State and Trends of Water Quality in the Manawatū Catchment

For all records to 30 June 2021

March 2023

horizons
REGIONAL COUNCIL

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EXECUTIVE SUMMARY

This report summarises the current state and trends of compulsory water quality attributes (identified in the National Policy Statement for Freshwater Management (NPS-FM) 2020) in rivers of the Manawatū catchment. This report also provides recommendations to inform the development of the 3rd generation action plan for the Manawatū River Leaders Forum.

Over the last 13 years, the Manawatū River Leaders Forum and its partners have undertaken much work to improve water quality in the Manawatū catchment. However, comparing the current state of the catchment against the National Objective Framework's (NOF) compulsory attributes suggests room for improvement in some areas.

The current state and trends of water quality in the catchment are presented in the following table:

Issue	Effects	State	Trends	Current and future mitigation measures
High nutrient concentrations	• Toxicity to aquatic life. • Excessive periphyton and phormidium biomass (blooms) that affect ecosystem health (also affects suitability for swimming). • Degradation of instream habitat and flow-on effects to aquatic life. • Dissolved oxygen fluctuations and habitat degradation.	• Nitrate toxicity is not generally a problem within the catchment. • Ammoniacal nitrogen toxicity is generally a point source issue. • Excessive algal blooms are a particular issue in the Mangatainoka, Mākākahi, Mākuri, Tīraumea and the main stem of the Manawatū River downstream of the Palmerston North wastewater treatment plant. • The three Manawatū River continuous dissolved oxygen sites are graded band C. The site on the Mangatainoka at Pahiatua Town Bridge is band D.	• Over the last 10 years there were improving trends in ammoniacal nitrogen and nitrate at both SOE and impact sites. • Predominantly degrading trends were identified for chlorophyll *a* at both SOE and Impact sites. • Trends in dissolved reactive phosphorus were more mixed. • 20 year trend analysis shows the majority of sites are improving for dissolved reactive phosphorus, nitrate and ammoniacal nitrogen. • 30 year trend analysis shows improving trends in dissolved reactive phosphorus at the Manawatū at Whirokino, Mangatainoka at SH2, and Ōroua at Awahuri Bridge but a degrading trend at Manawatū at Hopelands. An improving trend in nitrate was identified at all sites, and an improving trend in ammoniacal nitrogen was identified at all sites except Ōroua at Awahuri Bridge.	• Focusing on reducing both nitrogen and phosphorus to surface and groundwater. • Implementing farm plan recommendations. • Upgrading wastewater treatment plants. • Removing wastewater treatment plant discharges to water, particularly at low flows. • Riparian fencing and planting.
Poor clarity/ high sediment yields	• Additional nutrients (phosphorus bound to sediment). • Smothering of habitat. • Poor clarity affects recreational and aesthetic values and the ability of some fish and birds to see their prey.	• Most sites are below the national bottom line for suspended fine sediment (visual clarity). • Modelling undertaken by Manaaki Whenua shows there will be improvement in visual clarity with the continued implementation of the Sustainable Land Use Initiative (SLUI) programme. However, under climate change scenarios some river reaches currently meeting the national bottom line may not continue to do so, even with the SLUI programme. Despite this, continuing to implement SLUI is better than stopping in terms of outcomes under climate change.	• 10 year trend analysis shows decreasing visual clarity at the majority of sites. • 20 year trend analysis of visual clarity shows an improving trend (increasing clarity) at the majority of sites. • 30 year trend analysis shows an improving trend in visual clarity in the Manawatū at Hopelands, Mangatainoka at SH2, and Ōroua at Awahuri Bridge but a degrading trend at Manawatū at Whirokino.	• Riparian fencing and planting. • Continue and consider accelerating the erosion-prevention work under SLUI to be more climate resilient. • Carrying out best practice river engineering and drain maintenance. • Sediment and Erosions Control measures at work sites.

Issue	Effects	State	Trends	Current and future mitigation measures
High bacteria counts (Pathogens)	• Suitability for swimming. • Suitability for Mahinga Kai. • Suitability for secondary contact.	• Year round *Escherichia coli* (*E. coli*) is generally band D or E in the catchment. • 25 of the 26 primary contact sites are rated “Poor”, only Pohangina at Piripiri is rated “Fair”.	• 10 year trend analysis shows degrading (increasing) *E. coli* at the majority of sites. • 20 year trend analysis of *E. coli* counts show an improving trend at the majority of sites.	• Riparian fencing and planting. • Increased buffer width of some existing riparian fencing. • Implementing farm plan recommendations. • Upgrading wastewater treatment plants. • Improved effluent management.
Degraded aquatic habitat and life	• Macroinvertebrate communities. • Native fish.	• Macroinvertebrate Community Index (MCI) scores are indicative of mild organic pollution (band C) at most sites. Headwaters of the Manawatū tributaries are generally bands A or B, and the majority of downstream sites are generally band C. • Macroinvertebrate communities are particularly degraded in the lower Manawatū, Mangatera and Mangatainoka Rivers.	• Over the 10 year period, trends are generally degrading for MCI and Average Score per Metric (ASPM) at State of the Environment (SOE) sites. • Over the last 20 years, the majority of sites are showing an improving trend for MCI.	• Implementing the One Plan water allocation framework and reducing over allocation. • Carrying out best practice river engineering and drain maintenance. • Improving fish passage and habitat. • One Plan sediment and nutrient controls. • Riparian fencing and planting. • Avoiding loss of stream habitat and length.

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1 Introduction

This report summarises the current state and trends of compulsory water quality attributes (identified in the National Policy Statement for Freshwater Management (NPS-FM) 2020) in rivers of the Manawatū catchment. This report also provides recommendations to inform the development of the 3rd generation action plan for the Manawatū River Leaders Forum.

National Policy Statement

The NPS-FM 2020 provides the blueprint for local authorities to partner with tangata whenua and engage with communities to set the regional direction for freshwater management. As part of the NPS-FM, there is a National Objectives Framework (NOF) which sets out four compulsory values that must be considered when drafting the region's freshwater objectives, policies and rules:

- Ecosystem health,
- Human contact,
- Mahinga kai, and
- Threatened species.

The NOF also sets out compulsory attributes (measurable indicators of freshwater quality) to determine the state of the region's ecosystem health and human health risk from contact with water. These attributes are graded on a band range from A (good), B, C, D or E (poor). Some attributes have a national bottom line, a nationally set minimum acceptable standard. Monitoring sites with attribute grades below the national bottom line must be improved.

The compulsory attributes for ecosystem health in rivers include (but are not limited to):

- nutrients,
- chlorophyll *a*,
- macroinvertebrate indicators,
- sediment, and
- dissolved oxygen.

The compulsory attribute for human contact is *Escherichia coli* (*E. coli*), measured monthly as part of our State of the Environment monitoring programme and weekly at primary contact sites from November to April.

Monitoring in the Manawatū catchment

Horizons Regional Council monitors the attributes identified in the NPS-FM 2020 at many sites across the Manawatū catchment Figure 1 shows sites along the catchment's rivers and streams where staff monitor water quality monthly. These locations include:

- 56 State of the Environment (SOE) monitoring sites (areas that are not directly affected by point source discharges)
    - Macroinvertebrate monitoring occurs annually at 41 of these SOE sites
    - Periphyton monitoring occurs monthly at 31 of these SOE sites
- 13 impact sites (sites immediately downstream of a discharge from an industrial or sewage treatment facility)
    - Macroinvertebrate monitoring occurs annually at five of these impact sites
    - Periphyton monitoring occurs monthly at four of these impact sites

Figure 2 shows 26 primary contact sites (swimming spots) along the catchment's rivers and streams where staff monitor water quality weekly during the bathing season (1 November to 30 April).

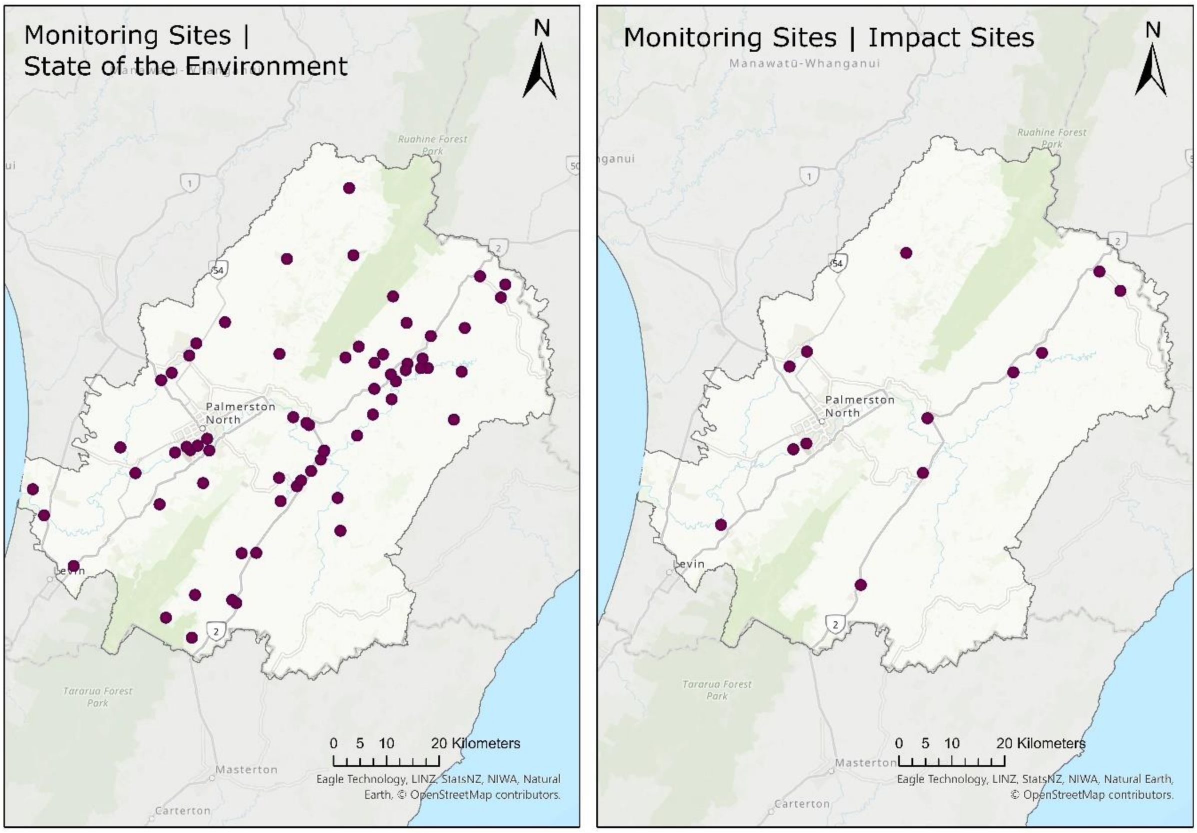


Figure 1: State of the Environment (left) and Impact (right) monitoring sites in the Manawatū catchment

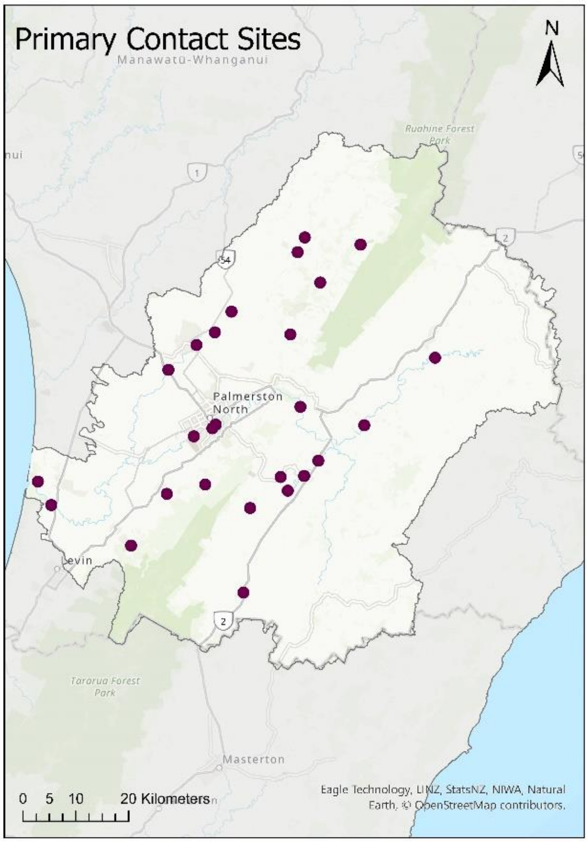


Figure 2: Primary contact monitoring sites in the Manawatū catchment.

