Mataura **catchment**

Published by Environment Southland, September 2024

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REGIONAL COUNCIL
Te Taiao Tonga

Mataura catchment

This document summarises scientific information, opportunities for action and the socioeconomic context for the Mataura catchment, which drains into the Toetoes (Fortrose) Estuary.

This is one of twelve catchment summaries prepared for the Murihiku Southland region.

Main features

Land area: 567,000ha

Major rivers and streams:
Mataura River, Titiroa Stream, Waimahaka Stream, Mokoreta River, Waikaka Stream, Waikaia River, Mimihau Stream, Waimea Stream, Nokomai River

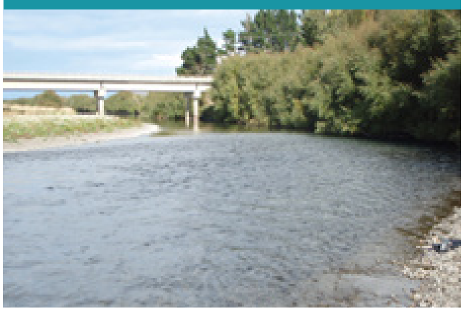
Aquifers:
Upper Mataura, Cattle Flat, Wendonside, Wendon, Riversdale, Waipounamu, Longridge, Waimea Plains, Croydon, Knapdale, Lower Mataura, Edendale Groundwater Zones

Lakes:
Lake Vincent, Lake Gow, Lake Scott, Blue Lake

Estuaries:
Toetoes (Fortrose) Estuary

Townships:
Fortrose, Wyndham, Edendale, Mataura, Gore, Riversdale, Waikaia, Balfour

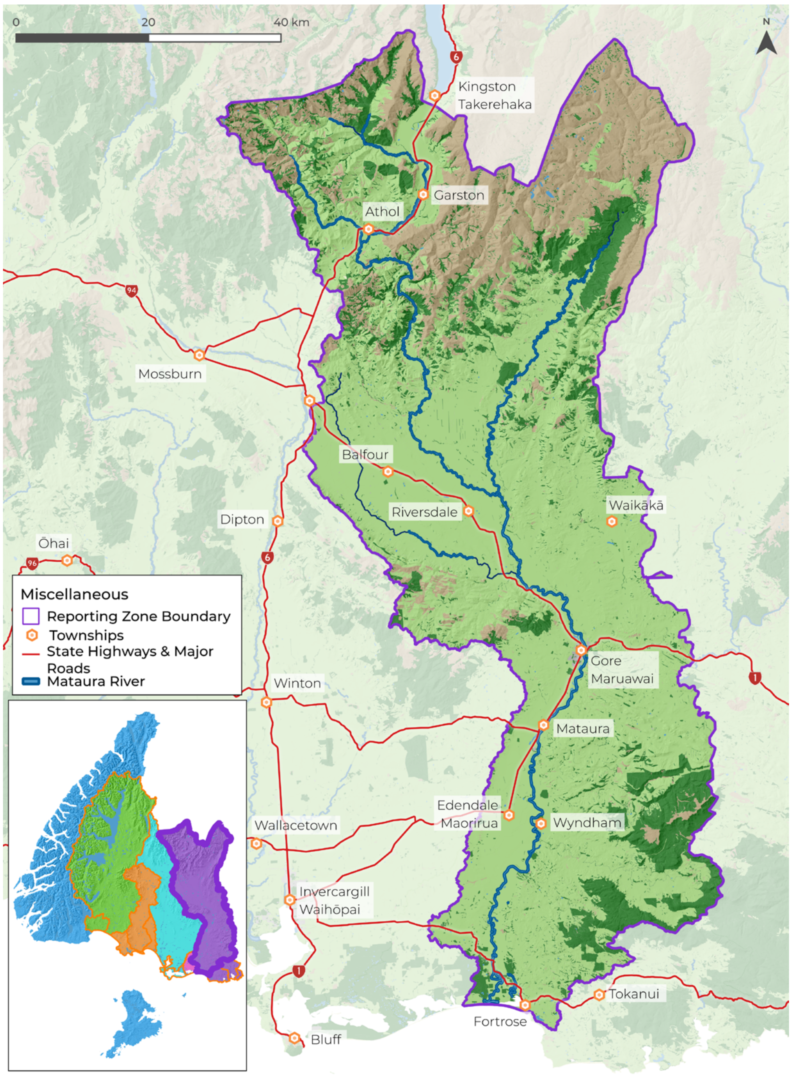
Population:
Approximately 17,000



The scientific data presented in this summary has been collated at the catchment scale to provide an understanding of freshwater quality and quantity challenges and their underlying factors. The summary provides an evaluation of the current state of freshwater within the catchment and highlights the magnitude of change necessary to meet freshwater aspirations.

The information in this document should be considered alongside other information sources, including mātauranga Māori.

Catchment outline



For most attributes, current state is assessed using data from the 2018 – 2022 period.

Key messages

Issues

- Monitoring indicates that freshwater ecosystem health is poor in many parts of the Mataura catchment. Nine of the 12 (75%) river attributes in this catchment summary do not meet their hauora targets. Seven of the 12 attributes are currently graded as poor or very poor in one or more river classes.
- Overall, the Toetoes (Fortrose) Estuary is in moderate ecological health. Specific areas in the upper reaches are starting to show signs of eutrophication. Pathogens, sediment, and nutrients are the main drivers of declining ecosystem health and increased risks to human health.
- Modelling indicates that large contaminant load reductions are required to achieve the desired outcomes for freshwater and the estuary. Reductions are required for nitrogen (78%), phosphorus (74%), sediment (35%) and *E. coli* (89%).
- There are several areas within the Mataura catchment where groundwater is highly contaminated with nitrogen. In places this means groundwater is unsafe to drink.
- Approximately 2000ha of wetlands have been lost since 1996 in the Mataura catchment. Of the remaining wetlands not on conservation land, 60% are at moderately high risk of being lost.

Opportunities for action

- Implementation of property-scale mitigations tailored to the land's physiographic characteristics, the sensitivities of the receiving environments and the outcomes sought in the catchment
- Large-scale land use change and de-intensification. This may be achieved through developing long-term catchment plans, promoting alternative land use options and diversification, or regulatory levers, or development in technology.
- Targeted estuary restoration of marginal vegetation, such as herbfields and wetlands, as well as saltmarshes and salt-tolerant shrub banks.
- Removal of nuisance macroalgae from new growth, areas where macroalgae is causing increased mud deposition near seagrass beds or marshlands and the fringes of current sediment deposition zones.

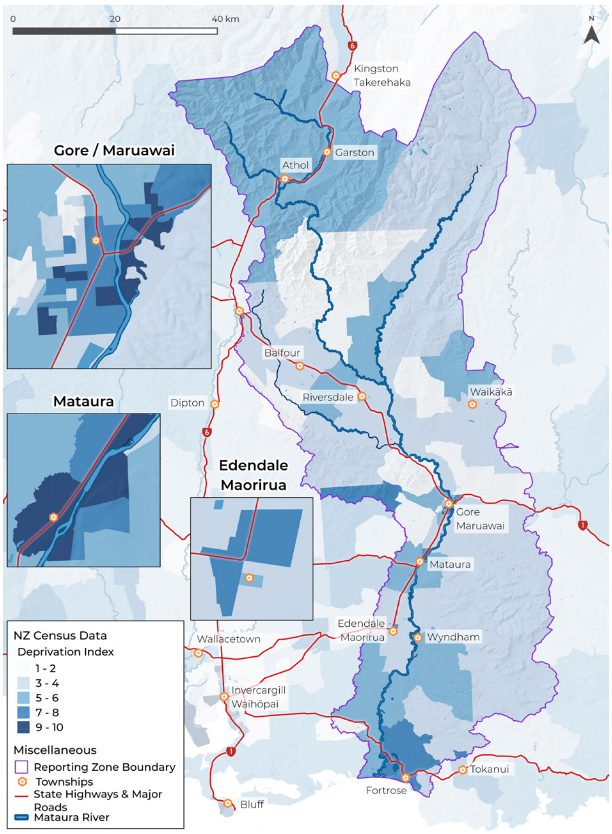
Active restoration techniques like sediment and macroalgae removal will only improve the estuary's long-term condition if contaminant inputs are also reduced.

Socioeconomic context for action

Historic socioeconomic shifts in the later part of the 20th century have shaped the communities in and around the Mataura catchment (current population 17,000). The impacts of neoliberal deregulation from the 1980s removed agricultural subsidies and export assistance, creating a period of austerity for many farming communities. The families that experienced the most significant financial pressures during this time had purchased land in the late 1970s and early 1980s, when land values were at their height. Much of the catchment was involved in sheep and beef farming during this period. Strikes and industrial reform at meat processing sites and a lack of other local industries outside of manufacturing and agriculture, made the entire catchment vulnerable to the impacts of deregulation. The rise in dairy farming across the region in the 1990s began to reverse economic conditions for the catchment ushering in large-scale land use, industrial and demographic changes.

Gore, the largest township in the catchment (population approximately 8,500), boomed after the Second World War but was affected by regional downturns and the closure of important local industries. The population went into a steady decline from the late 1970s until around 2008, when it began to rise steadily, aside from minor fluctuations. Population recovery elsewhere in the catchment took place at different times. The population of Mataura started to increase after 2013, while the rural areas of the upper Mataura River catchment stabilised by the early 2000s and began to increase again from the end of the decade, bolstered in part by a growing dairy industry.

Social Deprivation Index



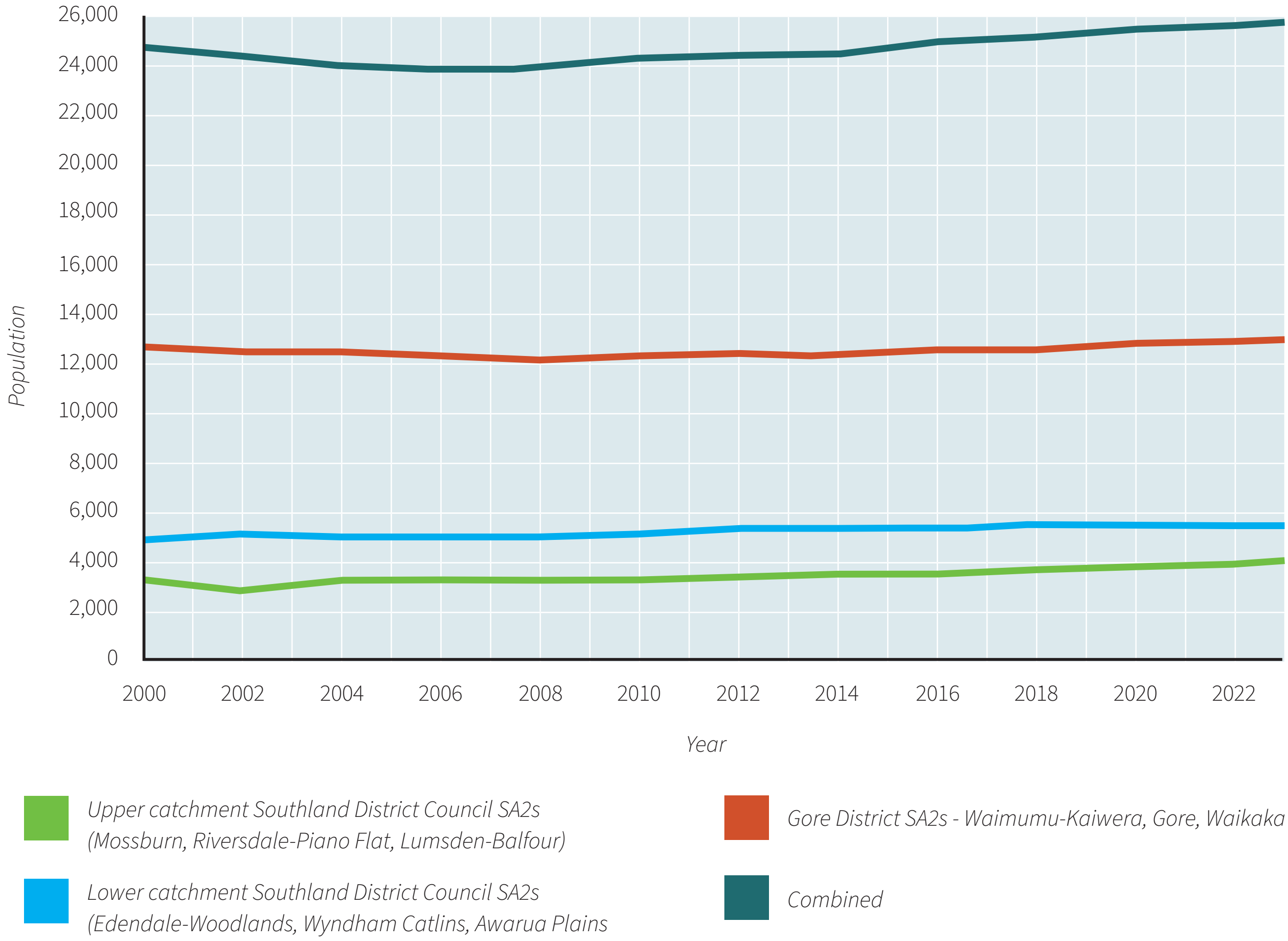
Social Deprivation Index

The Deprivation Index measures socioeconomic deprivation based on census information. It considers income, income benefits, communication access, employment, educational qualifications, home ownership, care support, living space and living conditions.

All of the settlements in the Mataura catchment depend to some degree on the economic activity produced by the surrounding farming hinterland. This rural-urban connection is a prominent feature of the Murihiku Southland region, where town and city centres support rural activity.

Most people live rurally outside the main settlements, and Census data suggests that around a third of the population is directly involved in primary industries (agriculture and timber). This figure is slightly lower in rural areas with other industries, such as the Edendale Dairy factory. However, even here, around a quarter of the population is directly involved in primary industry work. Employment rates for both full and part-time work across the catchment are very high, though Gore District is slightly behind Southland District.

Estimated population trends (Dot Loves Data, 2024)



The Mataura catchment is comprised of numerous statistical areas across two territorial authorities. Some parts of statistical areas may lay outside of the catchment. Therefore, this graph indicates general population trends across these areas, not the catchment itself.

Although most people in the catchment were born in New Zealand and identify as European or Māori, ethnicity is a constantly changing dynamic. Since the 2006 census, there has been a noticeable increase in the number of people born in Asia and/or who identify with Asian ethnicity. This trend is evident across the catchment, but more pronounced in the upper catchment. Māori continue to represent the second largest ethnicity in many parts of the catchment, especially in Mataura Township, where 1 in 3 people identify as Māori or of Māori descent.

The main demographic disparity throughout the catchment zone (and region) is fewer younger people (15-29). Youth often leave the region for tertiary education or employment in urban centres outside Murihiku Southland.

Although housing prices have increased regionally and nationally since 2020, the Murihiku Southland region, including many parts of the Mataura catchment, has remained among the most affordable places to buy or rent in New Zealand. This is not a general trend, as housing affordability (renting and purchasing) in the catchment is highly variable. For instance, Mataura, parts of Gore, and Riversdale are comparatively affordable, while other parts of the catchment are much less so.

Although both the Murihiku Southland and Gore districts are among the least socioeconomically deprived areas in New Zealand, the Mataura catchment contains some highly deprived areas. These areas, as identified in the 2018 Census, are primarily focused around the more closely settled areas such as Mataura, parts of east and south Gore, Edendale, and Wyndham. Parts of Mataura have some of the highest deprivation levels in the catchment and region. Conversely, the lower deprivation levels in the catchment tend to be in the newer suburbs of Gore and the surrounding rural areas. Areas like Balfour and the sparsely populated rural areas further out, such as Cattle Flat and Otama Valley, have lower deprivation levels.

