Our freshwater

Surface water quality

Northland has an extensive network of rivers and streams. None of them are considered major on a national scale as Northland's narrow land mass means most rivers are relatively short with small catchments. Most of the major rivers flow into harbours, rather than discharging directly to the open coast which means contaminants tend to take longer to disperse from these sheltered environments.

The Northern Wairoa River is Northland's largest river, draining a catchment area of 3650 square kilometres, or 29 percent of Northland's land area.

Flows in rivers vary considerably with rainfall and high intensity storms causing flash floods, while prolonged dry spells lead to very low flows in many smaller catchments. Northland's rivers are generally characterised as being slow flowing and muddy because the land is dominated by deeply weathered geology and fine clay soils.

Northland also has a large number of small, shallow lakes and associated wetlands. Most of these have been formed between stabilised sand dunes on the west coast. These dune lakes are grouped on the Aupōuri, Karikari and Poutō peninsulas. Most are between five and 35 hectares in area and are generally less than 15 metres deep. However, Lake Taharoa of the Kai Iwi group near Dargaville is one of the largest and deepest dune lakes in New Zealand. It covers an area of 237ha and is 37m deep. There are also a few volcanic and man-made lakes. Northland's largest lake is Lake Ōmāpere, which is 1160ha in area and located to the north of Kaikohe.

Northern Wairoa River – Northland's largest river

What do we want for water quality in Northland?

The operative Regional Policy Statement for Northland details existing council and community objectives for each natural and physical resource in our region. The objectives relating to water quality are:

- The maintenance or enhancement of the water quality of natural water bodies and coastal waters to be suitable, in the long-term, and after reasonable mixing of any contaminant with the receiving environment and disregarding the effects of any natural events for aquatic ecosystems, contact recreation, water supplies, and aesthetic and cultural purposes.
- The reduction and minimisation of the quantities of contaminants entering water bodies and coastal waters in particular those that are potentially toxic, persistent, or bio-accumulative.
- Avoid, remedy or mitigate the adverse effects of discharges of contaminants on the traditional, cultural and spiritual values of water held by tangata whenua.

The operative Regional Policy Statement also states anticipated environmental results as a consequence of implementing the policies and methods for achieving the water quality objectives:

- Water quality is suitable for desired purpose.
- Contaminants in water bodies are reduced.
- The adverse effects of contaminants in water bodies and coastal waters are avoided, remedied or mitigated.
- That all existing discharges of organic contaminants be via the best practicable option for treatment and disposal by the year 2004.
- That all new discharges of organic contaminants be via the best practicable option for treatment and disposal.
- Improved aquatic habitat.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

What are the issues affecting freshwater quality in Northland?

Like the rest of New Zealand, Northland's water quality varies greatly. In general terms, water is pristine in native forested headlands and then becomes increasingly contaminated as it flows through modified lowland catchments. These contaminants can enter the river in two ways:

- Point source discharges – the discharge of contaminants from a single facility at a known location (for example, a wastewater treatment plant) ; or
- Diffuse surface runoff – the discharge of contaminants via water running directly off the land, which can be either urban or rural.

The three main water contaminants of greatest concern in Northland are faecal pathogens, sediment, and nutrients. Pathogens are disease-causing organisms and obviously deserve being labelled contaminants however sediment and nutrients are only water contaminants by virtue of being in the wrong place; they belong on the land, not in the waterways.

While sediment and nutrients occur naturally in water, when too much soil and sediment washes off the land it becomes destructive in water. Nutrients, specifically phosphorus and nitrogen, should also stay on the land helping plants to grow there rather than in water. We want fertile land not fertile water.

Pathogens

When pathogens get into water they can make people and livestock sick. *Salmonella*, a well-known cause of food poisoning in humans, is also an emerging problem for livestock. Recent outbreaks in New Zealand have caused diarrhoea, loss of milk production, miscarriage, and deaths (Teague: 2011). The main sources of pathogens in freshwater are human sewage and animal manure.

While human waste in Northland is treated by wastewater treatment systems before being discharged to land or water, the extent and effectiveness of treatment varies. Storm overflows, broken sewer pipes, and poorly located and maintained septic tanks mean some sewage gets into water with little or no treatment.

When livestock manure gets into water, pathogens also get into water. Some manure is deposited directly into water where livestock have access to it. According to one study, dairy cows are over 50 times more likely to defecate straight into water rather than land, when given the opportunity (Parliamentary Commissioner: 2012).

Around 15% of dairy cow effluent is deposited in the shed during milking. Traditionally in Northland, this effluent was run through two-pond treatment systems and eventually discharged into water. These systems removed most of the solids, but pathogens often survived the process. Today, many dairy farmers irrigate shed effluent back onto land however pathogens can still be washed into the water if the storage pond overflows, the effluent irrigator breaks down, or the receiving land is too wet for the effluent to soak in.

The bulk of livestock manure is deposited directly onto pasture. Whenever it rains, some manure gets washed off the land into streams, rivers, and lakes. Additional sources of pathogens, such as Canada geese, dogs, and ducks, are insignificant nationally (Parliamentary Commissioner: 2012), but can be important in Northland (Northland Regional Council: 2011), particularly in small streams and ponded water.

Animal effluent and stream bank erosion create bacteria, water clarity, and nutrient problems in freshwater

Sediment

Sediment makes clear water murky (or turbid), smothers aquatic life, and sediment build-up alters water flows and exacerbates flooding. Sediment is made up of particles of soil and rock eroded from the land and washed or blown into rivers and lakes. Sediment is probably the most widespread and serious contaminant of water in Northland.