Oranga Wai | Our Freshwater Future

In the Horizons Region, the process to implement the NPS-FM is called Oranga Wai | Our Freshwater Future. This multiyear process will lead to a revised regional plan and policy statement (an updated One Plan) and a set of water quality targets for the region's waterways. Horizons is currently reviewing and setting these targets in partnership with iwi and hapū and engaging with the broader community. At this stage of the process, we cannot clearly indicate a direction towards achieving desired water quality outcomes. In many of our waterways, we will likely need to continue to reduce nitrogen, phosphorus, sediment and *E. coli* concentrations to achieve the region's water quality aspirations.

This report does not cover the cultural aspects of water quality in the catchment or mātauranga measures for the state of the wai (water). The council is currently working with iwi and hapū through the Oranga Wai process to determine attributes and targets for these measures. In future, we envisage that the reporting framework developed through this process will be more holistic and include reporting on mātauranga attributes.

2 Method

The state and trend of water quality in the Manawatū catchment was analysed according to the method outlined in Fullard and Patterson (In Press).

State

We calculated compliance statistics for attributes at monitored sites using five years of observations for the period ending 30 June 2021. We needed to have 30 samples (minimum) for monthly measures and five samples for annual measures to grade a site confidently. We calculated the state of water quality at primary contact sites using five seasons of data collected weekly between November and April, requiring a minimum of 30 samples over that period.

The results are then used to grade each site based on their performance against the NOF attribute bands (graded A to D or E), as identified in Appendix 2 of the NPS-FM (MfE, 2020). For attributes monitored mothly where we have lower confidence in our grade (where less than 30 samples were available), we have presented this as an open circle to give an indicative grade.

Trend

Where sufficient data were available, we assessed the trends of water quality attributes at monitoring sites in the Manawatū catchment to the period ending 30 June 2021.

Where possible, we assessed attribute trends at SOE sites over 10, 20, and 30 year periods. For impact sites, we assessed attribute trends over a 10 year period. For primary contact sites, we assessed attribute trends where data was available over five and 10 year periods.

3 Results

This section summarises the state and trends of water quality in the Manawatū catchment.

3.1 State

There are some attributes where more than one statistic is used to define their state. Where this is the case, we present an overall grade for the attribute. The worst grade of the two (or more) measures is presented as the overall grade.

3.1.1 Nutrients

Nutrients (nitrogen and phosphorus) are essential for plant growth. In healthy rivers and streams, nutrients occur naturally in low concentrations. However, higher concentrations of nutrients become an issue in freshwater, as it can cause excessive plant and algal growth, or become toxic to aquatic life. The compulsory nutrient attributes within the NPS-FM 2020 focus on nitrate toxicity, ammonia toxicity and dissolved reactive phosphorus and their effects on ecological communities.

Figure 3 shows the NOF grade for ammonia toxicity at SOE and impact sites. Ammonia toxicity generally sits within band A or B across SOE sites. There are some sites in the Manawatū catchment with results below the national bottom line (Bands C and D). These are largely associated with point source discharges (contaminants entering a waterbody from a single fixed point, such as a pipe or drain). The monitoring sites on Whitebait Creek is the exception to this as there are no known wastewater discharges upstream of these sites.

The following wastewater treatment plants (WWTPs) cause either localised or wider effects on ammonia toxicity.

- Palmerston North sewage treatment plant, or STP (immediately downstream and at lower SOE sites)
- Feilding WWTP (immediately downstream and at lower SOE sites)
- Dannevirke WWTP (immediately downstream and at lower SOE sites)
- immediately downstream of the Kimbolton WWTP, and
- both upstream and downstream of the Norsewood WWTP

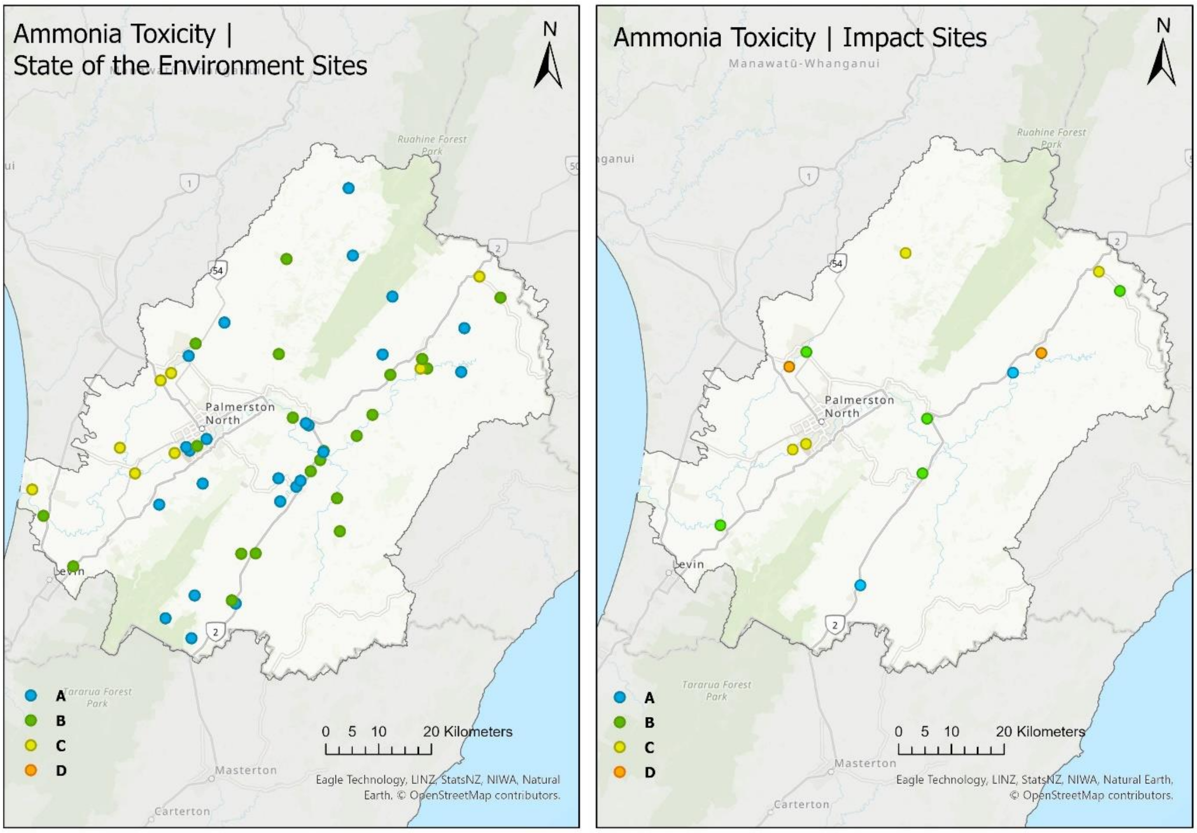
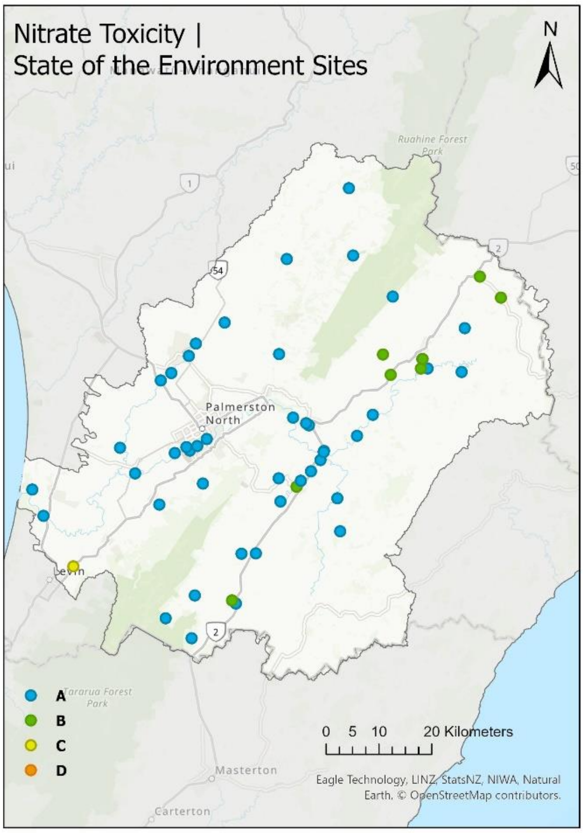


Figure 3: NOF grades for ammonia toxicity in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites. Open circles are sites where state is indicative only (there is less than 30 data points)

Figure 4 shows the NOF grade for nitrate toxicity at SOE and impact sites in the Manawatū catchment. Nitrate toxicity is generally not an issue in the catchment, except the Kōpūtaroa at Tavistock Road site, which is graded Band C which is below the below the national bottom line. The catchment's overall nitrate toxicity results do not mean that nitrogen is not an issue in the Manawatū catchment. The concentrations of nitrate that cause toxicity are much greater than the levels required to control nuisance algal growth. We will need to reduce nitrogen in the catchment to meet algal outcomes.



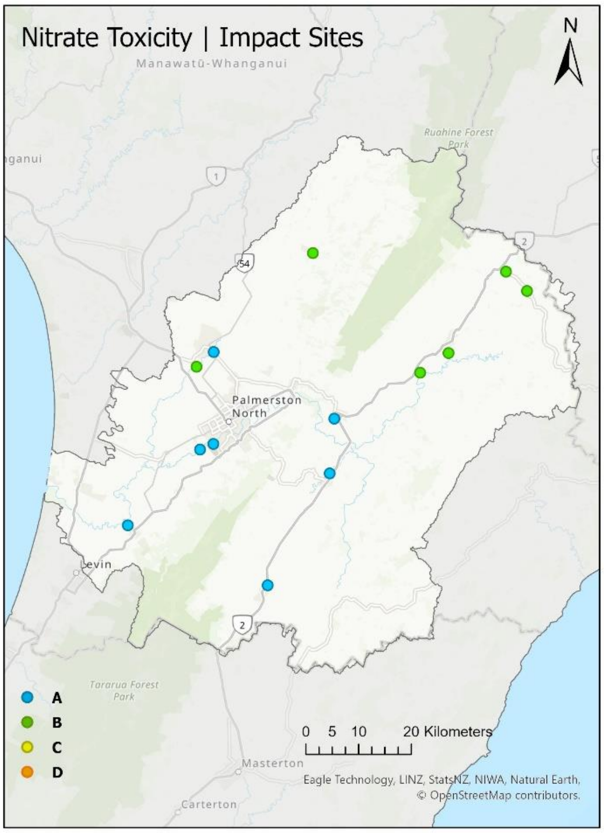


Figure 4: NOF grades for nitrate toxicity in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites. Open circles are sites where state is indicative only (there is less than 30 data points)

Figure 5 shows the NOF grade for dissolved reactive phosphorus (DRP) at SOE and impact sites in the Manawatū catchment. DRP concentrations are generally low at sites in the Mangatainoka catchment and the upper and middle Ōroua, upper Pohangina, Tāmaki, Kahuterawa and Tokomaru sub-catchments.