Gore District was a moderately deprived area in 2020, however, deprivation levels have slightly improved since 2022. More deprived areas have typically experienced deprivation for extended periods.

Summary

- Much of the rural economy (and associated urban industry) relies heavily on intensive agriculture, which increases risks from industry or regulatory changes.
- High deprivation levels in some urban and rural settlements (notably Mataura and Wyndham Townships) could result in less resilience and poorer wellbeing outcomes for their communities.
- Lower education attainment levels in parts of the catchment may reduce the capacity to adapt to economic, technological and environmental changes.
- Established catchment groups for the upper, mid and lower Mataura, provide a support system for members and may facilitate adaptation to external pressures and challenges.

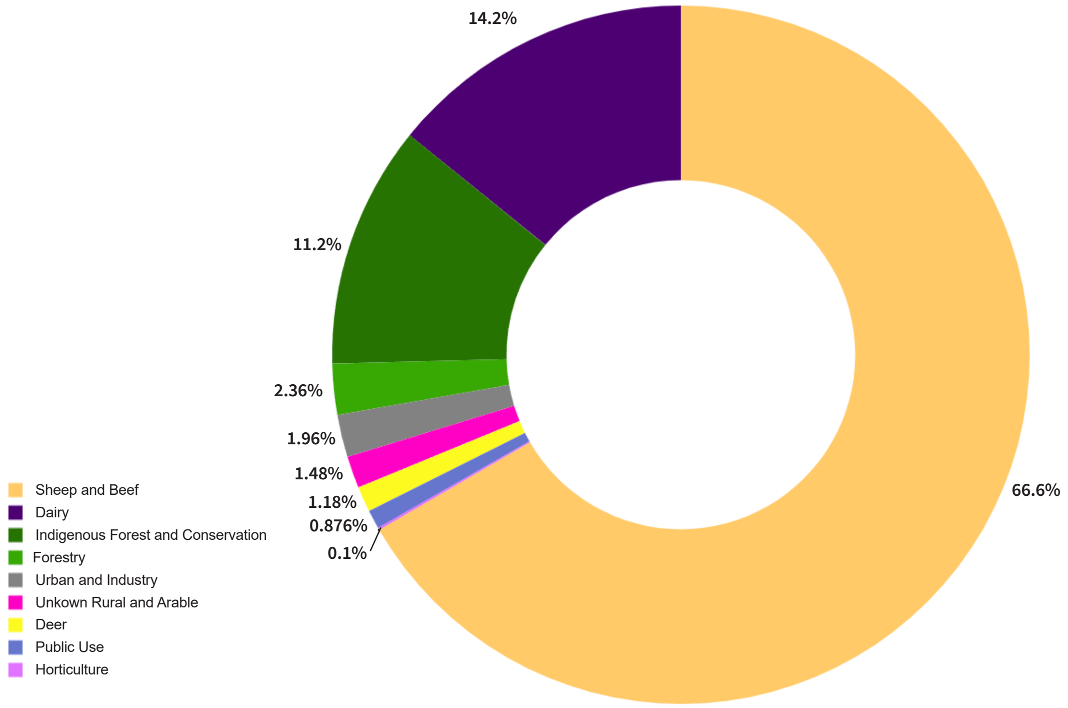
Catchment overview

The Mataura catchment extends from the Eyre Mountains, just south of Lake Wakatipu on the northern boundary of Murihiku Southland, to the Toetoes (Fortrose) Estuary. The headwaters drain alpine areas, native tussock and forested land, while the mid and lower reaches drain largely pastured farmland on the plains. There are several major tributaries (Waikaia, Waimea, Waikaka, Mokoreta) that have varying catchment characteristics ranging from alpine to predominantly lowland.

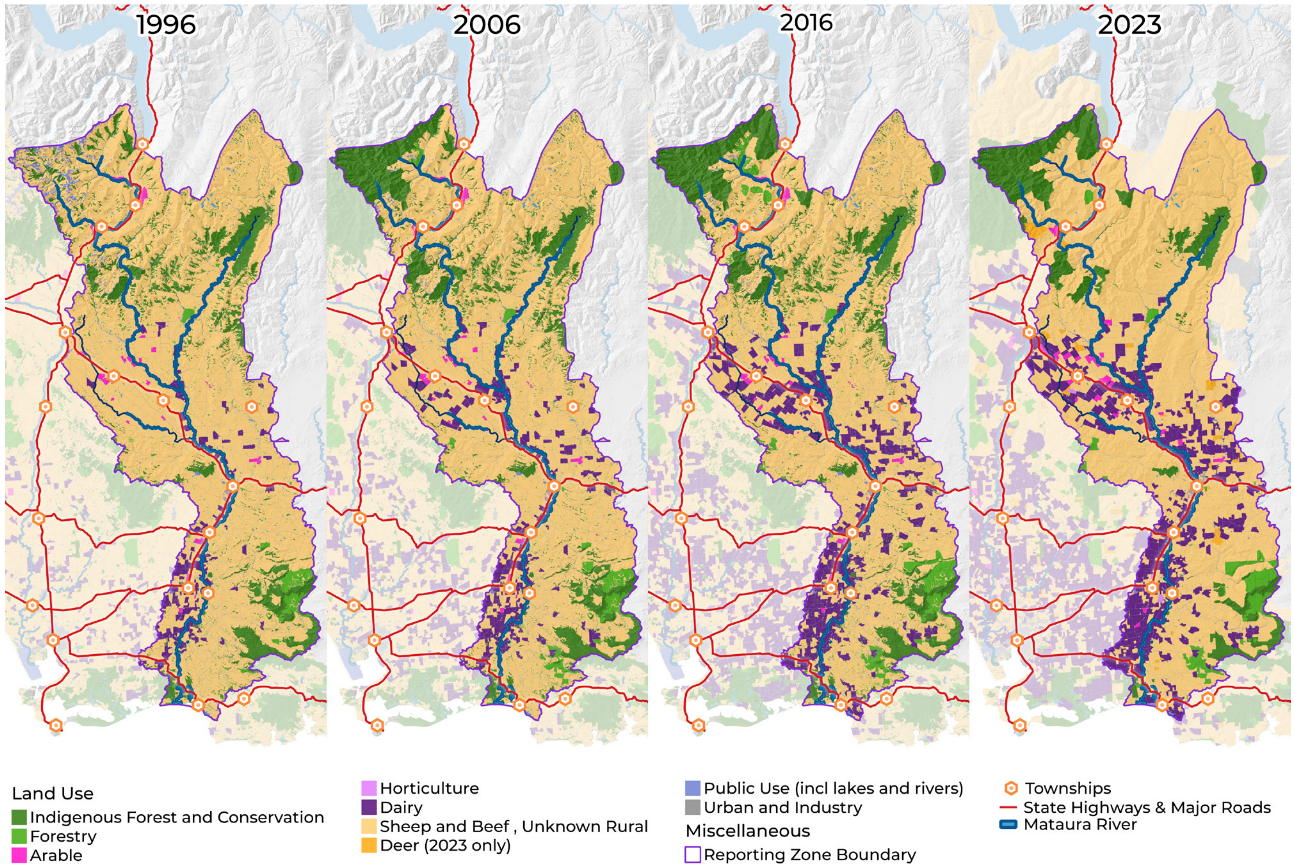
Land use

The Mataura catchment covers approximately 567,000 ha and is the second largest catchment in the region by area. About 473,655 ha (83.53%) is used for farming. Approximately 64,076 ha is Department of Conservation estate and/or indigenous forest. Land use is a mix of approximately 67% sheep and beef, 14.3% dairy, 2.3% commercial forestry and 2% urban and industry.

Large changes in land use have occurred in the last 25 years, particularly in the dairy sector. The change in total pastoral land area has been limited, indicating most of the land use change has been a shift from drystock to dairy farming. The growth of dairy farming represents an increase in agricultural land use intensity over this time, resulting in a large increase in contaminant loss and increased pressure on natural resources.



Historic land use



Please note that these maps and figures are indicative only due to land use class aggregation and differences in mapping methods.

Historic land use

	1996 to 2006	2006 to 2016	2016 to 2023	Overall 1996 to 2023
Pastoral land	↓ 4%	↓ 2%	↑ 9%	↑ 2%
Dairy	↑ 86%	↑ 88%	↑ 27%	↑ 350%
Drystock	↓ 8%	↓ 9%	↑ 6%	↓ 12%

Climate

Understanding climate at a catchment scale helps to explain spatial and temporal variation in landuse, water quality and quantity.

Current climate

The Mataura catchment can typically be considered to have a cool-wet climate, but contains some of the region's hottest areas. On average, the mean annual temperatures are 6-12°C, summer in the 12-18°C range and winter between 0-12°C. Typically, the coastal area sees 0-50 nights below 0°C, with the most inland areas seeing up to 150 nights annually.

Rainfall across the Mataura is variable. The headwaters receive lower annual average rainfall (500-1,000 mm/yr) than the lowland/coastal areas (1,000-2,000 mm/yr), as the headwaters start to move into north-westerly dominated weather patterns. The average number of wet days per year (>1 mm rainfall) ranges from 100-200 per year, with the headwaters at the lower end. The heaviest rainfall events are typically seen in the coastal/southern part of the catchment.

Future climate

Possible changes to the future climate of the Mataura catchment have been explored through several scenarios based on the representative concentration pathways (RCP) of 4.5 and 8.5. The outputs from these scenarios are summarised in the table.

Precipitation

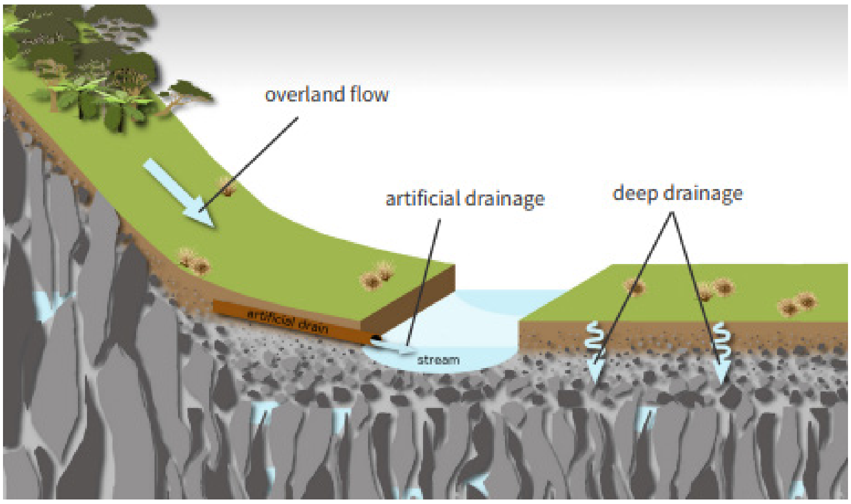
		Historic / now	RCP 4.5		RCP 8.5	
			Mid 21st century	End of 21st century	Mid 21st century	End of 21st century
Temperature	Daily mean (°C)		↑ 0.5-1	↑ 0.75-1	↑ 0.5-1.25	↑ 1.75-3.5
	Mean minimum (°C)		↑ 0-0.75	↑ 0.5-1	↑ 0.25-0.75	↑ 1-2
	Number of hot days		↑ 0-20	↑ 0-25	↑ 5-20	↑ 10-60
	Number of frosty nights		↓ 0-20	↓ 5-30	↓ 0-20	↓ 10-50
Rainfall	Annual rainfall change (%)		↑ 0-5% coastal East ↑ 5-10% for rest of catchment	↑5-10%	↑ 0-5% coastal East ↑ 5-10% for rest of catchment	↑ 5-10% Eastern catchment ↑ 15-20% for the rest
	Number of wet days	148-170	163-170	164-172	164-171	167-173
	5-Day maximum rainfall (mm)		↑ 0-15mm	↑ 0-15mm	↑ 0-15mm	↑0-15mm in upper west and mid ↑15-30 in upper east and coastal
	Heavy rainfall days	18-28	22-30	22-31	22-31	25-34
	Seasonal changes		Wetter spring for all, upper and mid-west; also a bit wetter in winter	Wetter autumn, winter, and springs	Concentrated to winter/spring	Concentrated in Winter and Spring

Catchment landscapes and hydrology

The biogeochemical and physical processes occurring within a catchment influence water quality. Understanding hydrology, geology and soil types within a catchment helps explain variations in catchment yields, water chemistry and water quality outcomes that are independent of land use.

Headwaters

Rain falling in the Eyre Mountains flows down the steep upper slopes covered in tussock and beech forest. Here, it passes through the thin layer of tussockland and shallow soils on sandstone and semischist bedrock of the Caples Terrane. Further down the catchment, the water encounters low-intensity hill country agriculture and, in some areas, exotic forestry on the gentler slopes and valley floors.



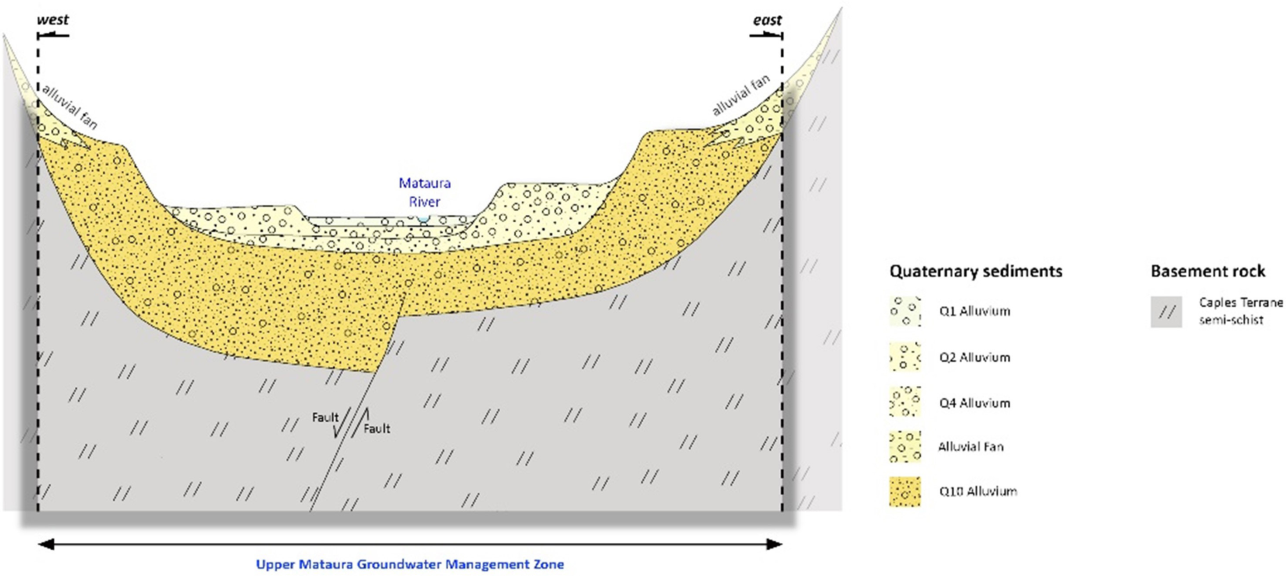
▲ *Conceptual illustration of the typical hydrological and landscape setting in the upper catchment hill country areas.*

Waterways in the headwaters are generally well distributed across the drainage area, small (< order 4) and with median flows less than one cumec. Flow lag times in the upper catchment are relatively short (hours/days), with limited subsurface flow pathways and steeper topography.

Relatively pristine water from the headwater hills flows to the bottom of the headwater valleys through recent alluvial gravel deposits. As water flows through these deposits, it mixes with localised recharge water from the surrounding land.

Low-intensity agriculture in the headwaters and more intensive land use on the valley floors result in nutrients, sediment and *E. coli* accumulating in the water flowing through them.

