The Science Story
Environmental Summary Report

Kaituna - Pongakawa - Waitahanui 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 Kaituna-Pongakawa-Waitahanui 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 for water quality, quantity, freshwater ecosystems and estuary health in the Kaituna- Pongakawa-Waitahanui WMA. Detailed information on which this summary is based can be found in the reports in the reference list.

PART A

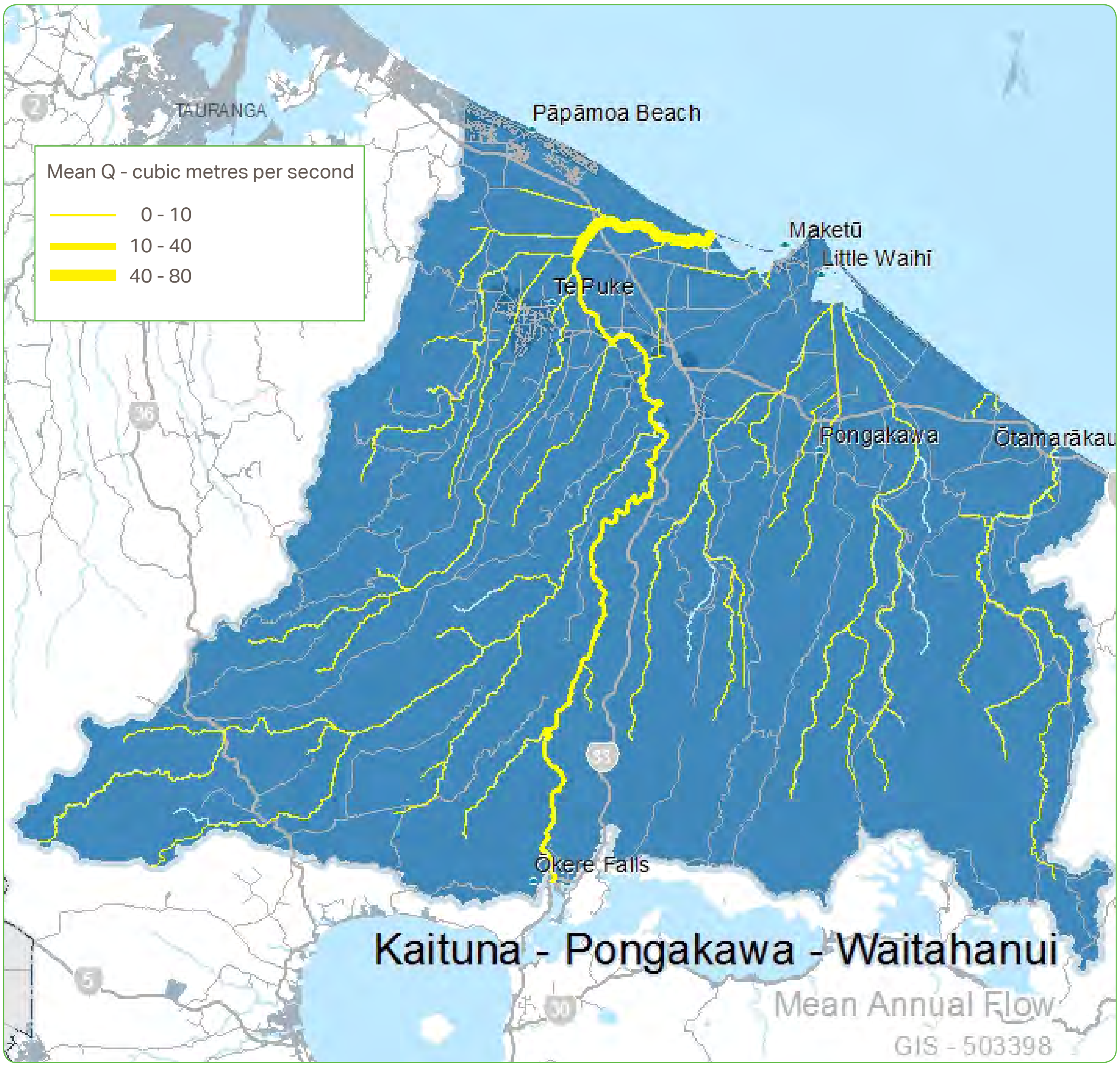
Catchment Description

The Kaituna-Pongakawa-Waitahanui WMA stretches along the coast from Pāpāmoa in the west to Ōtamarākau in the east, and rises southwards to the Rotorua Te Arawa Lakes catchment. It includes the Kaituna River catchment below Lakes Rotorua and Rotoiti, although the lakes do drain to the river. There are three large river catchments – Kaituna, Pongakawa and Waitahanui, and two major estuaries: Te Awa o Ngatoroirangi/Maketū and Waihī.

It has a growing population and includes the Waiāri Stream from which some of Tauranga City and Western Bay of Plenty's future municipal water supply needs will be drawn from. The WMA includes almost a quarter of the region's dairy farms and more than 1,000 kiwifruit orchards.

Thirteen different iwi groups have interests in the WMA. In the area to the west of State Highway 33, Te Maru o Kaituna River Authority has been established as a co-governance entity for the river. The purpose of the Authority is to restore, protect and enhance the environmental, cultural and spiritual health and well-being of the Kaituna River.

Physical extent of the WMA.