Sites below the national bottom line (band D) represent 37% (25 of 67) of the catchment's freshwater monitoring sites. These sites are located:

- in parts of the Upper Manawatū (including Manawatū at Hopelands and Weber Road),
- the Lower Ōroua (from downstream (d/s) of AFFCO, Feilding),
- the main stem of the Manawatū River downstream of the Palmerston North WWTP,
- the Kōpūtaroa Stream, and
- Whitebait Creek.

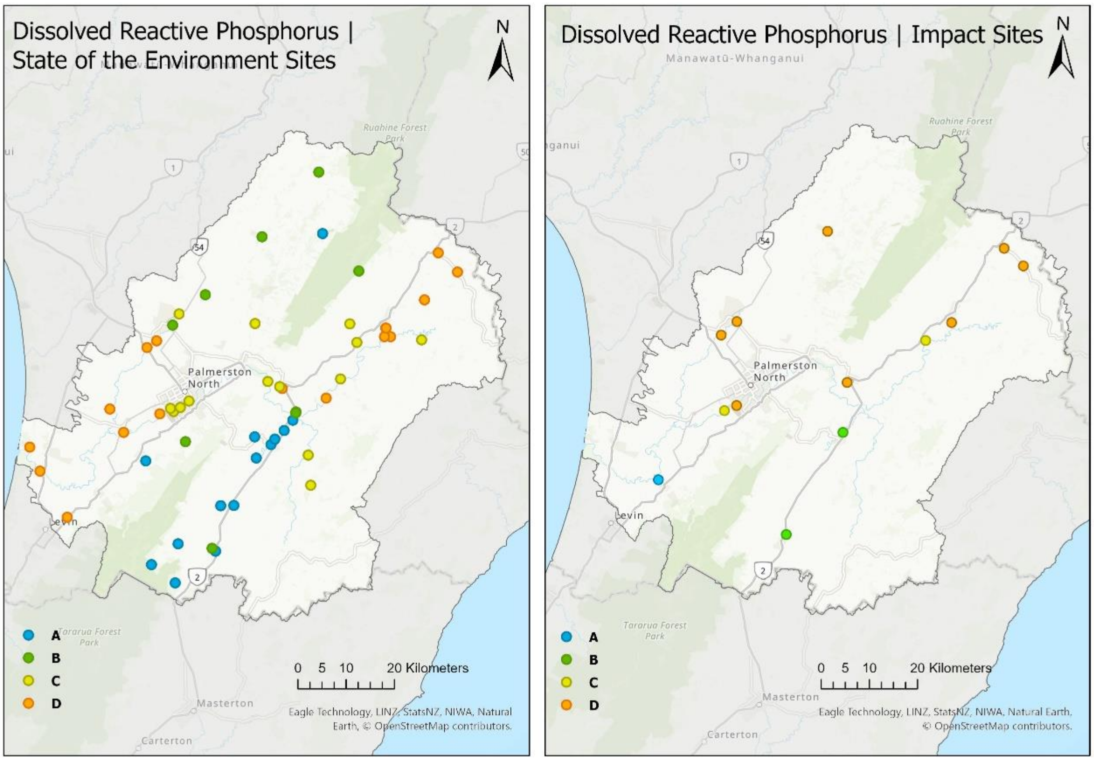


Figure 5: NOF grades for dissolved reactive phosphorus in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites. Open circles are sites where state is indicative only (there is less than 30 data points)

3.1.2 Periphyton

Chlorophyll *a* is a measure used to determine the abundance of algae on the bed of rivers and streams. Excessive algal growth can change aquatic communities as periphyton smothers the riverbed, changes the invertebrate community, affects food available for fish, and alters oxygen and pH levels. Managing nutrient input to the catchment's freshwater is key to reducing algal growth. The NPS-FM 2020 requires levels for nitrate and ammonia toxicity that are much higher than levels that restrict algal growth. As we implement the NPS-FM 2020, we will focus on identifying the levels of nutrient reduction required to manage periphyton growth.

NOF grades for chlorophyll *a* in the Manawatū catchment are mixed (Figure 6). Three sites are below the national bottom line:

- Manawatū downstream of the Palmerston North WWTP,
- Manawatū at Ōpiki Bridge, and
- Mākuri at Tuscan Hills.

The Tīraumea at Ngāturi site did not meet the sample requirements but the available observations indicate it is band D. Twelve sites are band A. These sites are located mainly in the upper reaches of the catchment's tributaries. The remaining sites are bands B or C.

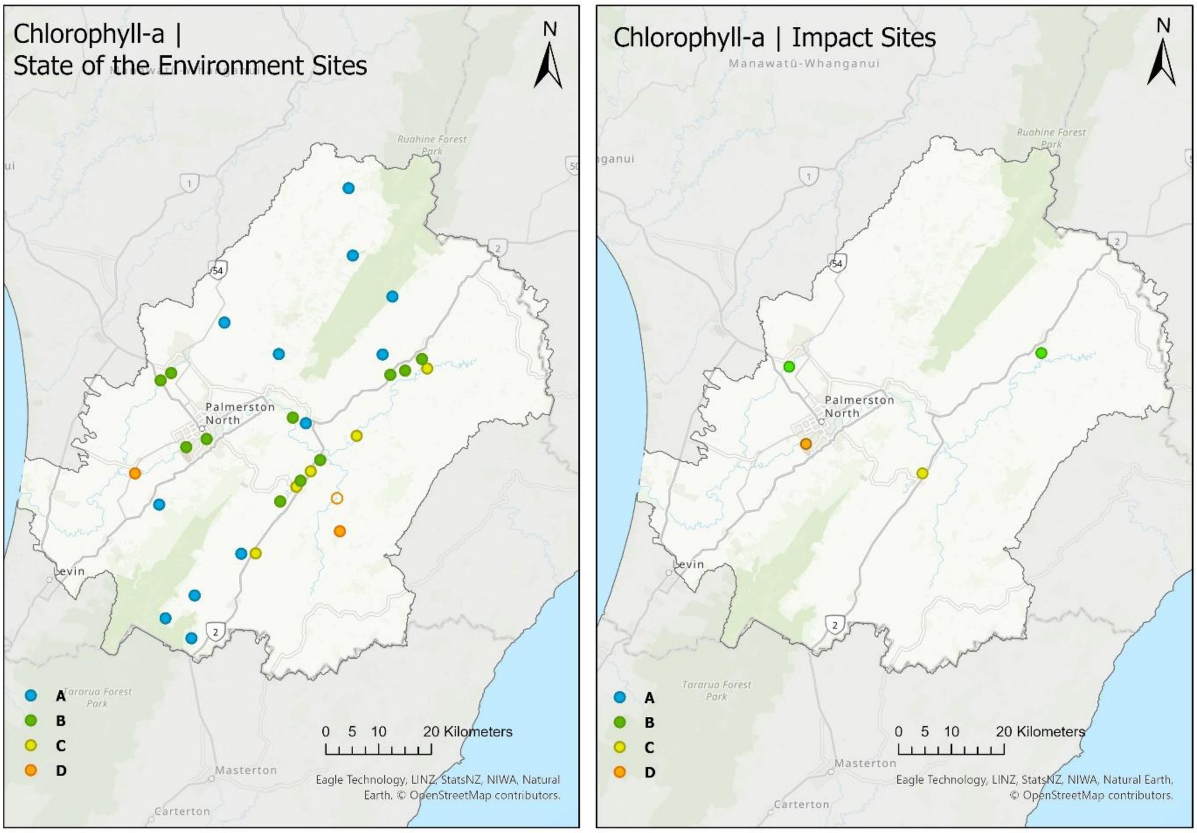


Figure 6: NOF grades for Chlorophyll-*a* in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites. Open circles are sites where state is indicative only (there is less than 30 data points)

3.1.3 Macroinvertebrates

Macroinvertebrates are small insects that inhabit our waterways. Three compulsory measures within the NPS-FM 2020 are associated with macroinvertebrate communities at monitoring sites. These are:

- the Macroinvertebrate Community Index (MCI),
- the Quantitative Macroinvertebrate Community Index (QMCI), and
- the Average Score Per Metric (ASPM).

Macroinvertebrate communities are widely used as indicators of stream ecosystem health because they include a wide range of species, each with relatively well-known sensitivity or tolerance to stream conditions. The higher the score of these metrics, the better the health of the macroinvertebrate community.

Figure 7 displays the NOF grades for the MCI at SOE (left) and impact (right) sites in the Manawatū catchment. The majority of sites are band C, which indicates that there is moderate organic pollution or increased nutrient levels at these sites. Three sites are below the national bottom line for this measure:

- Manawatū immediately downstream of the Palmerston North WWTP,
- Manawatū at Ōpiki Bridge, and
- the Mangatainoka River, upstream of the confluence with the Tīraumea River.

Two sites are band A: Mangatainoka at Pūtara and Mākākahi at the end of Kaipororo road.

The remaining sites are band B.

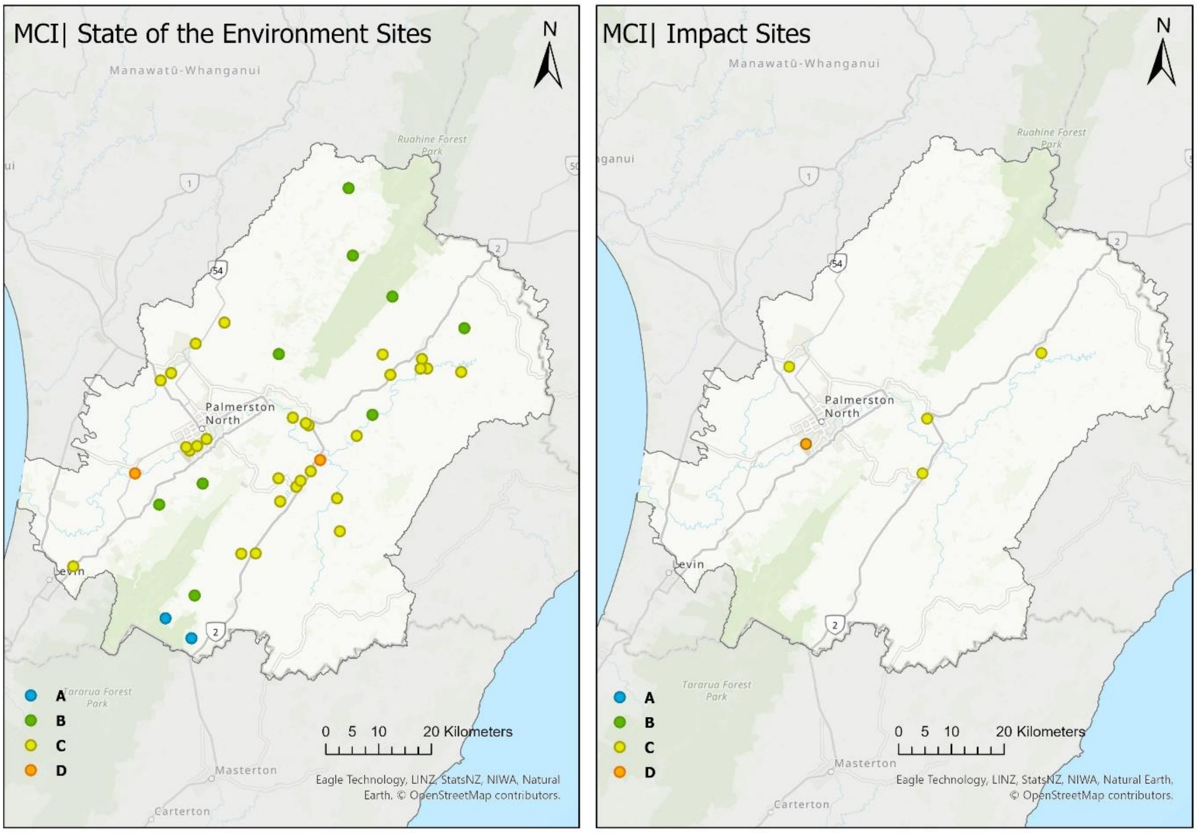


Figure 7: NOF grades for macroinvertebrate community index (MCI) in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites.