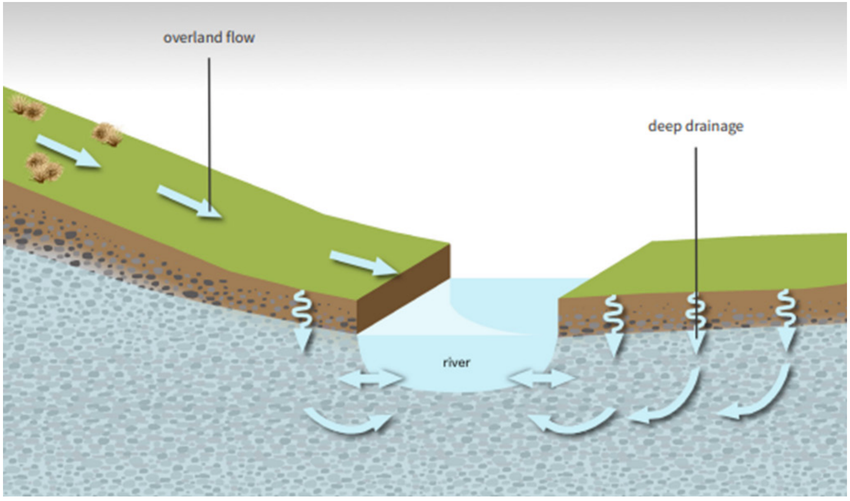
Hydrological concept diagram



Mid catchment

The Mataura flows through approximately 40km of relatively confined valley terrain accumulating water from small hill-country-dominated tributaries, before it discharges onto the more open alluvial plains downstream of Cattle Flat.

The Mataura meanders across plains dominated by intensive agriculture. It receives inputs of water derived from localised recharge, natural and artificial waterways and temporary overland flow pathways. This water generally carries higher concentrations of contaminants.



Conceptual illustration of the typical hydrological and landscape setting in the mid-catchment.

The Mataura River is joined by the Waikaia River, which flows through alpine and hill country areas. Downstream of their confluence, the river is further fed by the contrasting lowland, surface recharge-derived waters of the Waimea, Waikaka and Otamita streams.

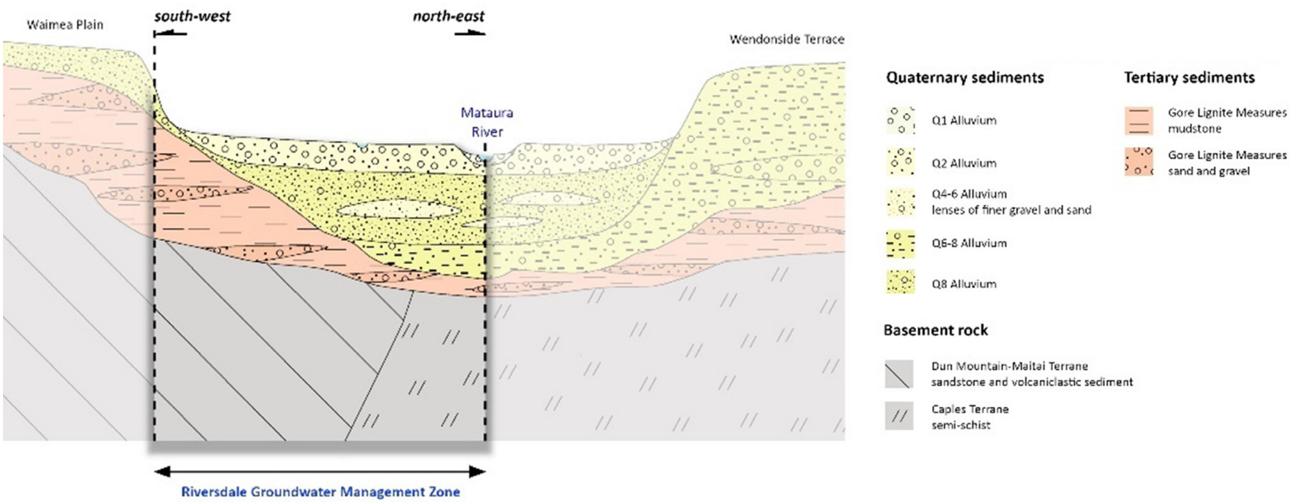
Through the mid-Mataura, thicker and older alluvial gravel deposits form layers adjacent to the river channel and across the width of the river valleys. These alluvial deposits host significant groundwater resources and are underlain by older Gore Lignite Measures and Caples Terrane bedrock.

Extensive drainage and stream modifications on agricultural land in the mid-Mataura have caused water to move faster through the landscape. On the flatter alluvial plains, water interacts with soils in the intensive agricultural areas, carrying nutrients, sediment, *E. coli* and other contaminants. Large areas of well-drained, oxidising soils and aquifers are vulnerable to nitrogen contamination and contribute to the Mataura via groundwater and stream discharges.

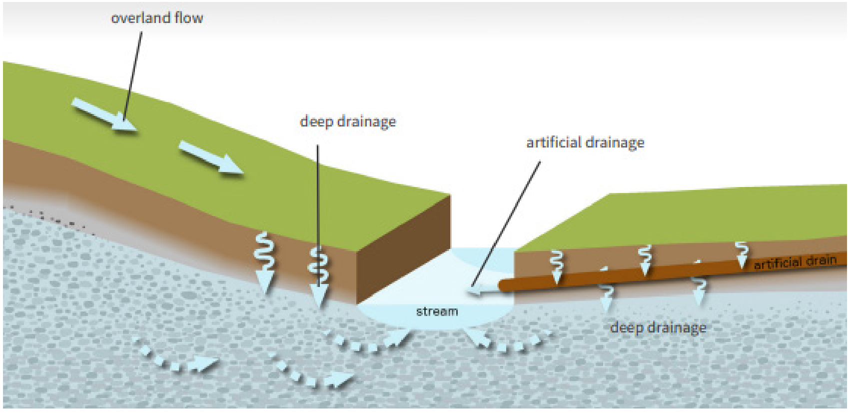
Flow pathways and lag times can vary greatly. Relatively long lag times (years) are associated with subsurface groundwater flows, while the modified surface hydrology results in short lag times for overland flow and artificial drainage networks.

Geological constraints funnel surface water and groundwater into the narrow incision through the clastic sedimentary rocks of the Murihiku Terrane at Gore.

Hydrological concept diagram



Lower catchment



▲ *Conceptual illustration of the typical hydrological and landscape setting in the lower catchment.*

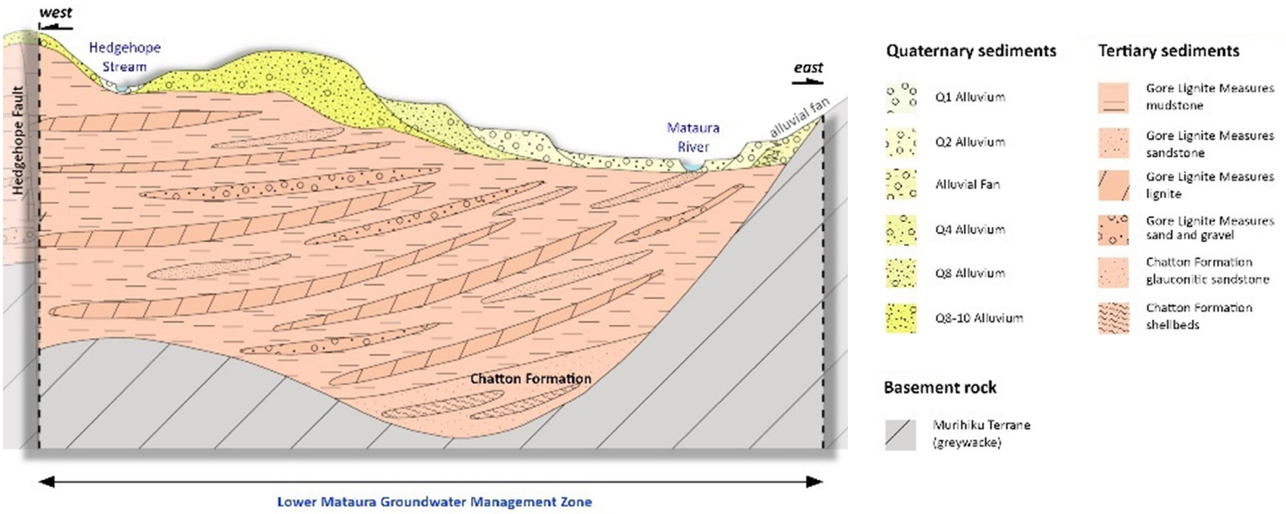
As the Mataura flows through Gore and its surrounding area, it receives stormwater, industrial, and municipal discharges. Below Gore, the river continues meandering south, flanked by alluvial terraces, with outcrops of the Tertiary Gore Lignite Measures often forming the riverbed.

The surrounding landscape is characterised by highly hydraulically modified land supporting intensive agriculture, which leads to rapid transport of water and contaminants to streams and the Mataura River. Large areas of oxidising soils and aquifers are vulnerable to nitrogen contamination and contribute to the Mataura via groundwater and stream discharges.

At the town of Mataura, the river cascades over outcrops of the Murihiku Terrane sandstones, forming the culturally and historically significant Te Au Nui Pihapiha Kanakana/Mataura Falls. This river and its banks have been highly altered for industrial use and are now constrained and flanked by concrete meat processing and abandoned paper mill buildings. Wastewater from the meat processing plant enters the river at this location and makes a significant contribution to the contaminant load in the river.

Further down the catchment, the Mataura receives stormwater, industrial and municipal wastewater discharges associated with the Edendale and Wyndham towns and the Fonterra milk processing plant. Tributary inputs are impacted by pervasive and intensive agriculture and consequently transport nitrogen, phosphorus, sediment and *E. coli* to the Mataura River. At the bottom of the catchment, the Mataura discharges into the Toetoes (Fortrose) Estuary.

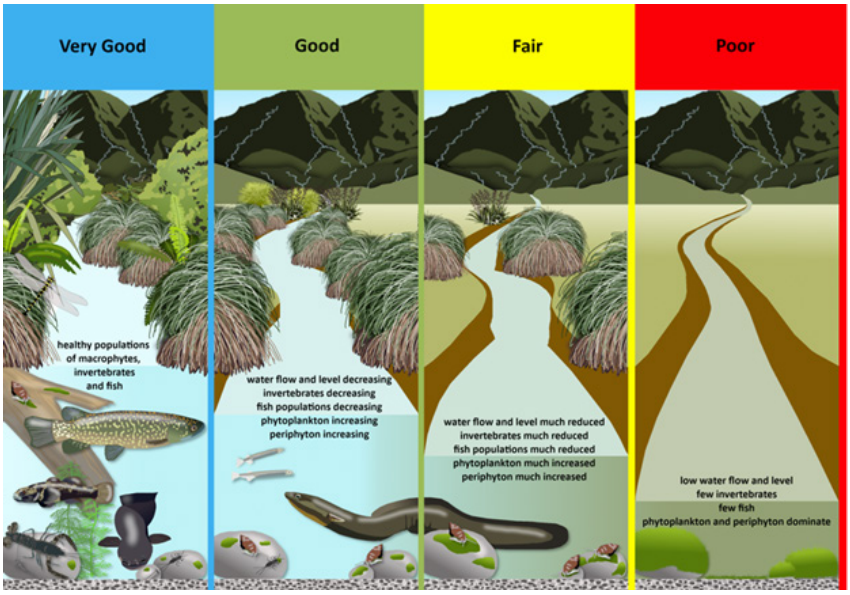
Hydrological concept diagram



What are the water issues for this catchment?

Freshwater outcomes and how we measure them

Freshwater outcomes can be described from ‘very good’ to ‘poor’. This spectrum helps us understand the current state of the freshwater environment and what we might be trying to achieve in the future. The image depicts this concept for rivers and streams.



Although many factors contribute to freshwater outcomes, we can only measure some of them to get an understanding of ecosystem health. We measure the aspects of the freshwater environment that can help us define and determine freshwater outcomes. These aspects are called ‘attributes’.

Attributes (the things we measure)

Attributes can relate to the ecosystem's physical or chemical environment or biological communities, such as periphyton, macroinvertebrates and fish. The measured state of an attribute tells us about some aspects of the environmental state, and together, they build a picture of the ecosystem's overall health. The more attributes we monitor, the more precise the picture can become.

Attributes may relate to ecosystem health or human health outcomes (e.g. *E. coli* or cyanobacteria concentrations). Some attributes are graded using ‘ABCD’ categories: A (very good), B (good), C (fair) and D (poor). In some cases, *E. coli* has an additional E (very poor) grade. Other attributes have simple ‘pass’ or ‘fail’ grades.

The more attributes with a higher grade, the better the overall ecosystem health. Conversely, when many attributes have poorer grades, the overall ecosystem health is poorer.

Hauora target attribute states

In 2020, Environment Southland and Te Ao Mārama Inc (TAMI) approved in principle the use of hauora as a freshwater target to be achieved within a generation. These targets provided the basis for the Regional Forum recommendations on how freshwater aspirations may be achieved.

The concept of hauora encompasses far more than the numeric attributes and targets described here. For simplicity, a reduced number of attribute states are presented in this document as they relate to ecosystem and human health. Hauora is a state of healthy resilience and is generally associated with the A 'very good' and B 'good' attribute states. However, attribute states that support hauora can be anywhere on the scale from A 'very good' to C 'fair', depending on the natural characteristics of that freshwater environment.

The natural characteristics have been differentiated through the use of classes.

We use monitoring results to compare the current attribute state with the hauora target state for different classes in the Mataura catchment.

Streams and rivers

River classes

'River classes' group rivers (or parts of rivers) with similar characteristics. Similarities can include natural characteristics of the rivers, such as climate, gradient and flow.

The river classes used in Murihiku Southland are: Mountain, Hill, Lowland, Spring-fed, Lake-fed and Natural State.

The Mataura catchment contains all six river classes. Over half of the rivers (by length) are Lowland, and slightly more than a quarter are Hill, while the Lake-fed, Natural State and Spring-fed classes make up a very small part of the Mataura catchment.

Target states can differ between attributes and between different river classes, which may have different target states for the same attribute.

Periphyton is an example of an attribute with different target states for different river classes.

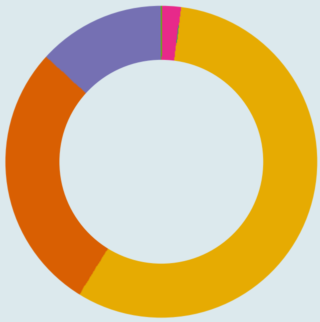
The different target states reflect the differences in natural characteristics for each river class.

- C target state: Lowland class
- B target state: Hill class
- A target state: Mountain, Spring-fed and Lake-fed classes.

Natural State waterbodies can be identified for management purposes but are assigned attribute targets according to their underlying river classification (displayed here).

