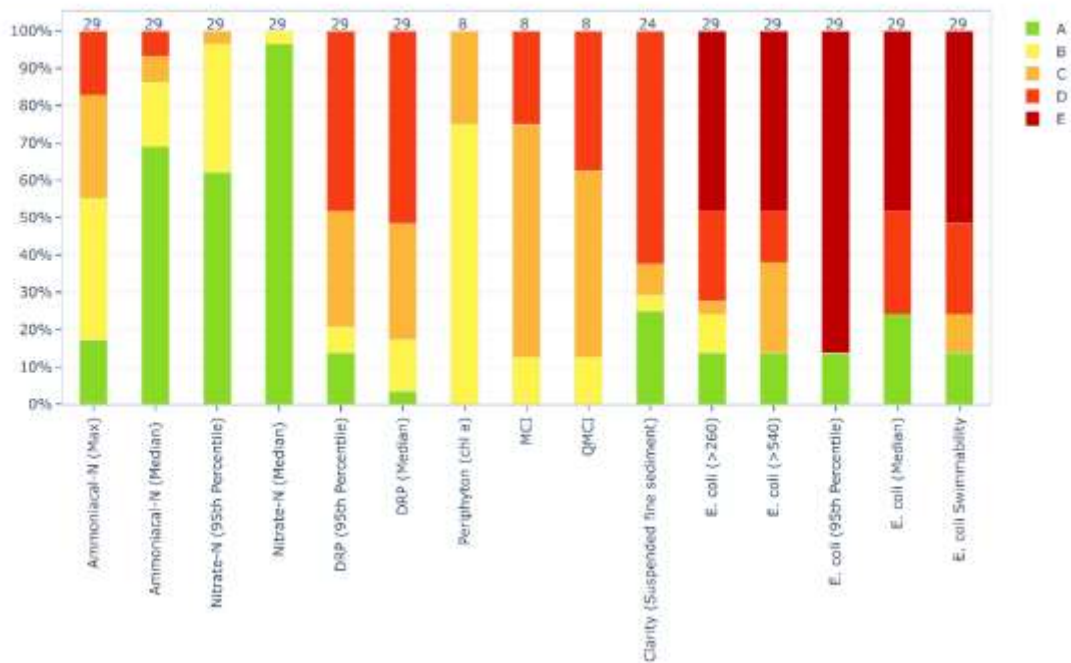


Figure 18: State of water quality in the Manawatū-Whanganui Region at impact sites compared to NOF 2020 attributes for the five-year period ending December 2019

2.2.61 Twenty-year trends at state of the environment sites (Figure 19) showed predominantly improving trends for *E. coli*, QMCI, ammoniacal nitrogen, soluble inorganic nitrogen and total nitrogen, whereas the sites are predominantly degrading for phosphorus, **Macroinvertebrate Community Index (MCI)**, and visual clarity.

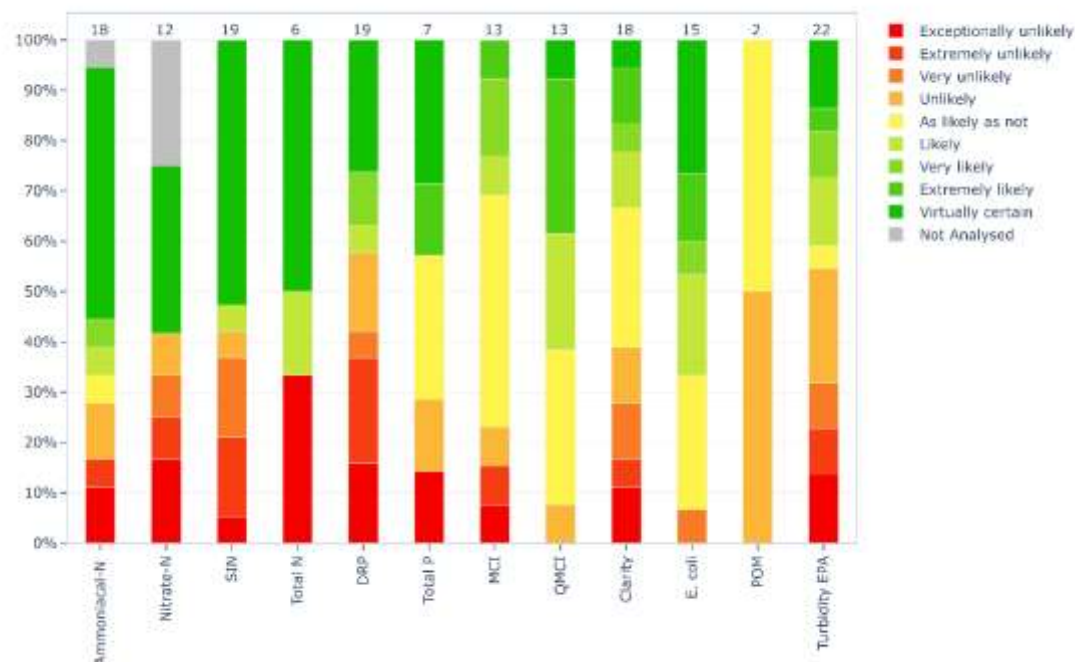


Figure 19: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Manawatū-Whanganui for the twenty-year period ending December 2019

2.2.62 Ten-year trends at state of the environment sites (Figure 20) showed predominantly improving trends for **Particulate Organic Matter (POM)**, ammoniacal nitrogen, soluble inorganic nitrogen and total nitrogen; whereas the sites are predominantly degrading for phosphorus, chlorophyll *a*, MCI, and visual clarity.

2.2.63 Ten-year trends at impact sites (Figure 21) showed improving trends for ammoniacal nitrogen and POM, whereas the sites are predominantly degrading for total and **Dissolved Reactive Phosphorus (DRP)** and visual clarity. Trends of the other indicators were more mixed.

#### 2.2.64 Report

Fraser, C., and Snelder, T. (2021). [Updated State and Trends of River Water Quality in the Manawatū-Whanganui](#). LWP Client Report 2021-02 prepared for Horizons Regional Council, January 2021.

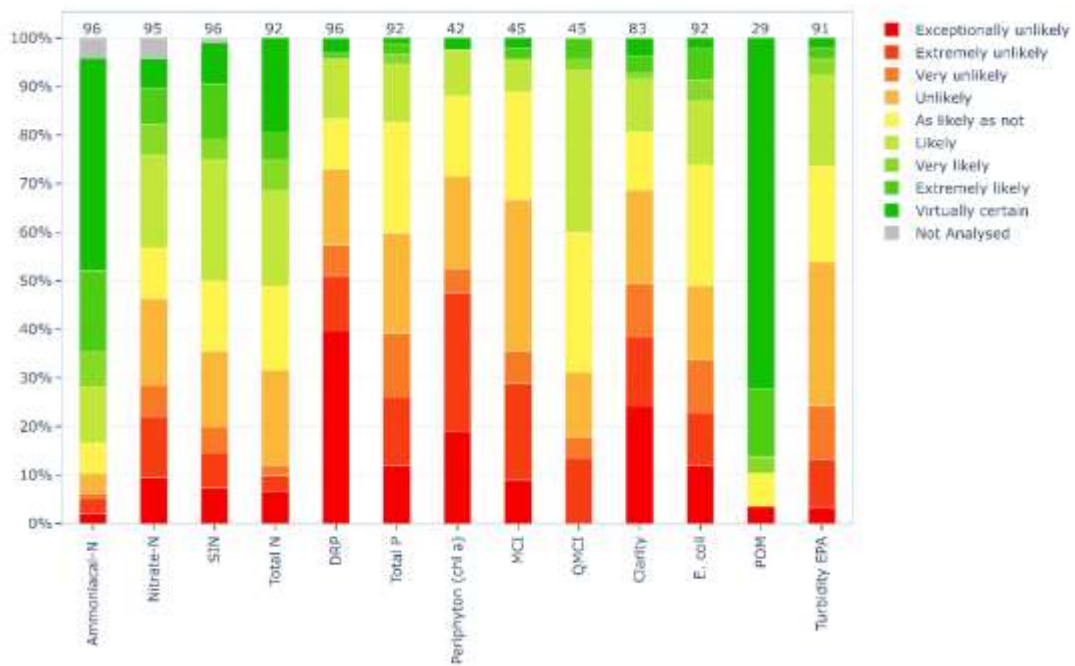


Figure 20: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Manawatū-Whanganui for the ten-year period ending December 2019

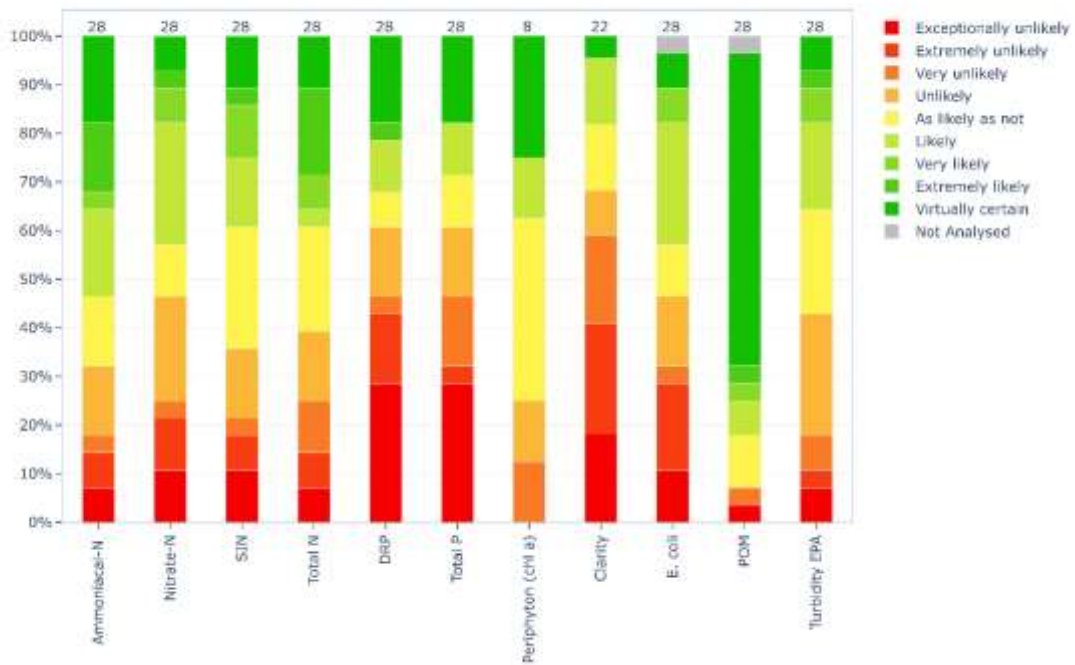


Figure 21: Unadjusted confidence of an improving trend in water quality at impact sites in the Manawatū-Whanganui for the ten-year period ending December 2019

## SUMMER BIOMONITORING PROGRAMMES

- 2.2.65 Summer water quality monitoring includes a range of projects on biological monitoring in the Horizons region, including macroinvertebrate, periphyton and fish monitoring. Much of this monitoring is flow dependant, so low flows and stable weather conditions throughout summer allowed significant progress to be made.
- 2.2.66 Freshwater aquatic macroinvertebrates provide a holistic view of water quality at a point as they are resident in a given water body for several months up to several years at a time. A metric named the **Macroinvertebrate Community Index (MCI)** and its variants measures the taxa composition i.e., which macroinvertebrates are found there, at a site, and are used to indicate nutrient enrichment. This monitoring can only be undertaken during low-flow periods.
- 2.2.67 Long-term macroinvertebrate monitoring is critical in measuring our current state and progress against measures in the One Plan and NPS-FM (2020).
- 2.2.68 Sampling for macroinvertebrates was completed by end of March for 95 sites, with all samples sent to laboratories for processing. These results are expected in the middle of the 2021-22 financial year. All results are displayed on the [LAWA](#) website and are incorporated with relevant state and trends assessments as they are undertaken.
- 2.2.69 Periphyton is the community of alga, cyanobacteria and fungi living on the beds of rivers and streams, and is important as a measure of nutrient enrichment. Both the One Plan and NPS-FM include periphyton measures that the regional council are required to meet.
- 2.2.70 Monthly periphyton monitoring has continued throughout the 2020-21 financial year at 63 sites. This data either was, or will continue to be, incorporated into state and trend reports for the region's waterways.
- 2.2.71 Freshwater fish monitoring is undertaken yearly at 12 SoE monitoring sites. Surveying, including electric fishing, netting and trapping was well progressed at time of writing, with nine of 12 sites planned for the year completed. Results are reported into the **New Zealand Freshwater Fish Database (NZFFDB)** administered by NIWA. They are used in our SoE reporting and will be used in part for assessing Horizons against the NPS-FM fish **Index of Biotic Integrity (IBI)** attribute.
- 2.2.72 Sampling undertaken on behalf of, or in conjunction with, consent holders Tararua District Council and Palmerston North City Council were completed successfully and results forwarded to the consent holders.
- 2.2.73 Surveys for didymo (*Didymosphenia geminata*) are undertaken in November, February and May each year at 14 sites across the region. At 25 August, May sampling has been undertaken, though not all results have yet been returned. All prior results were negative.

## ENVIRONMENTAL DNA FISH MONITORING PROJECT

- 2.2.74 The Science and Innovation Team has been involved in supporting a sector-wide, and regionally specific, development of Environmental DNA (eDNA) tools for fish monitoring (eDNA is DNA that is isolated from an environmental sample, such as water or soil, rather than from the individual specimen itself). Living

organisms constantly lose a stream of genetic material, through the loss of skin cells, scales, hair, and excretion of slime, faecal material, reproductive material or other forms of living matter. By collecting and analysing DNA from the environment, we are able to gather information on what species are living within that environment (with some caveats).

2.2.75 There were generally four parts to this programme:

- Support to Regional Council sector-wide development of the tool to refine monitoring methodologies. This helps provide statistical robustness to the results and is critical to understanding the data outputs;
- Confirm the tool is appropriately identifying species where they are known to be present;
- Investigate the technique as a tool for comparing upstream and downstream of potential barriers to fish passage, as a means to check the effectiveness of remediation efforts; and
- Carry out a short pilot study identifying the likely utility of this tool in lakes at this time.

2.2.76 The sector-wide approach to development of this tool resulted in the collective delivery of approximately \$150,000 of work, through staff time and sample processing, across the 16 councils. This work is still in the early stages of being written up, however it is expected that guidance relating to methodology should be forthcoming.

2.2.77 Several species, including upland bully and brown mudfish, were initially unable to be detected through eDNA methods. Work with the provider has resulted in these species being successfully detected through eDNA sampling in the Horizons region.

2.2.78 Two populations of lamprey (Figure 22), one later confirmed via electric fishing, and one population of brown mudfish that were previously unknown were identified through this work. It is expected that with further analysis of the results and further monitoring, additional new populations will be discovered.



Figure 22: Lamprey found for the first time in the Waikawa stream following a positive eDNA result.

2.2.79 Initial investigation of the utility of this tool around fish passes has been positive, with some ability to discriminate between the species found upstream and downstream of barriers to fish passage. As an example, Figure 23 shows clearly identifiable differentiation between populations upstream and downstream of a barrier.