Figure 8 displays the NOF grades for the QMCI at SOE (left) and impact (right) sites in the Manawatū catchment. The grades for this attribute are mixed.

Sites in the upper reaches of the Manawatū River's tributaries are mostly in band A. Eleven sites sit below the national bottom line, indicating severe organic pollution of the water or increased nutrient levels. These sites are located at:

- the Kōpūtaroa Stream,
- the Mākākahi River at Hāmua,
- the Mākuri River,
- the main stem of the Manawatū River, immediately downstream of the Palmerston North WWTP,
- the Manawatū River at Ōpiki Bridge,
- the lower Mangatainoka River,
- the Mangatera Stream at Timber Bay Reserve,
- the Tīraumea River at Ngāturi, and
- the Turitea Stream at No. 1 Dairy Farm.

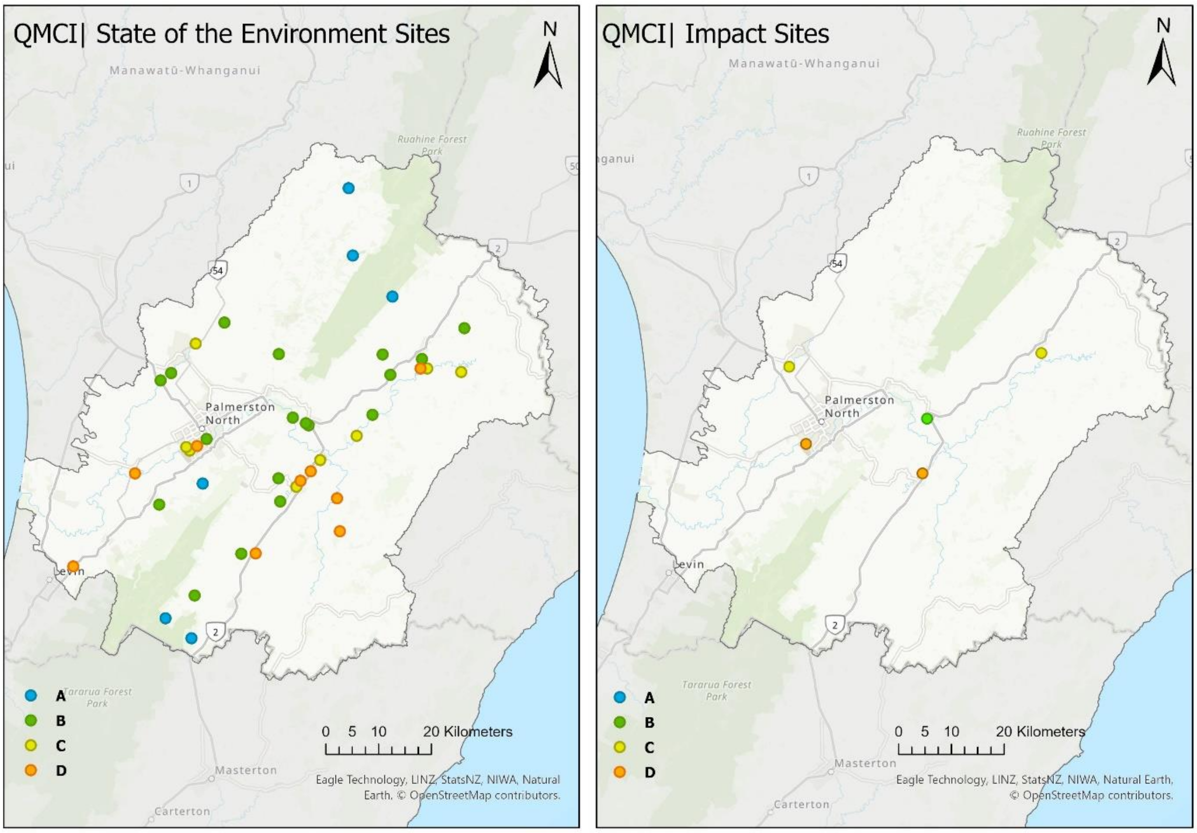


Figure 8: NOF grades for quantitative macroinvertebrate community index (QMCI) in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites

Figure 9 presents the NOF grades for average score per metric (ASPM) in the Manawatū FMU. Two SOE sites sit below the national bottom line: Manawatū at Ōpiki Bridge and Turitea at No.1 Dairy Farm. The only sites that achieve a grade in band A for this attribute are located along the forested boundary:

- Mākākahi at End Kaiparoro Road,
- Mangatainoka at Putara,
- and Tamaki at Tamaki Reserve.

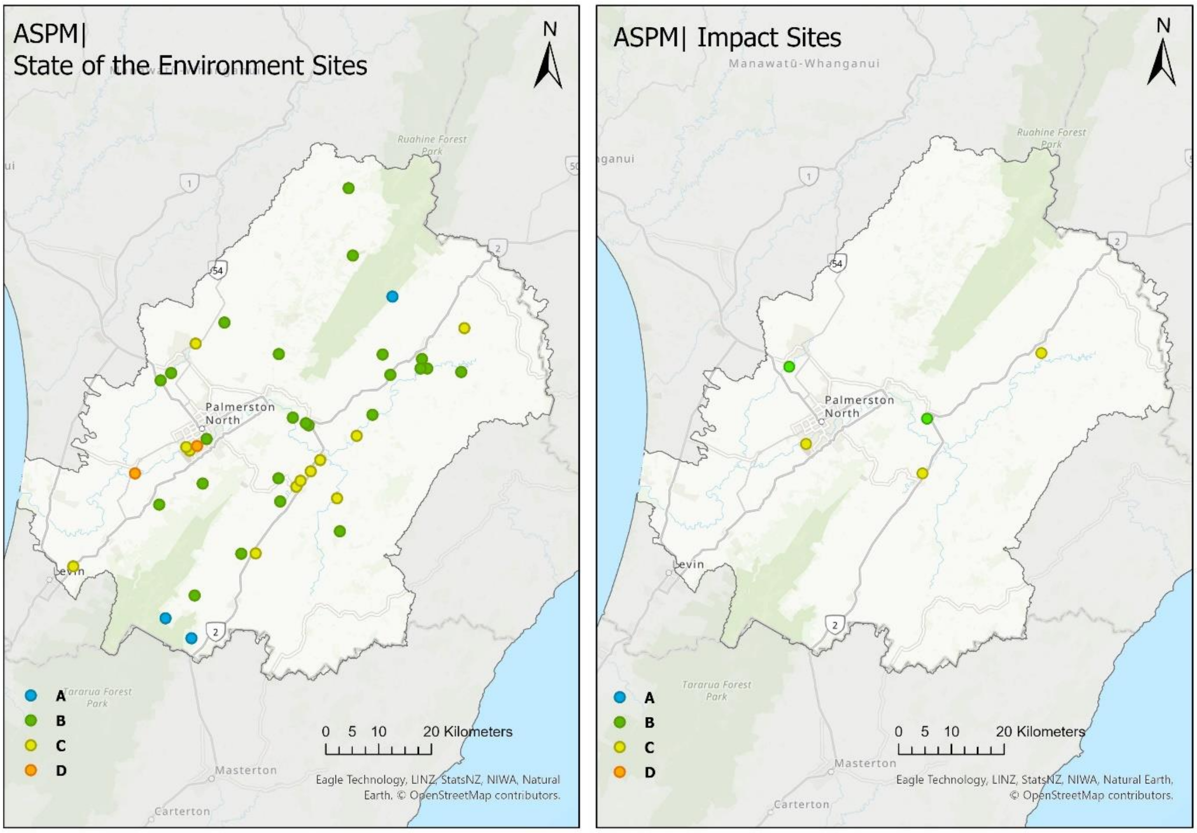


Figure 9: NOF grades for average score per metric (ASPM) in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites

3.1.4 Sediment

Sediment is tiny particles of soil or organic matter that has washed into or been directly discharged into our waterways. Whilst some erosion and associated sedimentation occurs naturally, in excessive amounts it can lead to impacts on the ecosystem by smothering habitat and reducing water clarity which can affect the ability of fish and birds to see prey, and by bringing in other contaminants such as phosphorus bound to it. The NPS-FM contains compulsory attributes for visual clarity – how far the naked eye can see through the water column and deposited fine sediment (small particles of sediment on the bed of the water way).

The sediment attribute reported here is suspended fine sediment (visual clarity).Suspended fine sediment can occur naturally due to a river or stream's erosive nature. This natural process varies significantly across the country, and we need to account for it in our attribute assessment. Based on the River Environment Classification, there are four classes of water way each with their own scale to grade this attribute that accounts for the topography, geology and climate characteristics of different river catchments.

Most monitoring sites where we assess visual clarity in the Manawatū catchment fall below the national bottom line (Figure 10). These sites include:

- 35 of 50 SOE sites, and
- seven of 11 impact sites.

However, some sites have good visual clarity and are graded band A. These sites are located in the following tributaries:

- Mangarangiora,
- Upper Pohangina,
- Upper Ōroua,
- Mākākahi,
- Ngatahaka, and
- Tamaki.