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

2,194 km of waterways

1197km in Kaituna/Maketū catchment including Kaituna River and 24 streams

997 km in Pongakawa/Waitahanui catchment including 8 primary streams

Catchment areas

587 km² Kaituna River

367 km² Pongakawa Stream

117 km² Waitahanui Stream

314 resource consents to take and use water

Major industry includes

- Te Puke township
- 167 dairy farms
- 1000+ kiwifruit blocks
- One meat works
- Exotic forestry

The Kaituna River catchment within the WMA starts downstream of Lakes Rotorua and Rotoiti at Ōkere Falls, and extends along the coast from Pāpāmoa East to Maketū. The Rotoiti and Rotorua lakes catchments also feed the Kaituna River, but are not part of the WMA. The Kaituna River flows north from Ōkere Falls, drops over a steep gradient through a number of gorges, travels west of Paengaroa and then discharges into the sea at Te Tumu. In the past, the river discharged into Te Awa o Ngatoroirangi/Maketū Estuary, but it was diverted to discharge at Te Tumu in 1958. Some flow was subsequently redirected back into the estuary in 1996 and works are underway to alter the existing diversion structures to allow more water to be diverted back into the estuary by June 2020. The major tributaries of the Kaituna River are the Mangorewa River, and the Parawhenuamea, Waiari, Ohineangaanga, Raparapahoe and Kopuaroa Streams.

Wāihi Estuary catchment

The Waihī Estuary catchment lies between the Kaituna River catchment to the west, and the Waitahanui Stream catchment to the east. It includes all waterways draining into the Waihī Estuary including Pongakawa, Pokopoko, Puanene and Wharere Streams. The Waihī Estuary catchment extends from north of Lake Rotoehu and Rotoiti catchments, down to the Waihī Estuary, and includes Paengaroa in the west and Ohinepanea in the east. North of State Highway 2, the natural drainage pattern of the area has been modified by a series of drains and canals. Four canals (the Kaikokopu, Wharere, Pongakawa and Pukehina) drain into the estuary.

Waitahanui Stream catchment

The Waitahanui catchment lies within the eastern part of the WMA. It includes all the land draining into the Waitahanui Stream. The Waitahanui catchment begins north of Lake Rotomā, and drains into the sea north of Ōtamarākau.

Soil

Geology, land use and soils influence water quality and quantity. There are two distinct soil and geological zones in the WMA. Both soil zones have very distinct chemical and physical characteristics which impact on their ability to support different land uses.

The upper areas of the catchments are made up of pumice soils formed by flows of hot gas and rock from the numerous volcanic centres in the region. High rainfall and rapid drainage in the Mamaku Ranges has caused excessive leaching of nutrients from the surface layers of the soil forming what are called podzol soils in these areas. These soils have a distinctive white leached layer below the upper soil horizon.

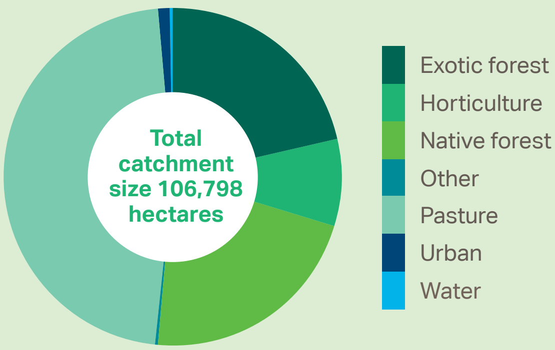
Lower catchments are comprised of organic, recent and gley soils over gravel. The soils typically have higher organic matter and drain more slowly.

Pumice soils, which make up the majority of the catchment, have coarse soil fragments causing them to drain water rapidly. This can assist with faster recharge of local groundwater but can also create a higher risk of excess nutrients leaching through the soil profile.

Land use

Currently, the biggest land uses in the catchments are native forest and forestry, followed by dairy farming, sheep/beef/deer/dairy support and kiwifruit. Sheep, beef, forest and forestry are predominately in the upper catchment and intensive dairying and kiwifruit in the lower catchment. There is a current trend towards kiwifruit expansion and for the last 10 years there has been dairy expansion.

Land use in the Kaituna - Pongakawa - Waitahanui catchments



Groundwater

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

Seven geological units have been identified in the WMA. The geological units that may transmit water have been used to identify likely groundwater systems. The geological systems are either unconfined, semi-confined to confined and in some instances fractured aquifer systems. The unconfined groundwater systems are hydraulically connected to each other and to surface water bodies. This means that the water (and mainly water soluble contaminants) can flow from one aquifer to another. Some systems are unconfined in one area (e.g. recharge areas) and confined in another area, where they are deeper and overlain with other geological units.

Estuaries

Within the WMA there are two major estuaries. The Waihī Estuary is one of the smaller coastal estuaries in the region. It is impounded by the Pukehina Spit and is the ultimate receiving environment for all rivers, streams and canals (Pongakawa, Pokopoko, Puanene, Wharere and Pukehina). It has 62 hectares of saltmarsh and the ecology is typically estuarine in nature with similar species composition as found in other estuaries on the north-east coast of New Zealand. It has a shallow tidal inlet of approximately 2.4 km² and the estuary bed is almost completely exposed at low tide.

Te Awa o Ngatoroirangi/Maketū Estuary is a shallow, inter-tidal estuary covering an area of about 233 hectares, including 13 hectares within Papahikahawai Lagoon which until recently was largely isolated from the rest of the estuary. The Kaituna River Estuary at Te Tumu is significantly smaller (2.3 km²) and fed almost exclusively from the Kaituna River. The major fresh water input to Te Awa o Ngatoroirangi/Maketū Estuary is from the Kaituna River through Ford's Cut, which is the only link from the river to the estuary. Since the partial re-diversion of the river in 1996, five percent of the river's flow is channelled through Ford's Cut into the estuary (during a mean tidal cycle this is approximately 150,000 m³). This is expected to increase to about 20% following the completion of the re-diversion scheme. A number of small streams (e.g. Waitipuia Stream) and unnamed drains also enter in the southern part of the estuary.

