River water quality

Our rivers are a jewel in our natural environment. To Māori, they are a taonga. The water they carry is essential for the plants, insects and fish who call them home, and they are an important resource for the people of our region. Rivers are also highly valued for recreational uses, such as swimming, fishing and other water sports.

How well our rivers provide for the wide range of values they support is dictated by the quality of water within them, and the health of their ecosystems. A variety of natural and human factors can affect freshwater systems. Our use of land, stormwater run-off, industrial and wastewater discharges can contribute contaminants to our waterways, including excess nutrients, sediment and bacteria. The activities within a catchment can interact and have compounding or cumulative effects on downstream receiving environments such as lakes and estuaries. Understanding the significance of each contributing factor and how they interact is complicated, especially in a dynamic and uncertain environment impacted by factors such as climate change.

The Council measures water quality in the region's rivers and streams to assess whether water is suitable for use for various purposes, and to better understand the effects of different pressures, such as climate, land use, industrial activities and urban and rural wastewater discharges. This section provides an overview of the current state of key indicators of river water quality: nutrients, sediment and bacteria.

80%
of monitored sites in
'A Band'
for nitrate and ammonia toxicity

15
water quality
monitoring locations

E. coli concentrations have
increased at
70%
of monitored sites
over the last 10 years

½
of all monitored sites were in
'A Band'
for visual clarity

What we know

The water quality of Taranaki rivers has been monitored since 1995. Two additional sites were added in 2015 to better represent the eastern hill country which, together with two national sites run by NIWA since 1989, brought the total number of sites monitored in the region to 15. At these sites, up to 22 physical, chemical and bacteriological indicators are sampled every month.

Results are compared against attribute criteria set out in the National Objectives Framework (NOF) of the National Policy Statement for Freshwater Management 2020 (NPS-FM). In this section we report on some of the main indicators of freshwater quality: nutrients and sediment, both key drivers of ecosystem health; and bacteria (*E. coli*), a measure of the suitability of rivers for human contact. For most attributes, the NOF sets 'national bottom lines' which represent the minimum requirement for water quality state that must be achieved.

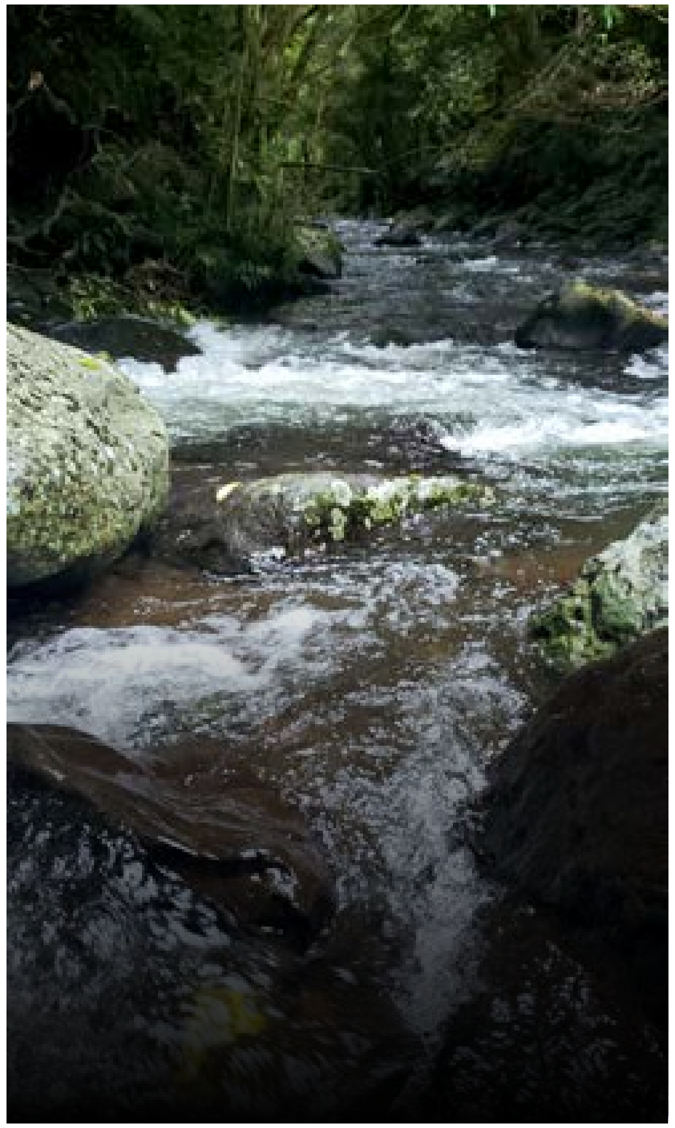
Changes in these attributes (trends) are determined over the long term (25 years) and short term (10 years), with trends adjusted for river flow.