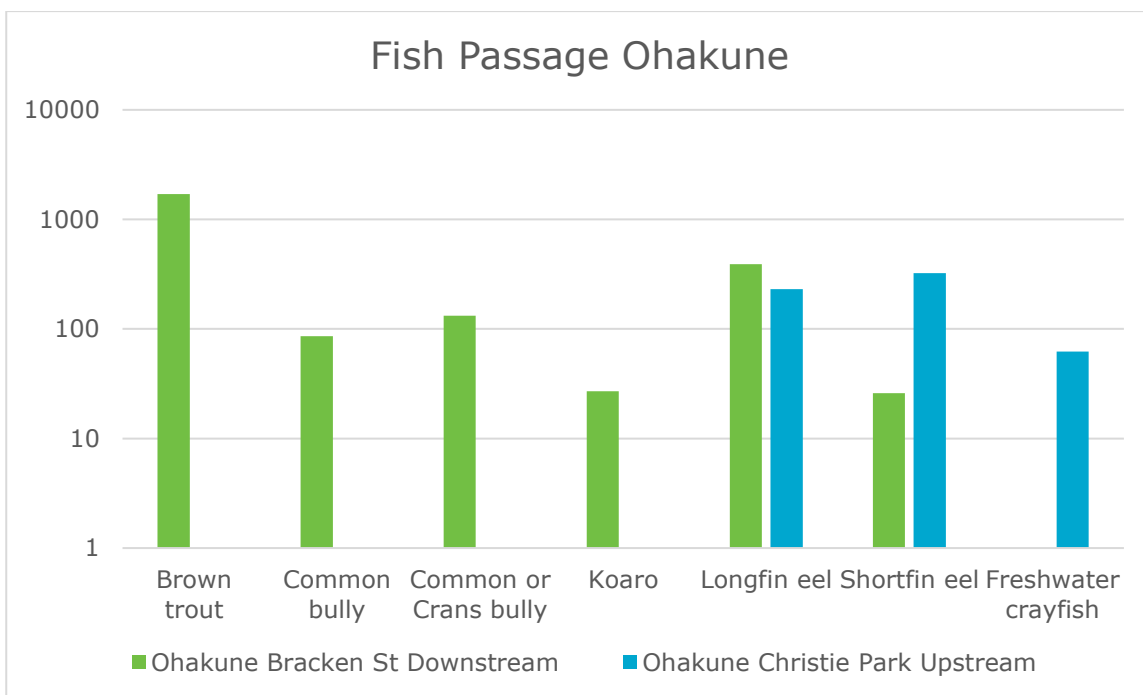


Figure 23: eDNA Monitoring results upstream and downstream of a series of structures in the Mangawhero River near Ohakune

2.2.80 Koaro (Figure 24) is one of the five species that make up the whitebait catch, and which has a threat classification of “at risk, declining” due to its dwindling population is particularly affected by barriers such as these. This is because they must travel to the sea as part of their life cycle, and returning koaro cannot get upstream of barriers as shown here. Brown trout are considered more susceptible to being washed out of small streams during higher flows compared to native species, and this could account for their presence below the barrier only. Of interest, longfin and shortfin eel are present both sides of the barrier, however these species are known for their ability to leave rivers and streams at night to move around barriers or between water bodies. Further work informed by additional sampling is necessary to progress the use of this tool for use around fish passes.



Figure 24: An adult koaro, such as that picked up by eDNA sampling in the Mangawhero River near Ohakune

2.2.81 This tool is being utilised by a number of organisations across the region and NZ including most if not all regional councils, a number of independent consultancies for resource consent processes, **Crown Research Institutes (CRIs)** and Department of Conservation. It is also being used by community groups and Iwi in a number of locations due to its ease of use, power of results and low cost. It is expected among the sector that it will continue to be developed as a cost-effective tool with more refinement occurring over time.

2.2.82 A short internal report outlining the findings of this project is intended to be completed in the 2021–22 financial year.

## 2.3 Regional Land and Fluvial programme

2.3.1 This is the annual report for the fluvial component of the land and fluvial monitoring and research activity.

## FLUVIAL PROGRAMME

- 2.3.2 The fluvial survey programme has been completed for 2020-21 as part of a long-term survey plan that has been developed cross-organisationally and overseen by the Engineering Investigations and Design team. This project funds cross-section surveys and reports to provide information on the changes in levels due to aggradation and degradation, or river channels and berms to inform river management and decision-making about gravel extraction.
- 2.3.3 The focus for the fluvial programme in 2020-21 was completion of the remaining four catchments in the South-eastern Ruahine area, which were paused due to Covid-19 Level 4 and Level 3 restrictions, and the Kawhatau Catchment and Rangitikei Catchment fluvial surveys.
- 2.3.4 The Kawhatau and Rangitikei catchment fluvial surveys were carried out using **Light Detection and Ranging (LiDAR)** with the wetted channel being bathymetrically surveyed. The Kawhatau is considered a key gravel resource for the Rangitikei River. **LiDAR** has enabled the survey to extend both upstream and downstream of previous surveys, which focused on gravel extraction beaches only to further our understanding of the fluvial processes occurring throughout the wider catchment. These surveys will inform gravel resource studies for both catchments, due to be completed in the 2021-22 financial year. The **LiDAR** 3-dimensional survey is also being used to help inform the Climate Resilience Rangitikei River Enhancement project below Bulls.
- 2.3.5 Historical aerial imagery orthorectified by removal of distortion across an image because of how the sensor has captured information from above the above the earth's surface, acquired in 2020-21, will be used to carry out geomorphic analysis to examine the connectivity and sensitivity of the Manawatū and Rangitikei catchments. The historical imagery is a valuable resource for other parts of the organisation, including informing coastal erosion and accretion, identification of hazardous activities and industries, land-use change and assessing erosion control susceptibility, and review of river and drainage scheme management.
- 2.3.6 Work is underway with consent planning staff and regional engineers to review best-practice guidelines for gravel extraction. Horizons has commissioned Professor Ian Fuller of Massey University to provide recommendations for technical assessments and best-practice guidelines for gravel extraction and monitoring requirements to ensure catchment integrity, habitat and ecosystem health are appropriately monitored. The report is due at the end of September and a copy of the report will be made available once it is completed.

## LAND PROGRAMME

### Soil map coverage - Horowhenua

- 2.3.7 The land programme for the 2020-21 year (and 2021-22) is focussed on obtaining S-Map coverage for the lowland area of the Horowhenua FMU. S-Map is the national online geospatial soil information system held and maintained by Manaaki Whenua. It is the only active and consistent soils database across the country. This data will be used to support the Our Freshwater Future – Oranga Wai process and provide more accurate soil information than that currently

available for catchment modelling. The land science budget is fully allocated to this project over the 2020-21 and 2021-22 years. This project has taken advantage of an opportunity provided by the **Ministry for Primary Industries (MPI)** offering funding for two-thirds of the total cost of the project, provided to support the availability of better soil information in areas with highly productive land uses. The land area covers 23,300 ha of lowlands in the Horowhenua FMU. A progress report is due in June 2021 and the final shapefiles will be available for internal use in June 2022 and the project is aiming to make the data available publicly online on the Manaaki Whenua S-Map [website](#) in August 2022.

## Regional Land use map

- 2.3.8 Over the 2020-21 year, a land-use map was updated for the region (funded internally by the Policy and Strategy team). Horizons commissioned Manaaki Whenua – Landcare Research to provide an updated land-use map, as well as the provision of a tool to enable Horizons to update land-use information on a regular basis.
- 2.3.9 The land-use classification combines multiple classifications from a range of sources including AgriBase, Land Cover Database v5.0, Horizons Regulatory data, the **Sustainable Land Use Initiative (SLUI)** Whole Farm Plans, and Valuation and ratings data. **A Land Use Management Support System (LUMASS, an open-source spatial modelling tool)** model for the automatic update of the land-use classification was developed, which allows us to update the land-use layer as updated input datasets become available. This map will be used to help inform the Our Freshwater Future process and ongoing support for freshwater accounting.

## Sediment Source and Transport

- 2.3.10 Horizons is a partner in the **Smarter Targeting of Erosion Control (STEC)**, programme led by Manaaki Whenua Landcare Research in partnership with Iwi, NIWA, regional councils and stakeholders. Key progress during year three of this five-year programme included continuing the measurement and monitoring of shallow landslides and earthflows, and quantifying the influence of tree planting on slope stability. Advances were made in the development of a **Temporal Erosion and Sediment Transport (TEST)** model to examine the effects of soil erosion on water quality. TEST will characterise where and when soil erosion occurs, what type of sediment is produced and how that sediment moves through catchments.

## 2.4 Whanganui and Kai Iwi FMU

- 2.4.1 As part of the freshwater programme, 10.149 km of stream fencing has been completed this year and 10,340 riparian plants planted within the Whanganui Catchment; and 7.089 km of stream fencing has been completed and 4,695 riparian plants have been planted along the Kai Iwi, Kaitoke and Ototoke streams. In addition to the Freshwater and Partnerships programme, the Land programme completed 34 km of stream fencing and 3,970 riparian plants. In the Whanganui and Kai Iwi FMU, Horizons combined programme (freshwater and land) completed 44.149 km of stream fencing and 13,360 riparian plants in the 2020-21 year. Including the stream fencing and planting, the land programme completed 603 ha of erosion control works and 3,146 ha of farm plans in the Whanganui and Kai Iwi FMU.

## SWIMMABILITY

- 2.4.2 A summary of the season’s swimmability results for the Whanganui and Kai Iwi FMU are displayed below (Figure 25). These are ranked by worst to best performing sites top to bottom. River and lake sites are measured for both microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. The results below are a composite of these and take the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed.
- 2.4.3 The Whanganui FMU sites are compliant with the guidelines for the majority of samples (Figure 25), with the worst performing site (the Ongarue River at Cherry Grove) being fully compliant on 65% of monitoring occasions. Given the relatively low compliance at the Ongarue site, faecal source tracking was undertaken at this site, including investigating the possibility of contamination from the Taumarunui storm water network. Sites upstream and downstream of the town were sampled and the primary drivers were found to be ruminant and avian, with some weak evidence of human-derived faecal source at the downstream site suggesting potential contamination of the storm water network (note: these results will be shared with Ruapehu District Council).
- 2.4.4 In the Kai Iwi FMU the two coastal sites are near always compliant with the monitoring standards (Figure 26) during the monitoring period. The three freshwater sites were however predominantly non-compliant with the swimmability standards and are in the worst category for more than half of the samples, requiring signage to be placed at these sites. Faecal source tracking investigations have been undertaken in previous years in both the Ototoka and Mowhanau catchments, with the major contributors typically being ruminant stock. These results have informed these catchments being a priority for Horizons stream fencing programmes (Figure 2).
- 2.4.5 The three freshwater sites have long-term notices in place as unsuitable for swimming on LAWA, due to the high number of non-compliances.

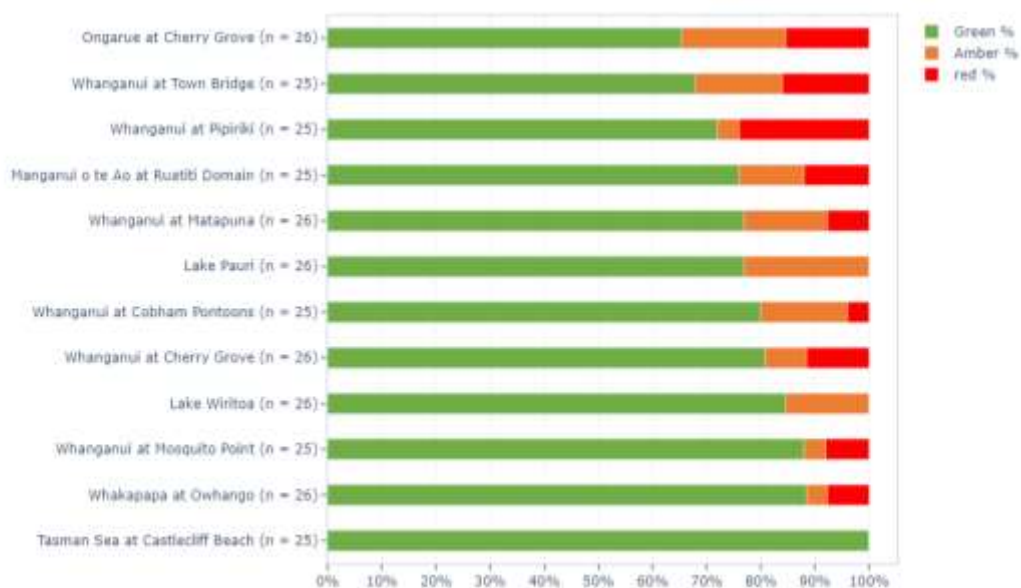


Figure 25: Swimmability in the Whanganui FMU for the 2020-21 season.

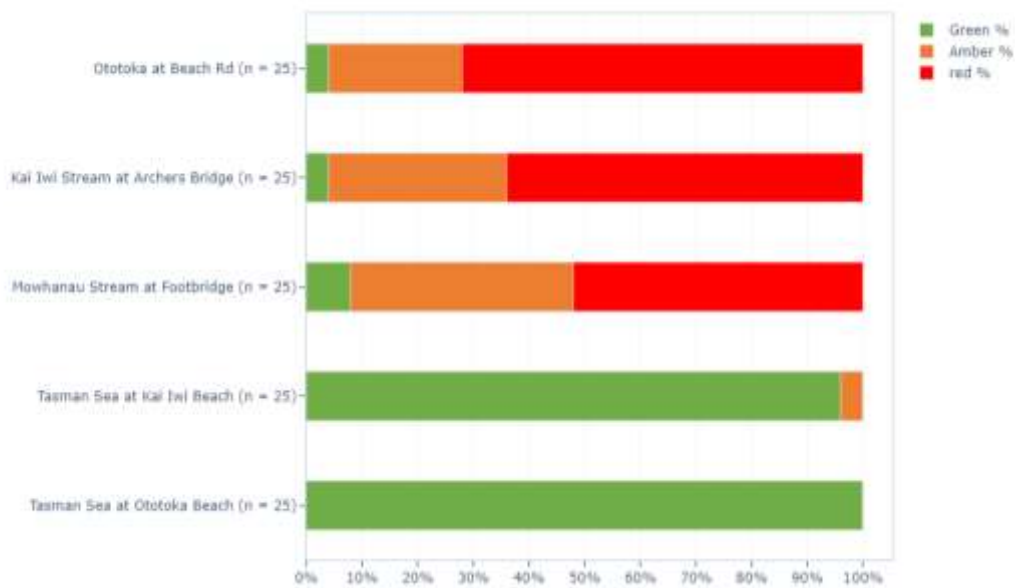


Figure 26: Swimmability in the Kai Iwi FMU for the 2020-21 season.

## RIVER STATE AND TRENDS

2.4.6 LWP Ltd were commissioned to undertake an analysis to update the river water quality state and trends for the region. The analysis calculated the state of water quality as compared to the NPS-FM 2020 National Objectives Framework (NOF) for a five-year period and the confidence of an improving trend in water quality and biological indicators for both a 10-year and 20-year period ending in December 2019. The trend analysis using raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.

