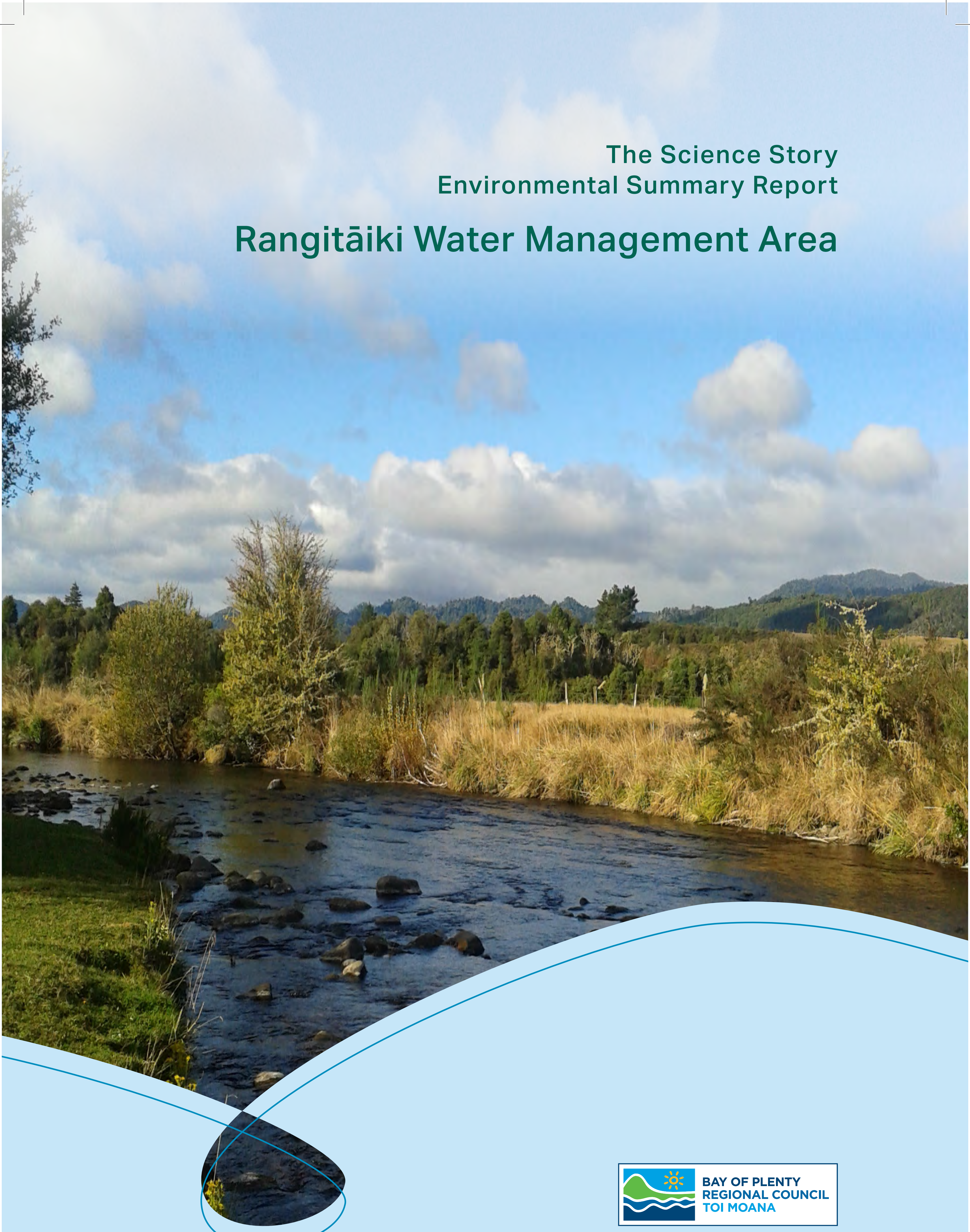
The Science Story
Environmental Summary Report

Rangitāiki Water Management Area



BAY OF PLENTY
REGIONAL COUNCIL
TOI MOANA

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This report was prepared by Stephanie Brown
WSP Opus - June 2018

The Bay of Plenty Regional Council is implementing the National Policy Statement for Freshwater Management (NPS-FM) by working progressively in priority catchment areas – called Water Management Areas (WMA). The Rangitāiki WMA is one of the region's nine WMAs where the Regional Council is working with community groups to implement the NPS-FM.

This report summarises our science information on current state and trends of water quality, quantity, and freshwater ecosystems in the Rangitāiki WMA. Detailed information on which this summary is based can be found in the reports in the reference list.