Nitrogen (nitrate and ammonia)

Nutrients are essential for the growth of aquatic plants, which are an important food source for many small invertebrates and fish. The main nutrients in waterways are inorganic forms of nitrogen and phosphorus. Only small amounts of each are required in a natural ecosystem; too much can cause excessive algae and plant growth. This may lead to adverse effects on oxygen and pH levels, water clarity and biodiversity. Nitrogen can be present in water in a number of forms (nitrate, nitrite, ammonia and organic nitrogen). In rivers and lakes, too much nitrogen can lead to excessive growth of aquatic plants or algae. At high concentrations, nitrate and ammonia can be toxic for fish.

The NOF attributes for nitrate and ammonia nitrogen national bottom lines are intended to protect against toxic impacts on sensitive instream species. In addition, the NOF requires councils to set limits on nutrient concentrations in water to protect ecosystem health, and to meet limits for other attributes that may by impacted by nutrients, such as the growth of algae (periphyton). These limits are likely to be much lower than those required to avoid toxicity effects.

For ammonia (toxicity), the NOF defines band A (no or little observed effect on any species) through D (approaching acute impact on sensitive species) for two measures: an annual median and annual maximum. The minimum standard, or national bottom line, is set between bands B and C and represents the difference between an occasional impact on 5% of species (band B) and a regular impact on 20% of the most sensitive species.