Wetlands

The Kaituna 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, nutrient, and underlying ground conditions (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

The majority of wetlands in the WMA have been lost due to land drainage and reclamation for agricultural development. There are three main wetlands remaining in the WMA. The Lower Kaituna Wildlife Management Reserve and Kaituna sand dune wetlands are of national significance. The Kaituna River wetlands are of regional significance.

WETLAND TYPE	HISTORIC AREA (ha)	REMAINING AREA (ha)	% REMAINING
Fen	2,154	56.8	2.6
Marsh	176.6	10.8	6.1
Swamp	11,286.8	410.6	3.6
Total	13,617	478.2	3.5

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 program to drain these waterlogged areas. In the 1800's rivers such as the Pongakawa, Wharere and Pukehina were channelised and straightened, and constrained within stopbanks to minimise flooding. Small lateral drains were also dug throughout the Kaituna Plains to help drain the waterlogged soil and allow agricultural development to occur. These modifications have had the effect of converting lowland swamps into a series of highly modified stream channels of significant length. The Kaituna Plains have an approximate area of 175 km², below the 20m contour, through which approximately 270 km of waterways flow. Of this, only about 20 km of the lower Kaituna River is relatively un-modified waterway– although this has been confined between large stopbanks to minimise flooding and by the having its flows from Lake Rotoiti regulated by the Okere control gates. The other 250 km of waterways on the Kaituna Plains (93%) are represented by highly modified and straightened smaller waterways and drains.

The Kaituna Catchment Control Scheme has 99 km of canals and drains and seven pump stations (14 pumps) in place to reduce flood impacts for low-lying landowners within the scheme service area.

Waihi Estuary is fed freshwater from a number of stream fed drainage canals - the Kaikokopu, Wharere, Pongakawa and Pukehina. Within the drainage scheme there are 13 pumps.

Lower Kaituna River scheme maintenance area.

PART B

State and Trends

Soil

Soils are monitored by the Regional Council at nine sites over a range of land uses in the 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 WMA so the information presented here relates to soil monitoring findings across the region.

What we know:

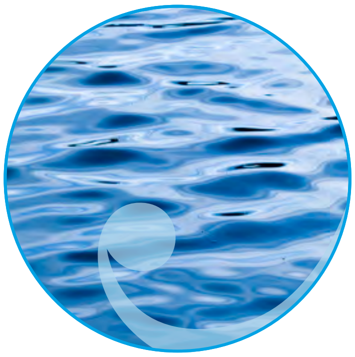
Trace elements (eg. cadmium, copper, zinc) have been included in the Regional Council's regional monitoring programme since 2010, as a result of concern regarding the potential risk of contaminant accumulation associated with land use practices such as fertiliser application and disease control.

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. Sampling between 2004 and 2009 showed that 26% of sites had cadmium levels exceeding the 1 mg/kg guideline value, which means there is a potential risk of accumulation in the food chain. In monitored kiwifruit orchard sites, copper and zinc concentrations over the ten-year period (2000-2010) appear to be increasing but are below guideline levels. Increasing use of copper sprays (now widely used to control PSA) are likely to have contributed to higher copper concentrations in soil samples.

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 regarded as being 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. Kiwifruit sites had a mean Olsen P concentration of 106 mg/kg in 2010.

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 eight gauging stations throughout the Kaituna 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.

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 rivers five-year seven-day mean annual low flow (Q_5 7-day). Q_5-7-day 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.

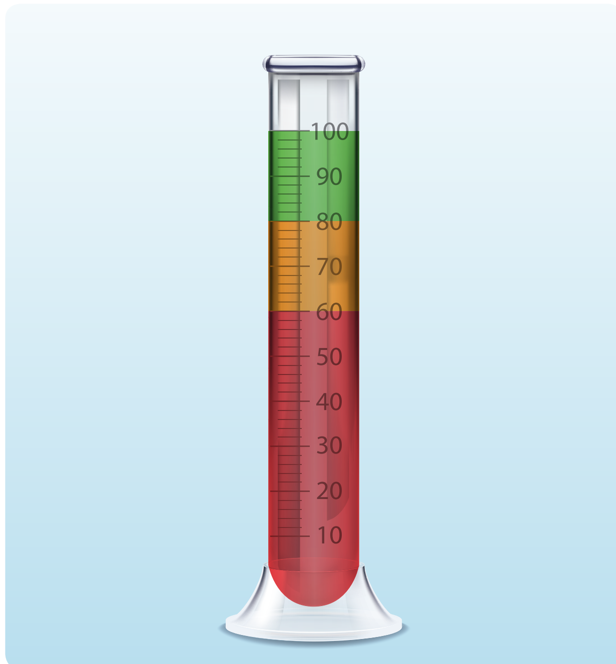
There are 314 current resource consents (as of 2016) in place that allow the holders to take and use water from ground or surface waterbodies in this WMA. The consents allow water to be abstracted for a variety of uses, including town supply, irrigation (for both pasture and horticulture such as kiwifruit), dairy shed use and frost protection.