2.4.7 The state of water quality at state of the environment monitoring sites within the Whanganui FMU is presented in Figure 27. Most sites were in the A band for nitrate and ammonia toxicity, median *E.coli* concentration and chlorophyll *a*. Grades for **Dissolved Reactive Oxygen (DRP)** and MCI/QMCI are mostly in band C with seven and two sites respectively below the national bottom line. With regard to swimmability and 95<sup>th</sup> percentile *E. coli* concentration sites are mostly in bands D and E but more mixed for the number of samples >540 and >260 *E.coli*/ 100ml. Two sites that are below the bottom line for DRP in this FMU are reference sites and due to the nature of the geology in the upper catchment elevated DRP at these sites is not unexpected

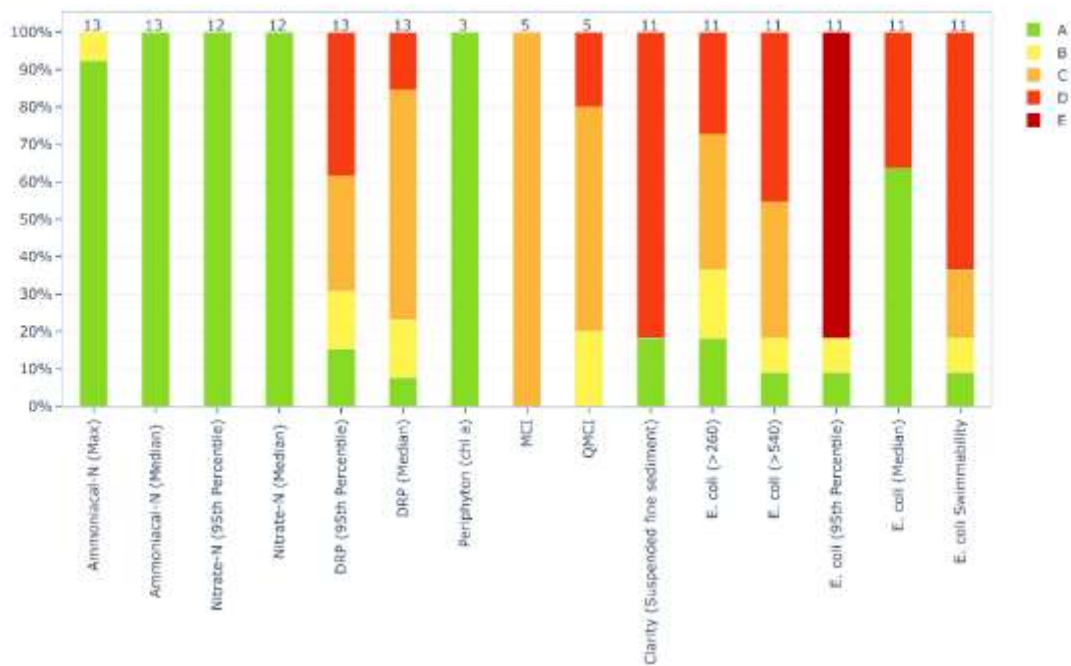


Figure 27: State of water quality in the Whanganui FMU at state of the environment sites compared to NOF 2020 attributes for the five-year period ending December 2019

2.4.8 Twenty-year trends at state of the environment sites (Figure 28) showed predominantly improving trends for *E. coli* and QMCI, although the sites are predominantly degrading for measures of nitrogen, phosphorus, visual clarity and turbidity.

2.4.9 Ten-year trends at state of the environment sites (Figure 29) showed predominantly improving trends for ammoniacal nitrogen although the sites are predominantly degrading for nitrogen, phosphorus, chlorophyll *a*, macroinvertebrate community index, turbidity and visual clarity.

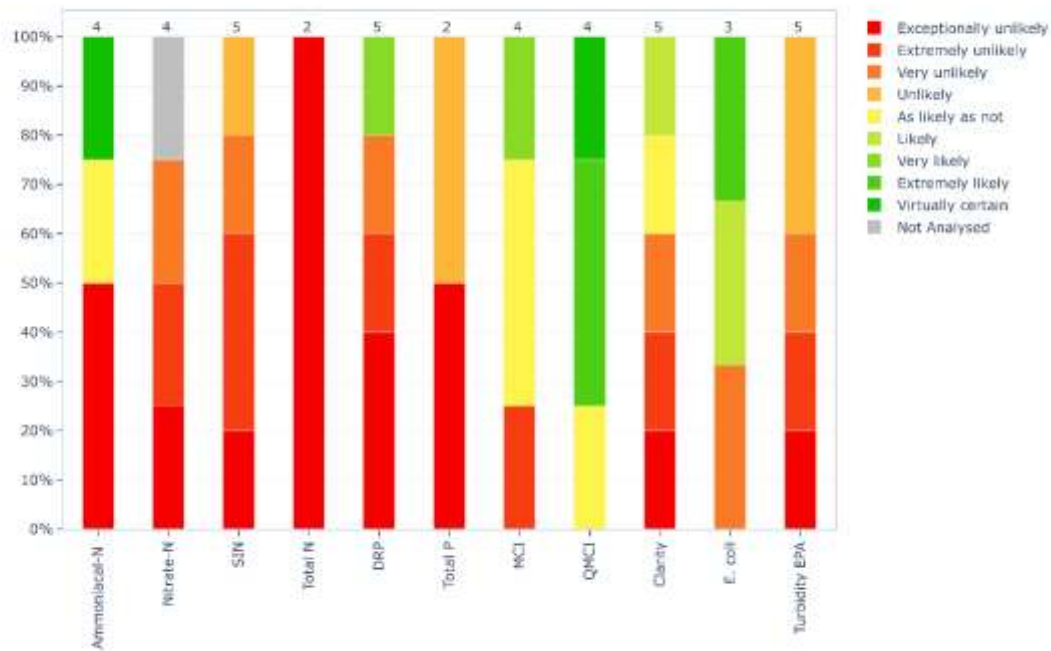


Figure 28: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Whanganui FMU for the 20-year period ending December 2019

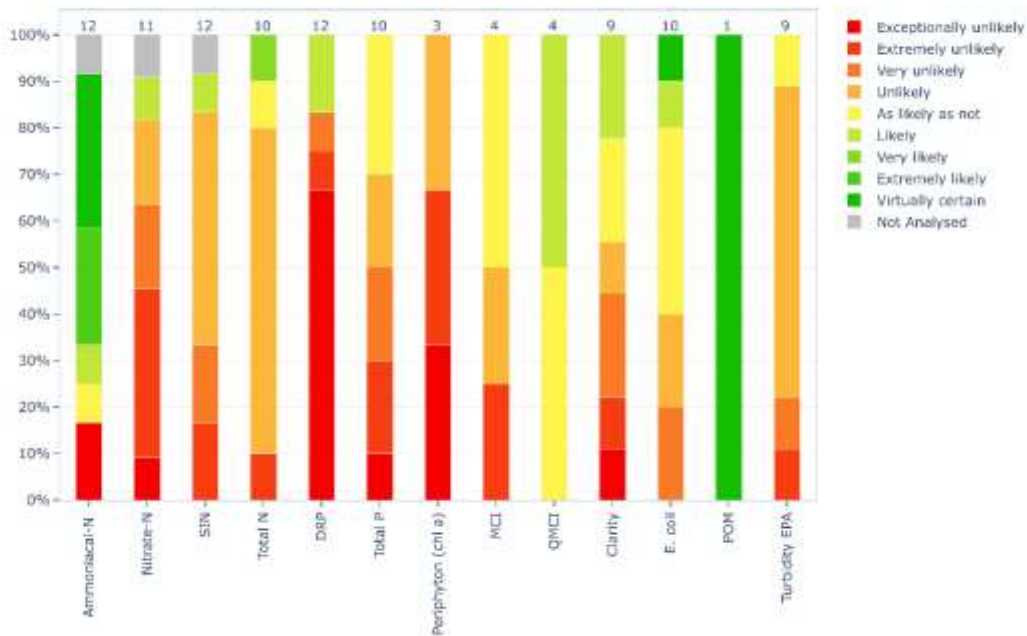


Figure 29: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Whanganui FMU for the ten-year period ending December 2019

2.4.10 The state of water quality for the state of the environment site in the Kai Iwi FMU is shown in Figure 30 The site is in band A or B for nitrate and ammonia

toxicity and bands b/c for DRP although it is below the bottom line for measure of *E.coli*.

Site	Ammoniacal-N (Max)	Ammoniacal-N (Median)	Nitrate-N (95th Percentile)	Nitrate-N (Median)	DRP (95th Percentile)	DRP (Median)	Clarity (Suspended fine sediment)	E. coli (>260)	E. coli (>540)	E. coli (95th Percentile)	E. coli (Median)	E. coli Swimmability
Kai Iwi Stream at Handley Road	Yellow	Green	Green	Green	Yellow	Orange	Red	Red	Red	Red	Red	Red

Figure 30: State of water quality in the Kai Iwi FMU at State of the Environment sites compared to NOF 2020 attributes for the five-year period ending December 2019. Green Band A, yellow the site is in Band B, orange B and C, red Band D and darker red Band E

## 2.5 Whangaehu FMU

### WHANGAEHU FRESHWATER IMPROVEMENT FUND (FIF) PROJECT

2.5.1 This programme focuses on the delivery of the Ngā Wai Ora o Te Whangaehu **FIF** project, which focuses on the protection and enhancement of waterways within the Whangaehu Catchment. The main components of the programme are supporting stock exclusion from waterways, riparian enhancement and planting where desirable, aquatic habitat enhancement, supporting industry and community-led initiatives, and a joint project with Ngāti Rangī.

2.5.2 The Ngā Wai Ora o te Whangaehu, which ran from 1 July 2019 was completed on 30 June 2021. The following activities have been completed (Figure 31):

- Targets for the Tokiahuru Stream fencing and planting project were 10 km of stream fencing and planting 4,000 riparian plants, with 9.871 km of fencing were completed over the life of the project and 4,410 riparian plants planted. This project had been sub-contracted to Ngāti Rangī for delivery;
- Stream fencing and riparian planting - the project achieved 83.449 km of stream fencing, exceeding its target of 50 km. Overall, the project has planted 15,952 riparian plants against a target of 10,000 plants for the entire project;
- Community projects - 17 community projects have been completed against a target of 10; and
- Fish barrier remediation - 10 barriers to fish passage were remediated against a target of five.

2.5.3 In addition to the Freshwater and Partnerships programme (as reported above), the Land programme completed 9.6 km of stream fencing and 2,140 riparian plants. In the Whangaehu FMU, Horizons' combined programme (freshwater and land) completed 93.049 km of stream fencing and 18,092 riparian plants in the 2020-21 year. Including the stream fencing and planting, the land programme completed 465 ha of erosion control works and 997 ha of farm plans in the Whangaehu FMU.

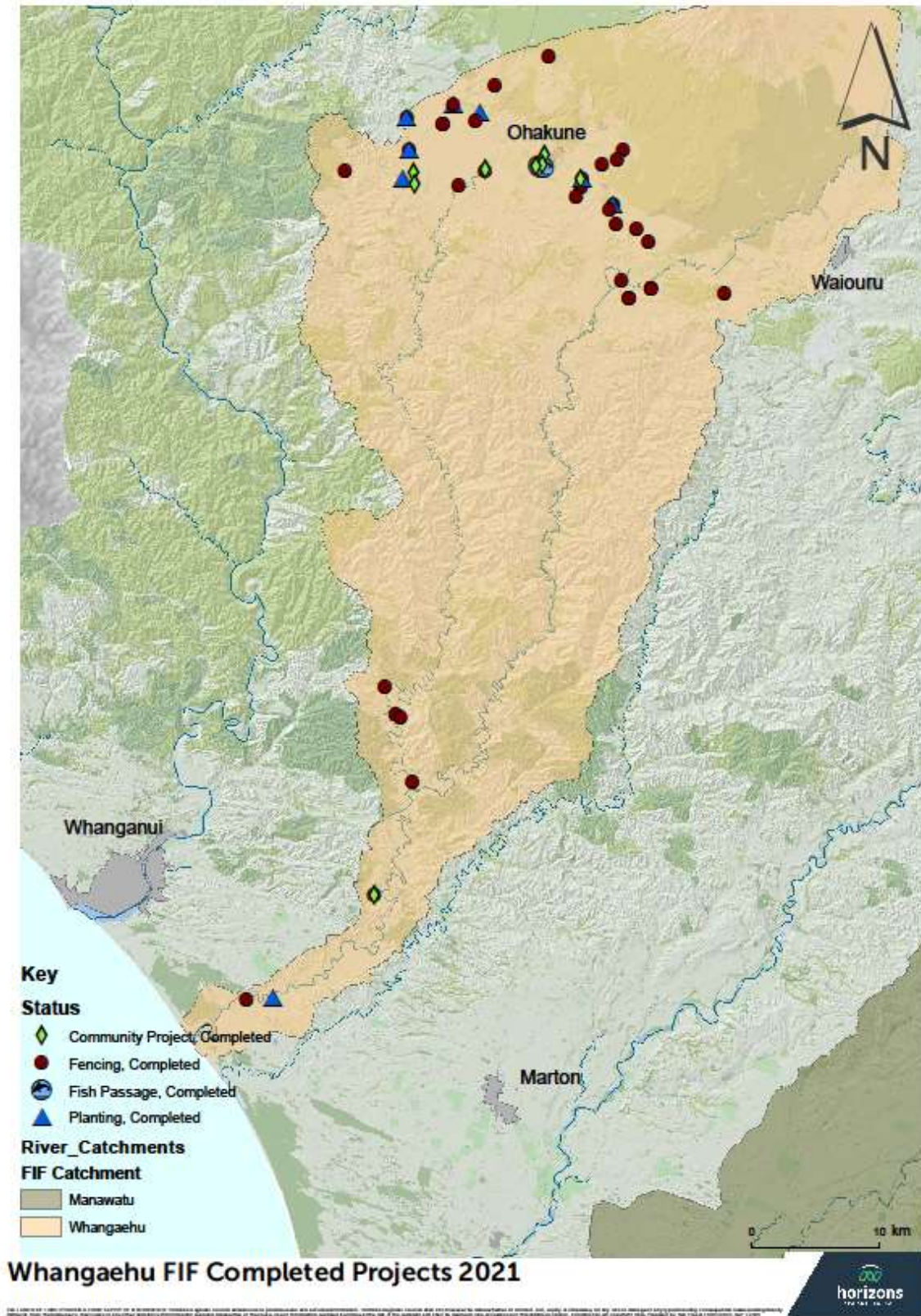


Figure 31: Stream fencing, riparian planting and community projects that have been completed in the Whangaehu Catchment as at 30 June 2021 for the 2020-21 financial and project year.

## SWIMMABILITY

2.5.1 A summary of the season's swimmability results for the Whangaehu FMU are displayed below. These are ranked by worst to best performing sites, top to bottom for each FMU. River and lake sites are measured for microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. The results below are a composite of these and take the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed.

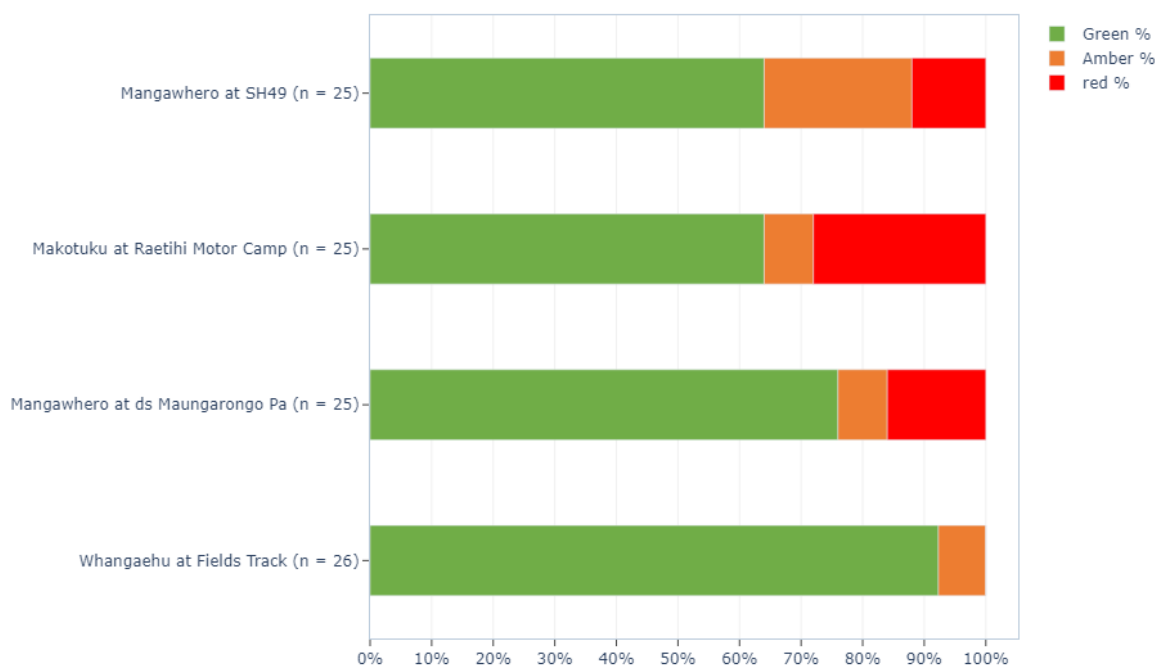


Figure 32: Swimmability in the Whangaehu FMU for the 2020-2021 season

2.5.1 The Whangaehu FMU is compliant with the guideline targets for most of the time (Figure 32), though the site in the Makotuku below the motor camp was non-compliant on 28% of sampling events over the sampling period.