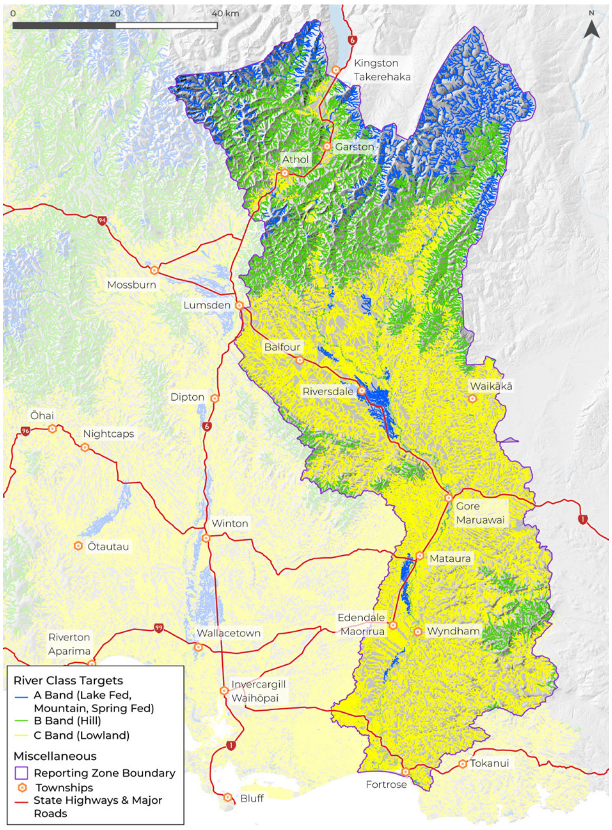
▸ *The map shows the distribution of periphyton targets for each river class within the Mataura catchment.*

Length of river network in each class



- *Hill = 2,474,938m*
- *Lake-fed = 1,633m*
- *Lowland = 5,022,064m*
- *Mountain = 1,167,853m*
- *Natural State = 10,374m*
- *Spring-fed = 167,612m*

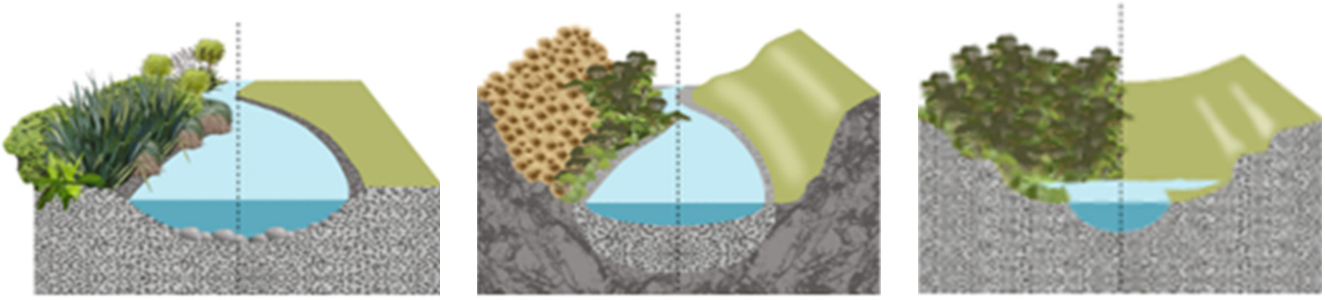
River class hauora targets



Results for the river classes

Hauora targets and current states for ecosystem and human health attributes are summarised in the table below for the catchment's Lowland, Hill and Mountain river classes. Table colours correspond to the 'ABCDE' grading for attributes described previously. Results show that Lowland and Hill rivers in the catchment have the most water quality issues.

Current state is assessed using data from the 2018-2022 period.



	Lowland		Hill		Mountain	
Ecosystem health attributes	Hauora target	Current state	Hauora target	Current state	Hauora target	Current state
Periphyton	C	C	B	A	A	A
Nitrate toxicity	A	C	A	B	A	A
Ammonia toxicity	A	B	A	B	A	A
Suspended fine sediment	C	D	C	D	A	A
Macroinvertebrates (MCI, QMCI)	C	D	B	C	B	B
Deposited fine sediment	A	A	A	C	A	A
Dissolved reactive phosphorus	B	D	B	B	A	A
Water temperature (summer)	C	D	C	C	B	C
Human contact attributes						
Benthic cyanobacteria	A	B	A	D	A	A
E. coli	A	E	A	E	A	A
Visual clarity	B	D	B	C	A	A

	Spring fed		Lake fed	
Ecosystem health attributes	Hauora target	Current State	Hauora target	Current State
Periphyton	A	-	A	-
Nitrate toxicity	A	-	A	-
Ammonia toxicity	A	-	A	-
Suspended fine sediment	B	-	B	-
Macroinvertebrates (MCI, QMCI)	B	-	C	-
Deposited fine sediment	A	-	A	-
Dissolved reactive phosphorus	B	-	A	-
Water temperature (summer)	B	A	B	-
Human Contact Attributes				
Benthic cyanobacteria	A	-	A	-
E. coli	A	-	A	-
Visual clarity	A	-	A	-

"-" data not available.

Periphyton is the algae and 'slime' that grows on the streambed forming the base of the food web in rivers. In some rivers, periphyton is essential for a healthy ecosystem. However, elevated nutrients and light levels can promote excessive periphyton growth. This 'nuisance' periphyton has detrimental effects, such as smothering fish and invertebrate habitat. It can cause greater variation in dissolved oxygen concentrations. The class scale assessment indicates that periphyton in the Lowland rivers and streams is in a 'fair – C band' state and meets the hauora target.

There are no long-term monitoring sites of spring-fed or lake-fed streams in the Mataura catchment.

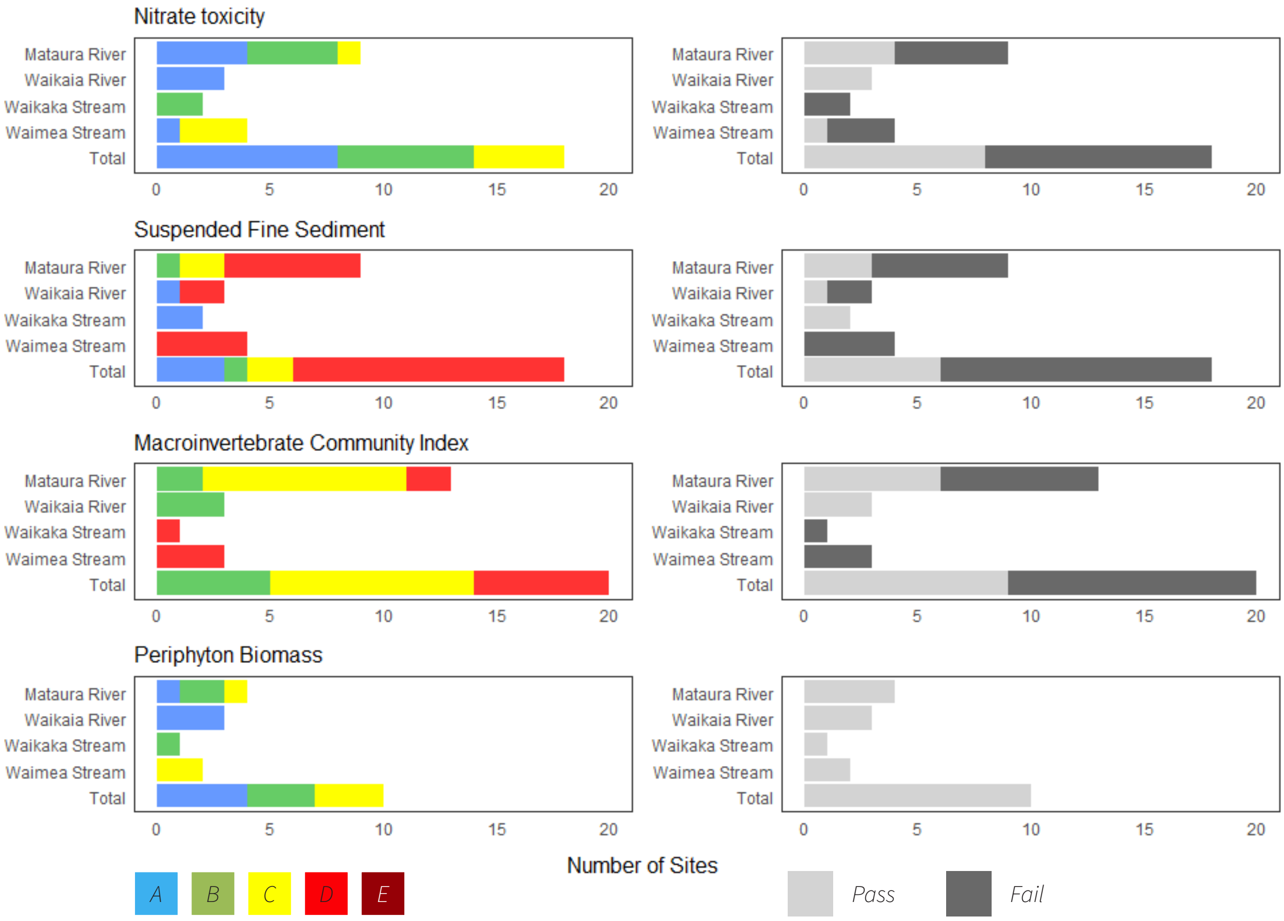
Results for streams and rivers monitoring sites

Ecosystem health

Nitrate toxicity and suspended fine sediment are measures of ecosystem health. For nitrate toxicity, the current state for the monitored streams and rivers in the Mataura catchment ranges from 'very good' to 'fair', with slightly fewer than half of the sites achieving the A-band target state. The current state for suspended fine sediment ranges from 'very good' to 'poor', with about two-thirds of monitored sites in a 'poor' state. Slightly fewer than half of the sites achieve their target state. For these attributes, the Waimea Stream and Lower Mataura are in particularly poor condition.

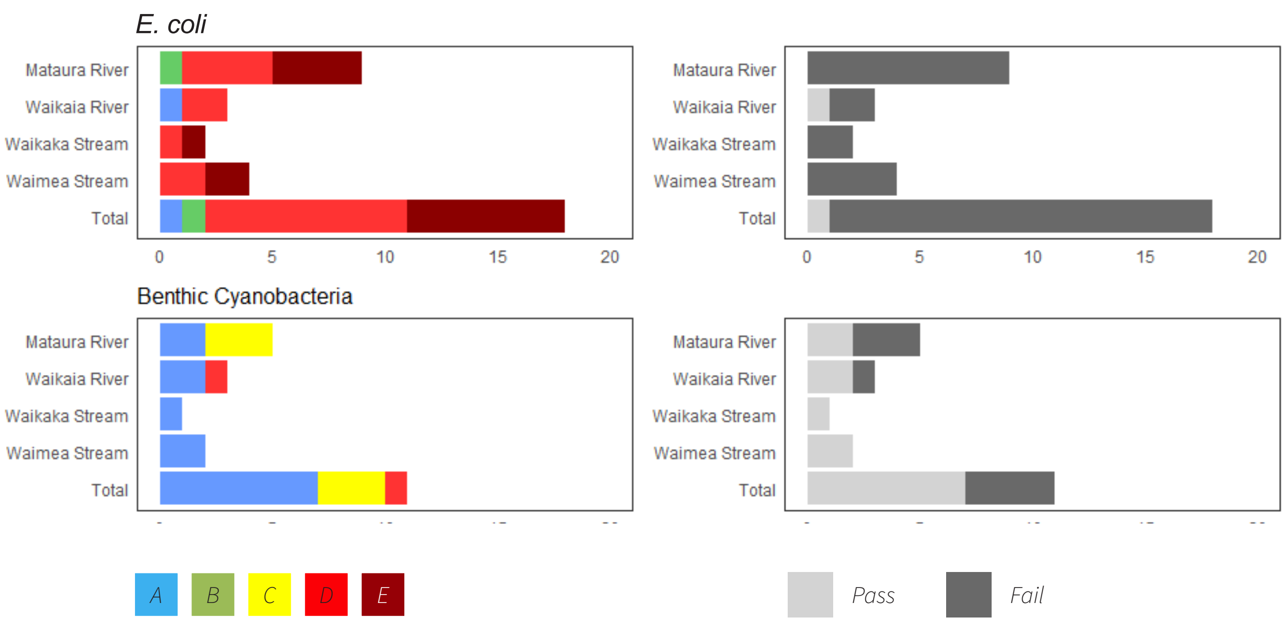
Macroinvertebrate Community Index (MCI) and periphyton biomass are measures of ecosystem health based on the aquatic life in streams and rivers. The current state MCI for the monitored streams and rivers in the Mataura catchment ranges from 'good' to 'poor', with eight out of 18 sites achieving the target state. The Waikaka and Waimea Streams are in poor condition, with all monitored sites within those streams in a 'poor' state. For periphyton biomass, the current state ranges from 'very good' to 'fair' across the catchment, and all monitored sites achieve the target state.

Dissolved Inorganic Nitrogen (DIN) is a measure of the nitrogen available to promote excessive plant and algae growth. Dissolved reactive phosphorus (DRP) is another nutrient that can support excessive plant growth. The Waimea Stream is in a degraded state, with most monitored sites being 'poor' for both DIN and DRP. The remaining sites within the Mataura catchment range from a 'very good' to a 'poor' state for DIN and a 'good' to a 'poor' state for DRP.



Human health/contact

The human contact attributes measure the suitability of the waterbodies for recreational use. Only one site (in the Waikaia River) meets the target of very good for *E. coli*, with almost all sites being in a 'poor' or 'very poor' state. Benthic cyanobacteria (toxic algae) in the Mataura catchment periodically reaches unsafe levels at sites in the Mataura and Waikaia Rivers, although seven of the 11 sites monitored for this attribute achieve the target state of 'very good'.



Water Conservation (Mataura River) Order 1997

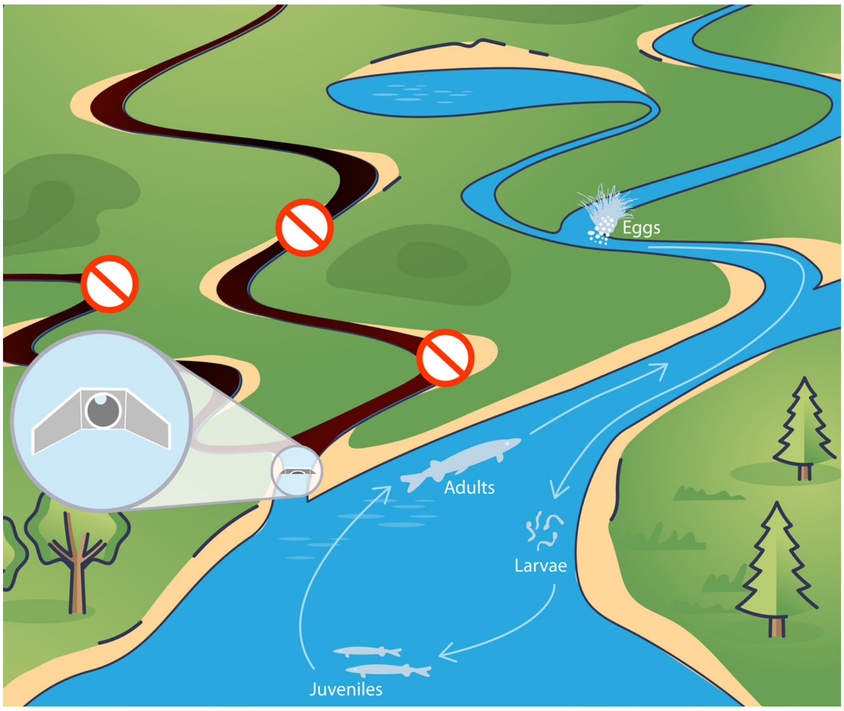
The Mataura River and many of its tributaries are subject to a Water Conservation Order, in recognition of the outstanding fisheries and angling amenities provided by the protected waters.

The Water Conservation Order provides an additional level of protection to preserve the fisheries and angling amenity values of the Mataura River and protected tributaries. There are extra rules which apply to water takes and discharges to water.

Fish passage

Fish passage barriers obstruct the passage of fish species. This particularly impacts migratory fish species that complete their lifecycles in both freshwater and the ocean, such as tuna/eels, kanakana/pouched lamprey and migratory galaxiids/whitebait. Generally, the closer a barrier is to the coast, the larger the area of habitat that becomes inaccessible to migratory fish, making it a higher priority for restoring passage. Common examples of fish passage barriers include structures like culverts, weirs and dams, while natural features such as waterfalls can also form barriers. Different fish species and life stages have varying climbing and swimming abilities, so a barrier for one species or life stage may not be a barrier for another.