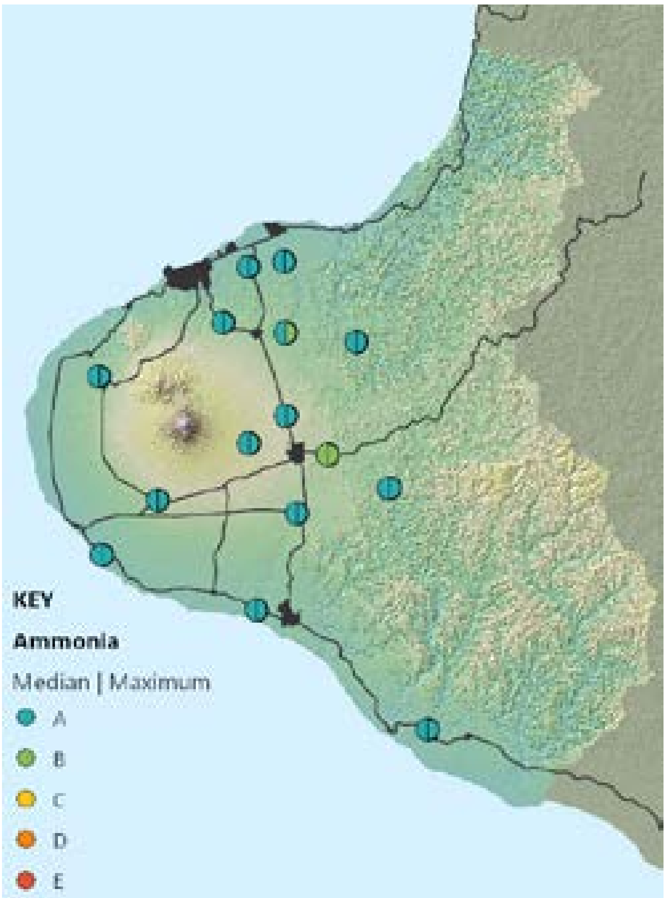


Attribute band and description	Numeric attribute state (as milligrams of ammoniacal-nitrogen per litre)	
	Annual median	Annual maximum
A - 99% species protection level: No observed effect on any species tested	≤0.03	≤0.05
B - 95% species protection level: Starts impacting occasionally on the 5% most sensitive species	>0.03 and ≤0.24	>0.05 and ≤0.40
National bottom line	0.24	0.40
C - 80% species protection level: Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species)	>0.24 and ≤1.30	>0.40 and ≤2.20
D - Starts approaching acute impact level (that is, risk of death) for sensitive species	>1.30	>2.20

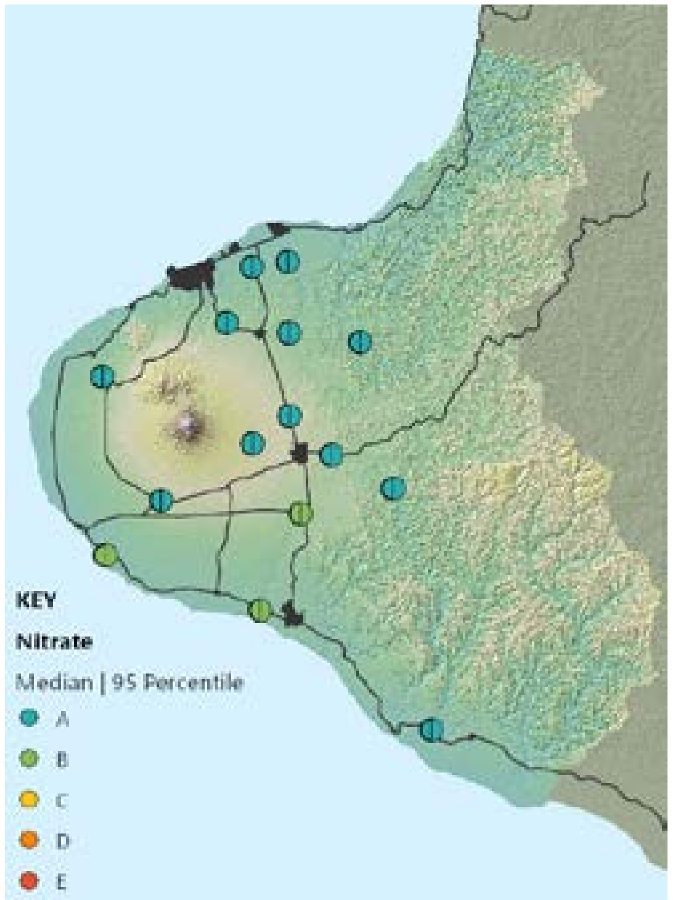
The NOF attribute table for ammonia (as NH_4-N) sets out the criteria for bands A through D for ammonia concentrations as a measure of toxicity in rivers and streams. The national bottom line is set below band B.

For ammonia, all Taranaki sites achieved the national bottom lines, with 14 of 15 sites achieving band A for annual median and 12 sites achieving band A for annual 95th percentile measures. The site in band B for both measures is impacted by discharges from the Stratford oxidation ponds.

Nitrate (toxicity) attribute bands range from band A (no or little effect on sensitive species) through to band D (impacts on growth of multiple species and approaching acute impact level for sensitive species at higher concentrations). The national bottom line sits between bands B and C. For nitrate, all 15 sites monitored in Taranaki achieved national bottom lines, with all but three falling in band A for both the annual median and 95th percentile measures. The sites in band B were in mid and lower parts of southern ring plain catchments, which are areas of more intensive pastoral agriculture.