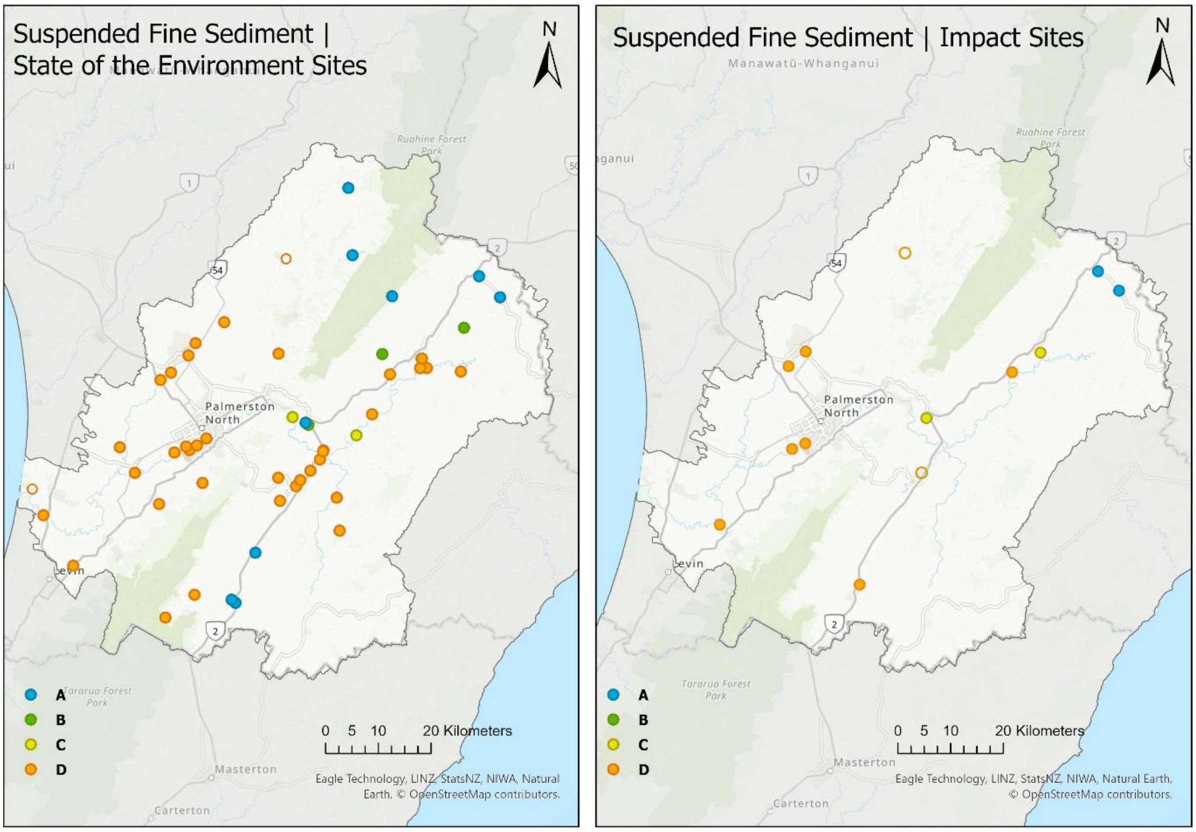


Figure 10: NOF grades for suspended fine sediment (Visual Clarity) in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites. Open circles are sites where state is indicative only (there is less than 30 data points)

Scenario modelling

To support implementation of the NPS-FM 2020, Horizons contracted Manaaki Whenua-Landcare Research (MWLR) to model erosion and suspended sediment loads across the region for a range of erosion mitigation and climate change scenarios (Vale *et al.*, 2022). We provided MWLR with the current state of reaches in the Manawatū catchment against the NPS-FM 2020's bottom lines from Fraser and Snelder's (2020) analysis.

MWLR applied three scenarios to the models, each considering different implementations of Horizons' Sustainable Land Use Initiative (SLUI):

- SC1: SLUI ceases operations
- SC2: SLUI continues at its current implementation rate
- SC3: SLUI ramps up activity, doubling the current implementation rate

Table 1 displays the proportion of river segments in the Manawatū catchment that meet each band by 2100 under each modelling scenarios (not considering climate change). When scenarios that accounted for climate change were modelled, many of the segments estimated to meet the national bottom line decreased, even with the implementation of erosion mitigations. However, these reaches performed worse when SLUI operations ceased as of June 2021, compared to the scenarios where SLUI activities continued at their current pace or were accelerated.

Table 1: Proportion of River segments in the Manawatū River network meeting the different NOF bands for Clarity under contemporary climate conditions with differing levels of erosion mitigation work implementation.

NOF Band	% of segments meeting the Band			
	2021	2100 Contemporary Climate		
		SC1	SC2	SC3
Band A	22%	23%	53%	62%
Band B	42%	43%	67%	73%
National Bottom line	59%	60%	75%	81%

3.1.5 Dissolved oxygen

Dissolved oxygen is a measure of the oxygen concentration of water, which is important for fish and other aquatic life to breathe. Dissolved oxygen levels can be impacted by the following:

- direct discharges of contaminants to water,
- photosynthesis of plants and algae within the waterbody, and
- other processes relating to the breakdown of sediment and organic matter in the water.

Four continuous dissolved oxygen monitoring sites exist in the Manawatū catchment:

- Manawatū River at Weber Rd,
- Manawatū River at Hopelands,
- Manawatū River at Teachers College, and
- the Mangatainoka River at Pahiatua Town Bridge.

All sites on the Manawatū River's main stem were graded C for the dissolved oxygen attribute. The Mangatainoka River at Pahiatua Town Bridge is below national bottom line and achieved a D grade (Figure 11).

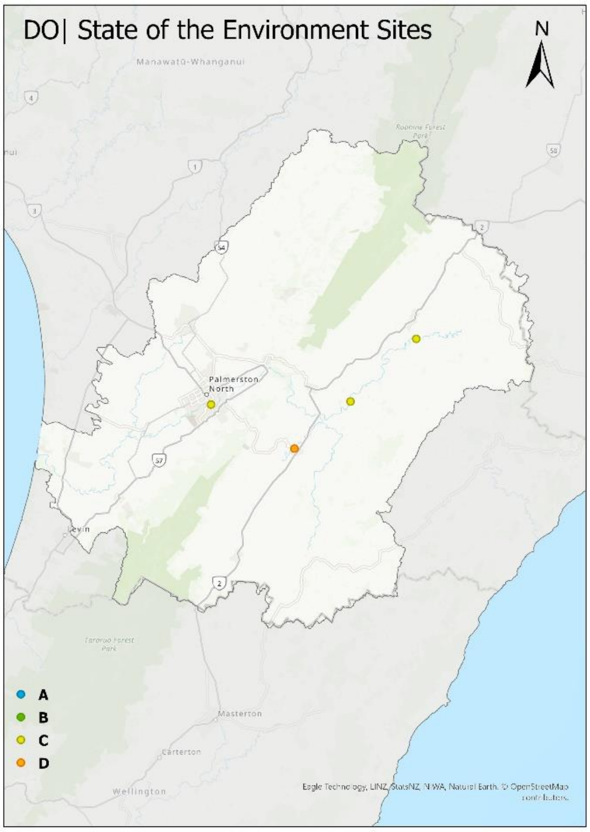


Figure 11: NOF grades for dissolved oxygen year round in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites

3.1.6 Escherichia coli

E. coli is a family of bacteria often found in large numbers in the guts of humans and animals. These bacteria enter the water through the following:

- direct discharges of contaminants to the water,
- stock access to water,
- poorly applied effluent to land, which causes runoff into the waterway, and
- overland flow during rainfall events.

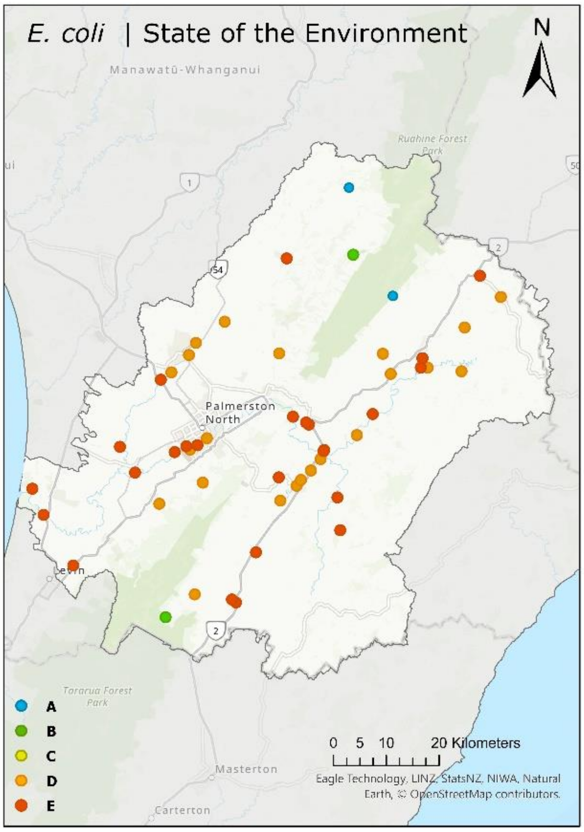
Measurements of *E. coli* indicate the presence of faecal matter within a waterway. High concentrations of these bacteria can be indicative of the presence of more harmful bacteria and viruses that can cause illness in humans (for example, cryptosporidium). The NPS-FM 2020 bands for the *E. coli* attributes reflect the risk of illness upon contact with the water.

There are two attributes for *E. coli*. One applies to SOE sites and is a year-round measure. The other applies to primary contact sites and is employed during the bathing season (1 November – 30 April).

Year Round

Figure 12 presents the analysis results for *E. coli* at SOE and impact monitoring sites. Several statistics determine the year-round *E. coli* grade. The results display the worst-performing statistic as the overall grade.

Two sites are graded A (Ōroua at Apiti and Tamaki at Tamaki Reserve), two sites are graded B (Mangatainoka at Pūtara and Pohangina at Piripiri), and the remainder are graded D or E.



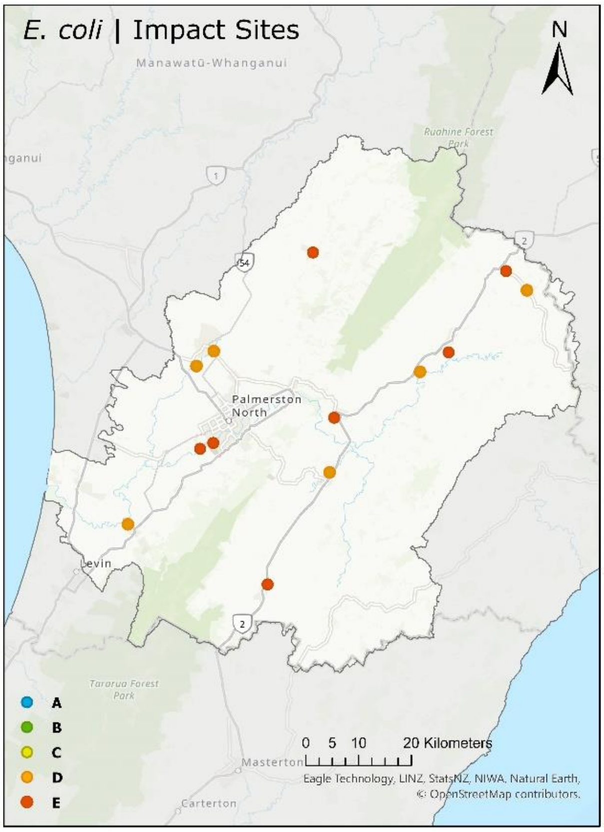


Figure 12: NOF grades for *Escherichia coli* year round in the Manawatū FMU for the five year period to 30 June 2021 at state of the environment (left) and impact (right) monitoring sites Open circles are sites where state is indicative only (there is less than 30 data points).

Primary Contact

Figure 13 displays the *E. coli* grades at freshwater primary contact sites across the Manawatū catchment. All but one of these sites are graded "poor" for primary contact *E. coli* attribute. The Pohangina River at Piripiri is the only site to achieve a "fair" grade.

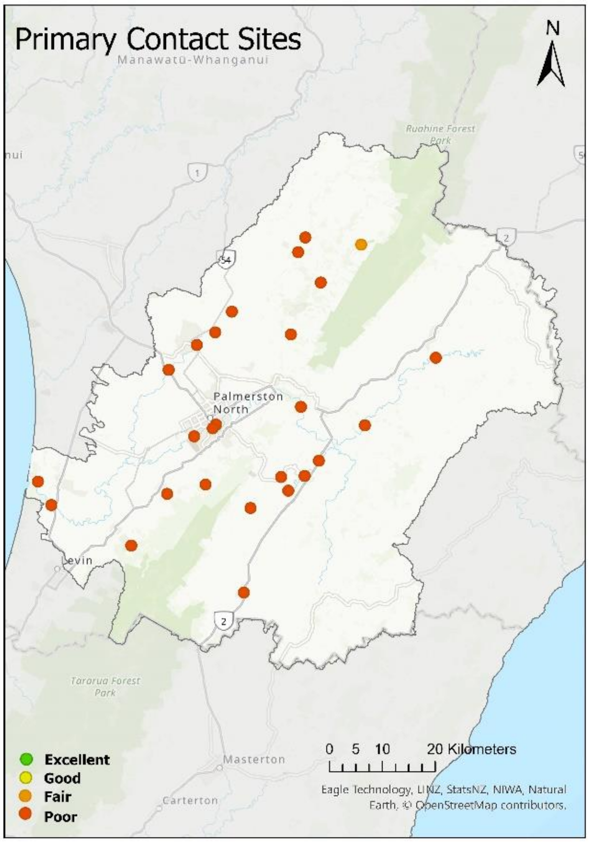


Figure 13: NOF grades for primary contact sites in the Manawatū FMU.