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

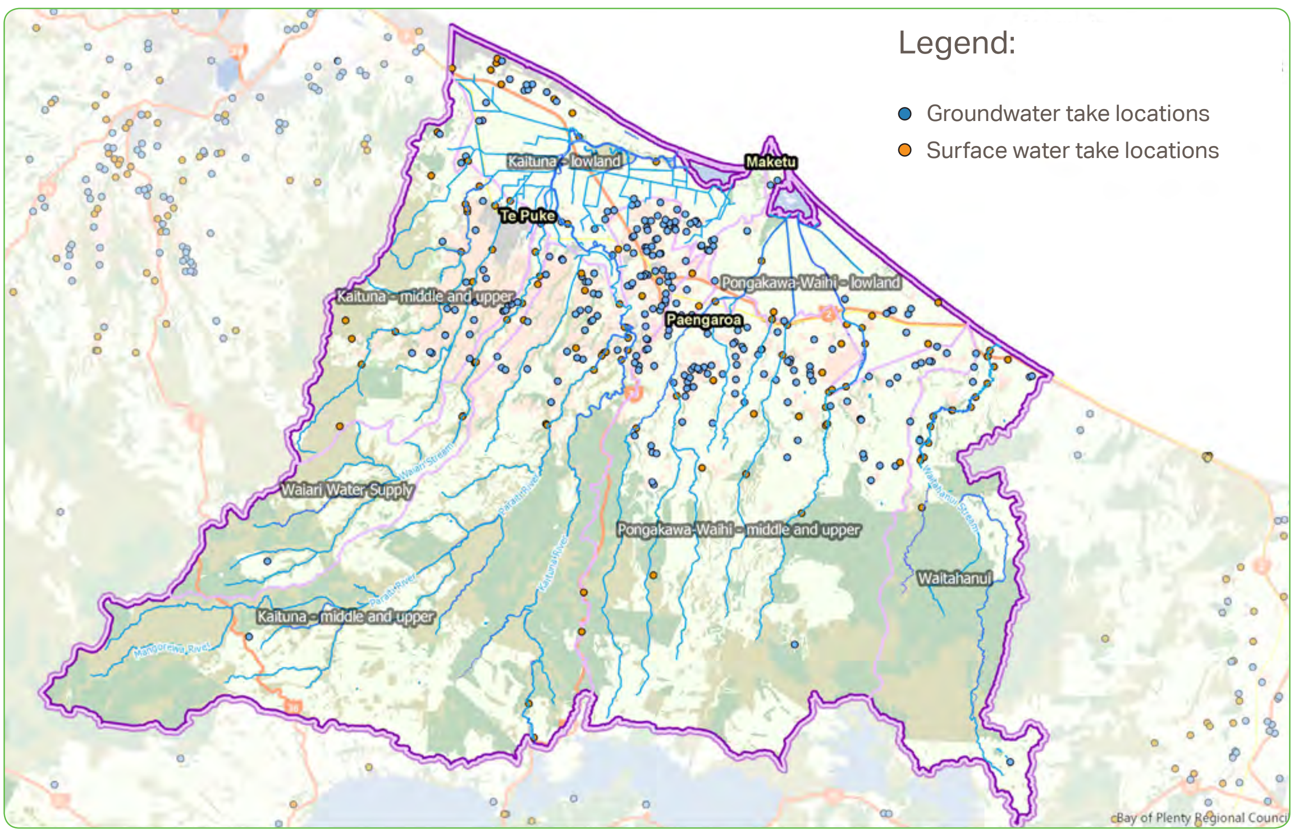
Surface water

The total volume of water allocated to water users through resource consents has reached or exceeded the regional default thresholds for most of the Kaituna 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 as at July 2017.

Groundwater

There are currently nine groundwater level and seven groundwater quality monitoring sites within the WMA that form part of the Regional Council's region-wide environmental monitoring programme. They provide useful information at a regional level but are insufficient to gain a detailed understanding of the localised aquifer system.

What we know:

Groundwater supports the flow of many streams and rivers within the WMA, so abstraction from groundwater has the potential to reduce surface water flow.

High groundwater use occurs on the Kaituna Plains and to some extent the low hills just above the plains.

The following trends can be determined from the WMA monitoring data:

- The groundwater levels in a monitoring bore in the Pongakawa area (Bore 2822 at 121 m deep) is declining (0.05 m/year over 21 years) but it is unclear at this time whether the decline is localised, or extends over the WMA. This uncertainty reflects lack of targeted monitoring bores in crucial locations. Groundwater levels in the other bores, however, are stable.
- Assessment of the Kaharoa lysimeter site shows that 50% of the mean annual rainfall volume infiltrates into the ground, but this is highly seasonal. For example, during winter, up to 70% of rainfall infiltrates into the ground, while only 20% of summer rainfall infiltrates into the ground.

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).

GROUNDWATER CATCHMENT	REMAINING ALLOCATION
Hauone	
Kaikokopu-Pokopoko-Wharere	
Lower Kaituna	
Maketū	
Mangaone Stream	
Mangorewa	
Newdicks	
Ohinepanea	
Ōtamarākau	
Pongakawa	
Pukehina	
Pukehina Beach	
Waitahanui	

Groundwater allocation compared to allocable flow set by region-wide interim allocation thresholds in PC9. 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 (no allocation available) (orange).

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

Water 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 systems 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

From monitoring data:

- Three water quality (Bores 3034 at 10 m deep, 3566 at 122 m deep and 4968 at 10 m deep) show levels of Nitrate-Nitrogen (NO_3-N) that indicate impacts from human activity (median concentration above 1.6 g/m^3 NO_3-N). We have yet to determine effects of this on surface water bodies.
- Five water quality bores have median bacteria levels (Enterococci and/or faecal coliforms) above the untreated drinking water maximum standard of 1 cfu/100 mL

Surface water

Surface water quality in this section refers to the physical and chemical properties of 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.