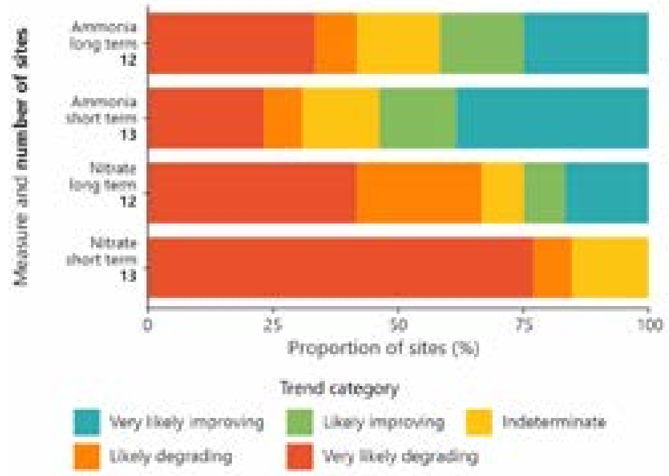
The current state of ammonia (toxicity) at monitored sites, as assessed against the NOF for both median and maximum measures.



The current state of nitrate (toxicity) at monitored sites, as assessed against the NOF for both median and 95th percentile measures.

The long-term trend for nitrate (toxicity) shows three of 12 sites improving (25%) and eight sites degrading (67%). The short-term trend shows no sites improving and 11 sites degrading (85%).

The long-term trend for ammonia (toxicity) shows five of 12 sites improving (42%) and the same number degrading. The short-term trend shows seven of 13 sites improving (54%) and four sites degrading (31%). The improvements occurred in mid and lower catchment sites, mainly on the ring plain. Deterioration occurred mainly in upper catchment sites, albeit at relatively low concentrations.



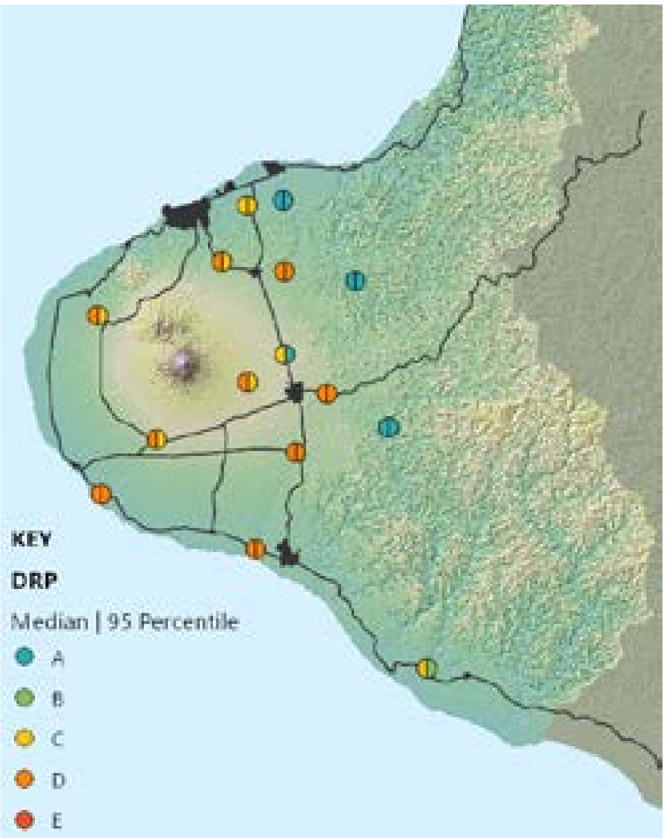
Summary of trends in nitrate and ammonia concentrations across monitored sites, over both short-term (10 year) and long-term (25 year) periods.

Phosphorus (dissolved reactive phosphorus)

Like nitrogen, phosphorus can be present in water in different forms, and is an essential nutrient for instream plant life. Most phosphorus enters rivers attached to sediment. In its dissolved form (dissolved reactive phosphorus) it is more readily available for plants and in certain conditions can lead to excessive growth of plants and algae. Phosphorus is naturally elevated in our region's soils due to the volcanic geology however fertiliser application along with the discharge of domestic and animal waste also contribute to elevated levels of phosphorus in Taranaki streams and rivers.