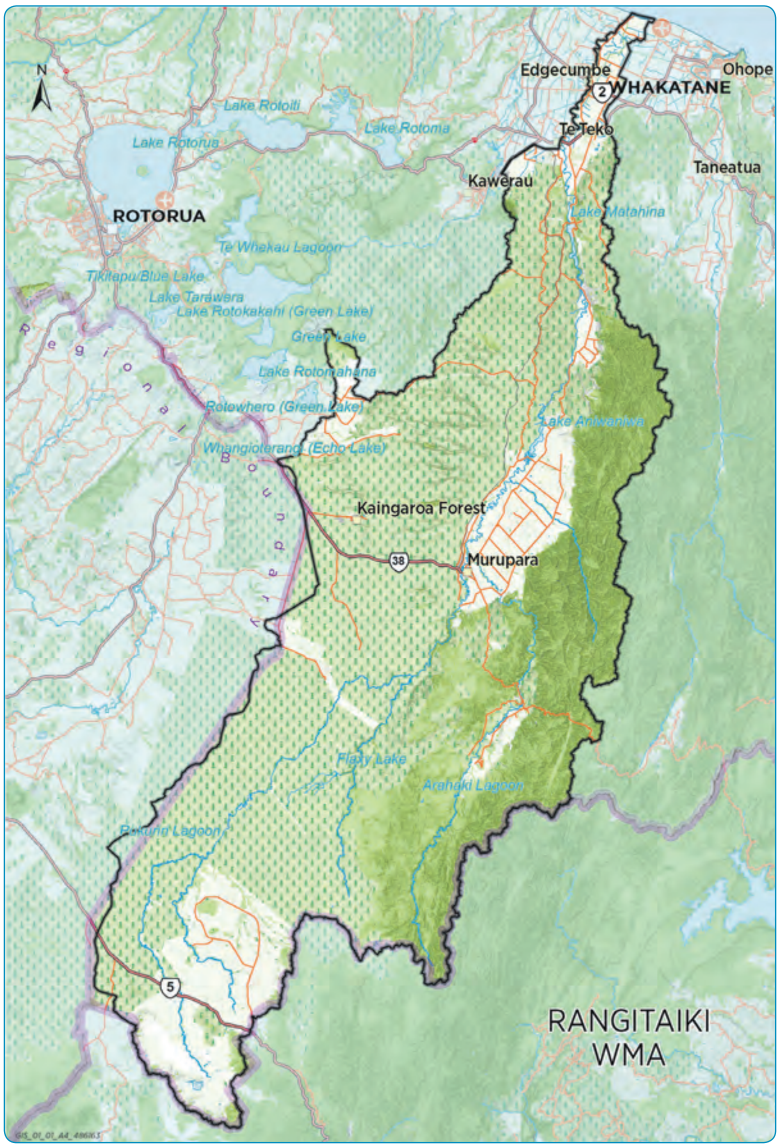
PART A

Catchment Description

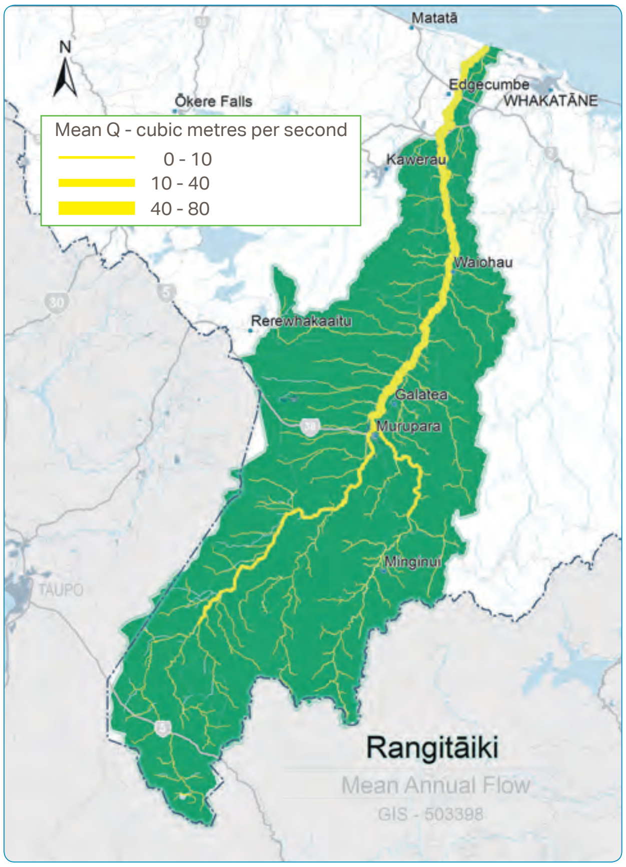
The Rangitāiki WMA is based on the Rangitāiki River catchment. The river flows north from the Kaimanawa Ranges and discharges to the coast near Thornton at the Rangitāiki River Estuary. The river originally discharged via two outlets: the Old Rangitāiki Channel to the Tarawera River in the west, and the Orini Canal in the east. The Thornton cut was put through in 1913 as part of drainage works on the Rangitāiki Plains.

The Rangitāiki River is the longest river in the Bay of Plenty, and at 2,947 km² is also the largest catchment with approximately 4,400 km of waterways. A number of large tributaries such as the Wheao, Whirinaki and Horomanga Rivers join the Rangitāiki in the upper half of its catchment.

Ten different iwi groups have interests in the WMA. The catchment is subject to the Rangitāiki River Forum, which is a co-governance entity for the river. The purpose of the forum is the protection and enhancement of the environmental, cultural, and spiritual health and wellbeing of the Rangitāiki River and its resources for the benefit of present and future generations.



Physical extent of the Rangitāiki WMA.



The map shows the modelled mean (average) discharge from the different rivers and streams.

There are three main tributaries:

- **Horomanga River** - flows from the Ikawhenua Ranges across the Galatea Plains and into the Rangitāiki River.
- **Wheao** - an upper tributary of the Rangitāiki River, it flows predominantly north through the Kaingaroa Forest to reach the Rangitāiki south of Murupara.
- **Whirinaki River –** a large tributary of the Rangitāiki River which flows out of the Whirinaki Forest park, through Minginui and Te Whaiti area and out onto the Galatea Plains near Murupara.

Approx. 4,500 km of waterways

The catchment includes the Wheao, Whirinaki and Horomanga rivers. At **155 km** in length, the Rangitāiki River is the longest river in the region.

At **2987 km²** in area, the Rangitāiki is the single largest catchment in the region

Major sectors include

Exotic Forestry · Farms · Recreation · Three hydro systems

Special features include

Tuna (eel) · White bait · Ecology · Heritage · Whirinaki Forest

6,560 residents · **More than 20 hapū**

Lakes and hydro schemes

Three hydroelectric power schemes occur in the catchment. In the upper catchment, the Wheao Power Scheme diverts water from the Rangitāiki River, the Wheao River and Flaxy Creek through a series of constructed canals leading to the power house, where it discharges back into the Wheao. This scheme was constructed in 1982.

Midway down the catchment is the second hydro-scheme, where the Rangitāiki River was dammed above the Aniwhenua Falls. The Aniwhenua Scheme was completed in 1979 and formed Lake Āniwaniwa (Aniwhenua) behind the Aniwhenua Dam. This is a relatively shallow lake with an area of 2.1 km². It is a valued recreational resource, especially for water skiing and fishing.

The Matahina Dam is the lowermost hydro-scheme on the river, approximately 20 km from the coast, behind which is Lake Matahina. This scheme was commissioned in 1967, and at 86 m, is the highest earth dam in the North Island. Lake Matahina is much deeper than Lake Aniwaniwa, but has a similar area (2.5 km²).

At the head of the catchment is Lake Pouarua which is located on private property in Lochinvar Station.

Soil

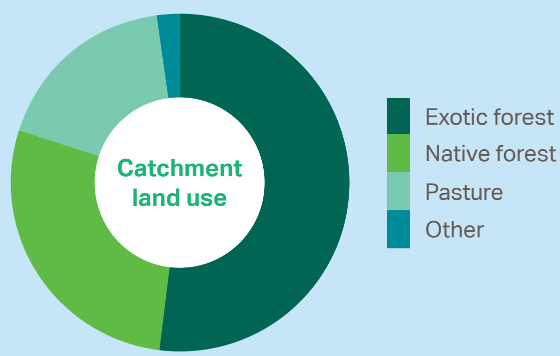
Geology, land use and soils influence water quality and quantity. The geology within the catchment is typical of the wider Bay of Plenty region with large areas of ignimbrite created by tephra flow events thousands of years ago.

Eighty-five percent of the Rangitāiki catchment is made up of pumice soils formed by flows of hot gas and rock from the many volcanic centres in the region. Higher rainfall and the presence of podocarp forests have led to the development of podzolised soils (low fertility and extreme acidity) in Te Urewera sections of the catchment. Low lying areas to the north of the catchment are characterised by poorly drained gley soils. These soils tend to hold water more frequently which results in distinctive greying of the soil with mottles often appearing.

Land use

Approximately 80% of the Rangitāiki WMA is currently in forestry, either plantation (55%) or indigenous (25%) and only 15% of the catchment is in highly productive grassland. There are a very small proportion of urban areas in the Rangitāiki WMA (less than 0.05%). One risk for water quality in the catchment, is the potential for conversion from forestry to more intensive landuse.