Whitebait lifecycle



In some cases, fish barriers may be desirable to protect populations of non-migratory galaxiids that struggle to co-exist with trout. In these cases, a barrier could be installed or maintained in a specific location to prevent trout from reaching the population of non-migratory fish.

In the Mataura catchment, culverts are the most common type of fish passage barrier, with some tide gates also present in the lower catchment. Considering fish passage during the design and installation of structures, along with regular maintenance, will help improve fish passage.

Mataura Falls

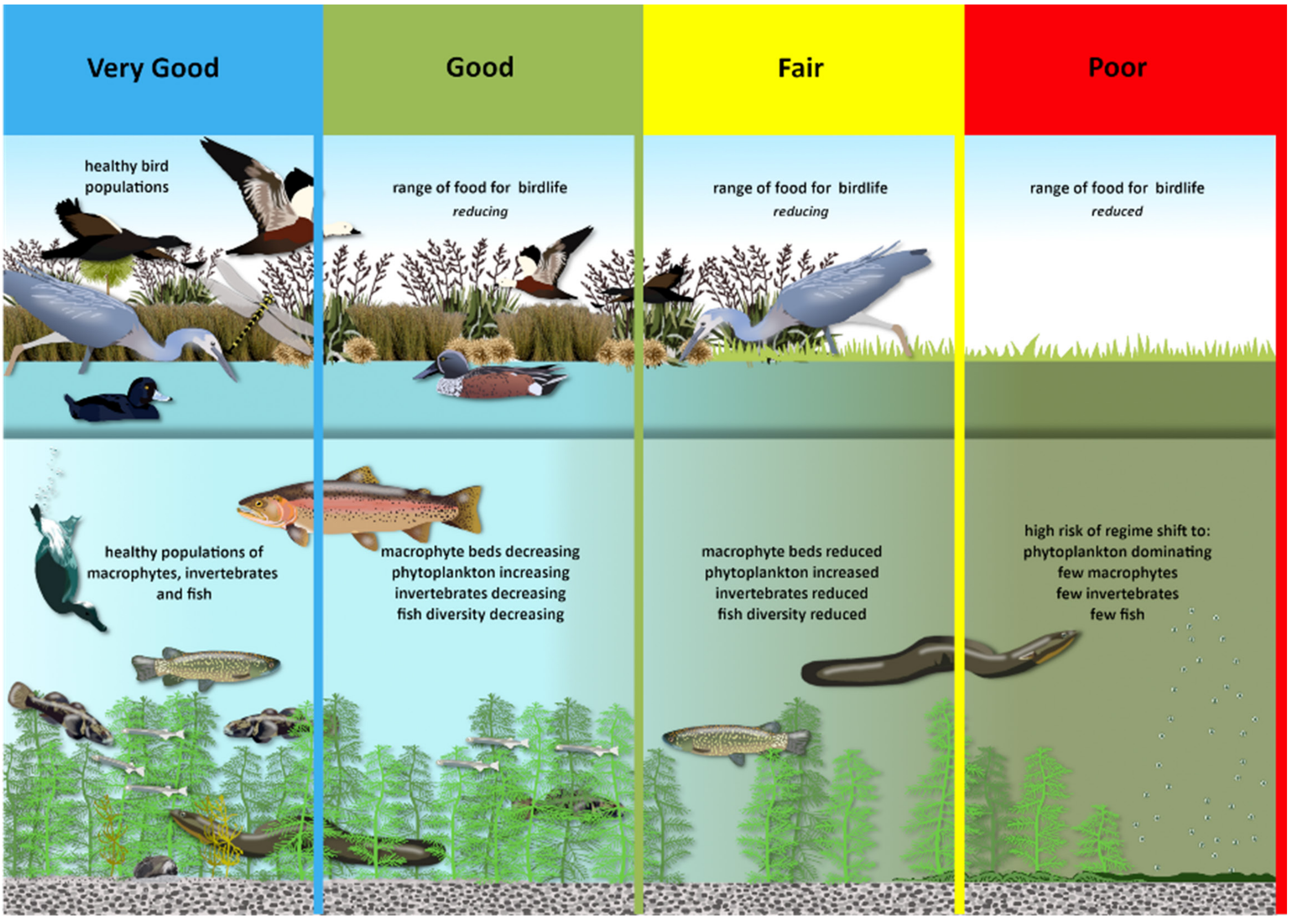
Te Au Nui Pihapiha Kanakana/Mataura Falls is a natural feature that has been impacted by artificial structures that present a barrier to fish passage. The falls are a traditional mahinga kai site for kanakana (pouched lamprey). A trap and transfer programme is now part of the kanakana management programme, undertaken by Hokonui Rūnanga. Kanakana congregating at the base of the falls are captured and released into the Mataura River above the falls and upstream of the concrete weir.

In 2006, a ten-kilometre section of the Mataura River, including the Mataura Falls, was designated as the first freshwater mātaitai. A mātaitai is a locally managed fishery reserve that usually allows customary and recreational fishing but prevents commercial fishing. Bylaws can be used to provide additional regulations within the mātaitai. In the Mataura River Mātaitai area, bylaws prevent all harvest of kanakana and shortfin and longfin tuna/eels.

Lakes

Lake freshwater outcomes can be described on a spectrum from 'very good' to 'poor'. This spectrum helps us understand the current state of the freshwater environment and what we might be trying to achieve in the future.

The concept is depicted for lakes in the image below.



Although many factors contribute to lake outcomes, we can only measure some to better understand ecosystem health. We measure the aspects of the freshwater environment that can help us define and determine freshwater outcomes.

Lake Vincent

Lake Vincent is a lowland shallow lake in the Mataura catchment. Shallow lakes are usually well mixed vertically through the water column. Shallow lakes in good condition typically have healthy plant communities and good water clarity. Lowland shallow lakes generally experience more pressure from land use than shallow lakes at higher altitudes. When the lake condition deteriorates, this outcome is often expressed as increased suspended sediment in the water column and loss of aquatic plants (macrophytes).

The ecosystem health attribute of macrophytes is in 'very good' condition and achieving the target state. Total phosphorus is in the 'poor' state at both sites, while total nitrogen has one site in the 'poor' state and one in the 'very poor' state. The target state of 'good' is not achieved for either of these nutrients, presenting an increased risk of higher-than-desirable plant growth. This result is reflected in the current state of phytoplankton, which fails to achieve the target state of 'good' at either site, with 'poor' at one site and 'very poor' at the other.

Current state is assessed using data from the 2018-2022 period.

Attribute	Hauora target	Current State
Phytoplankton	B	D
Total phosphorus	B	C
Total nitrogen	B	D
Ammonia toxicity (mg/L)	A	B
E. coli	A	A
Cyanobacteria (planktonic)	A	A
Mid-hypolimnetic dissolved oxygen	A	-
Trophic state (Trophic Level Index)	B	C
Nitrate toxicity	A	A
Macrophytes	C	A

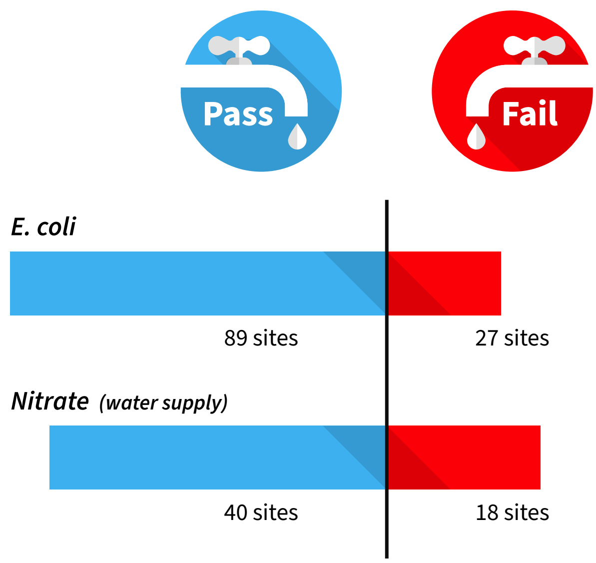
The *E. coli* concentrations are 'very good', achieving the target state. The cyanobacteria attribute also achieves the target state of 'very good'. Together, these attributes indicate no increased risk to recreational users that come into contact with water.

Groundwater

Human consumption – is it safe to drink?

The Mataura contains a diverse range of groundwater resources. Groundwater is typically accessible at shallow depths, with a median bore depth of 15m. Most utilised groundwater is hosted in Quaternary 1 – Quaternary 10 alluvial deposits.

Mataura groundwater assesment

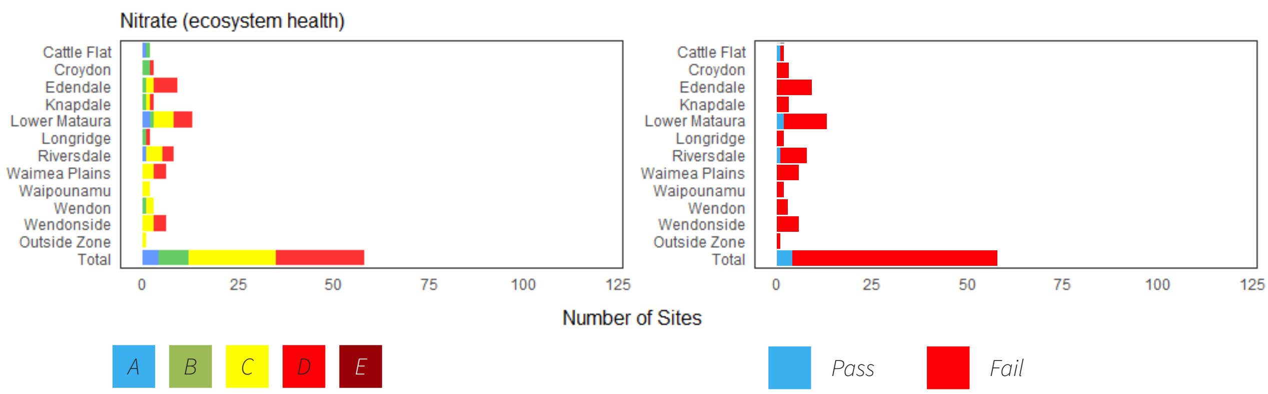


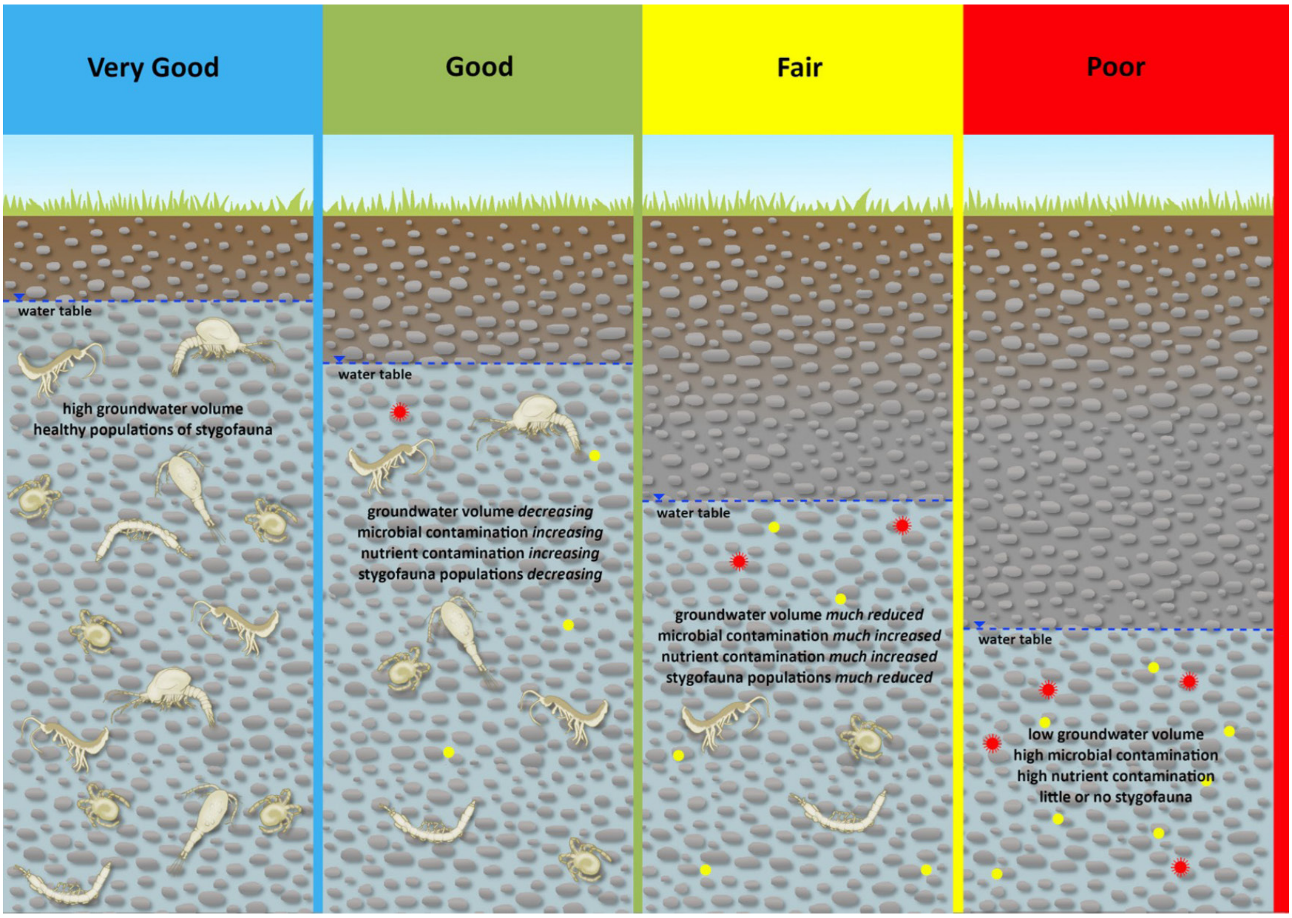
The main issues affecting groundwater's suitability for drinking are pathogens (*E. coli*) and nitrate. Target states for groundwater are based on the New Zealand drinking water standards and use a pass/fail assessment system.

More than three-quarters of monitored sites meet the target for the *E. coli* (water supply) attribute. All zones except the Upper Mataura and Wendon have some monitored sites that fail to meet the drinking water standard and target state. The nitrate (water supply) attribute is monitored at fewer sites, and about two-thirds of monitored sites pass the drinking water standard.

Ecosystem health

Nitrate concentrations are also used to monitor ecosystem health for groundwater ecosystems and connected surface waterways. Groundwater ecosystem health outcomes are represented conceptually in the figure below. Nitrate concentrations are one factor that contribute to overall ecosystem health. Nitrate concentrations related to surface water and groundwater ecosystem health outcomes are different from those used in drinking water, mentioned above.





The ecosystem health attribute nitrate toxicity has sites with current states ranging from 'very good' to 'poor', with most monitored sites in 'fair' or 'poor' condition. Moreover, most sites fail to achieve the hauora target of 'very good'. Cattle Flat, Lower Mataura and Riversdale are the only Groundwater Management Zones (GMZ) where any sites achieve the target, and all monitored GMZs have sites that do not achieve the target.