## RIVER STATE AND TRENDS

2.5.2 LWP Ltd were commissioned to undertake an analysis to update the river water quality state and trends for the region. The analysis calculated the state of water quality as compared to the NPS-FM 2020 National Objectives Framework (NOF) for a five-year period and the confidence of an improving trend in water quality and biological indicators for both a 10-year and 20-year period ending in December 2019. The trend analysis uses raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.

2.5.3 The state of water quality at state of the environment sites in the Whangaehu FMU is presented in Figure 33. Sites are in the A or B band for ammonia toxicity, most sites are in the A band for chlorophyll *a*, and there are sites below the bottom line (Band D or E) for all of the other indicators. The reference site for the Managawhero River at DOC headquarters is below the below the bottom

line for median DRP concentration in this catchment but due to the nature of the geology in the upper catchment elevated DRP at this site is not unexpected.

2.5.4 The state of water quality at impact sites, which are directly downstream of major point-source discharges, in the Whangaehu FMU is shown in Figure 34. Generally, water quality state is poorer immediately downstream of the point-source discharges than at the state of the environment sites.

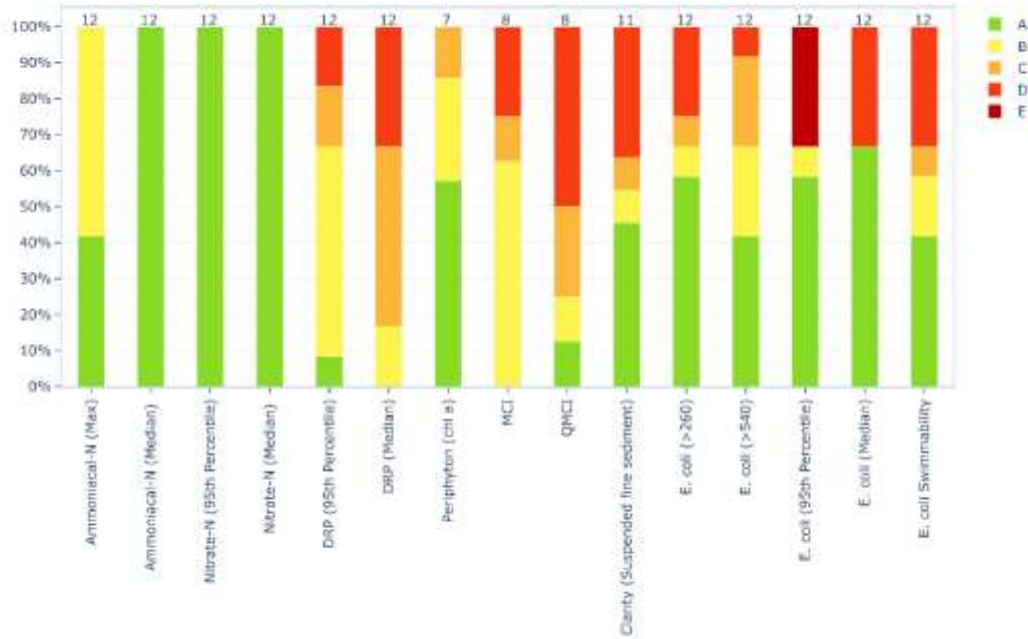


Figure 33: State of water quality in the Whangaehu FMU at state of the environment sites compared to NOF 2020 attributes for the five-year period ending December 2019

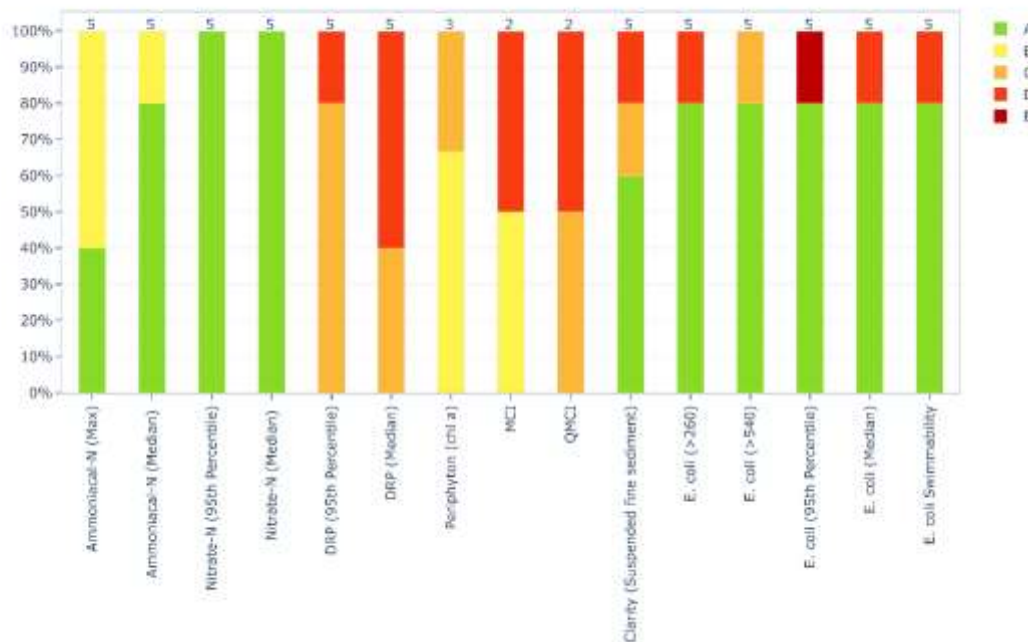


Figure 34: State of water quality in the Whangaehu FMU at impact sites compared to NOF 2020 attributes for the five-year period ending December 2019

2.5.5 Twenty-year trends are able to be calculated at one state of the environment site – Mangawhero at DOC Headquarters (a reference site) This site showed improving trends for ammoniacal nitrogen, soluble inorganic nitrogen, clarity, and *E.coli* and degrading trends for DRP, MCI and QMCI (Figure 35)

Site	Ammoniacal-N	Nitrate-N	SIN	DRP	MCI	QMCI	Clarity	E. coli	Turbidity EPA
Mangawhero River at DOC Headquarters	Virtually certain	Not analysed	Virtually certain	Exceptionally unlikely	Unlikely		Likely	Likely	As likely as not

Figure 35: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Whangaehu FMU for the 20-year period ending December 2019

2.5.6 Ten-year trends at state of the environment sites (Figure 36) showed predominantly improving trends for particulate organic matter (POM), ammoniacal nitrogen, clarity, chlorophyll *a*, total nitrogen and *E.coli* although the sites are predominantly degrading for nitrate, phosphorus and invertebrate measures.

2.5.7 Ten-year trends at impact sites (Figure 37) showed predominately improving trends for all measures except nitrate, SIN and total nitrogen.

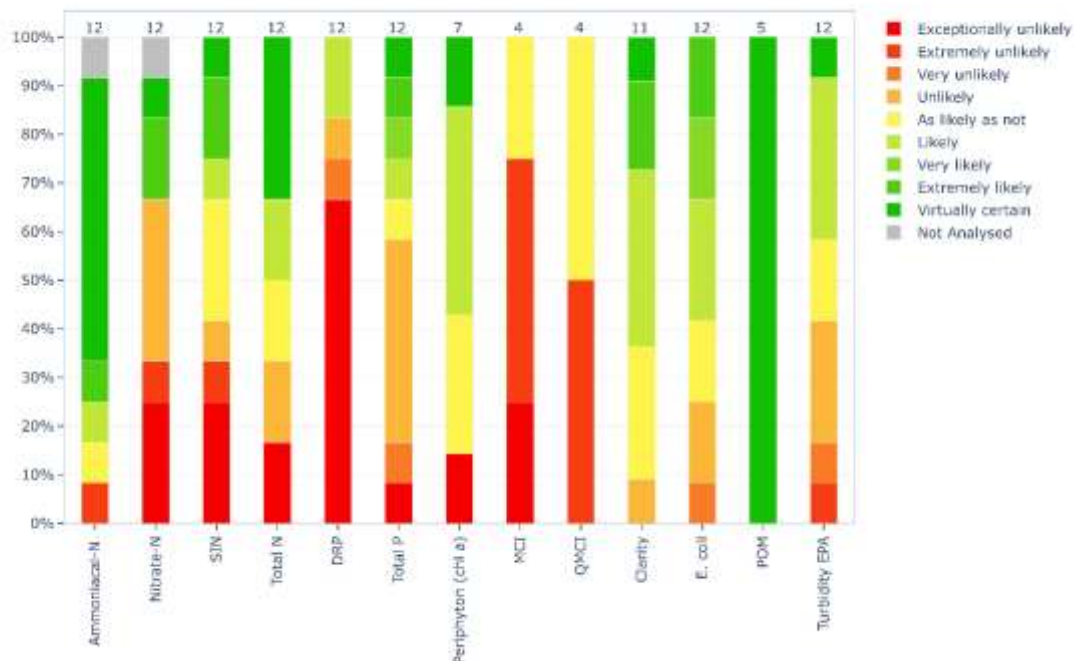


Figure 36: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Whangaehu FMU for the ten-year period ending December 2019

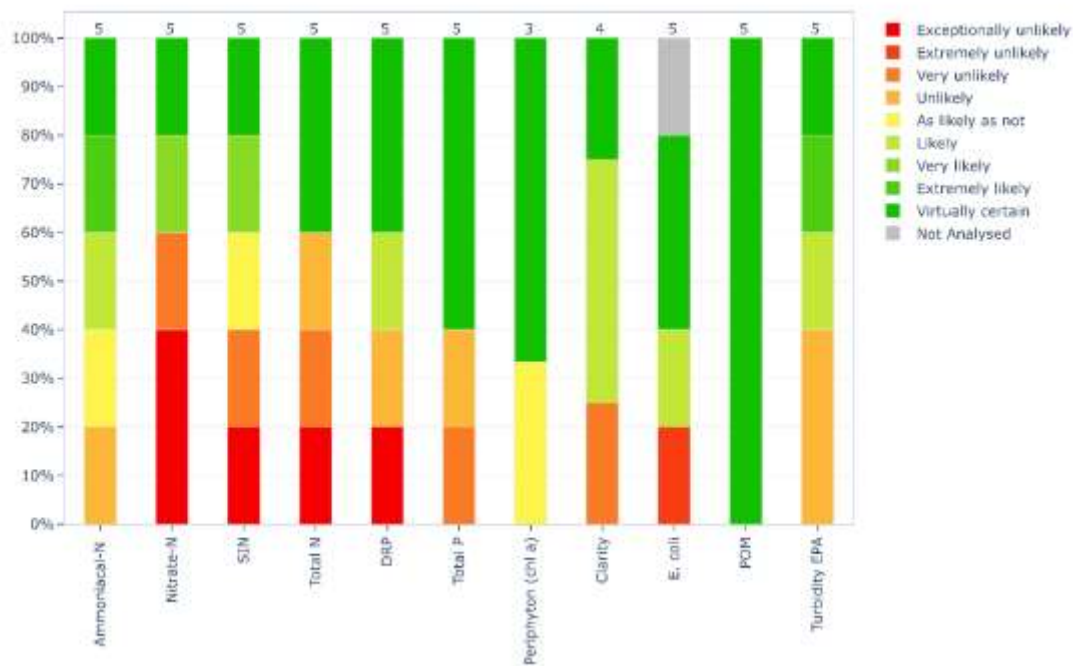


Figure 37: Unadjusted confidence of an improving trend in water quality at impact sites in the Whangaehu FMU for the ten-year period ending December 2019

## 2.6 Rangitikei-Turakina FMU

### PFAS MONITORING FOR OHAKEA

2.6.1 Horizons has been working with the **New Zealand Defence Force (NZDF)** on the ongoing monitoring of **per- and ploy-fluoroalkyl substances (PFAS)** and related compounds around Ohakea Air Force Base. PFAS are a large group of manufactured compounds that have industrial and consumer applications and have been in firefighting foam used at the base. This project will now proceed as a monitoring programme, undertaken on a biannual timeframe. Results will be reported as they become available.

#### 2.6.2 Reports produced

PDP (2021) [Ohakea: Surface Water and Groundwater Monitoring for PFAS, October 2020](#). Pattle Delamore Partners Ltd Client Report prepared for Horizons Regional Council, February 2021.

### STREAM FENCING AND PLANTING

2.6.3 The Freshwater and Partnerships Programme completed 17,886 km of stream fencing and planted 38,779 riparian plants within the Rangitikei-Turakina FMU in the 2020-21 financial year. In addition to the Freshwater and Partnerships programme, the Land programme completed 21.4 km of stream fencing and 31,870 riparian plants. In the Rangitikei-Turakina FMU, Horizons' combined programme (freshwater and land) completed 39.286 km of stream fencing and 70,649 riparian plants in the 2020-21 year. Including the stream fencing and

planting, the land programme completed 546 ha of erosion control works and 8,724 ha of farm plans in the Rangitikei-Turakina FMU.

## **FLUVIAL RESEARCH**

2.6.4 The Kawhatau and Rangitikei catchment fluvial surveys are reported on in the Land and Fluvial monitoring and research annual report above.

## **LAKE WAIPU/RĀTANA FRESHWATER IMPROVEMENT FUND (FIF) PROJECT**

2.6.5 As part of the **FIF** project, Horizons commissioned NIWA to complete a native and pest fish survey of Lake Waipu on 7 and 8 December 2020. This work aims to understand the availability of host species for kākahi (freshwater mussel) recruitment within the lake and the ongoing sustainability of the kākahi population. The native species shortfin and longfin eels, and common bully were found in the lake with goldfish the only introduced species encountered. A final report is due before the end of the financial year.

2.6.6 Horizons staff have been working with **Rangitikei District Council (RDC)** and MfE to update the project plan for the wastewater management component of this project, which is seeking to cease the discharge to water i.e., Lake Waipu and to fully apply the wastewater to land. This includes a meeting held with RDC, MfE, Horizons and landowners in December 2020. The work programme and annual work plan are to be updated to reflect the proposed changes while the end date of the project (June 2023) is unchanged.

2.6.7 Horizons continued to work with EDC and MfE for during the year on this project. In May, a further governance group meeting was held with Councillor Turkington being appointed as chair of the group.

2.6.8 The MfE wrote to Horizons in May 2021 to identify the delays in the land procurement by RDC the project, noting that the project secured \$875,000 of funding in 2017 and that the project deed was signed in May 2019 for project commencement 1 July 2019 and expiring 31 December 2023. The letter notes that visit to view land in December 2020 and the subsequent ecological assessment report prepared by Horizons that identified wetland and sand dune systems that made that site unsuitable. The letter notes that:

“The Ministry considers this project to have a high delivery risk, given the issues described above and this being year 2 of the project with no major deliverables being provided. As such, the Ministry is requesting Horizons Regional Council to procure suitable land for the project by 30 August 2021. If land is not procured, or close to procurement, the Ministry would like to meet with Horizon's Regional Council and project representatives to discuss alternative options to invest the Ministry's funding to improve the water quality of Lake Waipu, and ensure the needs of Ratana community are met.”

2.6.9 As at the end of June RDC was actively pursuing two opportunities for the procurement of land to enable irrigation. This project is actively working towards procurement before the 30 August 2021 deadline.

## **SWIMMABILITY**

2.6.1 A summary of the season’s swimmability results for the Rangitīkei-Turakina FMU is displayed below. These are ranked by worst to best performing, sites top to bottom for each FMU. River and lake sites are measured for both microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. The results below are a composite of these and take the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed.