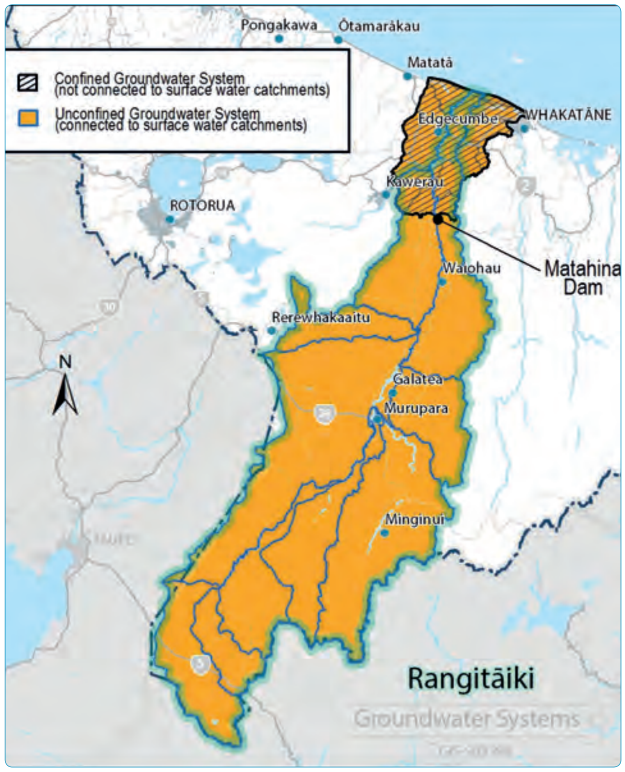
Rangitāiki catchment



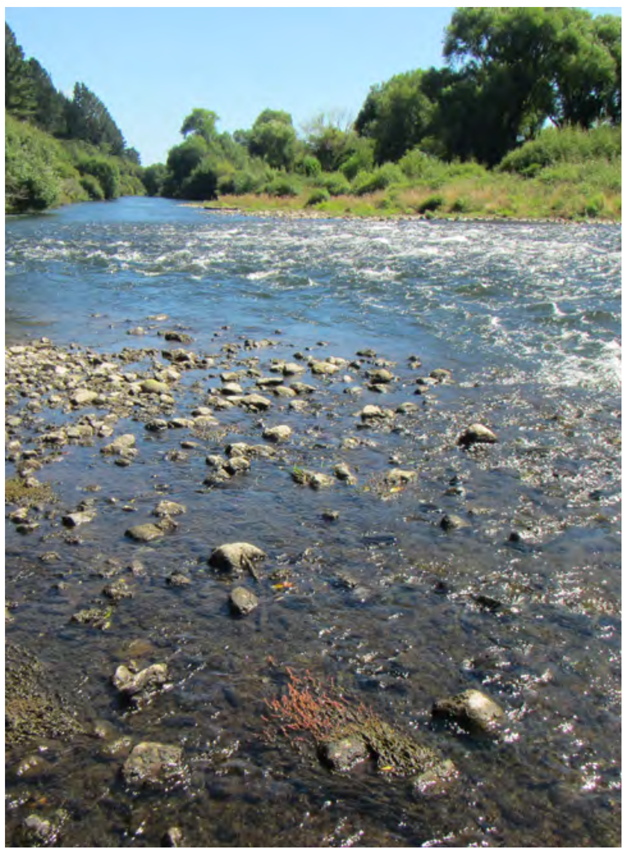
Groundwater

Groundwater is found underground in cracks and spaces in soil, sand and rock. It is stored in, and moves slowly through geological formations, which are called aquifers.

In the Rangitāiki catchment, interim thresholds for groundwater allocation are set in Proposed Plan Change 9 to the Regional Natural Resources Plan (PC9). The interim thresholds are based on a simple water balance model using surface water catchment boundaries to define groundwater management zones (see map). On the plains the groundwater systems extend beneath the Tarawera and Whakatāne-Waimana catchments (shown as black cross-hatch on map), that border the Rangitāiki WMA. There are two different water balance models within the Rangitāiki WMA; the Upper (above Matahina Dam) and Rangitāiki Plains area (below the Matahina Dam that includes the plains areas of the Tarawera and Whakatane - Waimana WMA).



The geological systems can be described as unconfined, semi-confined or confined. Unconfined aquifers are those in which water seeps from the ground surface directly above the aquifer. The water in the aquifer is not under pressure. Unconfined groundwater systems are hydraulically connected to each other and to surface water bodies. They may gain and lose water from surface water bodies that they are connected to. This means that the water (and mainly water soluble contaminants) can flow between aquifers and surface water bodies. Confined aquifers are those in which an impermeable layer exists that prevents water seeping into the aquifer from the ground surface located directly above. Water seeps into the aquifer from some distance away. The water in a confined aquifer is under pressure.



Some groundwater systems are unconfined in one area (e.g. recharge areas) and confined in another area, where they are deeper and overlain by other geological units. The groundwater systems of the Upper Rangitāiki WMA are predominantly unconfined aquifers. The plains groundwater systems consist of both confined and unconfined aquifers, which are hydraulically connected to surface water.

Groundwater in the Rangitāiki Plains is extracted for agricultural, commercial and municipal uses.

Wetlands

The Rangitāiki Plains are typical of lowland areas throughout New Zealand. Prior to European settlement, these areas were dominated by natural wetlands, meandering streams, and larger rivers. These waterways would have supported a unique assemblage of birds, fish, invertebrates, and plants that were adapted to these environments. As with most wetlands, they were highly productive and would have been valued by Māori for their multiple values.

Freshwater wetlands can be classified into types (e.g. swamp, marsh, fen) according to water and nutrient regimes and substrate characteristics.

A **FEN** is a wetland with mostly peat substrate that receives inputs of groundwater and nutrients from adjacent mineral soils. It has low to moderate acidity and oligotrophic (low) to mesotrophic (medium) nutrient inputs.

A **SWAMP** is a wetland located on peatland or mineral soils that has a moderate flow of surface water and/or groundwater. The water table is generally above ground, giving characteristic open water areas and permanent wetness. Swamps have moderate to high nutrient levels.

Image - By Rudolph89 - Creative Commons from Wikimedia Commons

A **MARSH** is a wetland located on mineral soils with a slow to moderate flow of surface water and groundwater. Drainage is better than in swamps, and the water table is usually just at or below the surface of the ground. Marsh wetlands are subject to high fluctuations of the water table. They experience temporary wetness and dryness throughout the year. Nutrient levels are generally high.

Image - By Phillip Capper - Creative Commons from Wikimedia Commons

SHALLOW WATER wetlands are characterised by the presence of open standing water, generally less than a few metres deep. They include the margins of lakes, rivers and estuary waters.

The majority of wetlands in the Rangitāiki WMA have been lost due to land drainage and reclamation for agricultural development.

There are only 44 wetlands remaining in the Rangitāiki WMA, covering only 930 ha.