The NOF describes the state of dissolved reactive phosphorus (DRP), for both median and 95th percentile concentrations. There is no national bottom line for DRP, but limits must be set to achieve water quality objectives.

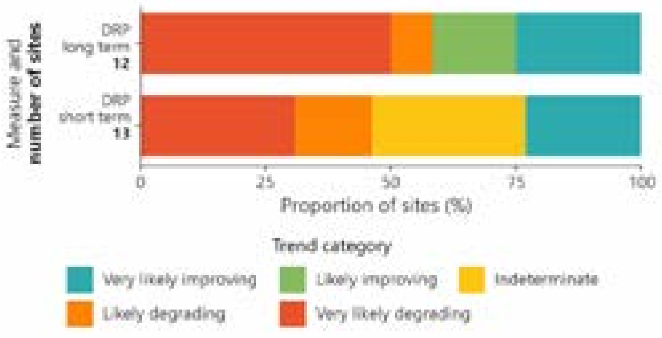
Monitoring results for the five years to 2020 show a strong spatial variation in the state of DRP regionally. This reflects the variation in geology between sites on the volcanic ring plain and those catchments sourced from the sedimentary hill country. All sites on the ring plain have median DRP concentrations within bands C or D, where ecological communities are expected to be impacted in streams where other conditions favour excessive algal growth and primary production. Most sites within hill country catchments fell within band A, where ecological communities are expected to be similar to natural reference conditions. One hill country site on the Whenuakura River however, was affected by a major erosion event in June 2015 and falls within band C.



The state of phosphorus at monitored sites, as assessed against the NOF dissolved reactive phosphorus (DRP) attribute.

Long-term trend analysis shows five of 12 sites improving (42%) and seven degrading (58%). While still uncertain, erosion control efforts in the hill country and removal or upgrading of major point source discharges on the ring plain (at Eltham and Stratford) may be contributing to reductions in DRP concentration over time.

Short-term trends show three of 13 sites (23%) improving and six degrading (46%). The degrading trends are largely found in upper and mid catchment locations on the northern (Mangaoraka and Waiwhakaiho) and eastern slopes of the ring plain (Maketawa and Pātea). Further investigation is required to determine the drivers of this degradation and the potential role of natural sources of phosphorus within the wider region.



Trends for DRP concentrations over both short (10 year) and long-term (25 year) time periods.

Sediment

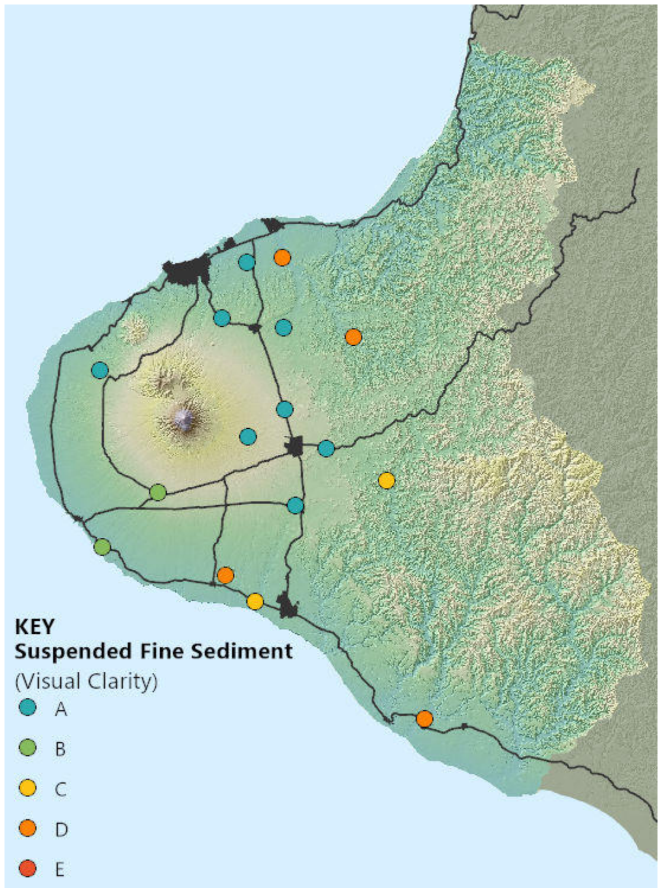
Erosion-prone land is managed to protect and conserve soils and to reduce the loss of sediment to rivers, lakes and estuaries, which can adversely affect freshwater and coastal ecosystems. In rivers, excess sediment can smother streambeds, reducing the amount of habitat available to insects and fish. It can also make water unsuitable for swimming and recreation, and reduce flood-carrying capacity of rivers.