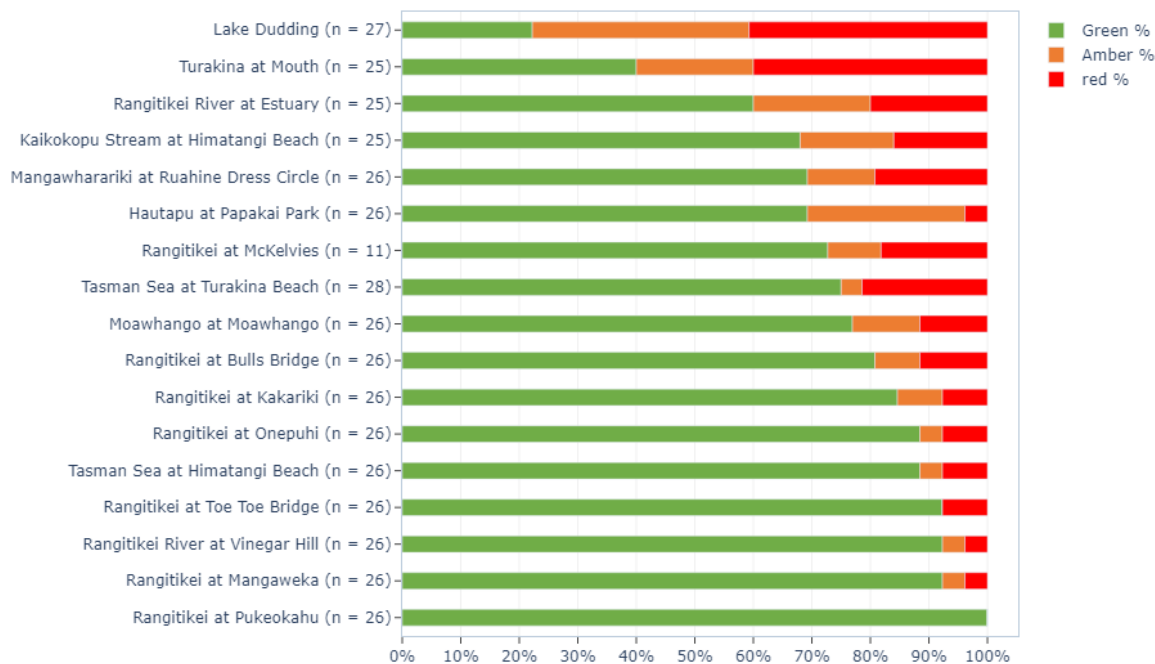


Figure 38: Swimmability in the Rangitīkei-Turakina FMU for the 2020-21 season.

2.6.2 The Rangitīkei-Turakina FMU has a range of sites with the worst compliance typically being at the estuaries and Lake Dudding. Lake Dudding was deemed unsuitable for swimming and had warning signs erected between 16 November 2020 and 21 January 2021 due to high bio-volumes of potentially toxic algae. Rangitīkei sampling at McKelvies was ceased mid-season due to accessibility issues.

## RIVER STATE AND TRENDS

2.6.3 LWP Ltd were commissioned to undertake an analysis to update the river water quality state and trends for the region. The analysis calculated the state of water quality as compared to the NPS-FM 2020 National Objectives Framework (NOF) for a five-year period, and the confidence of an improving trend in water quality and biological indicators for both a 10-year and 20-year period ending in December 2019. The trend analysis using raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.

2.6.4 The state of water quality at state of the environment sites in the Rangitīkei-Turakina FMU is presented in Figure 39. Results are mixed, although more in Band A for the ammonia and nitrate toxicity attributes. Some sites were below

the national bottom line for all indicators with band C being the bottom line for the toxicity attributes).

- 2.6.5 The state of water quality at impact sites (directly downstream of major point source discharges) in the Rangitikei-Turakina FMU is shown in Figure 40. Generally, water quality state is poorer immediately downstream of the point-source discharges than at the state of the environment sites.

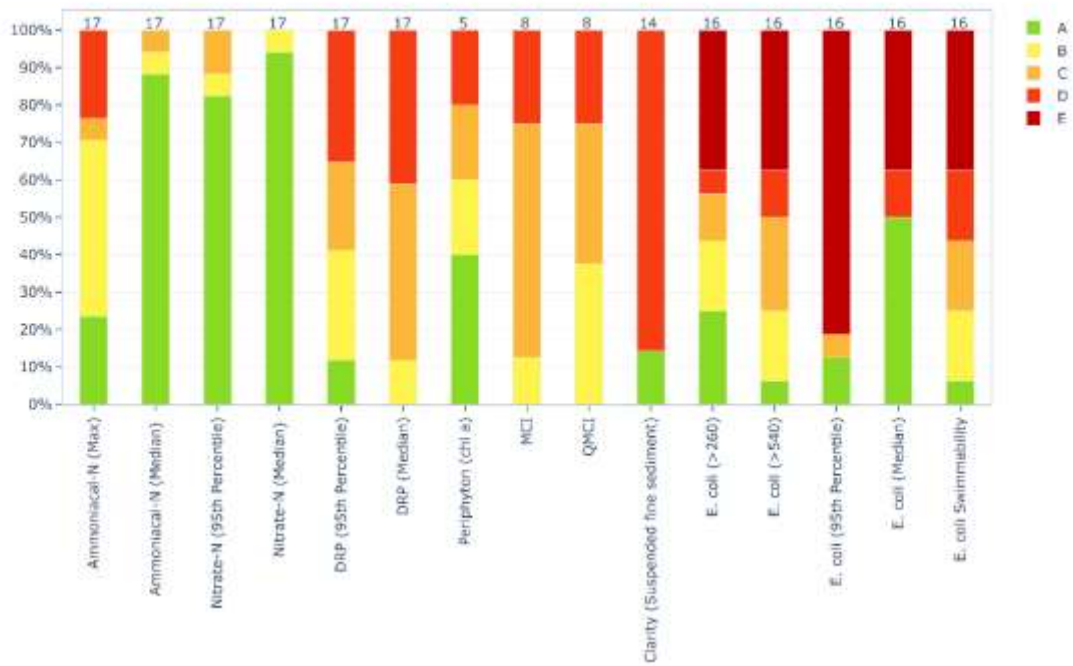


Figure 39: State of water quality in the Rangitikei-Turakina FMU at state of the environment sites compared to NOF 2020 attributes for the five-year period ending December 2019

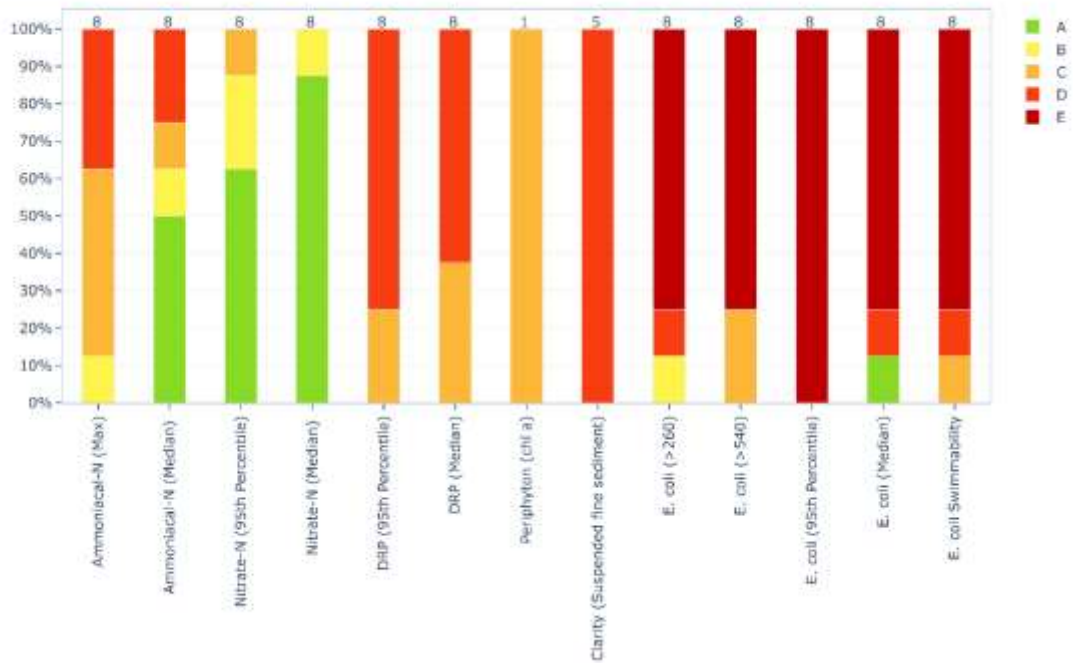


Figure 40: State of water quality in the Rangitikei-Turakina FMU at impact sites compared to NOF 2020 attributes for the five-year period ending December 2019

2.6.6 Twenty-year trends were able to be calculated for three sites with results mixed. The Hautapu River upstream of the Rangitīkei River confluence showed improvement across most indicators (Figure 41).

Site	Ammoniacal-N	Nitrate-N	SIN	Total N	DRP	Total P	MCI	QMCI	Clarity	E. coli	Turbidity
Rangitīkei River at Pukeokahu	Likely	Not analysed	Extremely unlikely		Unlikely		As likely as not	Likely	Exceptionally unlikely	As likely as not	Extremely unlikely
Hautapu River upstream of the Rangitīkei River confluence	Virtually certain	Virtually certain	Virtually certain		Virtually certain		Exceptionally unlikely	Likely	As likely as not	Virtually certain	Very likely
Rangitīkei River at Mangaweka	Unlikely		Likely	Likely	Extremely unlikely	As likely as not	As likely as not	As Likely as not	Very unlikely		Exceptionally unlikely

Figure 41: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Rangitīkei-Turakina FMU for the 20-year period ending December 2019

2.6.7 Ten-year trends at state of the environment sites (Figure 42) showed predominantly improving trends for particulate organic matter (POM), ammoniacal nitrogen, SIN and *E. coli* clarity, chlorophyll *a*, total nitrogen and *E. coli* but the sites are predominantly degrading for nitrate, phosphorus, chlorophyll *a* and macroinvertebrate community index.

2.6.8 Ten-year trends at impact sites (Figure 43) showed predominately improving trends for all measures except **Particulate Organic Matter (POM)**, which was largely improving.

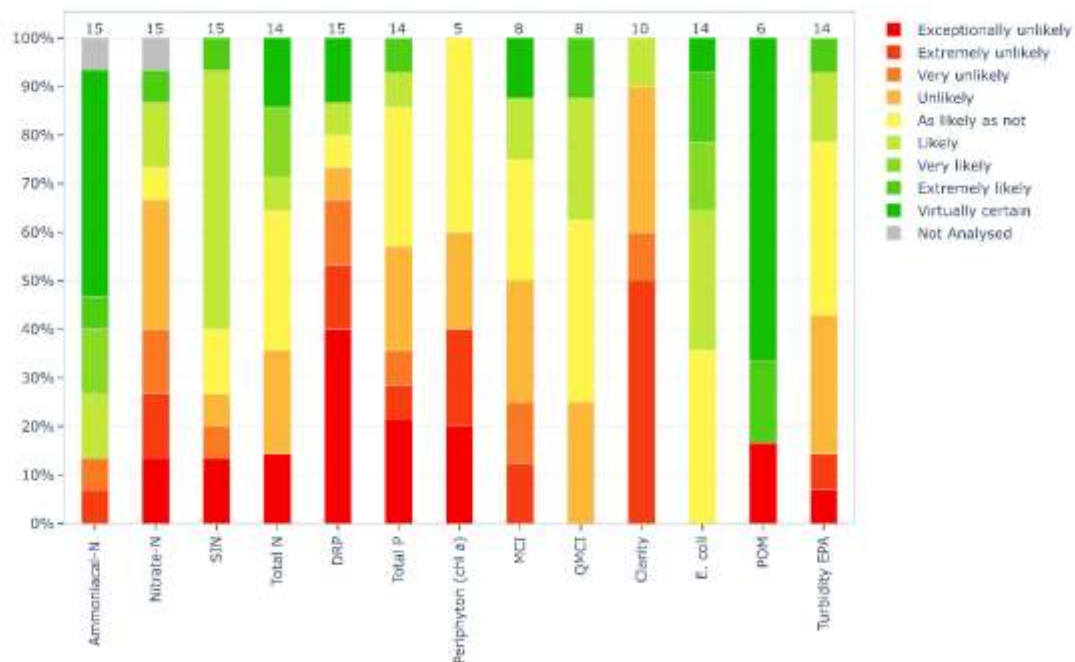


Figure 42: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Rangitīkei-Turakina FMU for the ten-year period ending December 2019

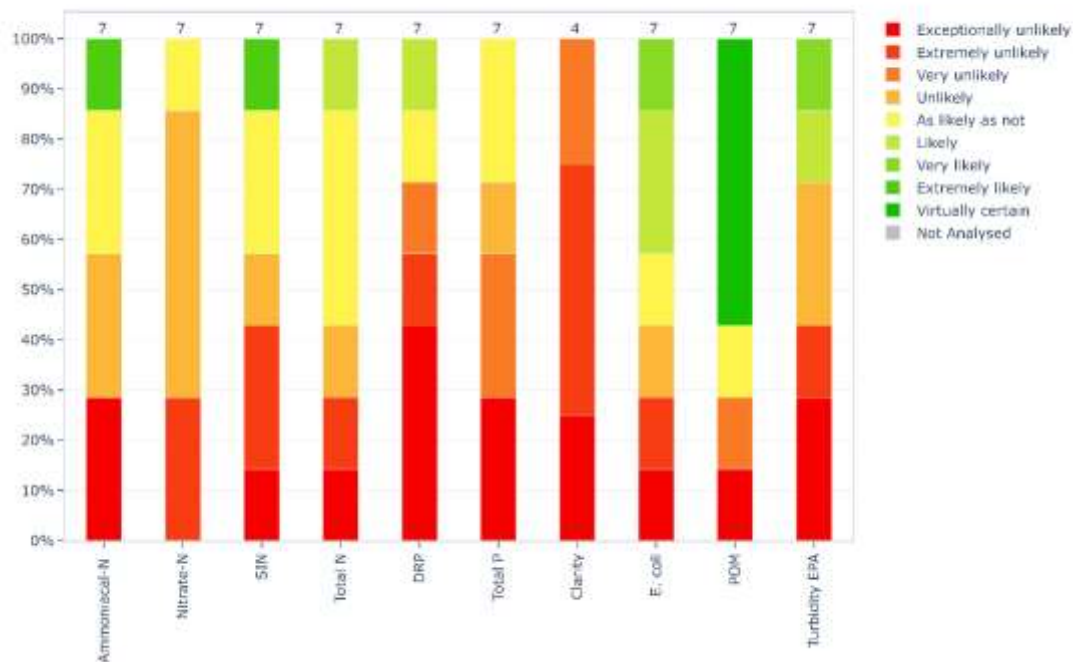


Figure 43: Unadjusted confidence of an improving trend in water quality at impact sites in the Rangitikei-Turakina FMU for the ten-year period ending December 2019