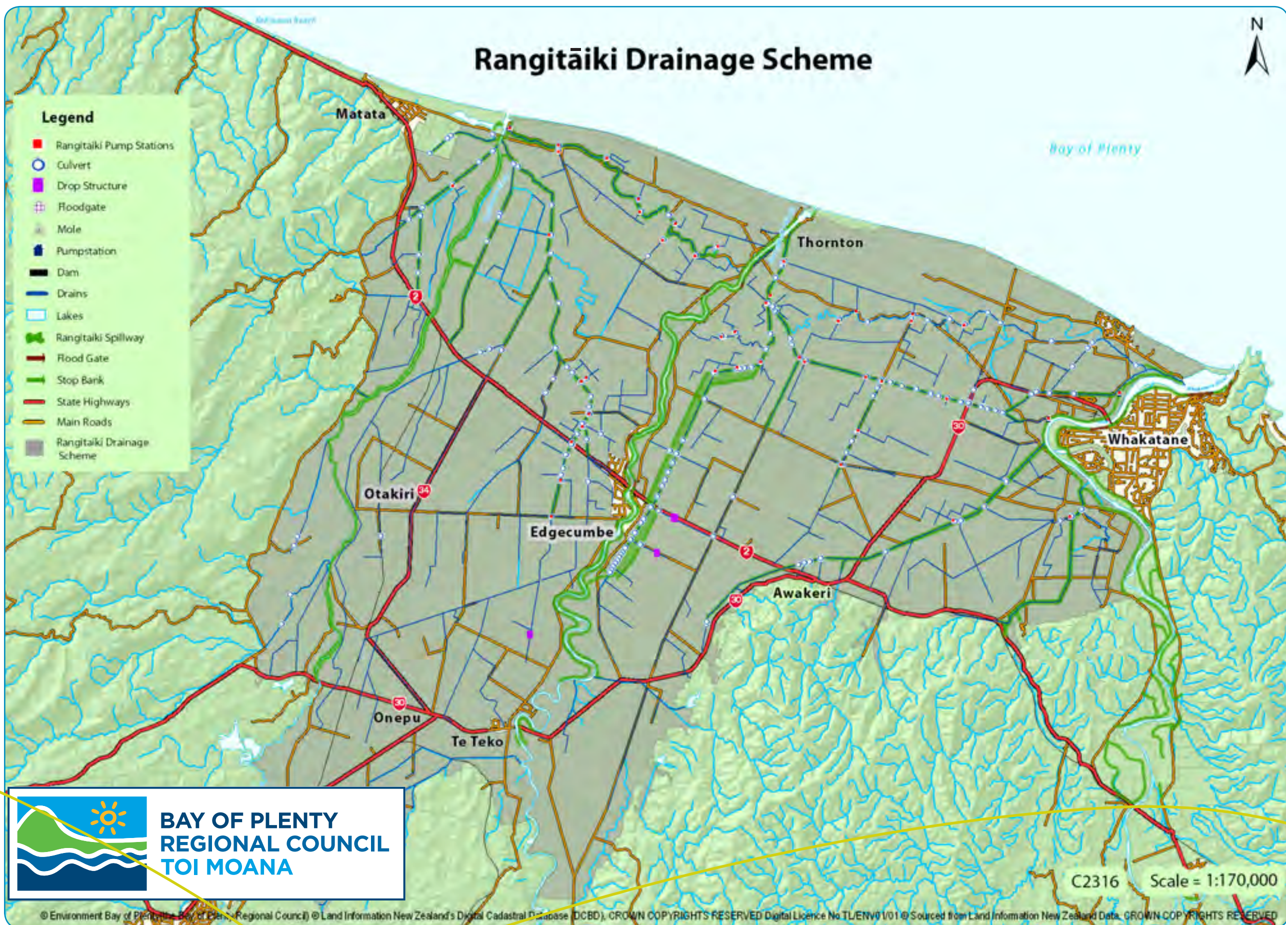
WETLAND TYPE	HISTORIC AREA (ha)	REMAINING AREA (ha)	% REMAINING
Fen	556	215	39
Marsh	757	134	18
Shallow water	-	19	-
Swamp	2676	562	21
Total	3989	930	23%

Drains and land drainage canals

Following European settlement, wetlands throughout New Zealand were seen as an impediment to agricultural development, and so early settlers commenced an ambitious programme to drain these waterlogged areas. In 1913 the Rangitāiki River was diverted from the Old Rangitāiki Channel and Orini Channel directly to the sea at Thornton. Construction of a large network of canals, including the Te Rahu, Kopeopeo, Awaiti – Omeheu, and Awakaponga canals occurred in the 1910s and 1920s.

The Rangitāiki Plains occupies an area of 335 km² with a total of 513 km of waterways, of which only 81 km are natural rivers – the mainstems of the Rangitāiki, Tarawera, and Whakatāne Rivers. However, even these natural rivers have been extensively modified; stop banks constrain the river to minimise potential flood damage to surrounding properties. The other 432 km of waterway length in the Rangitāiki Plains (84%) are represented by the large and small man-made drains.

The Rangitāiki Drainage Scheme provides drainage to much of the Rangitāiki Plains, an area of approximately 29,000 hectares between Matata, Whakatāne and Kawerau. It has 88 km of major canals, 240 km of drains and one pump station in place to enable productive use of the land for low-lying landowners within the scheme service area.



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PART B

State and Trends

Soil

Soils are monitored by the Regional Council at 14 sites over a range of land uses in the Rangitāiki WMA on a three, five or ten yearly cycle (depending on land use). The small number of soil monitoring sites and limited sampling makes it difficult to draw any conclusive trends specific to the Rangitāiki WMA so the information presented here relates to soil monitoring findings across the region.

What we know:

Trace elements (eg. cadmium, copper, zinc) have been included in the Regional Council's regional monitoring programme since 2010. They were included as a result of concern regarding the potential risk of contaminant accumulation associated with land use practices such as fertiliser application and disease control.

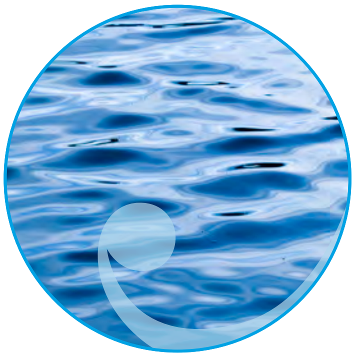
For the land uses monitored, many of the topsoil trace element concentrations are within environmental guideline values. For dairy pasture sites, increasing concentrations of cadmium and zinc were recorded over a 10-year period (1999-2009) but these increases were not statistically significant.

The Regional Council's 2015 monitoring shows that the average concentration of cadmium on dairy sites was 0.87 mg/kg. Concentrations of the element are approaching the recommended safe maximum level guideline adopted in New Zealand of 1 mg/kg. Almost one third of the sites monitored exceeded the guideline value in 2014. Land managers need to be aware of the accumulation of elements such as cadmium, and carefully manage the application of such fertilisers in the future.

Topsoil trace element concentrations were generally higher in agricultural land uses than background concentrations in indigenous forest sites. This suggests that soil land management practices are adding detectable quantities of trace elements to soils.

Soil nutrient levels (nitrogen and phosphorus) at monitored sites are high to excessive, due to application rates greater than can be used by plants. These excess nutrients in soil increase the risk of increased nutrient levels in receiving waters. Mean Olsen P (phosphorous) values on dairy farms have been increasing consistently, and in 2014 were 99.8 mg/kg compared with approximately 70 mg/kg in 1999. Both these values are higher than guideline values for volcanic soils (25-40 mg/kg). Kiwifruit, sheep/beef and deer sites have shown steady increases in Olsen P measurements.

Nitrogen is also increasing steadily in dairy soils. The amount of nitrogen available for leaching (AMN - anaerobically mineralisable nitrogen) and total nitrogen are close to reaching the upper limits of optimal farm production (pasture productivity). The upper limit of pasture productivity is where the benefit to pasture growth diminishes and the risk to the environment increases. Not only does excess fertility lead to land managers making an economic loss, it also increases the risk of contamination or eutrophication (excess nutrient levels) in nearby water bodies.



Freshwater

Water quantity

The Regional Council collects continuous river level information from gauging sites throughout the Rangitāiki WMA. River levels and flows are monitored for a number of reasons, including monitoring high flows for flood forecasting, and monitoring low flows to help set minimum flows for water allocation purposes. Part of the Regional Council's responsibilities include setting minimum flow and allocation limits in rivers subject to abstraction.

There are 121 resource consents in the catchment in place that allow for the take and use of water from ground or surface waterbodies. The consents are for a variety of uses, including town supply, irrigation (for both pasture and horticulture and dairy shed use).