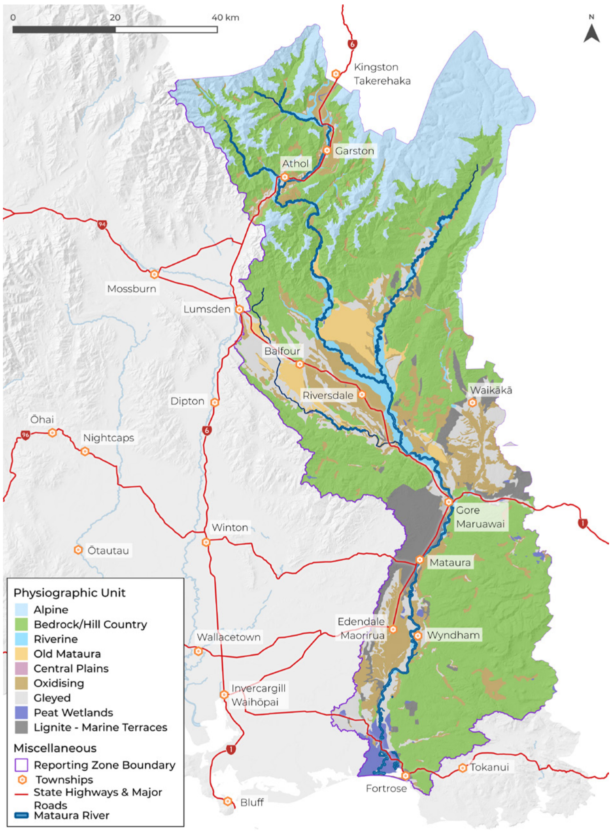
Groundwater contamination 'hotspots'

There are several areas within the Mataura catchment where the groundwater is highly contaminated with nitrogen. We call these 'hotspots'. Hotspots have been identified through sampling and modelling and are shown in red on the map below (right). These are the Waimea, Knapdale, Wendonside and Edendale areas. In some cases, nitrogen concentrations exceed the national drinking water standards and are unsuitable for human consumption. High concentrations are commonly the result of many years of intensive agriculture occurring on susceptible soils and aquifers.

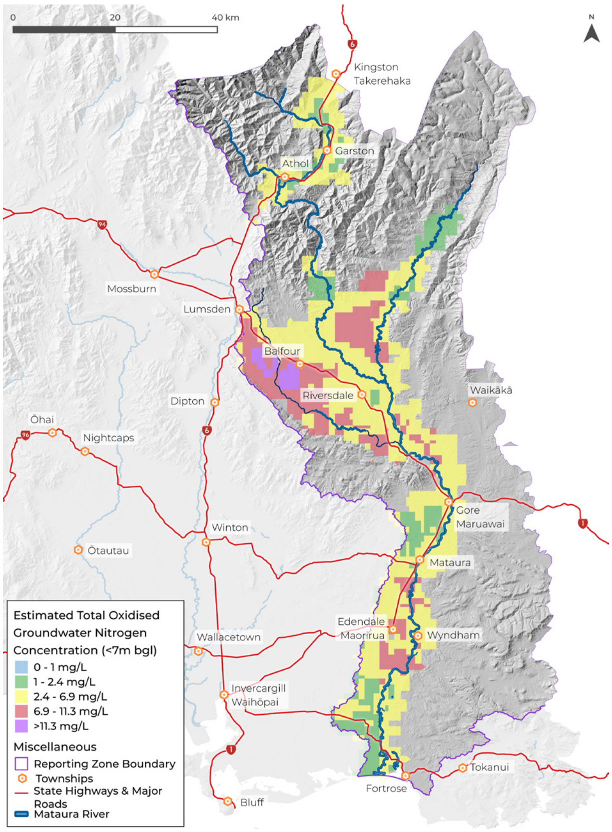
In addition to the hotspot areas, the Mataura exhibits elevated nitrate concentrations across much of the catchment (areas coloured yellow). These elevated nitrogen concentrations impact groundwater ecosystem health and contribute to contamination and eutrophication in surface water environments.

The maps below highlight areas susceptible to groundwater contamination due to the overlying land use and the natural characteristics of the soils and geology. Oxidising, Old Mataura, and Riverine are the physiographic zones considered most susceptible to groundwater nitrogen contamination. These zones are particularly prevalent in the Upper Mataura, Mid-Mataura and Edendale Terrace.

Physiographic zones



Groundwater nitrogen concentrations



Wetlands – how many do we have left?

Wetlands and water quality

Wetlands are increasingly being recognised for their functional values within the landscape. For example, their ability to intercept and attenuate agricultural runoff is now recognised as an important contribution to farm nutrient management.

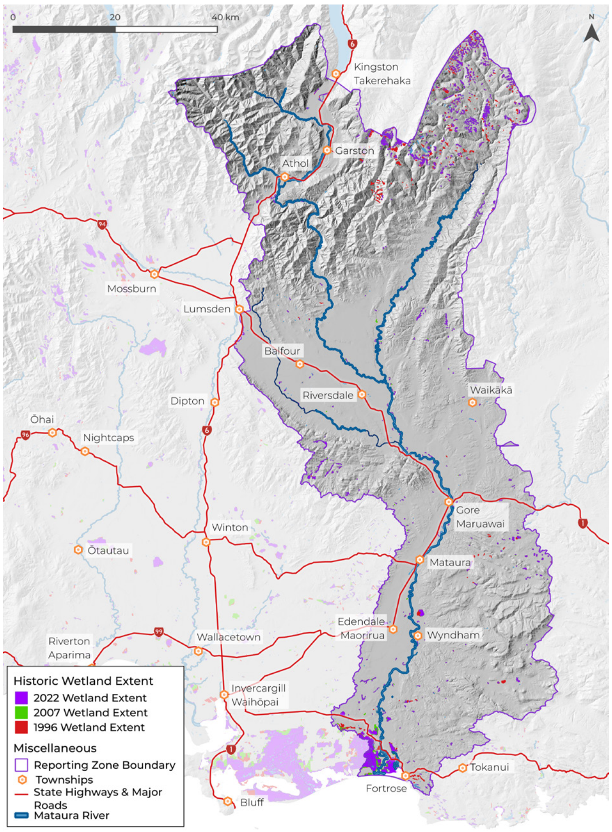
Wetlands purify water through sediment capture and storing nutrients in their soils and vegetation. This is particularly important for the agricultural nutrients nitrogen and phosphorus, which contribute to the eutrophication of receiving environments such as rivers, lakes and estuaries.

For the purposes of this document wetlands are generally defined as per the Southland Water and Land Plan definition.

The following areas were not included as wetlands in this classification:

- Wet pasture or where water ponds after rain
- Pasture containing patches of rushes less than 50% total cover
- Ponds of any kind unless associated with 0.5 or more hectares of terrestrial wetland.
- Areas of forest unless previoulsy identified as wetland.
- Areas associated with the main active flood channels of rivers.

Historic wetland extent



This map shows wetland extent over three time periods. Wetland areas lost since 1996 and 2007 are the red and green areas, respectively.

Current state

The current wetland extent in the Mataura catchment is 5,256 ha. Most of the wetlands that were lost were bogs and fens, which have primarily been converted to pasture farmland.

Remaining natural inland wetlands

There are currently 756 wetlands identified in the Mataura reporting zone that are larger than 0.5 ha. The zone incorporates the easternmost portion of the nationally and internationally significant Ramsar Awarua Wetland complex with high cultural and ecological values. It is largely protected on Department of Conservation land, but some also exist on private land. The Toetoes Harbour, which is also included in the Ramsar wetland, has areas of mudflats that are important for wading birds and zones of saltmarsh dominated by oioi (*Apodasmia similis*), and rare coastal turf communities with species such as half-star (*Selliera radicans*), occupying the area between mudflats and dryland.

Immediately north of the estuary is Council-owned land, the wetland parts of which have been retired to protect their values. These wetlands include rushland, sedgeland and shrubland dominated by manuka.

Other notable wetlands include The Reservoir, which is a small shallow lake (48 ha) situated 250 m from Haldane Beach. The lake was formed from the damming of a small coastal creek and now has a good vegetation community of flax, raupō and jointed rush along its margins. A large fen exists bordering Titiroa Stream west of Waimahaka, which has large areas of rushes. North of Wyndham, a large bog, 77 ha in size, exists with a large adjacent peat mine. Murihiku Southland is one of the few places in New Zealand where peat mining still occurs.

Southeast of Gore, near the catchment boundary, is an area comprising several moderately sized fens. The central part of the Mataura Catchment adjacent to the Mataura River has numerous oxbows, which may be natural or formed from river straightening.

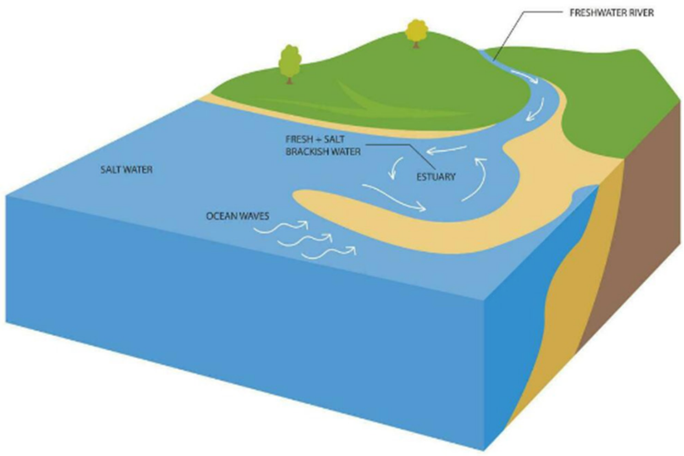
At the top of the catchment, in the Garvie mountain area, there are several Regionally Significant wetlands comprising large bogs, fens and shallow lakes. This area also has one of the highest concentrations of wetlands in Murihiku Southland, with approximately half of all the wetlands in the Mataura zone occurring here.

Of the remaining wetlands not on conservation land, there is a moderately high risk of losing more wetlands in the near future.

	1996 to 2007	2007 to 2022	Overall 1996 to 2022
Change in wetland area	↓ 23% 1646 ha	↓ 7% 394 ha	↓ 28% 2040 ha

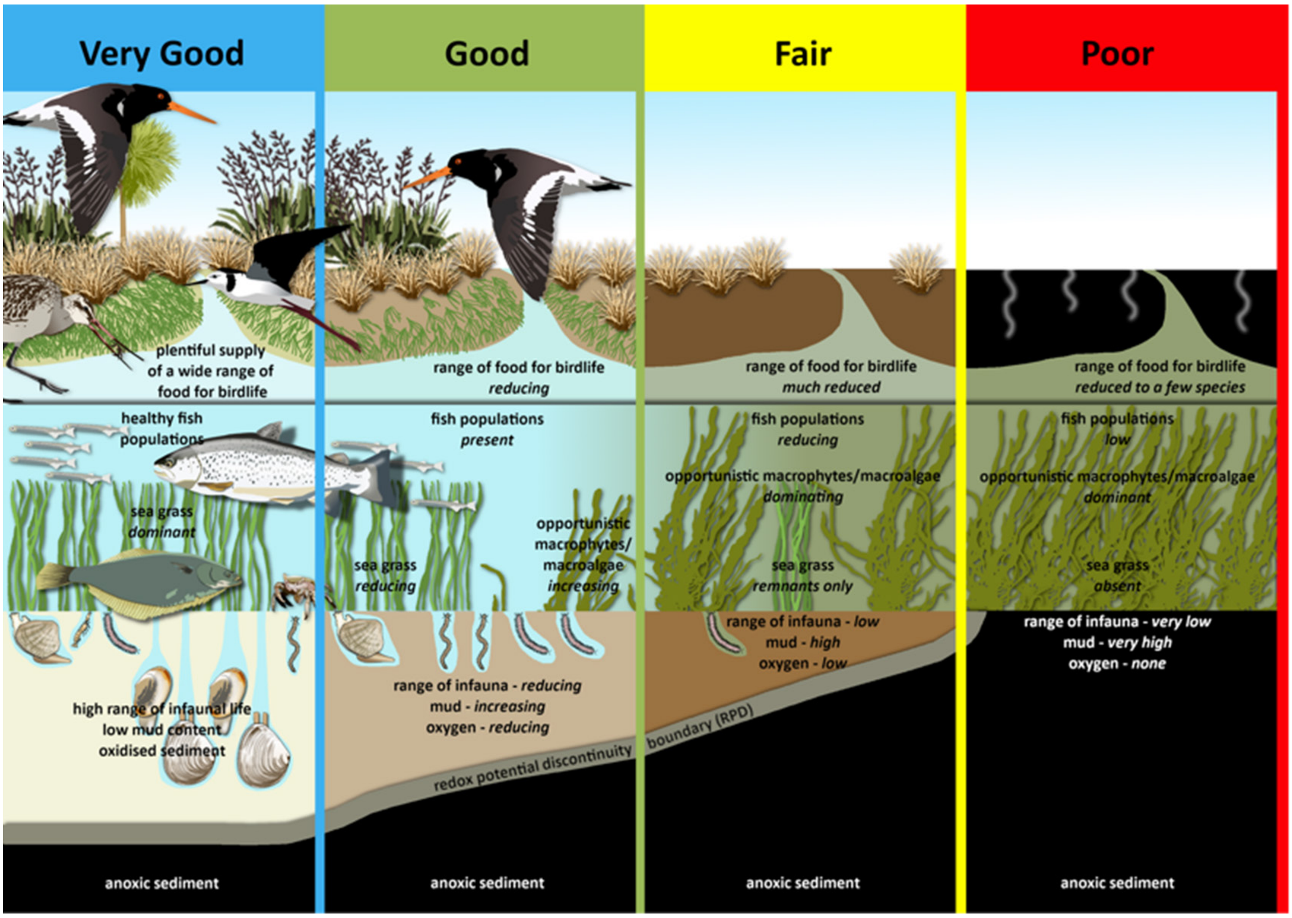
	1	2	3	4	5
Risk of Loss (1 = low, 5 = high)	5%	12%	23%	60%	0%

Toetoes (Fortrose) Estuary



Toetoes (Fortrose) Estuary is a tidal river estuary. This type of estuary is characterised as shallow, with short residence times (less than three days) and a high river flushing potential. These properties usually mean that fine sediment and nutrients are rapidly transported to the sea, and they have a low susceptibility to eutrophication. Eutrophication is generally expressed as excessive macroalgae growth.

Estuary health outcomes can range from 'very good' to 'poor'. Using an outcome spectrum can help us understand the state of the freshwater environment and what we might be trying to achieve in the future. The concept is depicted for estuaries in the image below. We measure various aspects of the estuarine environment that can help us define and determine estuary outcomes.



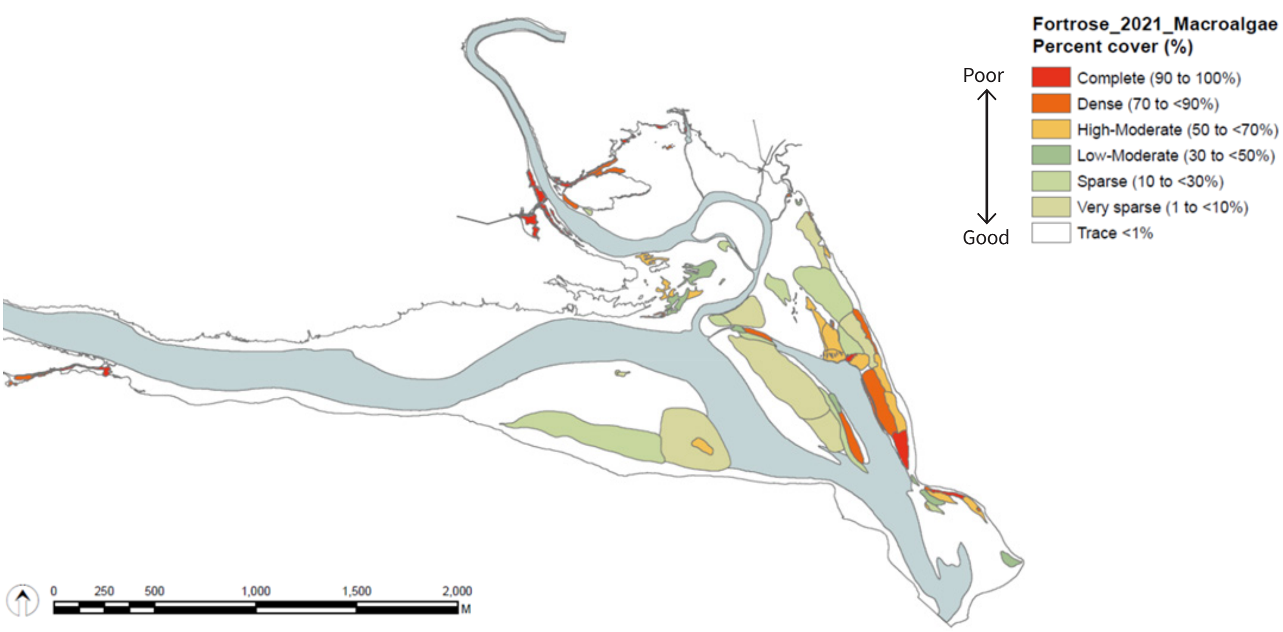
Monitoring results show that the main issues for Toetoes (Fortrose) Estuary are pathogens (human health) and high levels of nutrients and sediment (mud). Parts of the estuary also have dense beds of nuisance macroalgae. Heavy metals are not an issue for this estuary.