## 2.7 Manawatū FMU

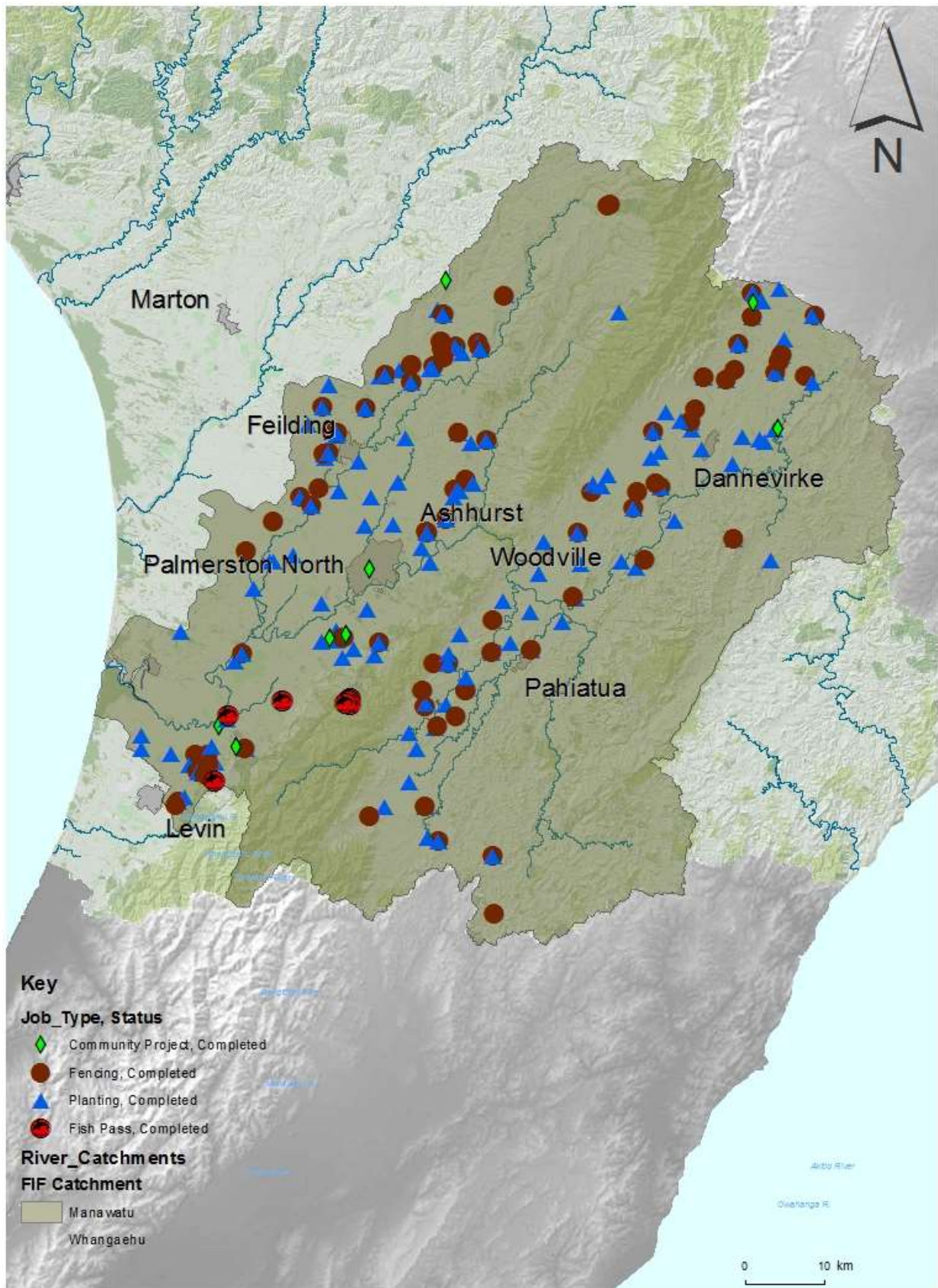
### MANAWATŪ FRESHWATER IMPROVEMENT FUND (FIF) PROJECT

- 2.7.1 Riparian planting has been the main focus during this reporting period. At the end of the financial year, a total of 114,515 native riparian plants had been planted at 135 different sites within the catchment. Help from the riparian planting assistants is making this season manageable. Staff have attended and been part of multiple school and community planting events around the catchment and organised a planting event for staff.
- 2.7.2 This financial year the Freshwater and Partnerships Programme completed 83.2 km of stream fencing and planted 114,515 riparian plants within the Manawatū FMU. In addition to the Freshwater and Partnerships programme, the Land programme completed 18.2 km of stream fencing and 1,060 riparian plants. In the Manawatū FMU, Horizons combined programme (freshwater and land) completed 110.5 km of stream fencing and 115,575 riparian plants, eight fish barrier repairs and 10 community projects in the 2020-21 year. Including the stream fencing and planting, the land programme completed 2,351 ha of erosion control works and 7,524 ha of farm plans in the Manawatū FMU.
- 2.7.3 The annual report for the Manawatū Awa FIF project was completed during this reporting period and submitted to MfE. Achievements against annual milestones are shown in Table 1 of this section.
- 2.7.4 When applications to the Manawatū Awa community grant fund closed on 30 July 2021 there were nine applications requesting \$125,820.64. The initial

assessment of the projects has been done and successful applications were to be decided by the Governance Group on 13 August 2021.



Figure 44: A staff planting day in the Stoney Creek Catchment.



**Manawatu awa FIF completed projects 2020-21**

Map prepared by L Ferguson, NRP Group 15 July 2021

Figure 45: Stream fencing, riparian planting and community projects completed in the Manawātū Catchment as at 30 June 2021.

## SWIMMABILITY

2.7.5 A summary of the season's swimmability results for the Manawatū FMU are displayed below. These are ranked by worst to best performing sites, top to bottom for each FMU. River and lake sites are measured for both microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. The results below are a composite of these and take the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed.

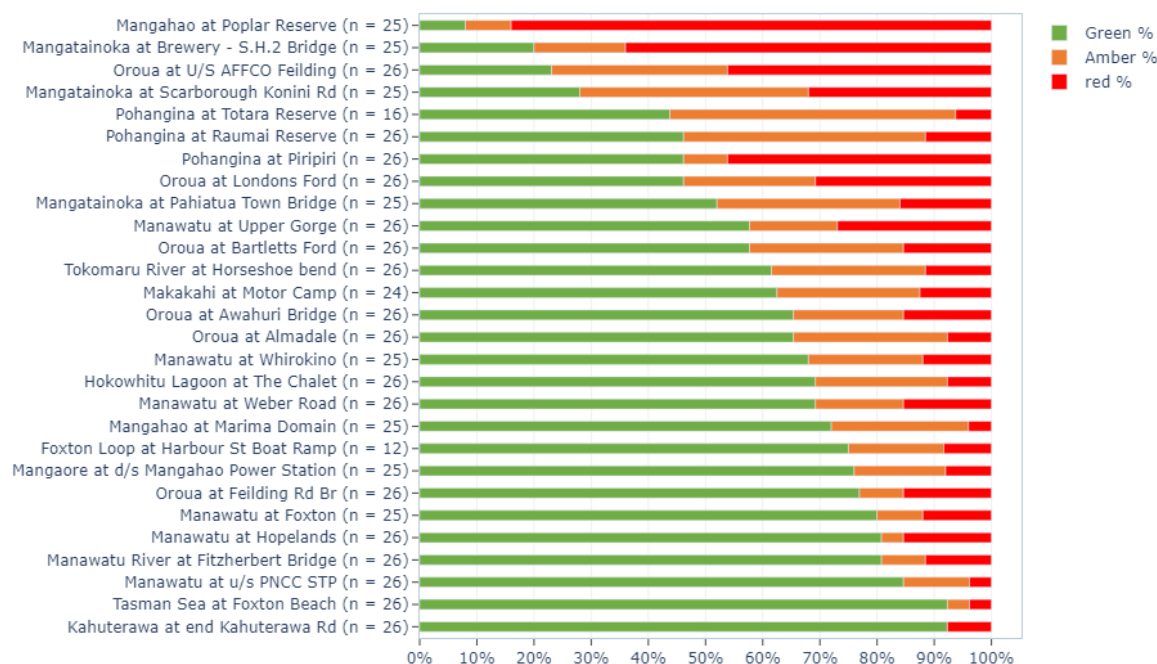


Figure 46: Swimmability in the Manawatū FMU during the 2020-21 season.

2.7.6 The Manawatū FMU has the most sites of any FMU and covers a complete range of outcomes. The poor results in the Mangatainoka River, Pohangina at Totara Reserve and several of the Oroua sites are driven in large part due to high levels of potentially toxic algae being present, rather than faecal contamination.

2.7.7 Potentially toxic algae monitoring was added to Hokowhitu Lagoon this season, and, aside from a brief exceedance over the New Year period, the levels were either amber (caution advised) or green (suitable for contact recreation). Monitoring for *E. coli* at Hokowhitu Lagoon began in November 2017.

## RIVER STATE AND TRENDS

2.7.8 LWP Ltd were commissioned to undertake an analysis to update the region's river water quality state and trends. The analysis calculated the state of water quality compared to the NPS-FM 2020 National Objectives Framework (NOF) for a five-year period and the confidence of an improving trend in water quality and biological indicators for both a 10-year and 20-year period ending in December 2019. The trend analysis used raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.

2.7.9 The state of water quality at state of the environment sites in the Manawatū FMU is presented in Figure 47. Most sites are in bands A or B for the ammonia and nitrate toxicity attributes, although some are below the national bottom line (Band C). The results are more mixed across the bands for chlorophyll *a*, invertebrates and DRP. Most sites were below the national bottom line for clarity and the different statistics for *E. coli*.

2.7.10 The state of water quality at impact sites (directly downstream of major point-source discharges) in the Manawatū FMU is shown in Figure 48. Generally, water quality state is poorer immediately downstream of the point-source discharges than at the state of the environment sites.

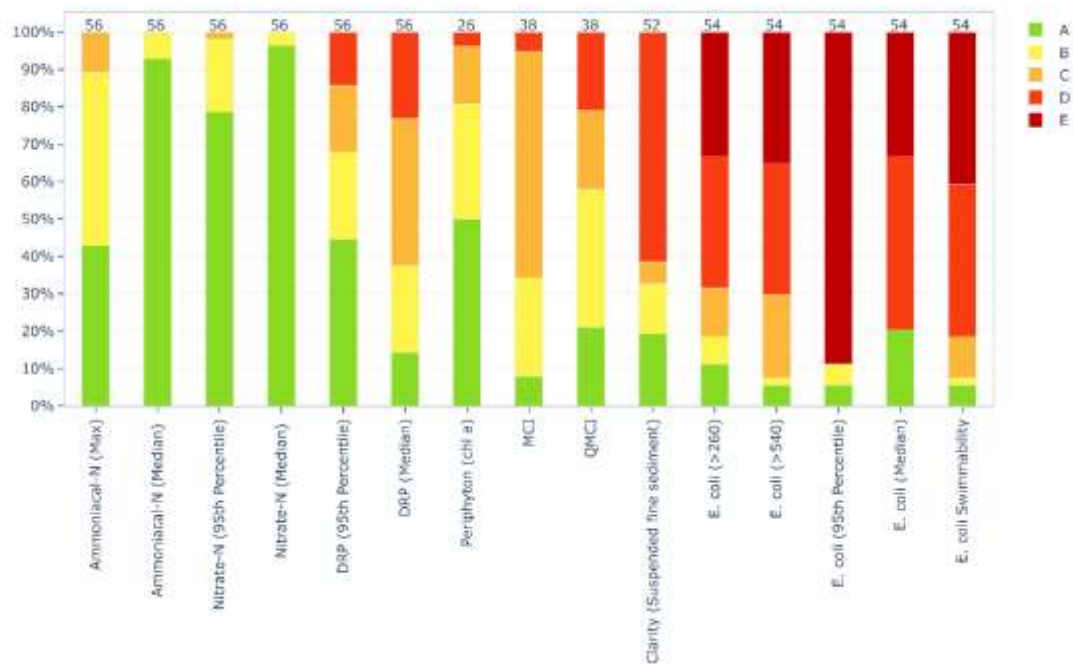


Figure 47: State of water quality in the Manawatū FMU at state of the environment sites compared to NOF 2020 attributes for the five-year period ending December 2019

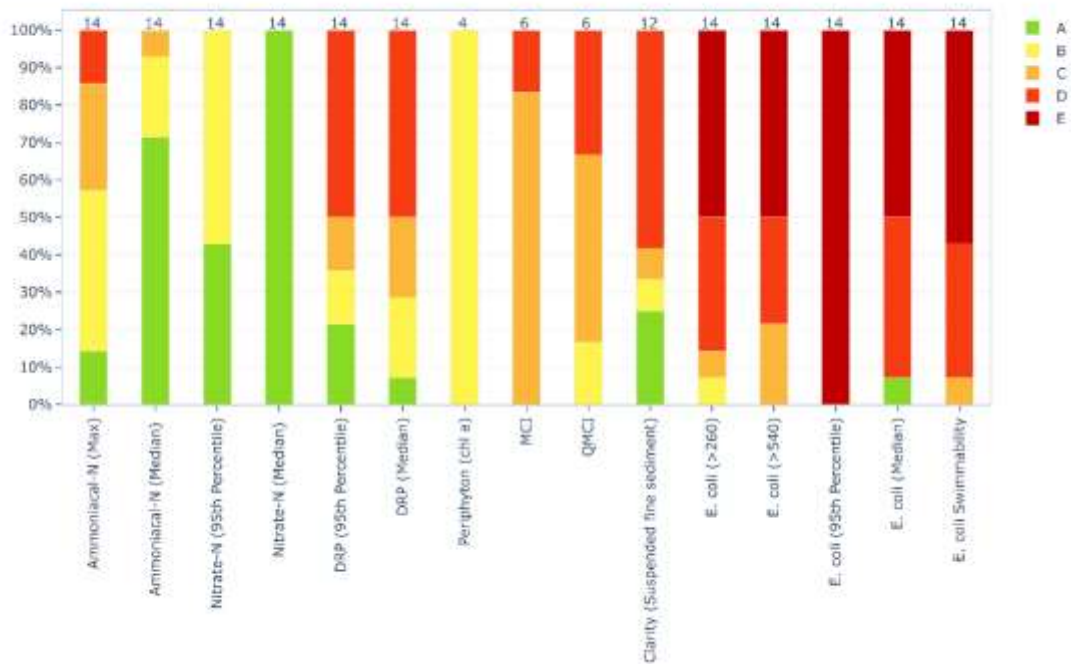


Figure 48: State of water quality in the Manawatū FMU at impact sites compared to NOF 2020 attributes for the five-year period ending December 2019

2.7.11 Twenty-year trends were able to be calculated for up to 11 sites although this varied by parameter. The trends were largely improving at the majority of sites across all measures except POM and clarity (Figure 49).

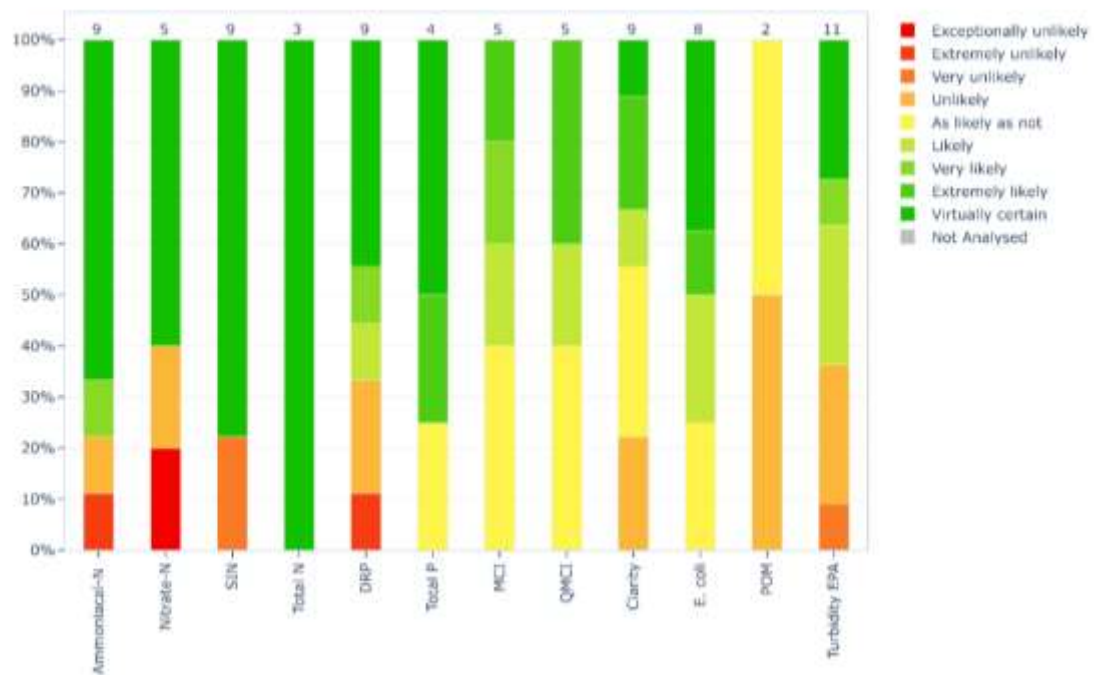


Figure 49: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Manawatū FMU for the 20-year period ending December 2019



Figure 51: Unadjusted confidence of an improving trend in water quality at impact sites in the Manawatū FMU for the ten-year period ending December 2019

## 2.8 Puketoi ki Tai (Coastal Tararua)

### STREAM FENCING AND PLANTING

2.8.1 This financial year the Freshwater and Partnerships Programme completed 0.274 km of stream fencing and planted 452 riparian plants within the Puketoi ki Tai FMU. In addition to the Freshwater and Partnerships programme, the Land programme completed 12.1 km of stream fencing and 2,250 riparian plants. In the Puketoi ki Tai FMU, Horizons combined programme (freshwater and land) completed 12.374 km of stream fencing and 2,702 riparian plants in the 2020-21 year. Including the stream fencing and planting, the land programme completed 404 ha of erosion control works and 2,247 ha of farm plans in the Puketoi ki Tai FMU.