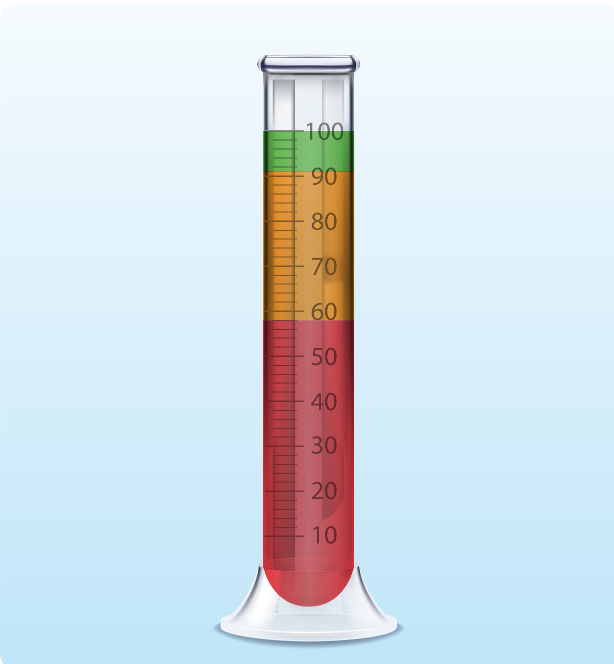
Given the importance of stream flows to ecological communities, and the fact that it is impossible to monitor flows in all waterways throughout the WMA, hydrological models can be used to predict stream flows. The Regional Council is currently working with experts to develop hydrological models.

Surface water

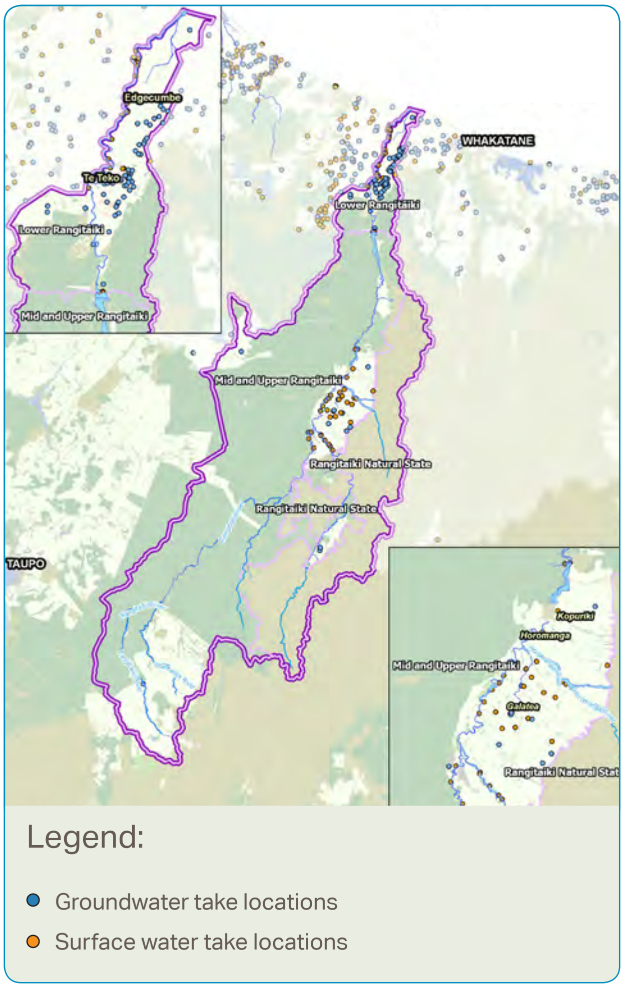
To minimise the chance of adverse environmental effects by abstracting too much water, region-wide default thresholds have been developed. These allow for the abstraction of 10% of a river's five-year seven-day mean annual low flow (Q_5 7-day). The Q_5 7-day flow is the seven day low flow value which has a 20% probability of occurring in any one year. Minimum flows have been set at 90% of Q_5 7-day - this is the flow at which water use restrictions are necessary. These region-wide thresholds will be replaced with more catchment-specific limits in the future, based primarily on more detailed estimates of effects on fish habitat and ecology. The exception to this is where a different minimum flow has been set for a specific activity via a resource consent, such as the minimum flows set in relation to Matahina Dam operations.

The total volume of water allocated to water users through resource consents has reached or exceeded the regional default thresholds for most of the Rangitāiki WMA's rivers and streams (as set in Proposed Plan Change 9 to the Regional Natural Resources Plan – PC9). However, we don't know exactly how much water all consent holders are actually using, as the requirement for water metering has not been universal, and there has not always been a requirement for consent holders to report water usage.

Water is also being taken by individuals for their domestic and stock drinking water needs, or for activities that are permitted by the Regional Natural Resources Plan. No resource consent is required for those permitted uses.



Surface water availability for streams in the WMA with resource consents to take water as at October 2016. Colour coding: percentage of streams where allocation exceeds interim allocation thresholds (red), allocation still available (green) and insufficient flow record information (orange).



Water take consent locations.

Groundwater

There are 11 groundwater level and water quality monitoring sites that form part of the regular monitoring programme however, they do not provide good representative coverage of the entire WMA.

What we know:

High groundwater use occurs on the plains.

In the unconfined systems groundwater supports the flow of many streams and rivers within the Rangitāiki WMA so abstraction from groundwater has the potential to reduce surface water flow and increase the risk of saline intrusion.

From monitoring data:

- Declining groundwater levels have been recorded on the plains (at Bore 2060 which is 60 m deep). There is an overall declining water level trend of 0.02 m/year (0.5 m drop over a 23 year period). However, this comprehensive record also shows decline and recovery cycles between 1989-1995, 1998-2004, 2004-2011.
- Bore 2509 (319 m deep) intercepts the Matahina Formation and older volcanics on the plains. A groundwater level decline occurred from 2004 to 2010, with a rise in groundwater levels in 2011. There is an overall declining water level trend of 0.3 m/year.

These water level declines were localised and not widespread over the entire aquifer system.

Allocation status

Region-wide interim thresholds for groundwater allocation are set in PC9 and have been calculated based on surface water catchment boundaries (to defined groundwater management zones) and a simple water balance model. The simple water balance model is based on limited information and has greater uncertainty associated with it compared to more complex groundwater models. Simple water balance calculations were undertaken to estimate the amount of groundwater recharge in each of the groundwater management zones. Groundwater recharge is the proportion of rainfall that infiltrates into the ground to replenish the aquifer. The calculations were based on rainfall minus actual evapotranspiration. An estimate of groundwater outflow to surface water discharging as 'base-flow' to streams was also subtracted. A proportion of the remaining balance was used to determine the groundwater resource available for allocation (allocable flow).

Based on 2016 data water allocation exceeds interim allocation thresholds in the Mangamako area, Nursey Drain, Rangitāiki Dunes and Waikowhewhe area groundwater catchment / management zones.

	GROUNDWATER CATCHMENT (MANAGEMENT ZONE)	ALLOCATION STATUS
Lower Rangitāiki	Edgecumbe Catchwater	
	Mangamako area	
	Ngakauroa Stream	
	Nursery Drain	
	Rangitāiki Dunes	
	Reids Central Canal	
	Waikowhewhe area	
Mid - Upper Rangitāiki	Headwaters	
	Kāingaroa South	
	Galatea Plains	
	Minginui	
	Kāingaroa North	
	Pokairoa	
	Waiohau Basin	
	Matahina	
	Ikawhenua	

Groundwater allocation compared to allocable flow. Colour coding – exceeds interim thresholds (red), does not exceed interim thresholds (green) and is an area where base-flow to surface water is greater than groundwater recharge area (no allocation available) (orange).

NOTE: Data used to determine allocation status is based on 2016 information.

Groundwater quality

Groundwater

There are two key indicators of groundwater contamination:

Nitrate - Nitrate is an indicator of groundwater contamination arising primarily from land use intensification and is monitored for both health and environmental reasons. From an environmental perspective, nitrate is a good indicator of general groundwater degradation as elevated levels often indicate the potential of other pollutants from human activities. Groundwater that is rich in nitrate has the potential to elevate nitrate levels in the surface water it is connected to. The drinking water standard Maximum Acceptable Value (MAV) for nitrate-nitrogen is 11.3 mg/L.