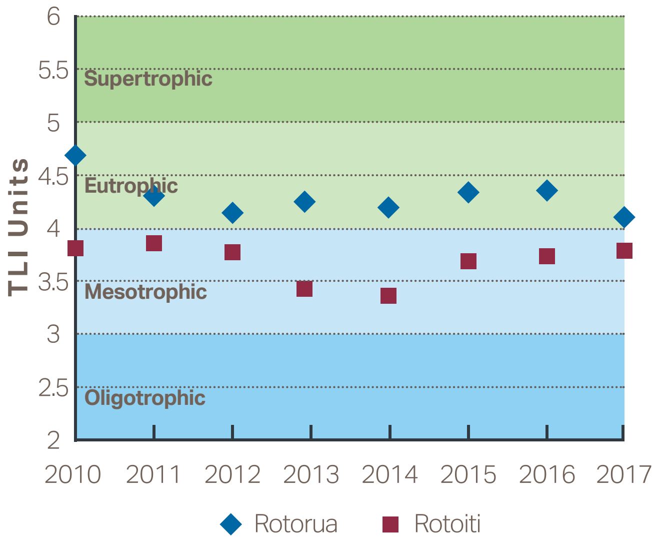
Water quality is impacted by many natural factors (e.g. climate, geology) and anthropogenic (human) factors (e.g. land use change, point-source discharges). Water quality in a river or stream can impact the ability of a waterway to support healthy aquatic ecosystems and community values such as swimming.

Lakes

The Rotoura lakes are outside of this WMA, but the Kaituna River headwaters flow from Rotorua and Rotoiti Lakes, so water quality in the WMA is affected by lake health.

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 Lake Rotorua to be eutrophic (nutrient enriched) which leads to poor water quality. Lake Rotoiti is classed as mesotrophic (average water quality). Lake and estuary eutrophication can produce unsightly scums of algae on the water surface, lead to decreased animal and plant diversity, and can also affect recreational water use.

Extensive work to reduce nutrient run-off and improve water quality in the lakes is ongoing. The TLI for both lakes has improved because of this work.



Trophic level index of Lakes Rotorua and Rotoiti 2010 - 2017

Rivers and streams

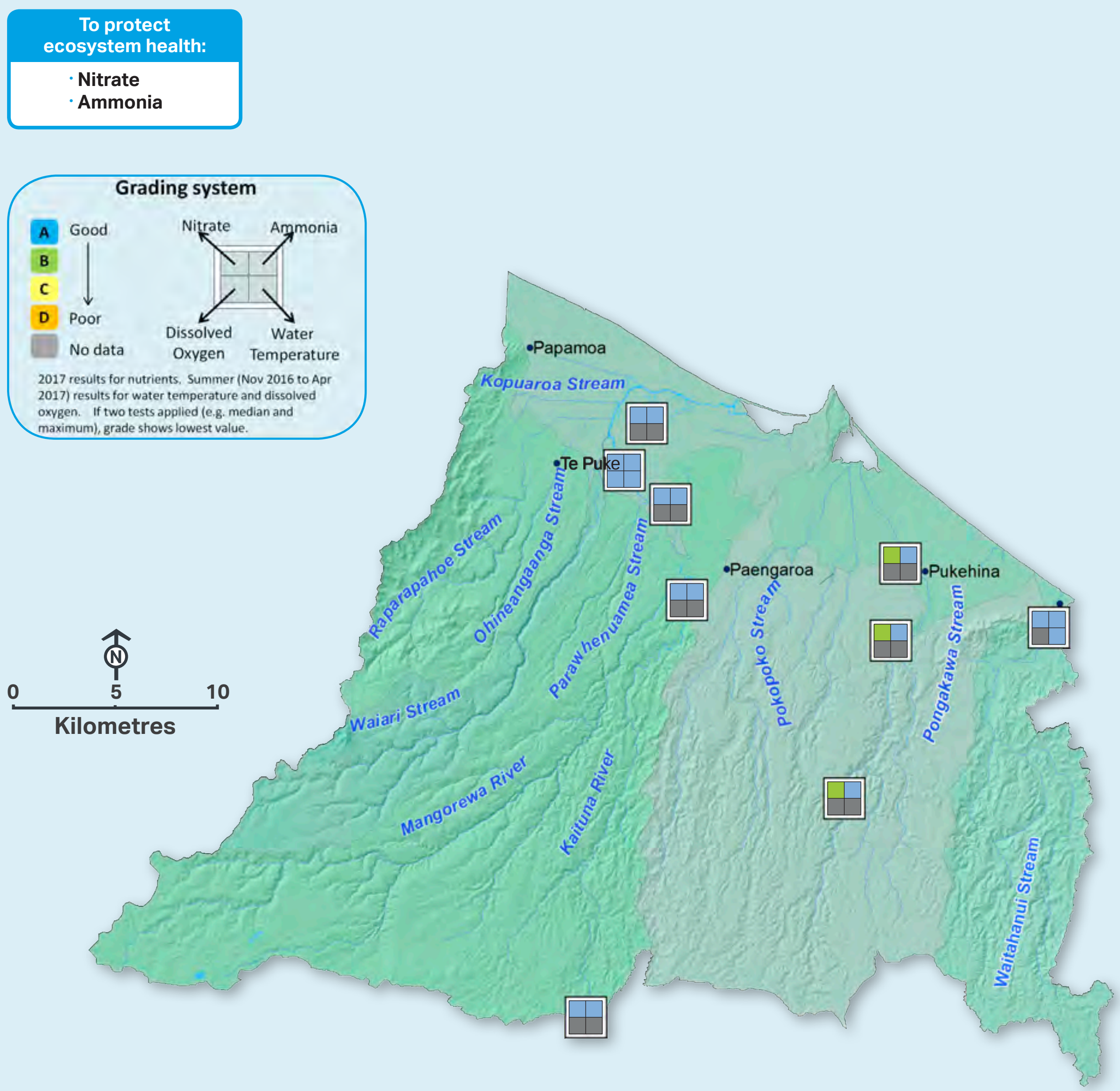
There are nine sites in the WMA that are regularly monitored for water quality physical attributes (temperature, dissolved oxygen, water clarity, turbidity and suspended solids), chemical attributes (nitrogen and phosphorus) and microbiology *(E. coli)*.

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.

Other parameters we need to consider in order to safeguard ecosystem health include dissolved oxygen, temperature and sediment quality.