3.2 Trends

3.2.1 10 year trends

Ten year trends (1 July 2011 to 30 June 2021) at SOE sites in the Manawatū catchment (Figure 14) show predominantly improving trends for ammoniacal nitrogen and nitrate nitrogen. Ten year trends indicate predominately degrading trends for visual clarity, *E. coli*, chlorophyll *a*, MCI, and ASPM. Trend results are more mixed for DRP. For a breakdown of trends by sites and parameters, see Appendix 1.

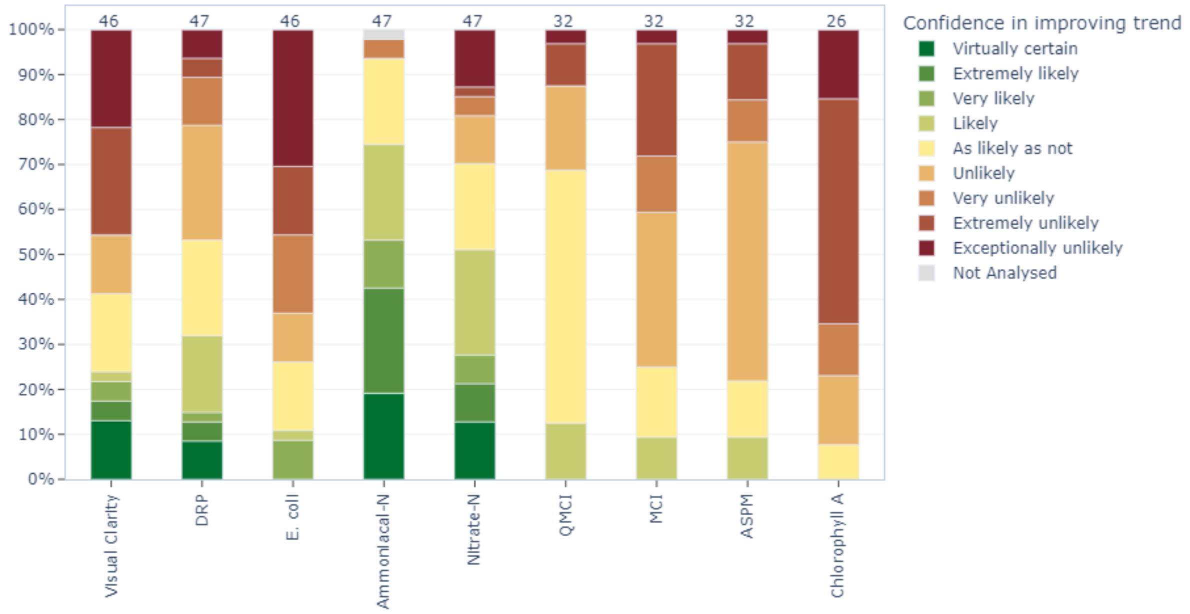


Figure 14: Confidence in trend direction for 10-year trends for water quality variables in the Manawatū FMU at state of the environment sites. For the period 1 July 2011 – 30 June 2021.

At impact sites across the Manawatū catchment, ten year trends showed predominantly improving trends for ammoniacal nitrogen and nitrate nitrogen (Figure 15). Conversely, trends for visual clarity, *E. coli*, and chlorophyll *a* are predominately degrading. Trend results for other water quality indicators were more mixed.

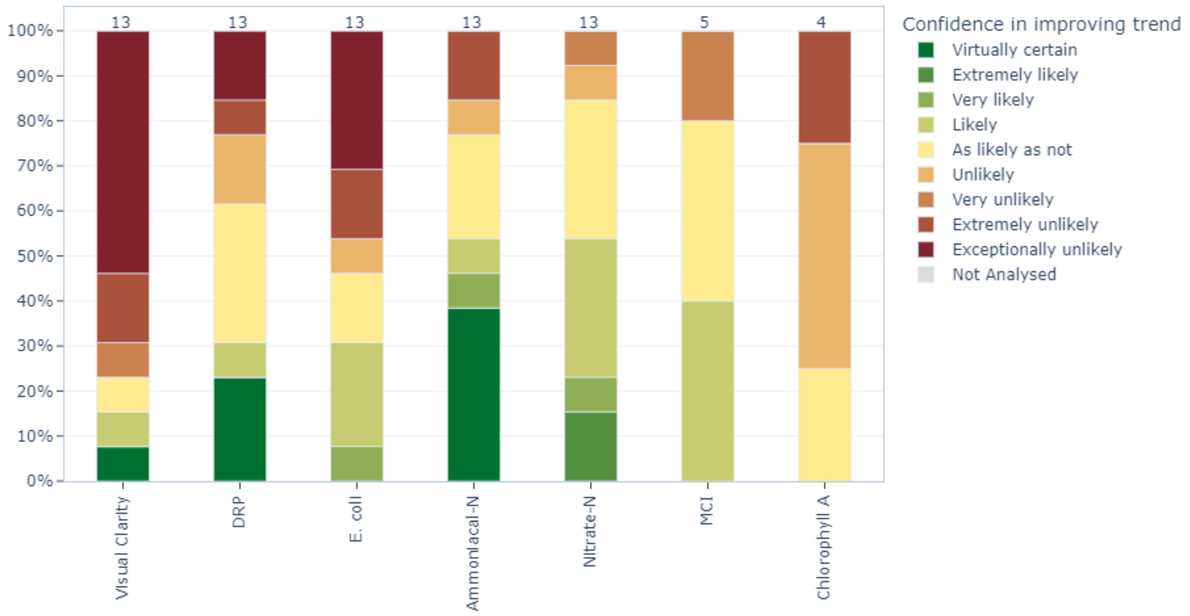


Figure 15: Confidence in trend direction for 10-year trends for water quality variables in the Manawatū FMU at impact sites. For the period 1 July 2011 – 30 June 2021.

3.2.2 20 year trends

Existing data allowed us to calculate the 20 year trends for up to eight SOE sites across the Manawatū catchment. The results indicated that all measures that could be analysed were predominantly improving (Figure 16). The few degrading trends were:

- Ōroua at upstream AFFCO Feilding for visual clarity
- Mangatera upstream of the confluence with the Manawatū River for DRP and Nitrate
- Manawatū at Hopelands for DRP
- Mangatainoka at SH2 for *E. coli*
- Ōroua at Awahuri Bridge for ammoniacal nitrogen.

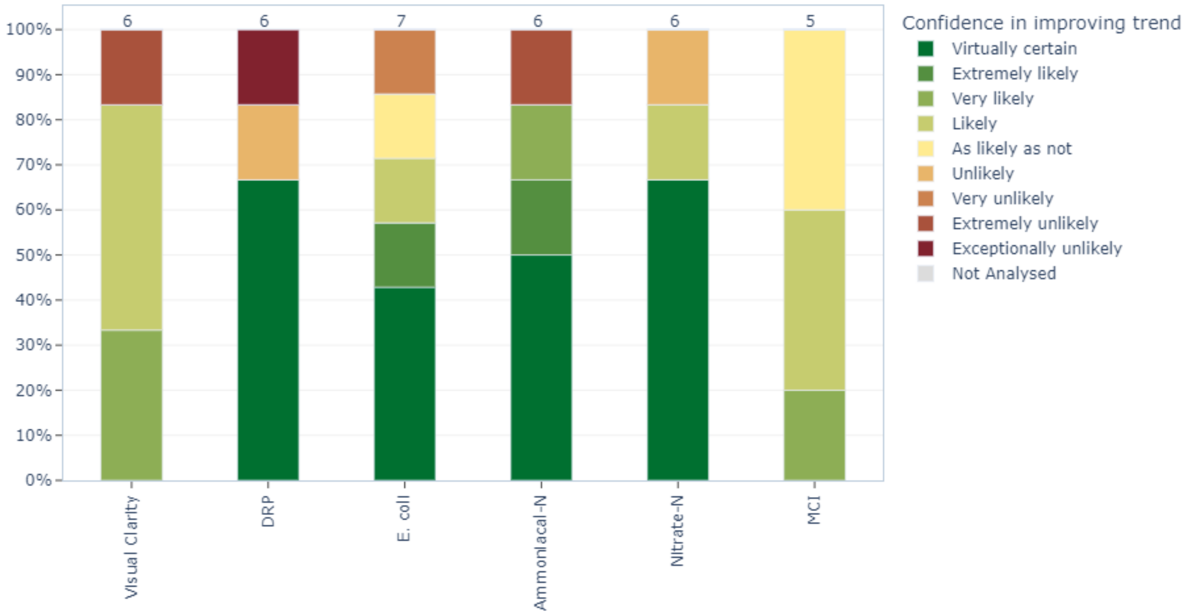


Figure 16: Confidence in trend direction for 20-year trends for water quality variables in the Manawatū FMU at state of the environment sites. For the period 1 July 2001 – 30 June 2021.

3.2.3 30 year trends

Existing data allowed us to calculate the 30 year trends of clarity, DRP, ammoniacal nitrogen and nitrate at four SOE sites across the catchment. The results showed improving trends at most sites (Figure 17). The exceptions were DRP at the Manawatū River at Hopelands and visual clarity at the Manawatū River at Whirokino. Results for these locations show likely and virtually certain degrading trends for these measures. At Ōroua River at Awahuri Bridge, an improving trend for ammoniacal nitrogen was indicated to be as likely as a degrading one.

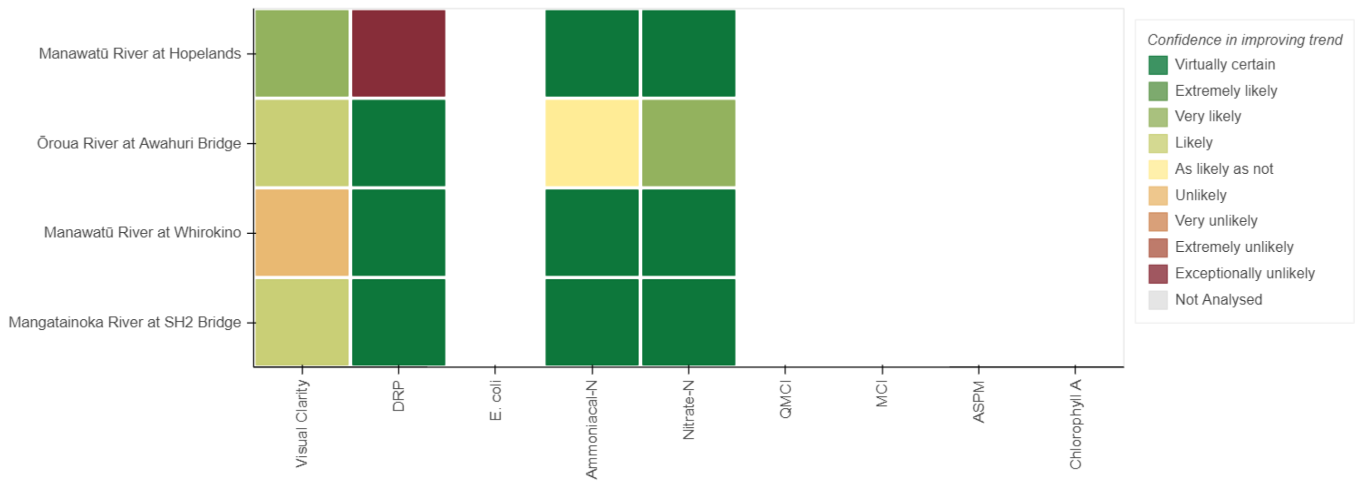


Figure 17: Confidence in trend direction for 30-year trends at individual state of the environment sites in the Manawatū FMU. For the period 1 July 1991 – 30 June 2021 Water quality variables with blanks (white rectangles) are not measured at that particular site or did not meet the 90% of sample years requirement for trend calculation. In this figure sites are ordered from worst (top) to best (bottom).