E. coli - Faecal indicator bacteria such as *E. coli*, Enterococci or faecal coliforms are an indicator of contamination from animal or human faeces and is monitored primarily for human health reasons. Bacteria contamination can occur as a result of effluent disposal, including overflows or leaks from on-site wastewater system such as septic tanks, and poor bore-head protection (allowing runoff from land, animals, general debris and other sources of contamination to get into the bore). For untreated drinking water supplies *E. coli* counts should be less than 1 cfu/100 mL.

Not enough data has been collected to date to be able to assess groundwater quality trends within this WMA.

What we know

Groundwater quality in the region generally does not appear to be changing over time. Trend analysis found relatively few variables having statistically significant changes over time. However, this can be due to the limited frequency of sampling, total number of samples and data gaps which can inhibit the ability to identify trends.

From monitoring data:

- Two groundwater quality monitoring sites (Bores 49 at 36 m deep, 466 at 16.8 m deep) show levels of Ammoniacal-Nitrogen (NH_4-N) that are above the drinking water standards.
- Two groundwater quality monitoring bores have recorded median bacteria levels (Enterococci and/or faecal coliforms) above the drinking water standard of 1 cfu/100 mL.

Surface water quality

Surface water quality in this section refers to the physical and chemical properties of flowing fresh water (e.g. temperature, dissolved oxygen, water clarity). The indicator bacteria *E. coli* is also included as an indicator of bacterial contamination in the waterway.

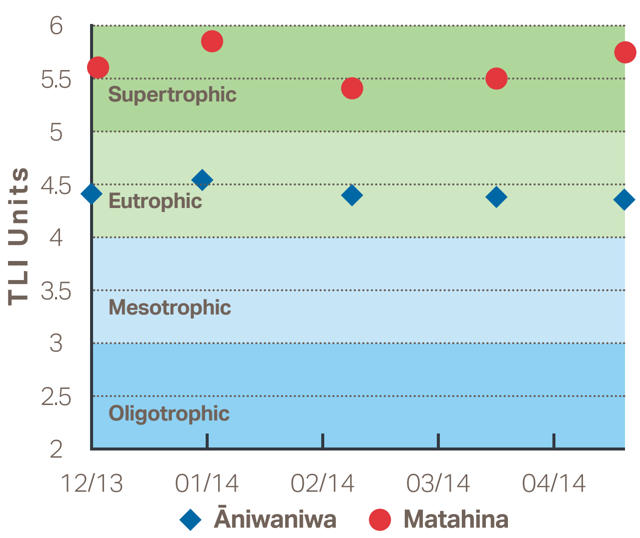
Water quality is impacted by many natural factors (e.g. climate, geology) and anthropogenic (human) factors (e.g. land use change, point-source discharges). Water quality in a river or stream can impact the ability of a waterway to support healthy aquatic ecosystems and community values such as swimming.

Lakes

As the river flows into both Lakes Āniwaniwa (Anawhenua) and Matahina, they are both considered receiving environments. These receiving environments often act like sinks, whereby contaminants delivered into the lakes by the river can accumulate over time. As water is released from the lakes back into the river, the quality of the water released from the lakes has an impact on the river downstream.

Lake health is described by using the trophic level index (TLI). TLI is calculated using total nitrogen, total phosphorous, water clarity, and chlorophyll-a (the pigment in algae). TLI results show that both lakes are nutrient-enriched, and that Lake Āniwaniwa (Anawhenua) is classed as eutrophic (poor water quality) and Lake Matahina is classed as supertrophic (very poor quality). These lakes often have unsightly scums of algae and floating plants on the water surface, which can lead to decreased animal and plant diversity, and affect recreation.

No monitoring is undertaken on Lake Pouarua.



Trophic level index.

Rivers and streams

There are seven sites in the Rangitāiki WMA that are regularly monitored for water quality physical attributes (temperature, dissolved oxygen, water clarity, turbidity and suspended solids), chemical attributes (nitrogen and phosphorus) and microbiology *(E. coli)*. Note that not all parameters are measured at all sites.

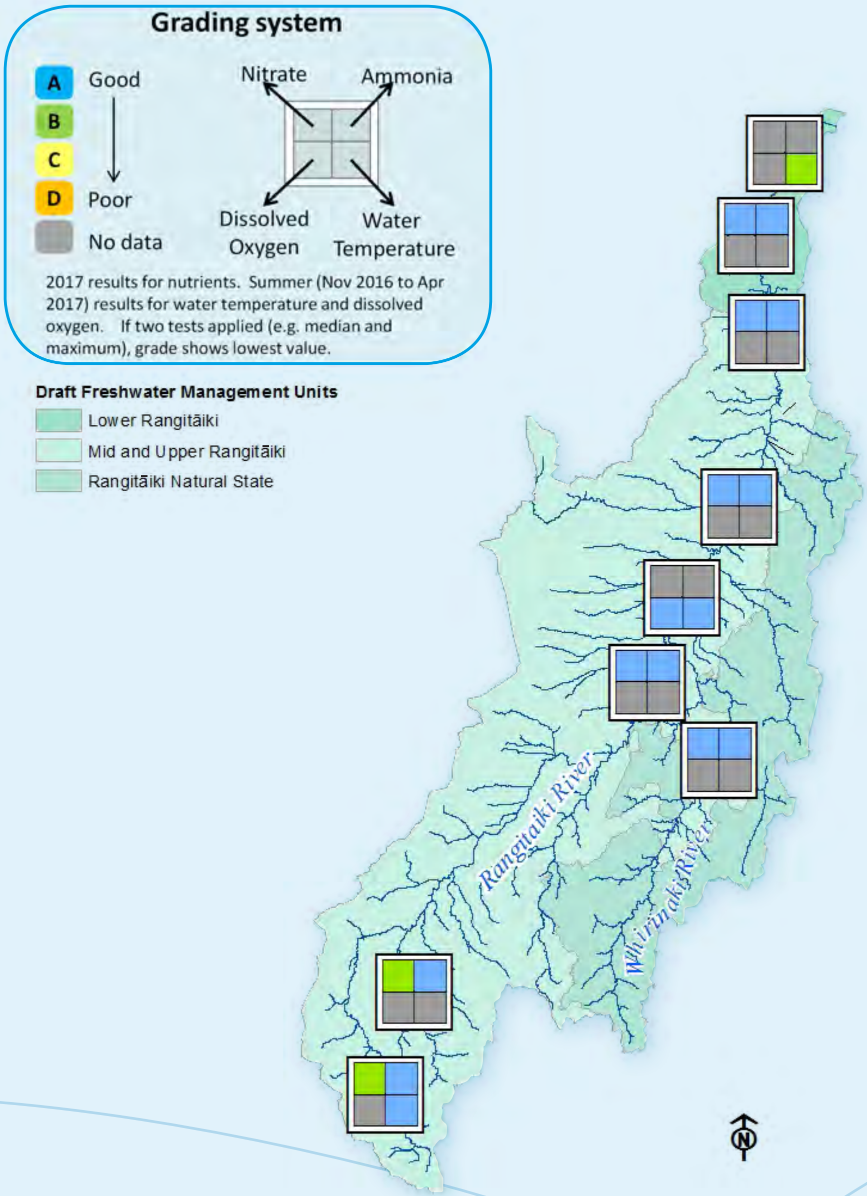
The NPS-FM sets compulsory national values for freshwater to protect 'human health for recreation' and 'ecosystem health'. It includes a series of 'bands' ranging from A to D, and National Bottom Lines for nitrate and ammonia (to protect ecosystem health), and *E. coli* and cyanobacteria (to protect human health for recreation) in rivers. Communities can choose to set levels stricter than those specified in the NPS-FM.