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

The only river site in the WMA that is monitored for swimability is the Pongakawa River at SH2. The site is graded 'B' meaning it is swimmable under the NPS-FM grading system.



Water quality
monitoring results 2017

The Kaituna and Pongakawa catchments flow into estuaries. Elevated nutrient concentrations have been recorded in the lower reaches of these rivers and are impacting the health of the receiving estuaries.

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. Different trends can be detected over different time periods, and using longer time periods generally increases the reliability of any trend detected. Trend information is available for five and ten year and long-term data sets where there was adequate data. The long term trend is reported here (see table below). There were six degrading trends observed in the long-term data (statistically significant and >1% change per year), these were for Total Phosphorus (TP), Nitrate-nitrite Nitrogen (NNN), and *E. coli*. There were two improving trends in the long-term data, both for Ammonium (NH_4-N) at Kaituna at Te Matai and Pongakawa at Old Coach Rd.

SITES	TP	NH_4-N (pH 8.0)	NNN	E.coli
Kaituna at Rotoiti Outlet				👍
Kaituna at Maungarangi Rd			👎	
Kaituna at Te Matai		👍	👎	👍
Pongakawa at Old Coach Rd	👎	👍		
Pongakawa at SH2				👎
Kaituna at AFFCO Intake			👎	

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

Ecology

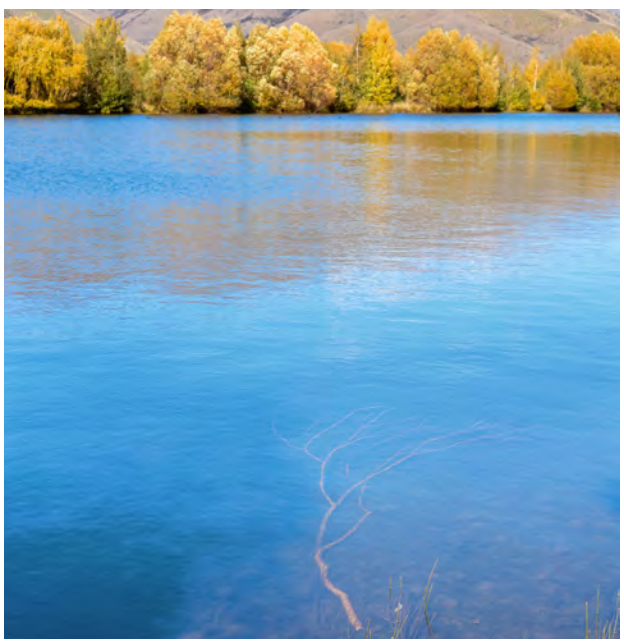
Lakes

The Rotoura lakes are not part of this WMA but the Kaituna River headwaters flow from Lakes Rotorua and Rotoiti so the ecological health of the WMA is influenced by the lakes.

Cyanobacteria are a group of single-celled organisms (bacteria) that live naturally in fresh water worldwide. Cyanobacteria are often referred to as 'blue-green algae' or 'toxic algae' even though they are not actually algae. Cyanobacteria can be benthic (live attached to the bottom of a stream) or planktonic (not attached to anything and live floating in the water column). Under certain environmental conditions, such as high levels of light and nutrients and warm water temperatures, cyanobacteria can multiply and congregate to form blooms. For planktonic cyanobacteria, blooms usually present as pea-coloured, soupy looking water or scum on the water surface which may also smell earthy or musty.

Cyanobacteria generated in Lakes Rotorua and Rotoiti sometimes spread into the Kaituna River, usually during summer months.

Since 2011 Lake Rotorua grading (using grades under the NPS-FM) has been 'A' and Lake Rotoiti was graded 'A' for four out of five sampling locations and 'C' for the fifth location. An A grading identifies the risk of people being exposed to cyanobacteria as no different to that under natural conditions.



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 in changes of 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 Lines.

Rivers in the WMA are dominated by unstable pumice beds where periphyton blooms will not develop. As such, no monitoring is being conducted.

Image - Landcare Research Phil Novis

Cyanobacteria

Some species of cyanobacteria produce toxins which may be harmful to humans and other animals.

The Kaituna River is a lake-fed river and planktonic cyanobacteria is monitored at two sites along its length. Both sites (Trout pool and Waitangi) were graded A band (under the NPS-FM) for cyanobacteria over the period 2011-2017.

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 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 the Environment monitoring programme. This programme has included 15 sites in the WMA which have been sampled more or less annually every summer since either 2001 (11 sites) or 2002 (six sites). A number of other studies have also surveyed invertebrate communities at sites throughout the Kaituna catchment as part of compliance investigations, or one-off ecological surveys.

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 WMA are very diverse, with a total of 121 different types of invertebrates (taxa) being recognised.
- The fauna is dominated by the freshwater snail, *Potamopyrgus*, followed by chironomid midges, four caddisfly genera and two mayfly genera (*Austroclima* and *Zephlebia*). The stonefly *Zelandobuis* was also relatively abundant throughout the area. Presence of mayflies and stoneflies indicate streams in good ecological condition, so the fact that these animals were so common suggests that overall stream health is relatively good.
- Average MCI scores show that 12 streams were in either excellent or good condition, and three streams are in fair condition. No streams were in poor condition. Streams with excellent health were mostly in the upper parts of the catchment, while streams in fair condition were at lower elevation and closer to the sea.
- The ecological health of waterways draining this WMA was slightly lower than other monitored streams throughout the region. This may reflect a couple of factors, including the fact that this WMA has a much higher proportion of its catchment area dominated by agriculture, and the fact that many of the streams sampled were dominated by highly mobile pumice stream beds.
- Stream ecological health differs greatly between different land uses, and it was lowest in urban streams, next lowest (but highly variable) in streams draining agricultural catchments, and highest in streams draining pine plantations and native bush.
- Trend analysis of the invertebrate data showed that ecological conditions in the majority of the monitored waterways throughout the WMA were stable. Significant increases in calculated biotic metrics such as the MCI were observed in only five of the sites, and strong evidence of changes to ecological health were observed in only three sites. This suggests that the ecological condition of most monitored sites has remained the same since 2001, most likely reflecting the fact that major changes to land-use have not occurred since 2001, which is when monitoring commenced.