3.2.4 Trends at primary contact sites

Existing data allowed us to calculate five year trends for *E. coli* concentrations during the bathing season (November to April) at 25 primary contact sites (swimming spots) across the Manawatū catchment. The data indicate *E. coli* concentrations are predominantly improving over five years (Figure 18). Only four of the 25 sites are degrading.

We calculated the 10 year trend for *E. coli* concentrations during the bathing season at the Manawatū at Foxton site. The trend results indicate *E. coli* concentrations are very likely improving.

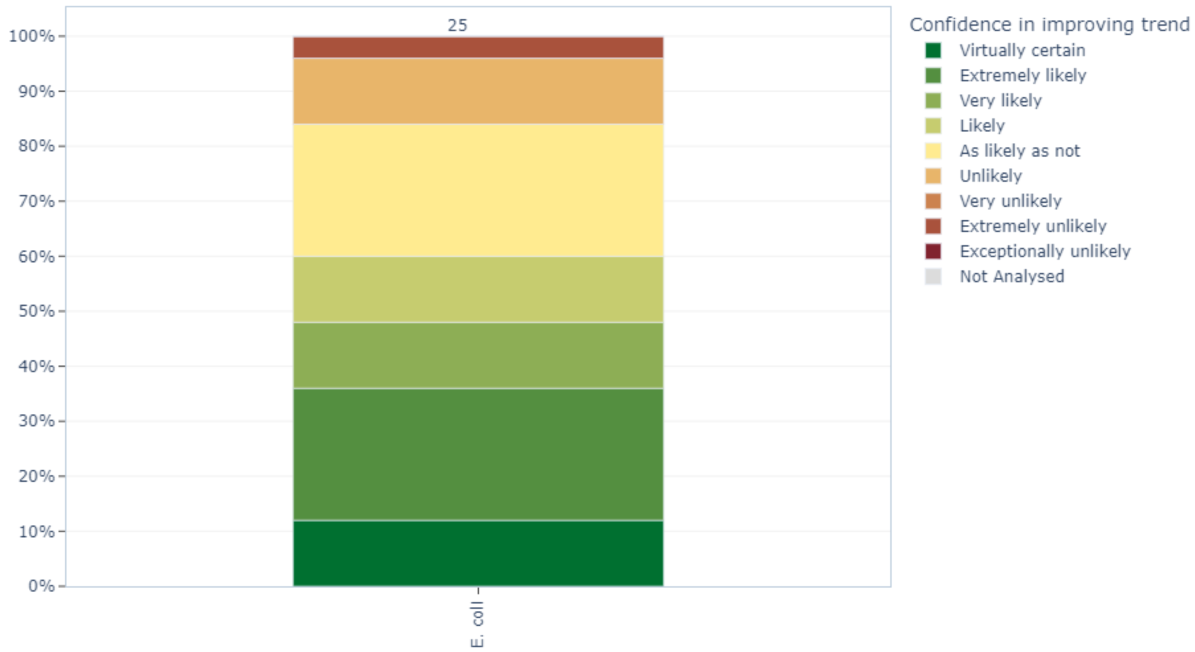


Figure 18: Aggregated confidence of a 5 year trend direction for *E. coli* trend at primary contact sites in the Manawatū FMU. For bathing seasons over the period 1 November 2016 – 30 April 2021

4 Interventions

This section discusses potential actions to improve the Manawatū catchment's water quality.

Point-source discharges (contaminants that enter a waterbody from a single fixed point, such as a pipe or drain)

- Continue to reduce the impact of point-source discharges by improving the treatment of contaminated water and investigate alternative disposal methods, including centralising treatment plants (bringing several smaller discharges into one treatment system where treatment is enhanced) where appropriate.
- Continue I&I (when stormwater (inflow) and groundwater (infiltration) enter and overload a wastewater system which reduces treatment effectiveness) investigations and improvements. This will reduce cross contamination of wastewater into stormwater by identifying and remediating any connections where wastewater enters the stormwater network.
- Consider using sustainable urban drainage practices such as rain gardens and sediment traps that reduce contaminants entering waterways via stormwater.

Land use

Continue to improve land use practices to reduce loss of nitrogen, phosphorous, sediment and *E. coli* into waterways. These practices include (but are not limited to):

- Reduction of nutrients that are lost from the root zone of pasture and crops or runoff the land when it is saturated.
- Management of critical source areas (landscape features that accumulate runoff and deliver it to surface water) to reduce contaminants entering the water
- Deferred irrigation (where irrigation is delayed to prevent runoff, ponding or leaching from overly dry or wet soil into surface or groundwater)
- Fertiliser management
- Stock exclusion (prevent stock contaminating the water by reducing their access to wetlands, lakes and rivers)
- Construction of bridges and culverts at stream and river crossings to reduce carrying contaminants into the water
- Riparian planting (establishing vegetation along the banks of rivers and streams that stabilise the soil and help filter contaminants before they enter the water).

The Our Land and Water Science Challenge, Actions to include in a Farm Environment Plan, has an online resource that enables landowners to filter the actions available for their farm system and zoom in to focus on any of five critical issues (nitrogen, phosphorous, *E. coli*, sediment and greenhouse gases)[1]. This tool indicates the costs, effectiveness, benefits, and disadvantages of each mitigation measure.

Other activities

- Continue to implement erosion controls on earthworks (for example, sediment ponds, bunds or silt fences) where sediment may enter the water
- Continue to reduce over allocation of water in the Water Management Zones where this is an issue
- Continue to implement sustainable practices around water use and irrigation such as installation of soil moisture meters, public education and messaging around water use in urban areas
- Continue to use good practice for works in the beds of streams and rivers and continue to adapt these as knowledge increases
- Continue to remove barriers to fish migration were there are benefits to native fish populations.

[1] https://ourlandandwater.nz/news/actions-to-include-in-a-farm-environment-plan/

5 Summary and conclusion

Over the last 13 years, the Manawatū River Leaders Forum and its partners have undertaken much work to improve water quality in the Manawatū catchment. However, comparing the current state of the catchment against the NOF's compulsory attributes suggests room for improvement in some areas.

The next steps in implementing the NPS-FM 2020 are to set water quality targets for our waterways to achieve our community's visions and environmental outcomes. This work will lead to resource use limits and action plans to reach targets over specified time frames.

6 References

Fullard L., and Patterson M., In Press, State and Trend of Water quality in the Lakes and Rivers of the Manawatū-Whanganui Region. For all records to 30 June 2021.

Fraser C., and Snelder T., 2020, *Load Calculations and spatial modelling of state, trends and contaminant yields,* Report prepared for Horizons Regional Council by Land Water People Ltd. Christchurch, , Horzions Report No. 2020/EXT/1672, ISBN: 978-1-99-000909-9.

Vale S. , Smith H., Neverman A,. and Herzig A., 2022, *Application of SedNetNZ with SLUI erosion mitigation and climate changes scenarios in the Horizons region to support NPS-FM 2020 implementation,* Report prepared for Horizons Regional Council by Manaaki Whenua – Landcare Research, Palmerston North, Horizons Report No. 2022/EXT/161, ISBN: 978-1-99-000988-4.

Appendix 1 – Trends by site

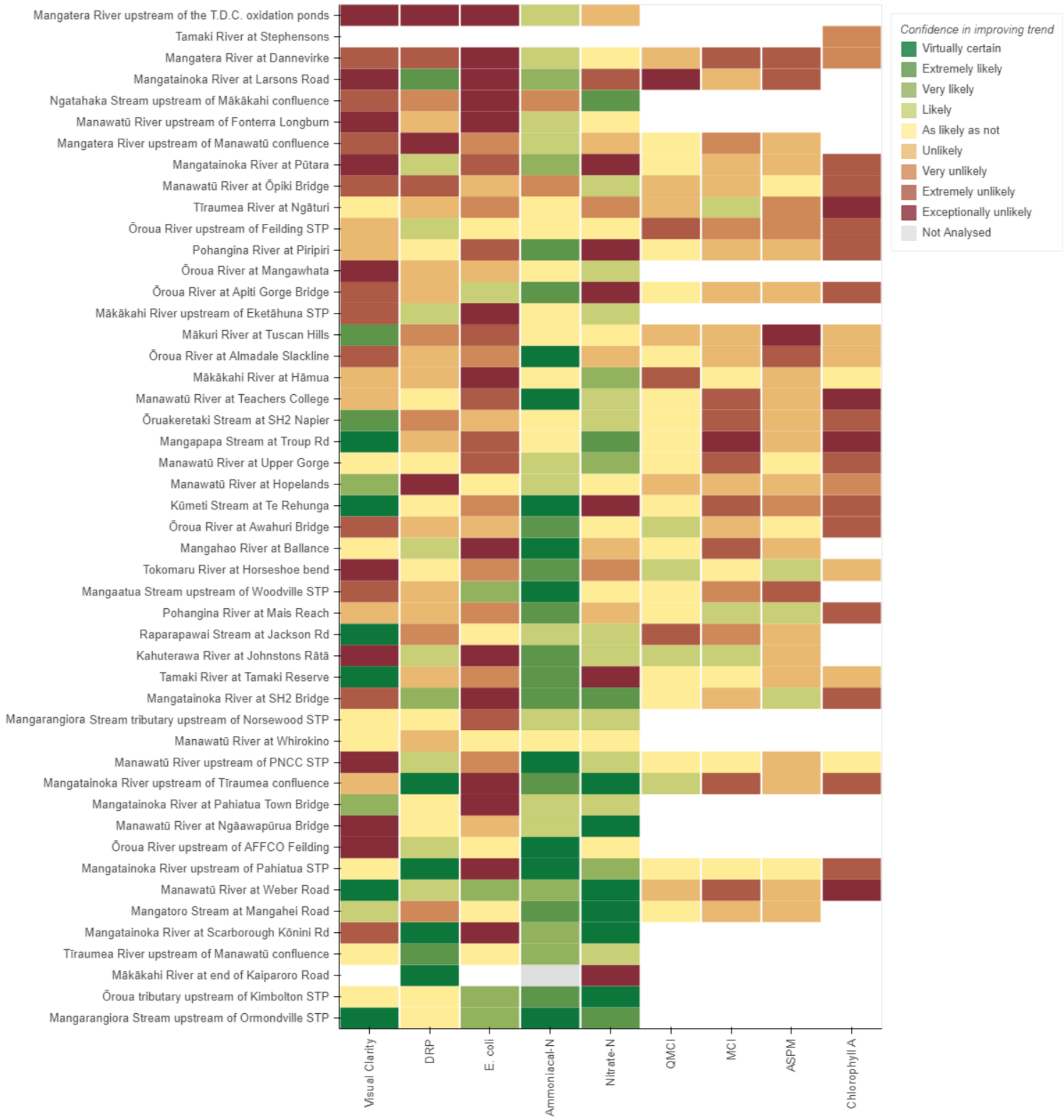


Figure 19: Confidence in trend direction for 10-year trends at individual state of the environment sites in the Manawatū FMU. For the period July 2011 – June 2021. Water quality variables with blanks (white rectangles) are not measured at that particular site or did not meet the 90% of sample years requirement for trend calculation. Grey rectangles indicate sites where insufficient uncensored data is available to meet trend calculation requirements. In this figure sites are ordered from worst (top) to best (bottom). Here DRP is Dissolved Reactive Phosphorus, MCI and QMCI are the Macroinvertebrate and Quantitative Macroinvertebrate Community Index, while ASPM is the macroinvertebrate Average Score Per Metric.