All of the sites monitored in these catchments in 2017 had nitrate and ammonia levels that were within the 'A' or 'B' band for both. This means that current levels of nitrate and ammonia in the water are unlikely to have an impact on sensitive species.

There are two river sites in the Rangitāiki WMA that are monitored for swimability. These are at Te Teko and the Thornton boat ramp. Both sites are graded 'A' meaning they are swimmable under the NPS-FM grading system. In 2017/2018 the river was also monitored at Matahina and Murupara where they were graded A.

To protect ecosystem health:

- Nitrate
- Ammonia



Water quality monitoring results

Trends

While water quality state provides a snapshot at a point in time, trends give an indication of whether water quality is improving or degrading over time. Different trends can be detected over different time periods, and using longer data periods generally increases the reliability of any trend detected. Trend information is available for five and ten year and long-term (25 years) data sets where there was adequate data. The long term trend is reported here.

There are four degrading trends observed in the long-term data (statistically significant and >1% change per year). These were for Total Nitrogen (TN) and Nitrate-nitrite Nitrogen (NNN) at Murupara and Te Teko. There are two improving and important trends in the long-term data, both for the Whirinaki at Galatea site for TN and Ammonium (NH_4-N).

SITES	TN	NH_4-N (pH 8.0)	NNN
Rangitāiki at Murupara	Degrading		Degrading
Rangitāiki at Te Teko	Degrading		Degrading
Whirinaki at Galatea	Improving	Improving	

Trends for water quality parameters over the long term data set (1990 - 2017 circa. 25 years). Only significant trends (>1% per year) are shown. (thumbs down) = Degrading and important (thumbs up) = Improving and important.

Ecology

Lakes

Lake macrophytes (aquatic plants) are important habitats for fish and invertebrates and play a key role in nutrient cycling. They are monitored using a lake health assessment scoring system called the Lake Submerged Plant Indicator (LakeSPI). LakeSPI values greater than 75% are considered excellent; values 0-20% are considered poor. NIWA has undertaken recent LakeSPI surveys at both Lakes Āniwaniwa and Matahina. These have shown that introduced macrophytes have largely out-competed native species found earlier in these two lakes. LakeSPI scores were thus very low - Āniwaniwa (Aniwhenua) is 12% and Matahina 10%. Lake Matahina especially has very few native macrophytes left, and is dominated by exotic species.

Rivers and streams

Periphyton

Periphyton is the term used to describe the slime that grows attached to rocks, stumps, and other stable substrates in rivers and streams. It is composed mostly of algae, although it can also contain quantities of fungi and bacteria. It is a natural component of rivers, and provides an important food source for invertebrates. It is also an important indicator of changes in water quality as any increases in stream nutrient levels may result in excessive growths of periphyton (called a bloom). Periphyton blooms have detrimental impacts on not only the ecological value of rivers, but also their recreational, aesthetic and cultural values.

The NPS-FM specifies that periphyton abundance (biomass) should be measured as chlorophyll-a, the dominant pigment of algae. The NPS-FM sets four bands (A to D) for periphyton biomass, with the D band representing conditions that fail to meet the national bottom line.

The Regional Council is currently monitoring periphyton cover in eight gravel-bed rivers in the Rangitāiki WMA. These results shave shown that algal biomass is generally low, and in the A or B-band. As such, excessive periphyton blooms are currently unlikely.

Image - Landcare Research Phil Novis

Cyanobacteria

Cyanobacteria (*Phormidium* - also called blue-green algae) are a group of bacteria that have chlorophyll and behave like plants. They occur naturally, but can 'bloom' under certain conditions. Some species of cyanobacteria produce toxins which may be harmful to humans and other animals. Cyanobacteria can either be found on the streambed on stable boulders and cobbles, or it can be planktonic in rivers that flow from lakes.

Monitoring of *Phormidium* cover has been undertaken at six sites since 2009 (three in river below Te Teko and three in the mid reaches of the Galatea Plains). The lower sites have always been graded A (an 'A' band in the NSP-FM is <20% cover). Two of the Galatea Plains sites commonly record cover between 20 and 50% (band C). Recently three other sites have been added to the monitoring programme. There have been no *Phormidium* blooms recorded at any of the sites.

Image - Landcare Research (Double Gill Mayfly)

Invertebrates

The most direct way to understand the health of a river ecosystem is to monitor the animals and plants living there. Unlike water chemistry, which may be highly variable from day-to-day depending on the timing of discharges and river flow patterns, stream invertebrates integrate all chemical, physical, and hydrological influences in their habitat over their aquatic life-stages, which in some cases can be many years. As a result, the numbers and types of invertebrates in a water body reflect the quality of their surroundings.

A freshwater invertebrate monitoring programme has been conducted in the Bay of Plenty since 1992 as part of the Regional Council's State of Environment monitoring programme. This programme has included eight sites in the Rangitāiki WMA which have been sampled more or less annually every summer since 2001. A number of other studies have also surveyed invertebrate communities as part of compliance investigations, or one-off ecological surveys as done in 2013-2014.

Ecologists have developed a number of metrics that describe the overall invertebrate community at a particular site. One of the most common metrics is the Macroinvertebrate Community Index (MCI) which involves checking which invertebrate species are present and how abundant they are. The MCI describes whether ecosystem health is excellent, good, fair or poor.

State and trends:

- The invertebrate communities in the Rangitāiki WMA are very diverse, with a total of 104 different types of invertebrates (taxa) being found.
- The most widespread invertebrate was a caddisfly (*Pycnocentria*) followed by the mayflies (*Coloburiscus*, *Deleatidium*, *Austroclima* and *Zephlebia*). Five other taxa were widespread and found in at least half of the sites sampled. The widespread distribution and high relative abundance of invertebrates such as mayflies and caddisflies suggests that many of the streams sampled during the survey were in relatively good ecological condition.
- Average MCI scores show that 102 (out of 117 sites) streams were in either excellent or good condition, and four are in poor condition.
- Stream health was highest in those draining native bush and exotic forest. Stream health was lowest in those draining pasture and was especially low in the mainstem of the Rangitāiki River on the plains.
- Trend analysis of the invertebrate data showed that invertebrate communities have not changed much over a 30-year period, even in streams draining pasture catchments. Lack of changes to stream health in highly modified pasture streams suggests that stream health changed before the earliest surveys (30 years ago) and that communities currently found have shifted to a new stable state.

Fish

Many fish (both native and introduced) are being adversely affected by human activities throughout New Zealand. In particular, activities associated with agricultural development such as removal of riparian vegetation, channel straightening and ongoing drain maintenance, water abstraction and inputs of nutrients and sediments are having demonstrable effects on fish communities throughout the country.

As with many councils, the Regional Council does not currently monitor fish communities as part of its annual State of the Environment monitoring. Any fish work conducted by the Regional Council is usually for focused studies to support operational projects or as part of compliance investigations. In 2014, 82 sites were surveyed for fish in the Rangitāiki WMA. This information was combined with data from the NZ Freshwater Fisheries Database (NZFFD) to create a dataset of 318 sites. This data was then used to describe the fish communities in the Rangitāiki WMA. All the data was also used to create a metric called the Fish Index of Biotic Integrity (Fish IBI score) that can be to measure the health of fish communities in streams within the region. This is the fish-equivalent version of the MCI.