Like nitrogen and phosphorus, sediment is a natural component in our region's rivers and streams. Hills, mountains and riverbanks contribute gravel, soil, silt and mud to waterways though erosion and run-off. In Taranaki, land use practices in the eastern hill country has led to excessive loss of soil and accumulation of sediment in rivers such as the Pātea, Tāngāhoe and Waitōtara. Further contribution from human activities such as production forestry, earthworks, gravel extraction, agricultural run-off and urban stormwater can also lead to excess sediment in freshwater and coastal receiving environments.

The NOF sets limits for suspended fine sediment in water. This is assessed using visual clarity, a measure of how easy it is to see a black disk through the water. Visual clarity is

reduced when water is discoloured, which is typically a result of high sediment concentrations. Visual clarity ranges from band A, where there is minimal impact on instream biota, through to band D, where ecological communities are significantly altered and sensitive species are at risk of being lost. The national bottom line is drawn between bands C and D.

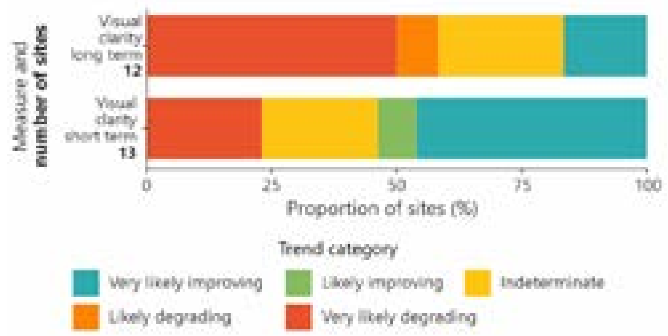
Visual clarity has been measured at 16 sites on streams around the region for between five and 25 years. Thirteen of the sites are on the ring plain, and three in the eastern hill country. The current state is assessed on median monthly values over the five years to June 2020. Eight sites (50%) achieved NOF band A for visual clarity, four (25%) fell within bands B or C, and four (25%) fell within band D. Of the four sites below the national bottom line, two are in the eastern hill country (Whenuakura and Waitara catchments) and two on the lower ring plain (Waiokura and Waitara).



The current state of suspended fine sediment (as visual clarity) monitored sites, as assessed against the respective NOF attribute bands.

Trends in visual clarity have been analysed over the long term (25 years) and short term (10 years) to 2020. Over the longer term, clarity degraded at seven of the 12 sites monitored (58%), and improved at two sites (17%) on the lower ring plain. The removal of point source discharges in both the Waingongoro and Pūnehu catchments may be contributing to this improvement.

Conversely, over the shorter term, visual clarity improved at seven of the 13 sites monitored (54%), with only three sites degrading (23%). Improvement occurred at all lower and most mid ring plain sites, and the Mangaehu hill country site. Degradation occurred in the Stony-Hangatāhua River (due to headwater erosion within Te Papakura o Taranaki), an upper ring plain site (Manganui) and a combined hill country and ring plain site (lower Waitara River). Further analysis is necessary to determine the drivers of these recent trends however fencing and planting of riparian margins on the ring plain, and erosion control measures taken in the eastern hill country, are expected to contribute to improvements over time.



Summary of trends for fine suspended sediment (as visual clarity) at these sites over both short (10 year) and long-term (25 year) time periods.

Significant amounts of erosion occur in the upper Stony-Hangatāhua River catchment where the river has carved a deep gorge within Te Papakura o Taranaki.