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 currently does not monitor fish communities as part of their annual State of the Environment monitoring. Any fish work conducted is usually for focused studies as part of investigations. In 2016 a freshwater fish survey in the WMA was undertaken and in combination (combined total of 251 sites) with data from the NZ Freshwater Fisheries Database (NZFFD). This data was used to describe the fish communities in the area, as well as calculate a metric called the Fish Index of Biotic Integrity (Fish IBI score) to measure the health of fish communities in streams. This is the fish equivalent version of the MCI.

The combined data showed that:

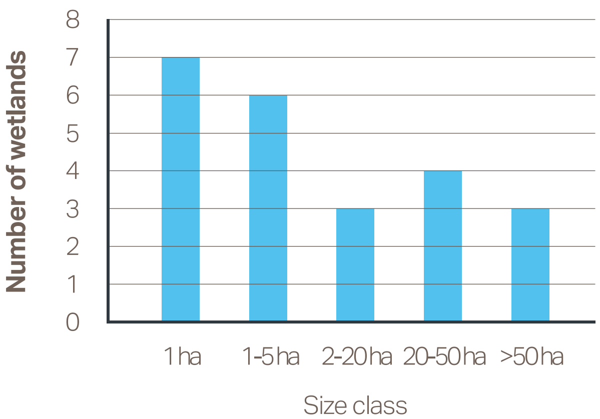
- There are 21 native fish in the WMA, many of which need to migrate between the sea and freshwater as part of their lifecycle.
- The 2016 survey found similar species to existing records in the NZFFD with the exception of a notable finding of shortjawed kokopu from a site in the Ohineangaanga Stream, and koaro and banded kokopu in a small number of other streams.
- Approximately one third of sites had Fish IBI scores characteristic of poor condition, approximately 23% were either moderate or excellent condition and 16% good condition. Six sites had no fish detected.
- Throughout the 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.

Wetlands

The three key threats impacting on the ecosystem health of wetlands in the WMA 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.

Only 478 hectares of wetlands remain in the WMA. This is only 3.5% of the estimated historic extent.

Most (56%) of the remaining wetlands in the WMA are smaller than five hectares, highlighting the loss of large ecologically important areas of wetlands.

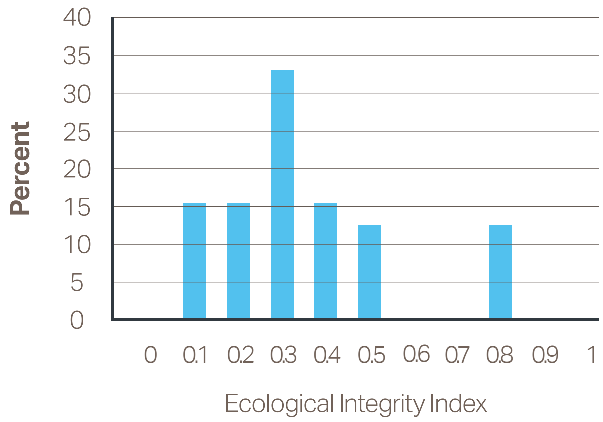


Size distribution of remaining wetlands in the WMA.

Three of the region's top ten most significant wetlands are in the WMA.

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'. Only two sites in the WMA have been sampled to date 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 (closer to 1) predicts good condition and low scores (closer to 0) poor condition. The average EI index for the WMA is only 0.32 (compared with 0.38 for the entire region). This highlights the degree to which wetlands have been modified in not only the WMA, but the entire region.



Ecological Integrity Index for the 13 WMA wetlands. A low EI Index means the wetland is likely to have been subject to greater levels of human disturbance.

Funding for 100 hectares of wetland re-creation in the lower Kaituna River catchment was allocated in the Council's Long Term Plan 2015-2025.

Estuaries

Estuaries are the transitional environment between rivers and the sea. Because of this, they have complex hydrology and water quality patterns that vary both spatially and temporally with every tidal cycle. Rivers and streams transport various contaminants including sediment and nutrients, and deposit them in estuaries where they can build up over time, often with negative ecological consequences. Poor water quality can also limit people's enjoyment of coastal waters for contact recreation or shellfish gathering.

Waihī Estuary

State and trends:

- The ecological health of the upper estuary is declining markedly. Monitoring results are showing low oxygen levels, build-up of nutrients and organic matter, loss of native sea grasses, reduced fauna due to anoxic sediments and algal growth. Overall estuary health is considered to be poor.
- Relatively high water column sediment concentrations have been detected. This is to be expected as material is re-suspended in the water column by a combination of wind and wave action and flood flows.
- Levels of nutrients (Total Phosphorus and Nitrogen, Dissolved Reactive Phosphorus, Nitrite-nitrogen, Ammonium-N), Turbidity, Dissolved Oxygen, and algal biomass (as chorophyll-a levels) are stable.
- Concentrations of indicator bacteria such as *E. coli* are rising. Water quality for swimming/primary contact is generally good but it is not safe for shellfish consumption some of the time.
- The shellfish community is dominated by bivalves and polychaetes. Cockle density and size have varied over time but no significant trends are apparent.
- Microalgae (*Gracilaria chilensis*) in recent times has been observed at nuisance levels in the upper estuary. These algae are a feature of changing conditions such as excess nutrients and changing salinity.