The combined data showed that:

- Brown (55% of total abundance) and rainbow (15%) trout are the most numerous species followed by longfin eels (12%), dwarf galaxias (11%) and shortfin eels (4%). Longfin eels and rainbow trout are the most widespread species.
- Only nine fish species have been recorded in the river above Lake Matahina.
- Preliminary analysis suggests that the trap and transfer programme as part of the Matahina Dam consent is having some success in relocating eels into sites where they were once uncommon or absent, but further work is required to confirm this trend.
- The 2014 survey found similar species to existing records in the NZFFD with the exception of a notable finding of new populations of dwarf galaxias in three small streams draining the Ikawhenua Ranges. However, of concern was the absence of these fish at three other sites where they have been previously recorded. This disappearance most likely reflects their displacement by the more aggressive rainbow trout.
- Approximately one third of sites had Fish IBI scores characteristic of poor condition or moderate and only 15% of sites had scores characteristic of excellent fish integrity. Six sites had no fish detected.

Throughout the Rangitāiki WMA, fish are under a wide range of pressures ranging from loss of habitat as a result of land-use change and engineering works to maximise hydraulic efficiency. The effects of the hydro-electric dams are also noted, although the current trap and transfer works appear to be mitigating some of these effects.

Wetlands

The three key threats impacting on the ecosystem health of wetlands are loss of wetland extent, excessive nutrient and sediment inputs, and changes to hydrology. These three factors act cumulatively to alter wetland processes, and result in altered wetland plant communities and reduced species diversity.

930 ha of wetland remains – approximately 23% of the estimated historic extent.

Most (70%) of the remaining wetlands are smaller than five hectares.

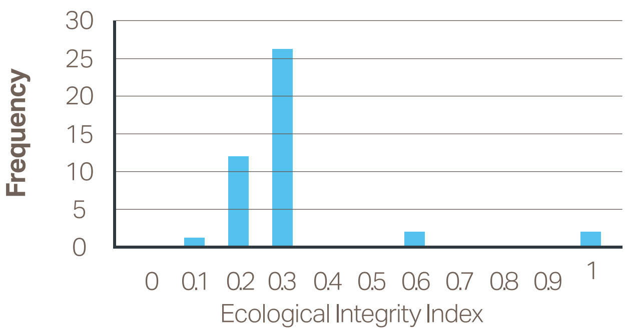
Wetlands in the Rangitāiki make up 24% of the wetland area in the region.

Four wetlands could be considered nationally significant and at least one regionally significant.

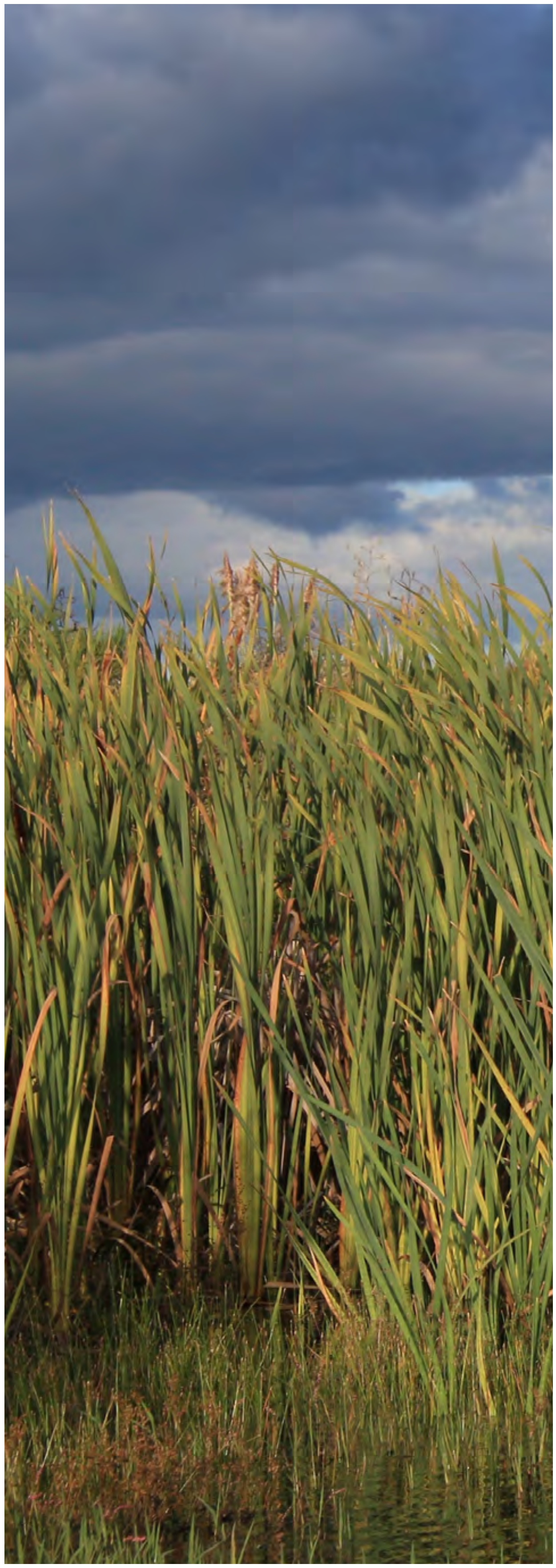
The Regional Council's wetland monitoring programme was initiated in 2014/2015. It includes collecting soil and plant samples, assessing species composition and undertaking a field based assessment of the 'Wetland Condition Index'. Eleven sites in the Rangitāiki WMA have been selected to be sampled. However, monitoring is not complete so there is not yet sufficient data to draw any conclusions for individual wetlands.

Wetland ecologists have created an Ecological Integrity (EI) index to assess wetland health. This is a measure of the naturalness of catchment cover, impervious cover, nutrient enrichment, introduced fish, woody weeds and drainage. A high EI score (close to 1) predicts good condition and low scores (close to 0) poor condition.

The EI index predicts that many wetlands in the Rangitāiki WMA are likely to be degraded as 90% have a score of 0.3 or less, and the average EI Index is 0.3 (compared with 0.38 for the entire region). This highlights the degree to which wetlands have been modified in not only the Rangitāiki WMA, but the entire region.



Ecological Integrity Index for the 44 wetlands in the Rangitāiki WMA. A low EI Index means the wetland is likely to have been subject to greater levels of human disturbance.



Summary

Soil

State:

High nutrients in intensive agriculture/horticulture land

Trend: Degrading

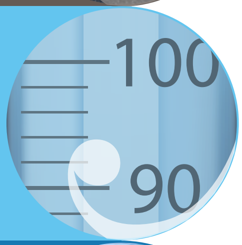
For intensive agricultural/ horticulture land

Water quantity - Is water available to allocate?

State:

Surface water - Allocation still available in 1 out of 12 catchments, 7 have no water available for allocation

Groundwater - Allocation still available in 12 out of 16 catchments



Water quality - Nitrogen and phosphorus

State:

A Band (for NPS-FM attributes)

Trend: Degrading

Can I swim here? - Faecal bacteria, toxic algae

State:

Usually good for swimming at the monitored sites

Trend:

No consistent trend

Stream health - Fish, invertebrates, oxygen

State:

Generally 'excellent' in upper catchment small streams, but only 'fair' closer to the sea

Trend:

No trends evident

Wetlands

State:

Most wetlands are highly impacted

Trend: Degrading

Wetland area

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