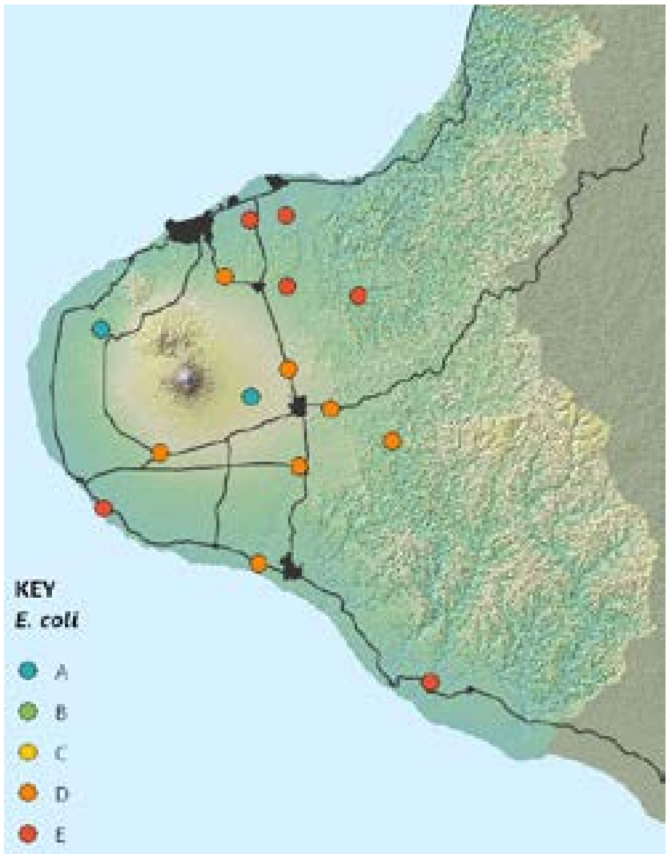
Bacteria (*E. coli*)

Water that is contaminated by human or animal faeces may contain a range of pathogenic (disease-causing) microorganisms which can pose a health hazard when the water is used for drinking or for recreational activities. Bacteria are present in the gut of people and animals and can enter rivers, lakes and coastal waters through animal and bird droppings, stormwater run-off, and effluent and wastewater discharges.

Faecal bacteria such as *E. coli* provide an indication that other pathogens harmful to humans may also be present. The NOF specifies an *E. coli* attribute for human health consisting of five categories or states (bands A to E) across four statistical criteria. The bands relate *E. coli* concentration to the risk of Campylobacter infection if water was swallowed during recreational activities. The four individual statistical measures are:

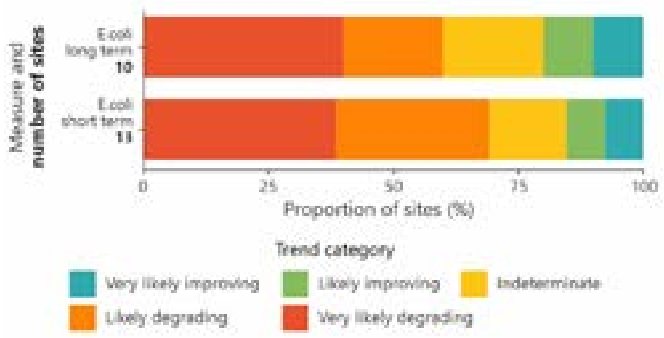
- Percentage of exceedances greater than 540cfu/100 mL (G540): This measure indicates how often the level of *E. coli* exceeds the acceptable threshold for swimming.
- Percentage of exceedances greater than 260cfu/100 mL (G260): This measure indicates how often the level of *E.coli* exceeds the point where additional monitoring is warranted.
- Median: The mid-point of measured *E. coli* concentrations.
- 95th percentile: an indication of the upper range of measured *E. coli* levels.