High levels of nutrients and sediment fuel the growth of nuisance macroalgae (seaweeds like Agarophyton and Ulva) – which crowd out and displace seagrass beds. Seagrass also struggles to grow in areas where sediment has a high mud content.

Results for attributes vary spatially across the estuary. For example, the upper tidal flats are more at risk of mud build-up, high nutrients, dense nuisance macroalgae beds and seagrass loss.

Attribute	Hauora target	Current state
Phytoplankton	A	No data
Total phosphorus	B	B
Total nitrogen	A	B
Ammonia toxicity (mg/L)	A	B
E. coli	ND	Fail
Cyanobacteria (planktonic)	<2 mm/year	Indeterminate
Mid-hypolimnetic dissolved oxygen	B	C
Trophic state (Trophic Level Index)	A	D
Nitrate toxicity	A	N/A
Macrophytes	A	A

Broadscale habitat mapping of Toetoes (Fortrose) Estuary in 2021 indicates areas of high eutrophication and macroalgal cover, with lower to moderate coverage across large portions of the estuary. Hotspots of macroalgae are at the entrance to Titiroa Stream and the area immediately adjacent to Fortrose township. These are areas of either high land-based input (Titiroa Stream) or likely lower flushing potential or depositional zones.



Water quantity – how much do we have, and how much are we using?

Surface water allocation

Surface water abstraction is predominantly governed in the Mataura catchment by the Mataura Water Conservation Order, which came into effect in 1997. This stipulates that at any point, 95% of the natural flow of the Mataura River upstream of the Mataura Island Bridge and select tributaries must remain. Below the Mataura Island Bridge, this proportion is 90%. Work is underway to review consents affected by an over-allocation of part of this catchment. Until this review is complete, allocation figures cannot be confirmed.

Groundwater allocation

Most groundwater allocation thresholds are set using a proportion of annual rainfall recharge to aquifers, varying depending on the aquifer type. In the Mataura catchment, there are 12 Groundwater Management Zones. Groundwater takes can be highly connected to surface waters, impacting on river flows. These takes are managed by stream depletion allocation. Depending on the degree of stream depletion, the groundwater take may be subject to the same restrictions as a surface water take.

The majority of allocated groundwater is consented for irrigation (69%) with other uses including dairy (16%), industry (9%) and municipal (5%).

Monitoring data provided by consent holders for the 2022/2023 season indicates that groundwater use is generally greater than 50% of the total volume allocated, with irrigators using 52-53%, industry 84-85%, municipal 91.8% and dairy up to 68-80% of their respective consented groundwater allocations.

	Groundwater percent allocated (%)
Upper Mataura	38.7
Waimea Plains	26.4
Wendon	14.9
Cattle Flat	3.3
Wendonside	89.6
Waipounamu	62.0
Riversdale	70.0
Longridge	5.3
Knapdale	6.8
Croydon	47.0
Lower Mataura	5.6
Edendale	39.2

	Groundwater use (%) (22/23 season)
Irrigation	52-53%
Industry	84-85%
Municipal	91.8%
Dairy	68-80%

How much do we need to reduce contaminants to achieve a state of hauora?

Regional contaminant modelling

We have undertaken contaminant modelling to help us better understand water quality across Murihiku Southland. This modelling utilises monitoring data to estimate water quality in all waterbodies (excluding Fiordland and Islands). This expanded view of water quality allows us to estimate the reductions in contaminant load and concentrations required to achieve the identified target attribute states and to test the impact of different land use scenarios.

For this work, we focused on four main contaminants of concern: nitrogen, phosphorus, sediment, and *E. coli*. Actions taken to reduce the impact of these contaminants on our freshwater systems will have benefits for ecological and human health outcomes.

How much do contaminant loads need to be reduced?

Load is a measure of the total mass of a contaminant (in kg or tonnes) coming from a given area past a given point over time. For example, the total amount of nitrogen delivered to the sea by a river in one year.

We use loads to quantify contaminants here because they describe the amount of contaminants lost over a whole catchment area. It is the land that consequently needs to be managed to reduce those loads. It is important to remember that concentrations (e.g., the mass of the contaminant per litre of water in the waterbody in kg/L) must also be considered. Concentrations in waterbodies are affected by the size of the contaminant load lost from land and the amount of water available to dilute that load. Hence, water takes and climate can affect concentrations too.

Concentrations are the relative amount of contaminant present in a given volume of water at that time. Concentrations are important because they have direct relevance to toxicity attributes as well as ecological processes.

This modelling considers draft targets for the following attributes:

Rivers
Periphyton biomass, nitrate toxicity, dissolved reactive phosphorus, visual clarity, suspended sediment, *E. coli*.

Lakes
Total nitrogen, total phosphorus, phytoplankton.

Estuaries
Macroalgae.

This modelling accounts for the loads and concentrations required to achieve target states everywhere for all the above attributes.

Estimated load reductions for the Mataura catchment are given in the table. Load estimates were calculated using sites with ten years of data and relates to 2017.

Contaminant	Total Load (2017 - Best estimate*)	Percentage load reduction required to achieve hauora (Best estimate*)
Total Nitrogen	4,500 Tonnes/Year	↓ 78% (69-85)
Total Phosphorus	163 Tonnes/Year	↓ 74% (59-86)
Sediment	494,000 Tonnes/Year	↓ 35%
E. coli	164 peta *E.coli*/Year	↓ 89% (76-98)

These values represent our best estimate. Levels of uncertainty are indicated by the 90% confidence interval shown in brackets where available.

What options do we have to reduce nutrient and sediment loads?

We have modelled different scenarios to indicate how far each may go toward achieving the required estimated nitrogen load reductions. We have also bundled multiple scenarios to test the effect of combining multiple strategies.

This work is not intended to assess individual properties or activities; rather, it generalises land use so that we can make some broad catchment scale assessments of the impact of different actions. This can also help give information about the differences between possible allocation approaches.

The results for each of the scenarios modelled are presented below. Explanations of each scenario can be found in our published reports. The coloured table cells indicate how far each scenario achieves the required load reductions.

The table above indicates that most of the mitigation scenarios we tested do not achieve the reductions required to support a state of hauora. This outcome is because the reduction in contaminant loss is very large and will likely require more widespread changes to how land is used, rather than maintaining the status quo and relying on implementing mitigations.

We have also modelled phosphorus and suspended sediment load reductions under different mitigation options. These results are not presented here for simplicity, but broadly show:

- None of the modelled scenarios achieved the phosphorus reductions required to achieve hauora. The range of reduction achieved was between 0% and 52%.
- Implementing existing rules and regulations relating to sediment is estimated to achieve a 10% reduction in sediment load in the Mataura. This is less than the required 49% reduction to achieve hauora.

ID	Scenario	Reduction in nitrogen load (%)	Remaining deficit from target (%)
Individual methods			
1	100% adoption of established farm Good Management Practice (GMP) mitigations	7	71
2	Adoption of all established and developing farm mitigations	21	57
3	Wetlands returned to the same area as existed in 1996	1	77
4	Establishment of wetlands in a way that treats all surface runoff from agricultural land	33	45
5	Establishment of large community wetlands in inherently suitable areas	8	70
6	All wastewater point sources are discharged to land rather than directly to water	4	74
7	Reducing land use intensity on flood prone land	1	77
8	Reducing land use intensity on public land	5	73
9	Destocking (10% reduction drystock, 20% reduction dairy)	16	62
10	Riparian planting (full shading of streams <7m wide)	3 (indirect effect on periphyton)	73
Bundled methods			
11	1996 wetlands returned, wastewater discharged to land (3 + 6)	3	75
12	Established and developing farm mitigations, 1996 wetlands, wastewater to land (2 + 3 + 6)	26	52
13	Established and developing farm mitigations, 1996 wetlands, wastewater to land, repurposing public land (2 + 3 + 6 + 8)	31	47
14	Established and developing farm mitigations, 5% wetlands, wastewater to land, repurposing public land (2 + 4 + 6 + 8)	50	28
15	Established and developing farm mitigations, community wetlands, wastewater to land (2 + 5 + 6)	30	28
16	Established farm mitigations, wastewater to land, plantain on dairy farms, 1996 wetlands, repurposing of Environment Southland land, forestry expansion (1 + 6 + 3 + new individual methods)	27	51

Required reductions likely achieved *Within uncertainty range* *Deficit remaining*

Reducing load from pastoral land across the catchment

In addition to the above, we looked at different nitrogen load reduction scenarios for dairy and drystock farms. The purpose of this work was to help show the reductions that could be achieved via reductions in loss from drystock and dairy land.

The table shows the load reduction achieved for each combination of simulated reductions. The coloured table cells indicate how far each combination achieves the required load reductions. For example, we can see that a 40% reduction in loss from dairy farms in combination with a 20% reduction from drystock farms is predicted to result in an approximately 26% reduction in TN load for the whole catchment.

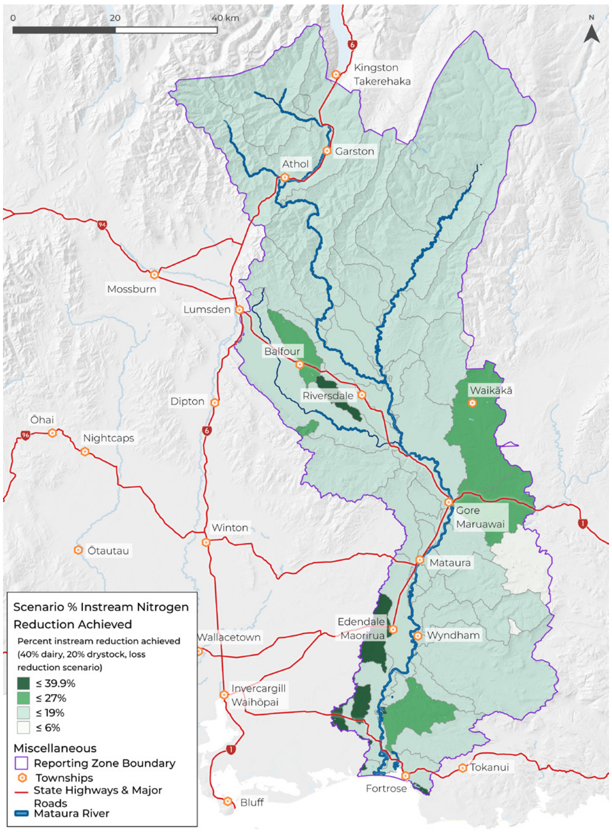
Basin-wide mean % TN reduction, relative to baseline

Drystock loss rate reduction (%) \ Dairy loss rate reduction (%)	0%	20%	40%	60%	80%
80%	41%	49%	57%	64%	72%
60%	31%	39%	46%	54%	62%
40%	21%	28%	36%	44%	51%
20%	10%	18%	26%	33%	41%
0%	0%	8%	15%	23%	31%

Dairy loss rate reduction (%)

Required reductions likely achieved — *Within uncertainty range* — *Deficit remaining*

Instream nitrogen reduction achieved (%)



The map shows how the modelled nitrogen reductions achieved are predicted to vary spatially across the sub-catchments. It highlights that we might expect larger percentage reductions (up to 33%) achieved in some smaller sub-catchments, but the majority of the catchment area achieves a 19% or less reduction under that scenario.

Opportunities for action

We've put together opportunities for action in the Mataura catchment to reduce contaminant loads and improve the state of freshwater.

The catchment

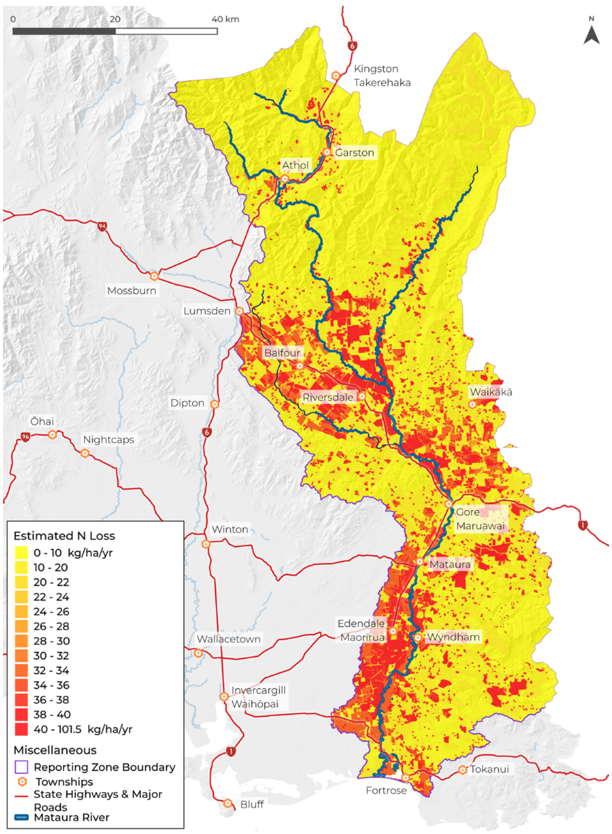
Scale of the problem

The maps below show the spatial distribution of intensive land use and the associated estimated nitrogen loss, the modelled in-stream nitrogen concentrations (using monitoring data), and the modelled excess nitrogen load patterns across the catchment. These maps help to demonstrate the spatial scale of the reductions required. Excess loads depend on the modelled concentrations and all the defined targets locally and downstream. This load excess map indicates the magnitude of nitrogen load reductions to achieve all river and estuary targets for the entire catchment area.

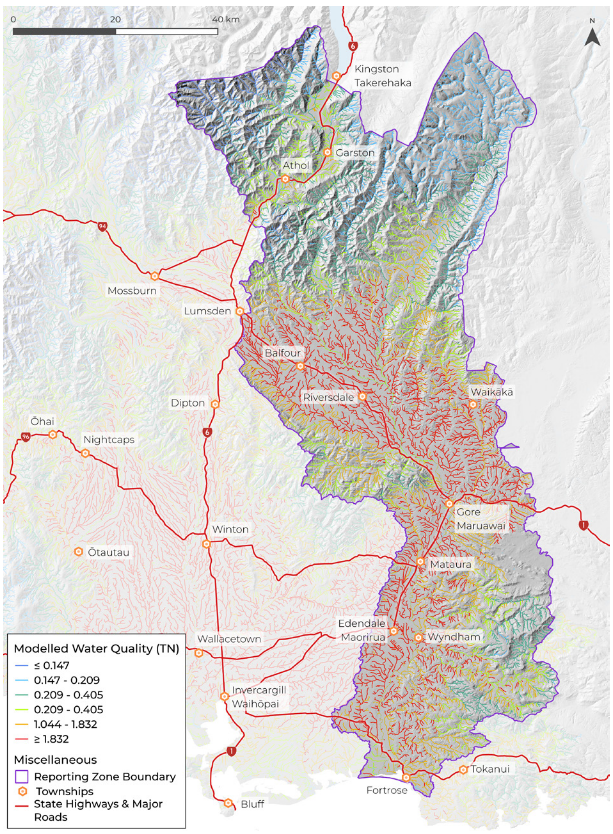
High nitrogen loads may be difficult to mitigate and implementing improved management practices alone is unlikely to achieve the desired outcomes for freshwater and the estuary. Consideration should be given to the potential for large-scale catchment mitigations and changes to how land is used.