### SWIMMABILITY

2.8.2 A summary of the season’s swimmability results for the Puketoi ki Tai FMU are displayed below. These are ranked by worst to best performing sites, top to bottom for each FMU. River and lake sites are measured for both microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. The results below are a composite of these and take the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed.

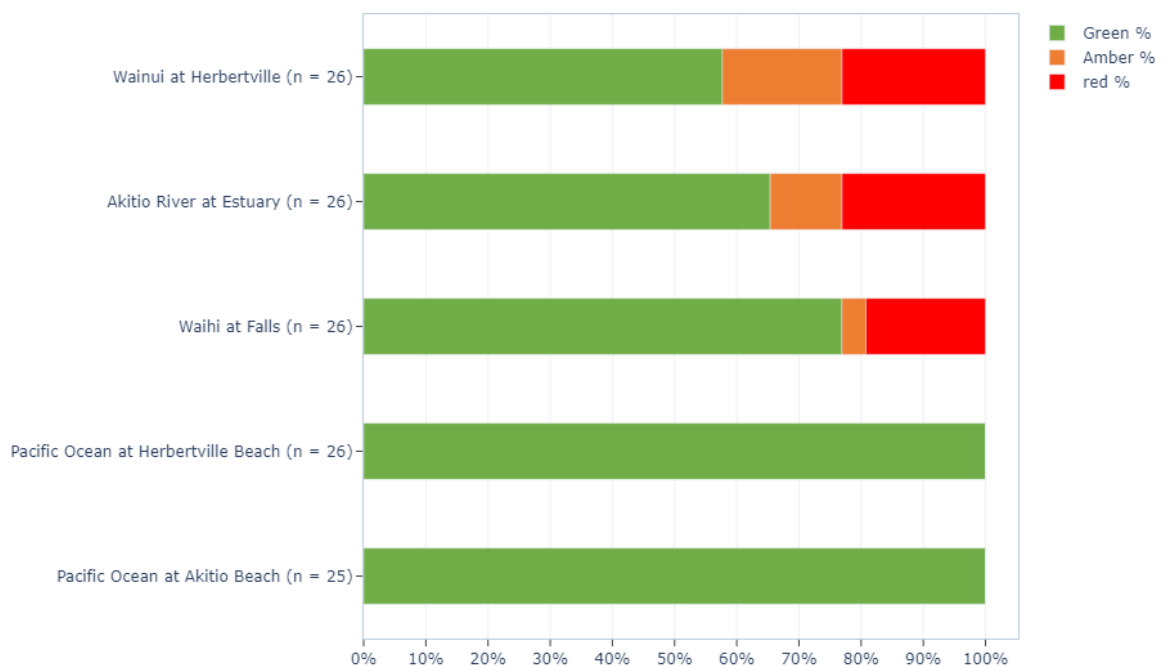


Figure 52: Swimmability in the Puketoi ki Tai FMU for the 2020-21 season.

2.8.3 The Puketoi ki Tai FMU had typically high levels of compliance, with the Wainui site having the highest instance of non-compliance. Faecal contamination investigations undertaken in the Wainui Catchment were dominated by ruminant markers, suggesting contamination is primarily from livestock in the catchment

rather than contamination from septic tanks or other human sources. This FMU hasn't been a target for Horizons Freshwater and Partnerships project, however SLUI is active there.

## RIVER STATE AND TRENDS

**2.8.4** LWP Ltd were commissioned to undertake an analysis to update the river water quality state and trends for the region. The analysis calculated the state of water quality as compared to the NPS-FM 2020 National Objectives Framework (NOF) for a five-year period and the confidence of an improving trend in water quality and biological indicators for both a 10-year and 20-year period ending in December 2019. The trend analysis using raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.

**2.8.5** The state of water quality at state of the environment sites in the Puketoi ki Tai FMU is presented in Figure 53. The sites are in bands A or B for the ammonia and nitrate toxicity and DRP attributes and below the bottom line for invertebrate, clarity and *E. coli* attributes. The state of water quality at the impact sites (directly downstream of major point-source discharges) is in the same band across all attributes as the upstream site.

Site	Ammoniacal-N (Max)	Ammoniacal-N (Median)	Nitrate-N (95th)	Nitrate-N (Median)	Dissolved Reactive Phosphorus (95th)	Dissolved Reactive Phosphorus (Median)	MCI	QMCI	Clarity (Suspended fine sediment)	E. coli (>260)	E. coli (>540)	E. coli (95th)	E. coli (Median)	E. coli (Swimmability)
Owahanga River at Branscombe Bridge	Green	Green	Green	Green	Green	Green	Red	Red	Red	Red	Red	Red	Red	Red
Pongaroa River upstream of the STP	Yellow	Green	Green	Green	Green	Yellow	White	White	Red	Red	Red	Red	Red	Red
Pongaroa River downstream of the STP	Yellow	Green	Green	Green	Green	Yellow	White	White	Red	Red	Red	Red	Red	Red

Figure 53: State of water quality in the Puketoi ki Tai FMU at state of the environment and impact sites compared to NOF 2020 attributes for the five-year period ending December 2019. Green is in Band A, yellow Band B, orange bands B and C, red Band D and darker red Band E.

**2.8.6** Ten-year trends at state of the environment and impact sites (Figure 54) are mixed.

Site	Ammoniacal-N	Nitrate-N	SIN	Total N	DRP	Total P	MCI	QMCI	Clarity	E. coli	POM	Turbidity EPA
Owahanga River at Branscombe Bridge	Extremely likely	Very likely	Virtually certain	Unlikely	Likely	Unlikely	Extremely unlikely	Extremely unlikely	Very Likely	As likely as not		Likely
Pongaroa River upstream of the STP	Likely	Unlikely	As likely as not	Unlikely	Unlikely	Exceptionally unlikely			Likely	Unlikely	Extremely likely	Very unlikely
Pongaroa River downstream of the STP	As likely as not	Unlikely	As likely as not	Unlikely	As likely as not	Exceptionally unlikely			Likely	Unlikely	Extremely likely	Very unlikely

Figure 54: Unadjusted confidence of an improving trend in water quality at state of the environment and impact sites in the Puketoi ki Tai FMU for the ten-year period ending December 2019

## 2.9 Waiopehu FMU

- 2.9.1 The Waiopehu FMU encompasses the Lake Horowhenua and Lake Waiwiri, Waitarere Beach, and the Ōhau and Waikawa river catchments. Lake Horowhenua is a taonga for local iwi/hapū and has a degraded state below many national bottom lines for water quality. Toxic cyanobacteria cause the lake to be regularly closed for recreation. The state of the water quality is related to sediment and nutrients entering the lake and the legacy contaminants already present.
- 2.9.2 The Ōhau and Waikawa estuaries also show signs of nutrient enrichment, with **estuary trophic index (ETI)** scores within the moderate and poor categories. These catchments are at risk of further eutrophication as a result of land use. Further investigation is needed to establish the state of health of the Hōkio, Waiwiri and Wairarawa estuaries.
- 2.9.3 The Ōhau River itself is generally in good health, with a number of water quality and ecosystem health attributes achieving NOF Band A or Band B. The Waikawa Stream, and its tributary the Manakau Stream, show mixed results.

### **STREAM FENCING AND PLANTING**

- 2.9.4 The Freshwater and Partnerships Programme completed 0.954 km of stream fencing and planted 4,373 riparian plants within the Waiopehu FMU during the 2020-21 financial year. In addition to the Freshwater and Partnerships programme, the Land programme completed 1.3 km of stream fencing. In the Waiopehu FMU, Horizons combined programme (freshwater and land) completed 2.254 km of stream fencing. Including the stream fencing and planting, the land programme completed 24 ha of erosion control works and 2,037 ha of farm plans, in the Waiopehu FMU.

### **WORK TO DATE**

- 2.9.5 Work to improve the state of freshwater in Waiopehu FMU has been underway since 2013, with Horizons working in partnership with the Lake Horowhenua Trust, Lake Horowhenua Domain Board, Horowhenua District Council, and the Department of Conservation as co-signatories to the Lake Horowhenua Accord. Past and ongoing initiatives, and funding, include:
- Installation of a fish pass over the Lake Horowhenua weir to enable fish migration between the sea and the lake (Freshwater Clean-up Fund).
  - Construction of a sediment trap at the bottom of the Arawhata Stream, predicted to reduce sediment phosphorus loads into the lake via streams by more than 25% (Freshwater Clean-up Fund).
  - Lake-weed harvesting to reduce cyanobacteria blooms and the toxicity effects of the lake weed on fish in the spring (Freshwater Clean-up Fund).

- Sediment and erosion control plans for vegetable growers covering 80 percent of the horticultural land in the Arawhata Sub-catchment of the Lake Horowhenua Catchment (Freshwater Clean-up Fund).
- Riparian fencing totalling 16 km has been erected and 24,000 plants put in along stream banks by local communities and landowners with support from Horizons and the Freshwater Clean-Up Fund.
- The Future Proofing Vegetable Production project led by LandWISE, which focusses on working with growers in Horowhenua District to develop use of precise nutrient prescription and precise nutrient application, maximise retention of nutrients, and recapture nitrates that move beyond the root zone (Sustainable Farming Fund).

## **FUTURE FOCUS**

2.9.6 The focus for the next few years in the Waiopēhu FMU will be to carry out weed harvesting on Lake Horowhenua, complete the Jobs for Nature Horowhenua FMU water quality interventions project and upgrade our water quality monitoring programme. This upgraded monitoring programme will inform the preferred water quality interventions through Jobs for Nature and allow completion of freshwater accounting to inform the implementation of the new NPS-FM. Several current and future work streams are working towards improved water quality for Lake Horowhenua. The following diagram illustrates how the proposed work programmes dovetail together (Figure 55).

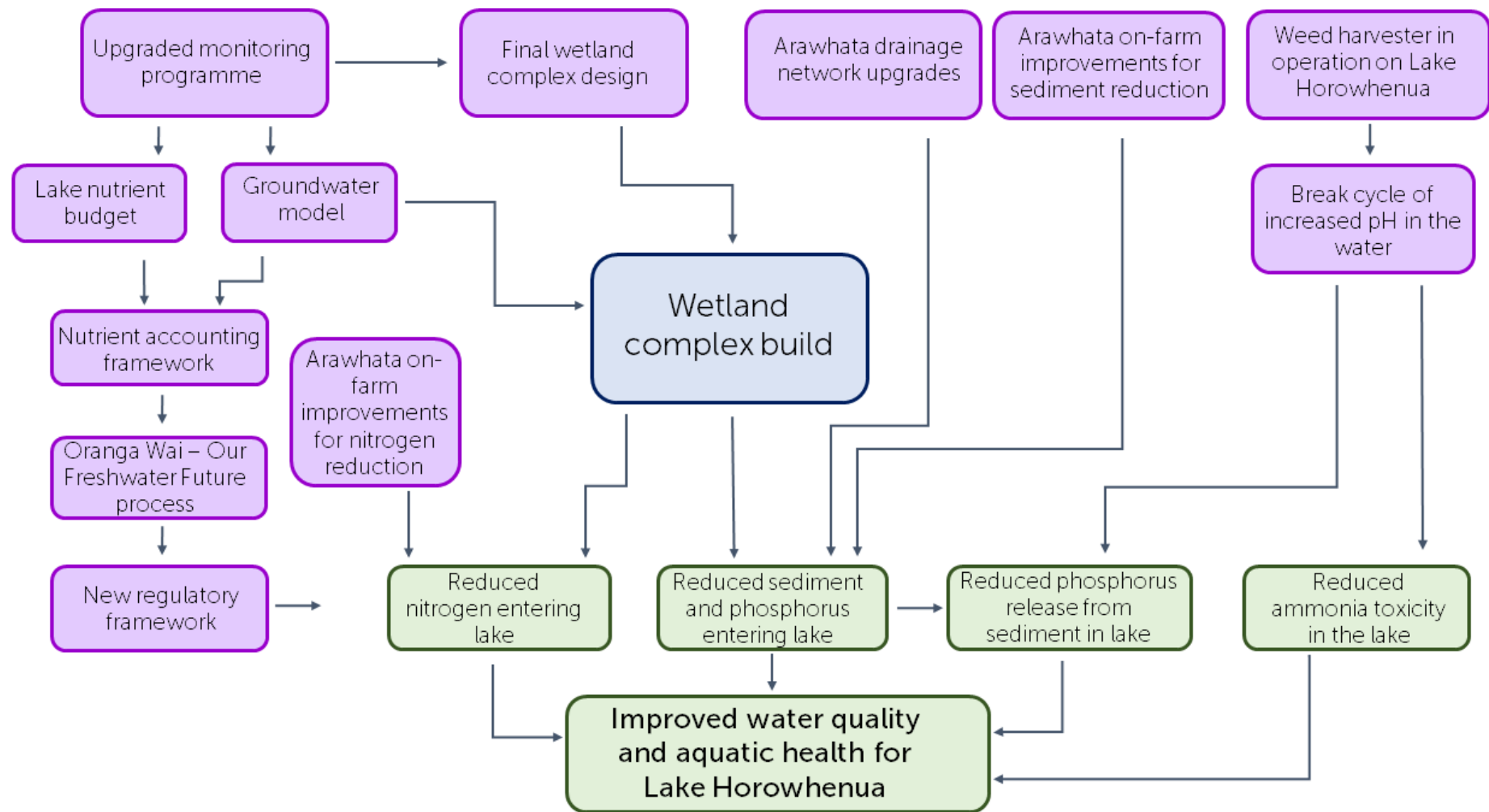


Figure 55. Diagram demonstrating how work streams in the Lake Horowhenua Catchment work towards improved water quality for the lake. Other regulatory activity is also underway for the stormwater consenting process.

## **WEED HARVESTER**

2.9.7 Lake weed harvesting was recommended as a key restoration option for Lake Horowhenua and incorporated into the Lake Horowhenua Accord and the Lake Accord Action Plan. Lake weed alters the chemistry of the lake by increasing the pH of the water, lowering the nitrate concentration (raising the toxic ammonia concentration) and providing a favourable environment for phosphorus release and promoting cyanobacteria blooms. Harvesting weed interrupts this cycle and provides an environment more favourable to fish and other aquatic life, including native lake plants.

2.9.8 Construction of the Arawhata boat ramp, which will enable the launching of the weed harvester onto Lake Horowhenua, was completed on 12 May 2021.

2.9.9 The first season of weed harvesting is due to commence in the spring of 2021 as a trial period where two blocks of weed will be harvested at different heights (300 and 500 mm above the lake bed) and a third block will be left as a control. Each block will be monitored for turbidity, macrophyte weed-bed cover, survival of the weed following the harvesting period, the extent of fish by-catch, and other water quality parameters within the weed harvesting area. Two monitoring buoys were deployed in addition to the current long-term monitoring buoy in June 2021 to provide some of this data.