Te Awa o Ngatoroirangi /Maketū Estuary

State and trends:

- The ecological health of the estuary is declining, particularly the upper areas where there are low oxygen levels and a build up of organic matter. The partial re-diversion of the Kaituna River will help improve estuary health in time.
- Suspended solid concentrations are increasing. This significant and meaningful trend could be due to stirring of sediments by wind or increased inputs from other inflows.
- Total Phosphorus and Nitrogen, Dissolved Reactive Phosphorus, Ammonium-N, Dissolved oxygen, *E-coli*, and chorophyll-a levels are stable.
- Water quality for swimming/primary contact is generally good but is not safe for shellfish consumption some of the time.
- There is a lack of infauna (animals such as shellfish that live in the sediment) in the upper estuary due to anoxic (oxygen deprived) sediments however infauna densities increase in the mid estuary. Pipi are commonly found in the lower estuary channel but mussel populations have declined due to increased sand coming into the estuary. Cockle size and density varies considerably over time largely as a result of changing habitats.
- Microalgae (*Gracilaria chilensis*) have been blooming.
- The estuary is a risk from nuisance plant and algae growth and increasing nutrients, which can reduce oxygen levels.

	Suspended Solids	Dissolved Reactive Phosphorus	Ammonium	Chorophyll-a	E.coli	Enterococci	Faecal coliforms
	SS	DRP	NH_4-N	Chl-a	E. coli	Ent	FC
Waihī Estuary					👎	👎	👎
Maketū Estuary	👎						
Kaituna Estuary		👎	👎	👎		👍	

Significant trends in Waihi and Te Awa o Ngatoroirangi/Maketū Estuary. Only significant trends (>1% per year) are shown.

Trend:

👎 degrading and important

👍 improving and important

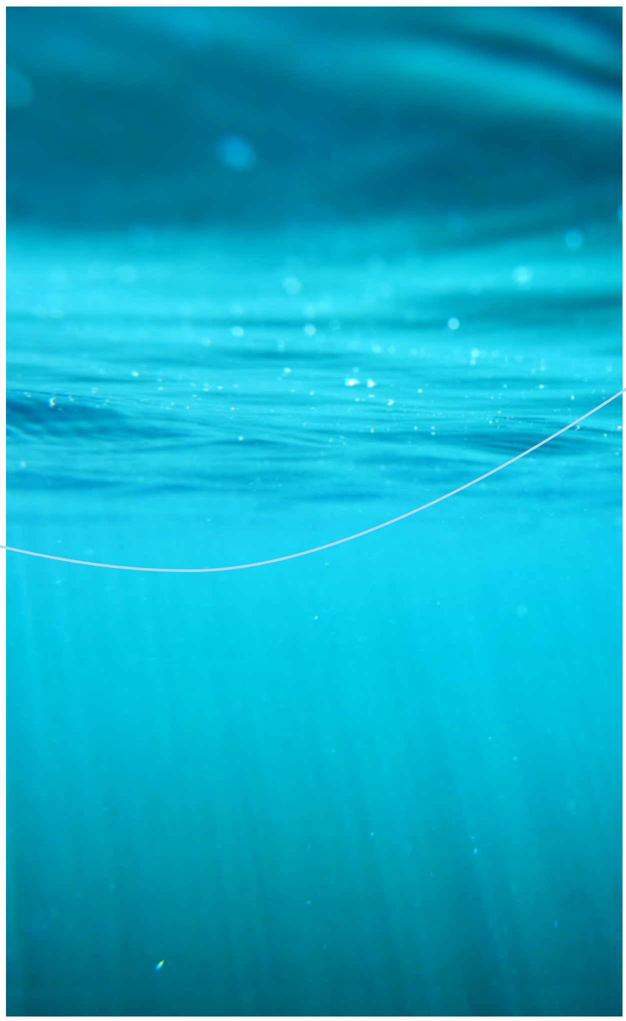
Is it safe to swim and eat shellfish?

The safety of sea water (for recreational purposes) is determined by measuring the 'indicator' bacteria Enterococci to find out whether the water is contaminated by faecal material. Water that is contaminated by faecal material can contain many different types of pathogens (bacteria and viruses) which have the potential to make people sick. The suitability of shellfish for consumption is also tested. Faecal coliforms are sampled and counted indicating the potential presence of bacteria, protozoa and viruses.

	2014/15	2015/16	2016/17
Maketū at Surf Club	100%	95%	100%
Waihī Estuary	95%	80%	100%

Percentage of water samples that complied with the 'safe' swimming guidelines during summer monitoring.

The 'Suitability for Recreation Grade' (SFRG) is generated through a combination of a faecal contamination risk assessment and by direct weekly measurement of appropriate bacteriological indicators at the site. The SFRG uses five grades from 'very good' to 'very poor'. Since 2010/2011 the SFRG grade at the Maketū Surf Club has been 'good'. For Waihi Estuary the grade has been 'good' or 'fair'.



Summary

Soil

State:

High nutrients in intensive agriculture/horticulture land

Trend: Degrading

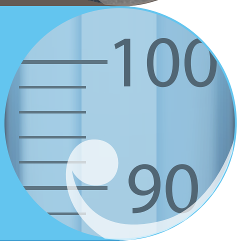
For intensive agricultural/ horticulture land

Water quantity - Is water available to allocate?

State:

Surface water - Allocation still available in 4 out of 20 catchments, 12 have no water available for allocation

Groundwater - Allocation still available in 10 out of 13 catchments



Water quality - Nitrogen and phosphorus

State:

A or B 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 catchments, but only 'fair' closer to the sea

Trend:

No trends evident

Estuary health

State:

Poor

Trend: Degrading

Wetlands

State:

Most wetlands are highly impacted

Trend: Degrading

Wetland area

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