Large nitrogen reductions over large spatial areas will likely require changes to land use over a long period. It might be through exploring and adopting different land uses or technological advances in farm systems and management. The hydrology of the catchment has been extensively modified through stream channel straightening and artificial drainage. Efforts to implement nature-based solutions and slow water flow are likely to have multiple benefits for water quality, biodiversity, flood mitigation, and catchment resilience.

Estimated nitrogen loss

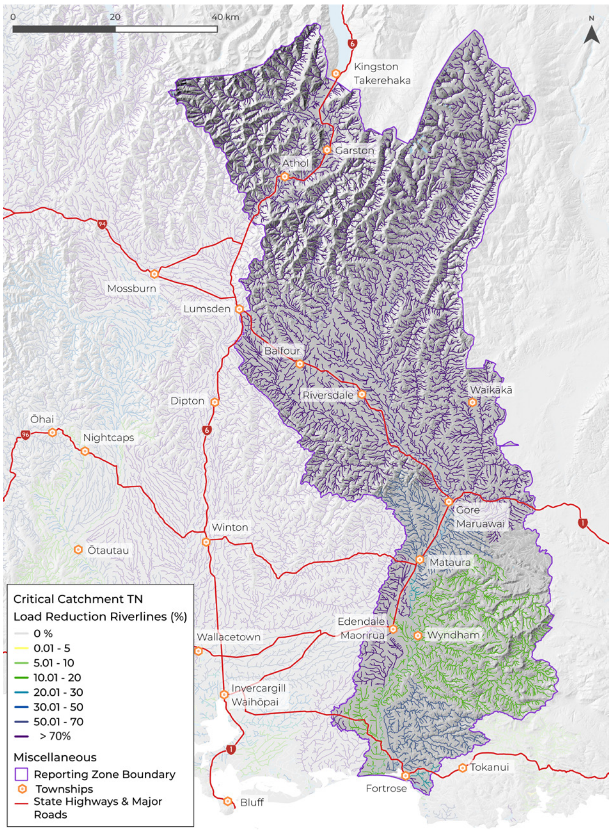


Modelled water quality (Total Nitrogen)

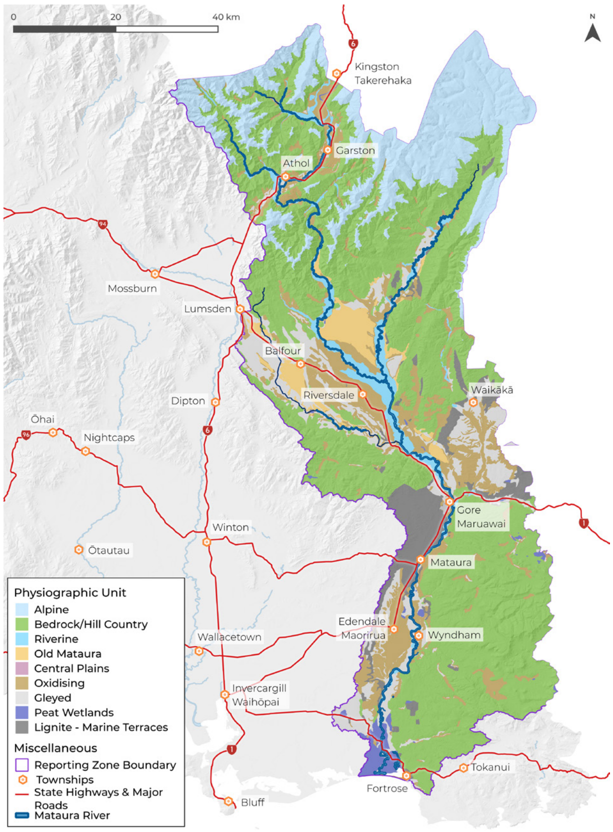


▲ *Nitrogen loss in this graphic is an approximation and is only differentiated by land use, soil drainage, rainfall/irrigation, and slope.*

Critical catchment TN load reduction (%) riverlines



Physiographic zones



Farm scale opportunities for action

Farm scale actions should be tailored to physiographic settings and catchment priorities. In the Mataura catchment, load reductions are required for all major contaminants (nitrogen, phosphorus, sediment, and *E. coli*).

We can use farm scale observations, physiographic information, and our understanding of water quality to help refine the most relevant actions for a given location or landscape.

Physiographic zones help us to understand better how contaminants move through the landscape. Each zone has common attributes that influence water quality, such as climate, topography, geology and soil type.

Physiographic zones differ in how contaminants build up and move through the soil, through areas of groundwater, and into rivers and streams.

Contaminants can move from the land to waterways via:

- overland flow (or surface runoff)
- artificial drainage - e.g. tile drains and mole pipe drainage
- deep drainage (or leaching) - of either nitrogen or phosphorus to groundwater
- lateral drainage (or horizontal movement through the soil) - of phosphorus and microbes

These key transport pathways for contaminants differ for each physiographic zone. Understanding differences between zones allows for the development of targeted land use and management strategies to reduce impacts on water quality.

Widespread implementation of property actions to improve water quality can have significant co-benefits for catchment hydrology (flood risk and climate change resilience) and biodiversity outcomes.

Farm scale or more resolute physiographic information may be available in some locations. We promote using the best information available to identify farm-specific risks and solutions.

The following maps help to identify the most important actions to focus on in different parts of the catchment.

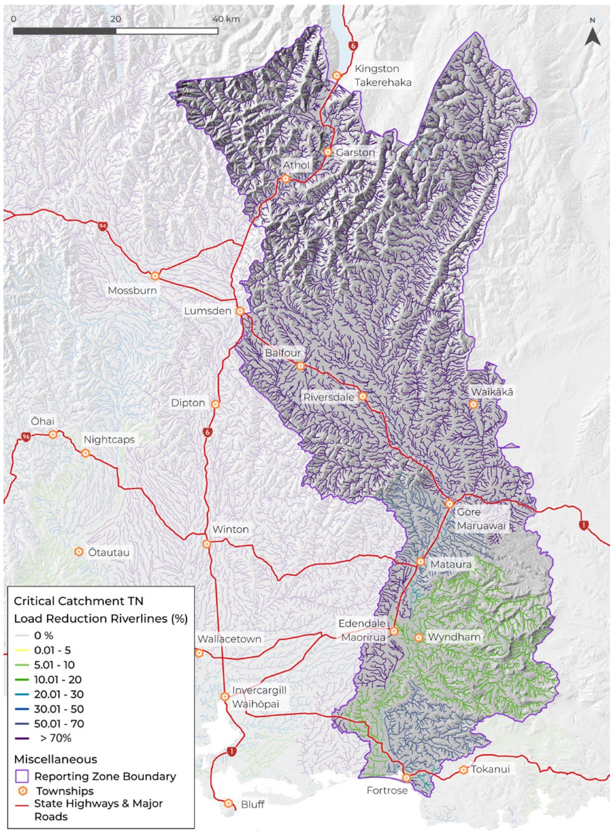
Nitrogen

Over time, reductions are required across the catchment area to achieve hauora targets.

Reducing nitrogen loss should be a priority in all farm-scale mitigation planning.

Determining which mitigations to use will depend on each farm and its circumstances. Physiographic information can help inform what likely contaminant loss pathways need attention in different locations. As shown above, the excess load map indicates where nitrogen loss mitigation should be a particular focus in farm planning. This map indicates the magnitude of nitrogen load reductions needed to achieve all river and estuary targets for the entire catchment area.

Critical Catchment TN Load Reduction (%) Riverlines



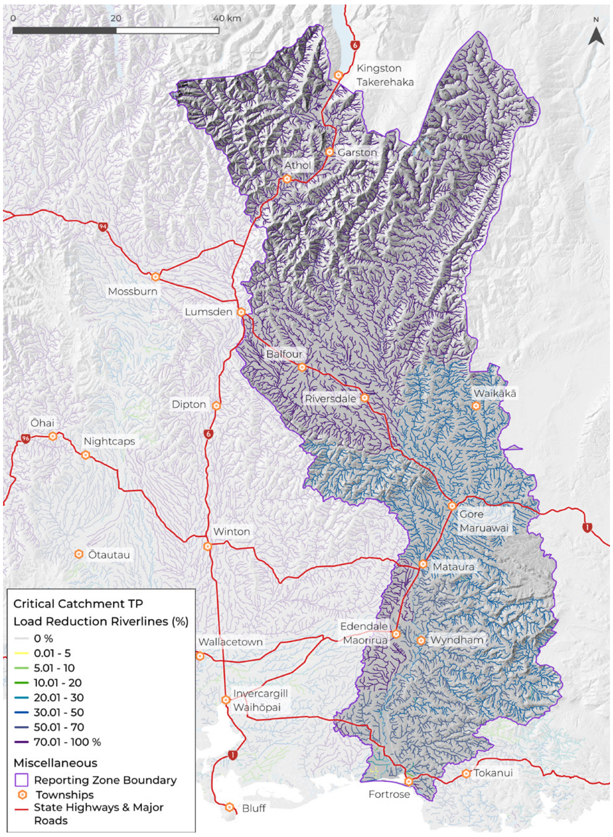
Phosphorus

Over time, reductions are required across the catchment area to achieve hauora targets.

Reducing phosphorus loss should be a priority in all farm-scale mitigation planning.

Determining which mitigations to use will depend on each farm and its circumstances. Physiographic information can help inform what likely contaminant loss pathways need attention in different locations. The excess load map shown here indicates where phosphorus loss mitigation should be a particular focus in farm planning.

Critical Excess TP Load (%)



Sediment

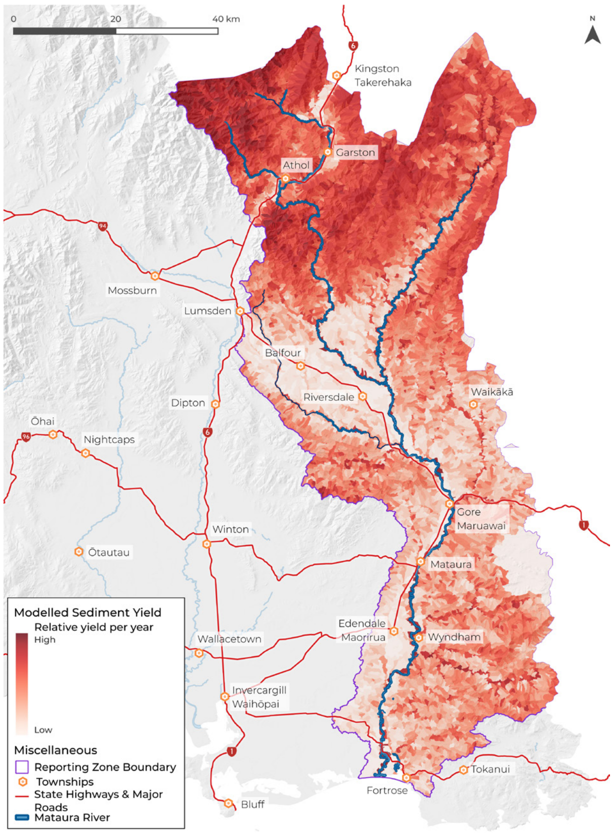
The map (right) shows how we expect sediment loss to vary throughout the catchment.

Some areas of high sediment loss in the upper catchments are associated with natural erosion. Sediment from natural erosion generally impacts waterways less than agricultural land sediment. Agricultural sediments are usually finer and carry higher concentrations of nutrients.

Areas of higher sediment loss rates are shaded darker red in the map. These are generally areas with more sloping land, soils susceptible to erosion, and where stream bank erosion is likely an issue.

Properties within the shaded, darker red areas should specifically look for opportunities and mitigations to reduce sediment loss.

Modelled Sediment Yield



E. coli

The risk of *E. coli* loss to water depends on landscape type, slope, stock and vegetation. Property scale assessments should be used to mitigate the highest risk loss pathways on farms.

Catchment scale actions

Mitigations or actions must occur across the entire catchment to address the magnitude of change required.

Consider opportunities to facilitate land use change that reduces environmental impact or encourages deintensification over time. This may be through developing long-term catchment plans and catchment projects, pilots and promotion of alternative land use options, or implementation of regulation.

Catchment-scale actions could include:

- implementation of a mechanism to generate and allocate funding for environmental enhancement and/or transformation within the catchment,
- restoration or creation of wetlands,
- removal of fish passage barriers,
- the widespread establishment of riparian shading,
- habitat retention and enhancement,
- large-scale adoption of methods to retain water in the landscape,
- adoption of a holistic approach to river and drain management,
- edge-of-field mitigations.

Toetoes (Fortrose) Estuary – opportunities for action

Overall, the estuary is in moderate ecological health, and specific areas in the upper reaches are starting to see stronger signs of degradation. Pathogens, sediment, and nutrients are the main drivers of declining ecosystem health. Attributes associated with risks to human health, as measured by pathogens, are much worse.

- Targeted estuary restoration of marginal vegetation, such as herbfields, and wetlands, such as saltmarshes and salt tolerant shrub banks.
- Removal of nuisance macroalgae from areas of new growth, areas where macroalgae is causing increased mud deposition near seagrass beds or marshlands and the fringes of current sediment deposition zones.

Active restoration techniques like sediment and macroalgae removal will only improve long-term conditions if contaminant inputs to the estuary can be reduced significantly.

Groundwater – opportunities for action

Areas of highly contaminated groundwater will likely require targeted nitrogen action via management and changes in farm systems. Areas within the Oxidising, Old Mataura and Riverine physiographic zones that are also shaded yellow and red in the physiographic map shown previously are likely high-risk areas. In these locations, landowners should implement management plans focusing on key pathways and the stockpile of property scale actions that target nitrogen loss via deep drainage.

E. coli contamination of groundwater and groundwater drinking supplies is widespread across the Mataura catchment.

Actions to reduce E.coli in groundwater:

- Ensure good well-head protection is in place for all bores, especially bores used for drinking water.
- Carefully consider the proximity of contamination point sources to bores. These can be things like septic tanks, stock sheds and effluent storage.
- Carefully consider effluent application on freely draining soils or soils with a high likelihood of bypass flow (cracks or conduits that may allow effluent to flow directly to groundwater).

Urban and industrial opportunities for action

The Mataura Catchment has numerous point source discharges that contribute to the contaminant loads in the river. Examples of stormwater and wastewater discharges include Balfour, Riversdale, Waikaka, Gore, Mataura, Edendale-Wyndham, and Gorge Road. Examples of industrial discharges are Mataura Valley Milk, Silver Fern Farms Waitane, Alliance Mataura, Daiken Southland and Fonterra Edendale.

Industrial and municipal point source discharges are estimated to account for approximately 5% of the total nitrogen load and 16% of the total phosphorus load in the catchment.

Actions taken to reduce these loads as much as possible by improving treatment or avoiding discharge to water should be considered.

- Removal/improvement of wastewater and stormwater discharges.
- Ensure wastewater and stormwater are not cross-connected in municipal systems.
- Target improvements to on-site wastewater disposal systems to reduce the risk of human faecal contamination of freshwater.
- Urban development incorporates best-practice stormwater management methods.

Published by:
Environment Southland, 2024