The overall standard for *E. coli* is assigned based on the worst grade across the four criteria. While there is no national bottom line, national 'swimmability' targets have been set using band C as the minimum requirement. Using these criteria, only two sites In Taranaki (13%) met the swimmability standard. The other 13 sites (87%) fell within band D for two or more criteria, typically failing to achieve the 95th percentile measure, and hence failed to meet swimmability standards. The median, G260 and G540 requirements were met by four (27%), four (27%) and six (40%) sites, respectively.



The current state of E. coli at monitored sites, as assessed against the respective NOF attribute bands.

Analysis of long-term trends in *E. coli* concentrations show two of 10 sites improving (20%) and six degrading (60%). Over the shorter 10-year period, two of 13 sites have shown improvement (15%) while nine have deteriorated (69%).



Summary of trends in E. coli concentrations at monitored sites over both short (10 year) and long-term (25 year) time periods.

Broadly speaking, sites in the upper river catchments showed better results compared to the sites in the middle and lower catchments. This is common in catchments throughout New Zealand, and generally reflects the increasing cumulative impacts of intensive agriculture, urban stormwater and wastewater discharges as water makes its way downstream through the catchment.

What we're doing

Improving monitoring technology

We are deploying new technology at monitoring sites in the Waingongoro and Mangaehu catchments to collect continuous measurements of water quality indicators including pH, conductivity, turbidity and temperature and nitrate. This equipment provides a much more comprehensive understanding of water quality without the need to physically collect water samples, which can be challenging during high river flows.

In time, we hope to increase the number of sites collecting continuous water quality measurements and improve our understanding of how rivers and streams respond to natural drivers such as a changing climate and human activities such as land use.

A Council officer checks a continuous water quality monitoring instrument in the Waingongoro River.

Catchment modelling

The Council recently commissioned the development of catchment water quality models to estimate the water quality state across all river and stream reaches in Taranaki. Despite some limitations and uncertainty, these models provide a more comprehensive picture of water quality across the region than can be provided by site-specific monitoring data alone. Through this modelling approach we're able to make predictions about the water quality at any given location based on a range of environmental characteristics that are common to those catchments where monitoring data is available. These characteristics include the geology, land cover, elevation, rainfall and the number of farmed animals.

To refine these models and improve our understanding of the actions we can take, we need to assess whether contaminants are the result of human activities or natural processes. The Council will undertake investigations to better understand the role of natural processes in contributing to both phosphorus concentrations in our ring plain rivers, and sediment loads in the eastern hill country. We're also looking into how climate change will affect Taranaki into the future, how this may impact on our freshwater quality and our ability to meet water quality targets, particularly in relation to sediment loads.

Drawing on this information, these models will help us estimate the likely impact that any future changes we make will have on freshwater. This will help inform conversations as a community around changes we need to make, and which tools in our toolbox we can employ to achieve our collective vision for freshwater in Taranaki.

Where we're heading

Since our last State of Environment report in 2015, a number of key programmes and interventions designed to reduce inputs of nutrients to our waterways have continued. These have included the roll out of the regional riparian management programme, the diversion of dairy shed effluent discharges from water to land-based irrigation and hill country farm plan development and implementation.

The diversion of remaining dairy shed effluent discharges from water will continue as consents come up for renewal, further reducing direct discharge nutrients, sediment and bacteria to waterways. It is expected that discharges to land will make up a minimum of 85% of all dairy effluent discharge consents by 2025, up from approximately 60% in 2021.

In the hill country, there will be a continued focus on extending the coverage of properties with comprehensive farm and agroforestry plans, and most importantly supporting the implementation of those plans on the ground. We anticipate these interventions will result in improvements in regional water quality, although it is clear that further work will be required in some areas to meet minimum water quality standards and/or achieve water quality targets.

The Council is required to establish action plans to improve freshwater quality above minimum standards, to achieve target states, or where monitoring indicates any deterioration in water quality. These requirements apply to all compulsory attributes set out in the NOF, which include nutrients, suspended and deposited sediment, and *E. coli*. Work is under way to understand the current loads of these various attributes, and the reduction in load that will be required to meet potential targets.