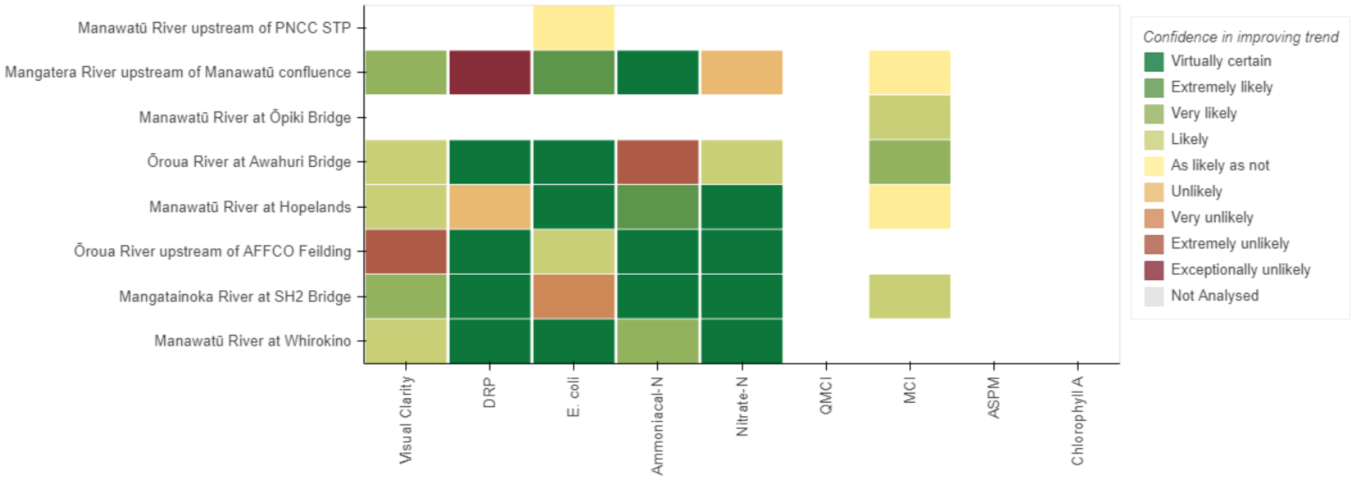


Figure 20: Confidence in improving 20-year trends at individual state of the environment sites in the Manawatū FMU. For the period July 2001 – June 2021. Water quality variables with blanks (white rectangles) are not measured at that particular site or did not meet the 90% of sample years requirement for trend calculation. In this figure sites are ordered from worst (top) to best (bottom). Here DRP is Dissolved Reactive Phosphorus, MCI and QMCI are the Macroinvertebrate and Quantitative Macroinvertebrate Community Index, while ASPM is the macroinvertebrate Average Score Per Metric.

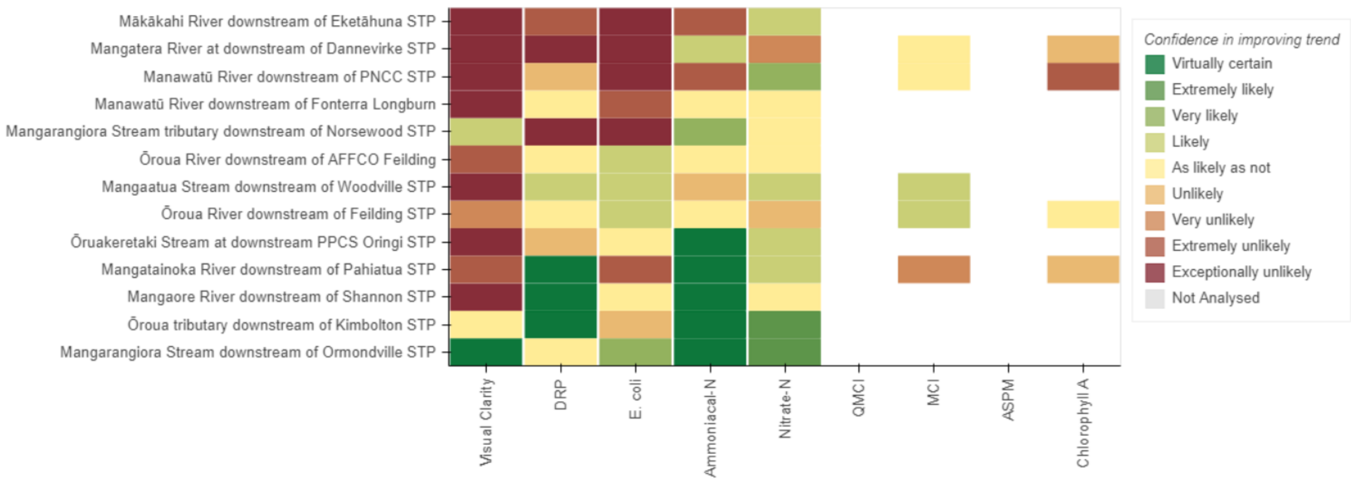


Figure 21: Confidence in trend direction for 10-year trends at individual impact sites in the Manawatū FMU. For the period July 2011 – June 2021. Water quality variables with blanks (white rectangles) are not measured at that particular site or did not meet the 90% of sample years requirement for trend calculation. In this figure sites are ordered from worst (top) to best (bottom). Here DRP is Dissolved Reactive Phosphorus, MCI and QMCI are the Macroinvertebrate and Quantitative Macroinvertebrate Community Index, while ASPM is the macroinvertebrate Average Score Per Metric.

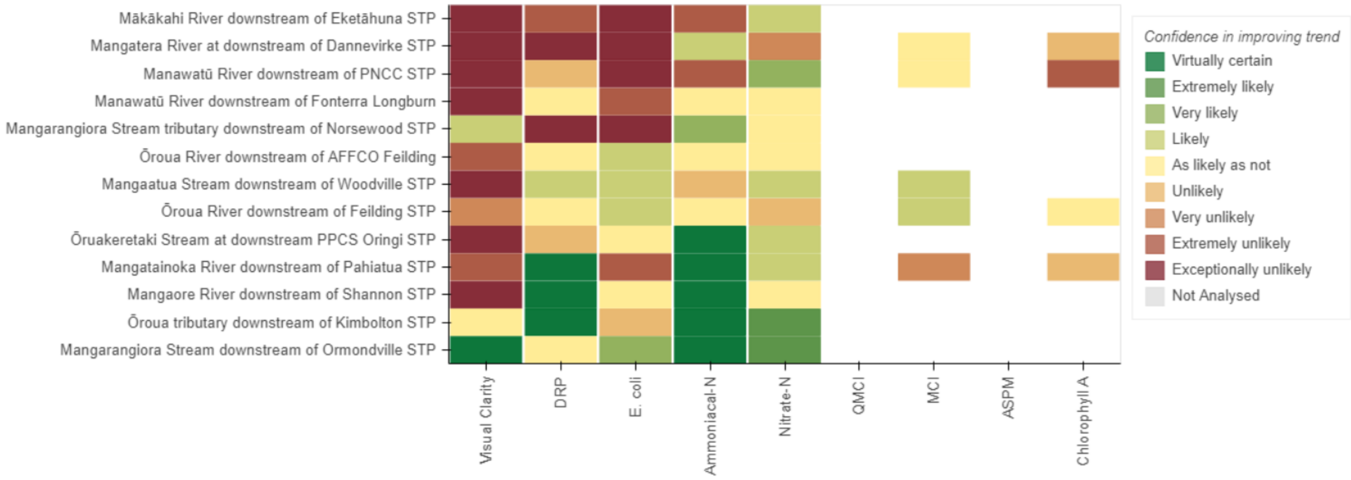


Figure 22: Confidence in trend direction for 10-year trends at individual impact sites in the Manawatū FMU. For the period July 2011 – June 2021. Water quality variables with blanks (white rectangles) are not measured at that particular site or did not meet the 90% of sample years requirement for trend calculation. In this figure sites are ordered from worst (top) to best (bottom). Here DRP is Dissolved Reactive Phosphorus, MCI and QMCI are the Macroinvertebrate and Quantitative Macroinvertebrate Community Index, while ASPM is the macroinvertebrate Average Score Per Metric.

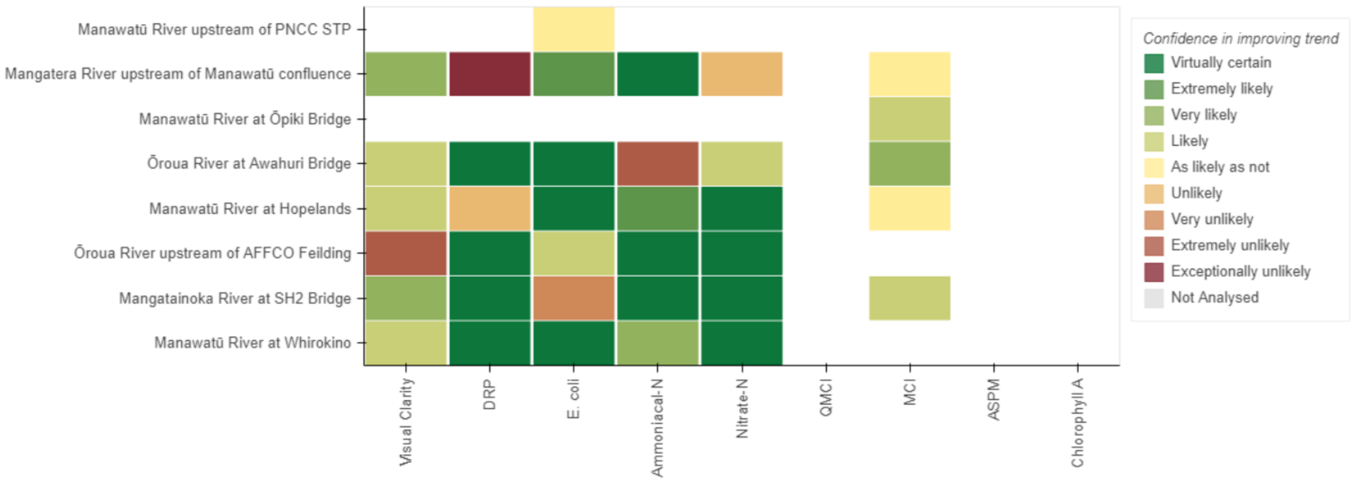


Figure 23: Confidence in improving 20-year trends at individual state of the environment sites in the Manawatū FMU. For the period July 2001 – June 2021. Water quality variables with blanks (white rectangles) are not measured at that particular site or did not meet the 90% of sample years requirement for trend calculation. In this figure sites are ordered from worst (top) to best (bottom). Here DRP is Dissolved Reactive Phosphorus, MCI and QMCI are the Macroinvertebrate and Quantitative Macroinvertebrate Community Index, while ASPM is the macroinvertebrate Average Score Per Metric.

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