## **FUTURE-PROOFING VEGETABLE PRODUCTION**

2.9.10 This section summarises the work with the horticulture sector through the Freshwater and Partnerships programme to improve water quality.

2.9.11 The Future Proofing Vegetable Production project was a three-year project that concluded in June 2021. The project, led by LandWISE, was funded by the MPI Sustainable Farming Fund, Regional Councils (including Horizons) and industry partners. It focused on developing and testing new production techniques for vegetable growers including precise nutrition prescription, precise application, maximising retention of nutrients, and recapturing nitrate that moves beyond the rootzone. The overall aim is to reduce nutrient leaching and improving efficiency while maintaining production. Through working with the growers in the Arawhata catchment (as well as other focus areas in New Zealand), the following key outcomes were achieved over the course of the project:

- The Nutrient Budget developed by LandWISE is being used by growers in the crop planning stage to ensure planned fertiliser practice follows industry good practice. The Nutrient Budget has also been part of evidence for the Hawkes Bay Regional Council Plan Change TANK process. An online app version is currently in development.
- Adoption of the Nitrate Quick Test soil test to be used to validate any additional fertiliser applications.
- More regular calibration of the growers' fertiliser equipment has shown that there can be large variability in application, and improving this practice will help to identify issues early. Understanding of nitrate pathways has improved with growers through the use of Nitrate Quick Tests.

## **FRESHWATER IMPROVEMENT FUND**

2.9.12 The Freshwater Improvement Fund project for Lake Horowhenua has been put on hold by the Ministry for the Environment and is open for discussion between the Lake Horowhenua Trust and the MfE.

## **JOBS FOR NATURE – HOROWHENUA FMU WATER QUALITY INTERVENTIONS**

2.9.13 In 2020, a four-year \$12.5 million project was announced for a Horowhenua FMU water quality interventions programme with a focus on remediating nutrients and sediment in the Lake Horowhenua Catchment. This project is funded with \$11.2 million through the Jobs for Nature Covid-19 recovery programme administered through the MfE and co-funded by Horizons with \$1.3 million. One of the major projects is to establish a wetlands complex within the Arawhata Sub-catchment and develop other associated works programmes to inform further interventions within the Horowhenua FMU, with the aim of improving water quality and aquatic health in the catchment.

2.9.14 Key elements of the proposed work programme are:

- Establish a governance group by June 2021.
- Produce reports and modelling of the groundwater and nutrient/sediment pathways and sources within the FMU to refine the placement of interventions for water quality improvement, by June 2024.
- Implement at least one intervention that will result in water quality improvement in the FMU, including designing and building a wetland complex, also by 2024.
- Communicate information on the lake and FMU to iwi/hapū and the wider community.
- Employ one Freshwater Coordinator – Horowhenua FMU, and three monitoring/science staff (3.5 FTEs).

2.9.15 The four-year funding term for this project commenced on July 1 2020 and the Deed of Funding was signed with MfE in February 2021. The following has been carried out in Year 1:

- The land designated for the development of the wetland complex was purchased by Horizons Regional Council on 1 June 2021
- Five monthly Governance Group meetings have been held.
- Procurement for the first phase of monitoring, focussed on continuous and automated data around the wetland site, is underway.
- A workshop with technical experts was held in August 2020 to refine information and data gaps.
- A wetland feasibility study in the Arawhata sub-catchment, including conceptual designs, was carried out by Jacobs engineering consultancy.
- The Sedimentation and Drainage Management Plan for the Arawhata sub-catchment has been completed by Tonkin + Taylor.
- A workshop was held in April 2021 with technical experts to discuss the science and research workstream of the project and scope a path forward for final design of the wetland treatment complex.

- The development of a groundwater conceptual model, contracted to environmental consultants Pattle Delamore Partners (PDP), will be available in August 2021.
- A communications plan and planning for community engagement to be held in September 2021 is underway.
- The Horowhenua FMU Freshwater Coordinator and two assistant data technicians have been appointed while one role remains to be filled.

## **MONITORING AND SCIENCE**

- 2.9.16 Lake Horowhenua and its tributaries have been monitored monthly for nutrients, sediment and *E. coli*, and flow since 2013. Water quality state and trends are available on [LAWA](#). Continuous flow and turbidity monitoring at the base of the Arawhata Sub-catchment has been in place since 2018 and continuous flow monitoring was installed on the Pātiki and Mangaroa streams in 2019. There are 17 groundwater level monitoring sites in the Horowhenua Catchment and monthly lake-level measurements were recently established for Lake Waiwiri.
- 2.9.17 An intensive fortnightly monitoring programme was implemented in the Ōhau and Waikawa catchments between 2016-19, to inform nutrient sources and groundwater/surface water interactions. This data will be used to inform estuary limit setting, a project now in the scoping stage.
- 2.9.18 The monitoring programme to support the Jobs for Nature project will include the following, in addition to the established SoE programme:
- A synoptic survey of the Arawhata, Mangaroa and Pātiki streams with radon, tritium, nitrate and isotopes to be sampled to establish the groundwater/surface water interactions and determine nutrient sources.
  - Automated and continuous monitoring of groundwater and surface water in and around the proposed wetland site.
  - Shallow piezometers to understand shallow groundwater in the proposed wetland site.
  - An extended groundwater monitoring programme for groundwater level and water quality. Additional groundwater bores will be established, particularly in the Arawhata Sub-catchment, to determine groundwater flow and nutrient pathways.
  - The addition of nitrogen and oxygen isotope sampling to the current surface water SoE monitoring programme, to help identify sources of nitrate in the Lake Horowhenua tributaries.
- 2.9.19 The conceptual groundwater model for the Horowhenua FMU has been contracted to PDP Ltd and the intensive monitoring will help inform a more detailed and refined groundwater model in later years of the project.
- 2.9.20 Nutrient limit setting for the Ohau and Waikawa estuaries is currently underway and contracted to DHI and Salt Ecology.

## SWIMMABILITY

2.9.21 A summary of the season’s swimmability results for the Waiopēhu FMU is displayed below. These are ranked by worst to best performing sites, top to bottom for each FMU. River and lake sites are measured for both microbial (*E. coli*) and cyanobacterial (potentially toxic algae) measures of contact recreation suitability. The results below are a composite of these and take the worst case, so if a site is red for one category and orange for the other on any given sampling occasion, the red category is displayed. Sampling of Lake Horowhenua and the Hokio Stream were not undertaken due to health and safety risks. These will be reassessed for future seasons, particularly with the new boat ramp installed in Lake Horowhenua.

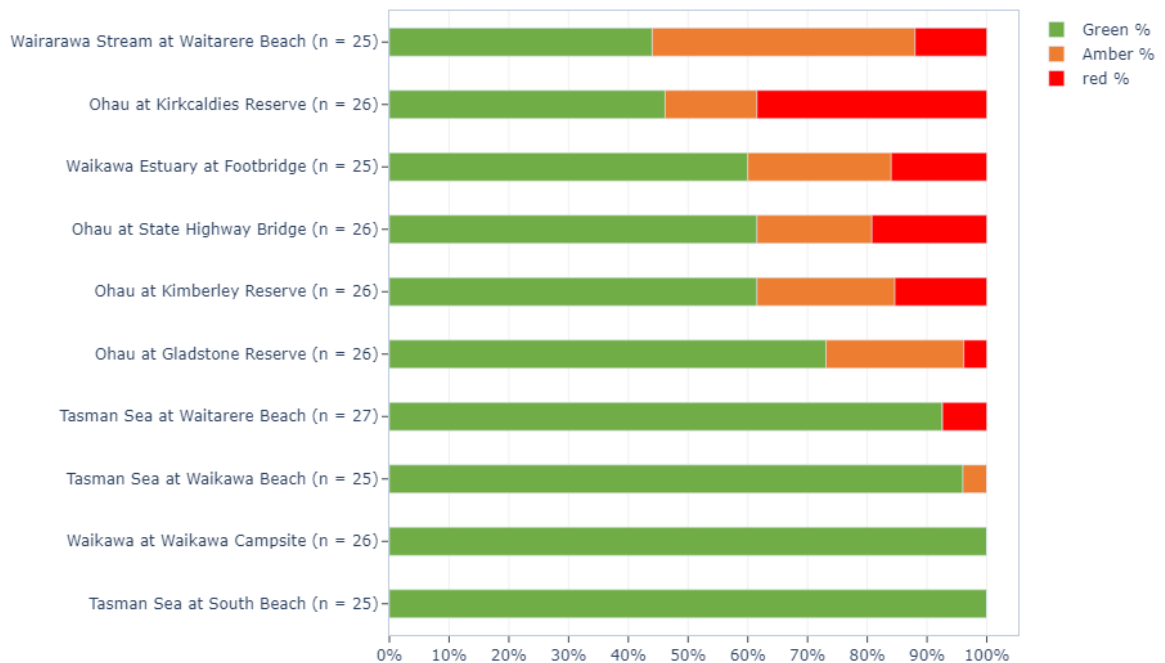


Figure 56: Swimmability in the Waiopēhu FMU for the 2020-21 season.

2.9.22 The Waiopēhu FMU sites (Figure 56) are split into two distinct groups with the coastal sites, and sites at the top of the catchment (Waikawa campsite, and Gladstone reserve) typically being compliant with guidelines while sites lower in the catchment often had elevated results for faecal contamination.

## RIVER STATE AND TRENDS

2.9.23 LWP Ltd were commissioned to undertake an analysis to update the river water quality state and trends for the region. The analysis calculated the state of water quality as compared to the NPS-FM 2020 National Objectives Framework (NOF) for a five-year period and the confidence of an improving trend in water quality and biological indicators for both a 10-year and 20-year period ending in December 2019. The trend analysis using raw data (that is data that is not adjusted to remove the influence of flow or climate). It is important to note the trend analysis presented below provides an indication of the direction of the trend but does not give an indication of the size of the trend.

2.9.24 The state of water quality at state of the environment sites in the Waiopehu FMU is presented in Figure 57. Most sites are in Bands A or B for the ammonia and nitrate toxicity attributes, although there are some below the national bottom line (Band C). Most sites are below the national bottom line for clarity and the different statistics for *E. coli*.

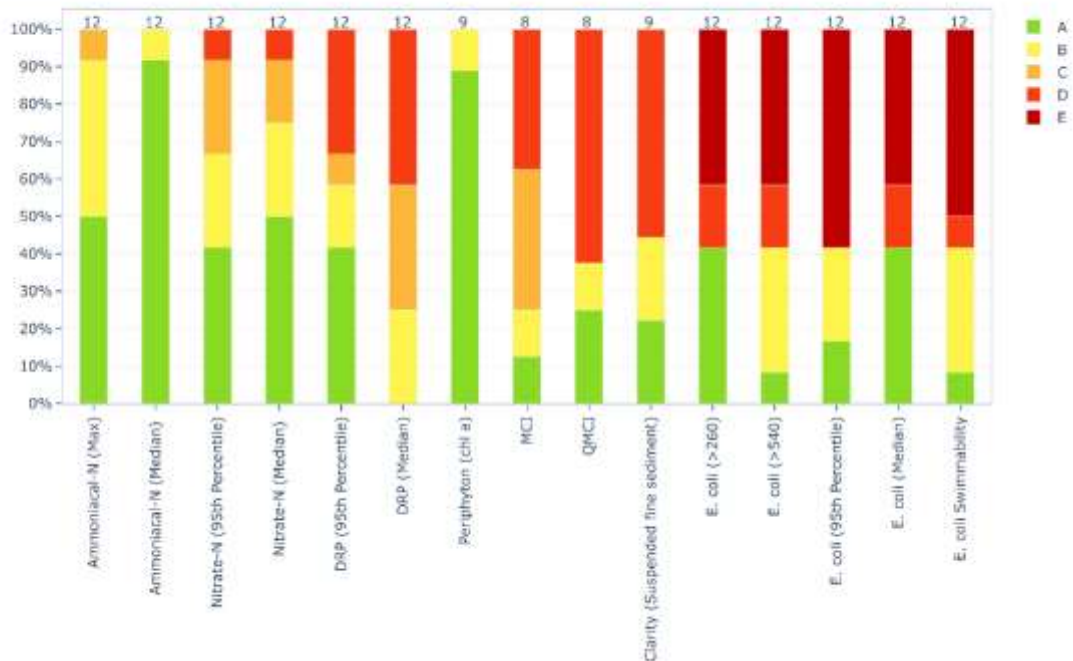


Figure 57: State of water quality in the Waiopehu FMU at State of the Environment sites compared to NOF 2020 attributes for the five-year period ending December 2019

2.9.25 Twenty-year trends were limited in the Waiopehu FMU and the results were mixed (Figure 58).

Site	Ammoniacal-N	SIN	DRP	E. coli	Turbidity EPA
Arawhata at Hokio Beach Road	Not analysed	Virtually certain	Extremely unlikely		Exceptionally unlikely
Ōhau River at Gladstone Reserve				As likely as not	Extremely likely

Figure 58: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Manawatū FMU for the 20-year period ending December 2019

2.9.26 Ten-year trends at state of the environment sites (Figure 59) showed predominantly improving trends for ammonia nitrogen, total nitrogen and *E. coli* whereas, the sites are predominantly worsening for chlorophyll *a* and clarity.

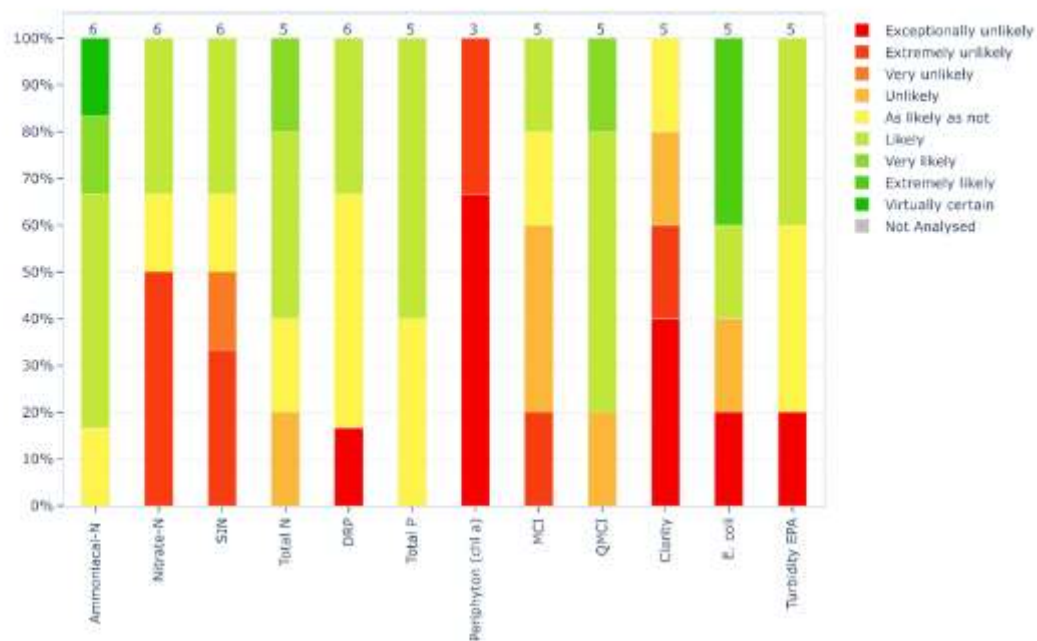


Figure 59: Unadjusted confidence of an improving trend in water quality at state of the environment sites in the Manawatū FMU for the ten-year period ending December 2019

### 2.9.27 Reports

#### Reports produced

Emond, H., Austin, D., Baker, T. J (2021). [Arawhata wetland – conceptual design report](#). Jacobs client report prepared for Horizons Regional Council, April 2021

Ferguson, R (2021). [Integrated sediment, nutrient and drainage management plan for the Arawhata Catchment](#). Tonkin + Taylor client report prepared for Horizons Regional Council. March 2021.

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