Erosion itself is a natural process – even the Waipoua River (one of Northland's pristine rivers) turns brown when it's in flood, and native ecosystems are adapted to such conditions. The problem is that land use activities that disturb soil accelerate erosion and increase the amount of sediment discharged to water. The loss of most of the region's wetlands and original forest cover has exposed soil to accelerated erosion.

Sediment in the Kaihū River after a storm event

Sediment ranges in size from fine particles of clay to boulders. Smaller particles of silt and clay tend to float in the water as 'suspended sediment'. In calm water, they gradually settle to the bottom forming soft layers of 'deposited sediment'. Waves, winds, and floods can stir up deposited sediment, filling the water with suspended sediment again.

Sediment is also a major source of phosphorus because phosphate clings to the surface of soil particles carried into water. Phosphorus is one of the two problem nutrients discussed in this report.

Pasture produces two to five times more sediment than an equivalent area of forest (Blaschke, P. et al.: 2008.). Animals can break down banks, putting soil directly into streams. Overgrazing pastures leaves soil exposed and sheep tracks along hillsides create channels for water to carry away soil into rivers, lakes, wetlands, and ultimately the coast.

Other land uses can also produce large amounts of sediment in waterways. Losses of soil from plantation forests are lower than from pasture for most of the forest rotation but when the trees are harvested and replanted, erosion rates go up 10-100 fold. Opencast mining, market gardening, urban development, and road building can all put sediment into water (Parliamentary Commissioner: 2012).

Nutrients

Plants and algae require nitrogen and phosphorus to grow, which are found naturally in water bodies. However, too much nutrient can cause algal blooms and other unwanted plant growth that impact on aquatic ecosystems.

Both nutrients occur in different chemical forms. The two common forms of nitrogen in water are nitrate and ammonia, whereas phosphorus mainly exists as phosphate. Both common forms of nitrogen – nitrate and ammonia – are highly soluble in water whereas phosphorus – in the form of phosphate – usually clings to soil and sediment.

Man-made sources of nitrogen include fertiliser runoff, urine from farm animals, and treated wastewater discharges. Phosphate usually gets into waterways via erosion, as sediment, because it clings to soil particles. Much of the phosphorus in freshwater today is a legacy of erosion caused by land clearance and fertilising for sheep farming.

Sewage and animal effluent are rich in both nitrogen and phosphorus. Many smaller wastewater treatment plants have limited treatment capability, leaving behind much of the nitrogen and phosphorus. Some sewers overflow at times and septic tanks can be poorly located and maintained. Animal effluent comes from dairy sheds, piggeries, freezing works, mole and tile drains, and from animals entering waterways. Manure can also wash off paddocks in heavy rain. Household detergents are also a source of phosphorus.

Although point sources of nitrogen and phosphorus can be very significant at specific places and times, overall they are much less significant than the diffuse sources. The great majority of the nitrogen that gets into fresh water comes from animal urine. The amount of phosphorus that gets into fresh water with sediment far outweighs inputs from point sources.

Nutrient rich overflow from a treatment pond discharging to a drain

Resource consents

Point source discharges which cannot meet permitted activity criteria in the regional plans require resource consent. As at 31 December 2011 there were about 900 resource consents for discharges to water and another 450 for discharges to land. They include farm dairy effluent discharges, municipal wastewater discharges, stormwater and industrial discharges. Figure 55 and Figure 56 show the approximate number and type of consented discharges to water and to land in Northland at 31 December 2011.

Figure 55: Northland Regional Council discharge to water consents

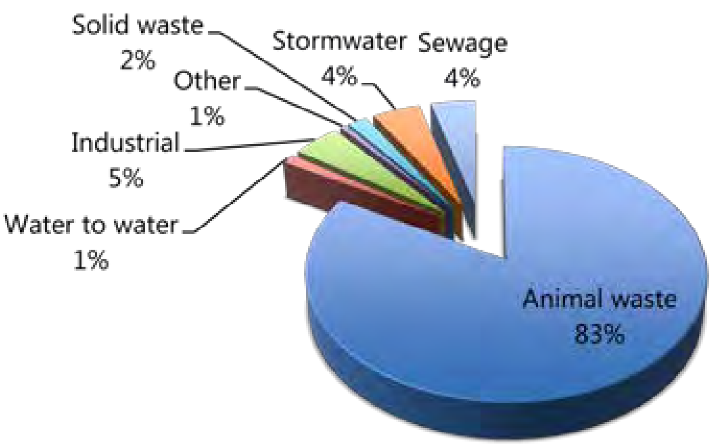
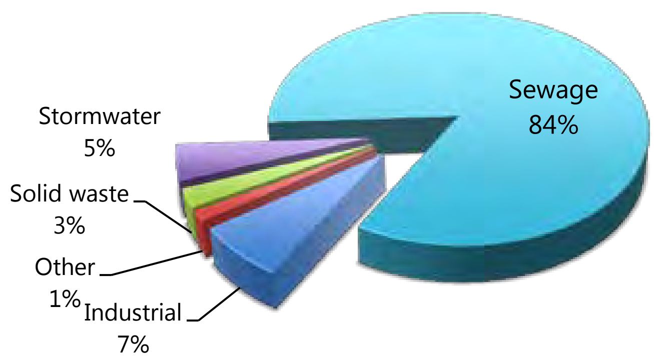


Figure 56: Northland Regional Council discharge to land consents

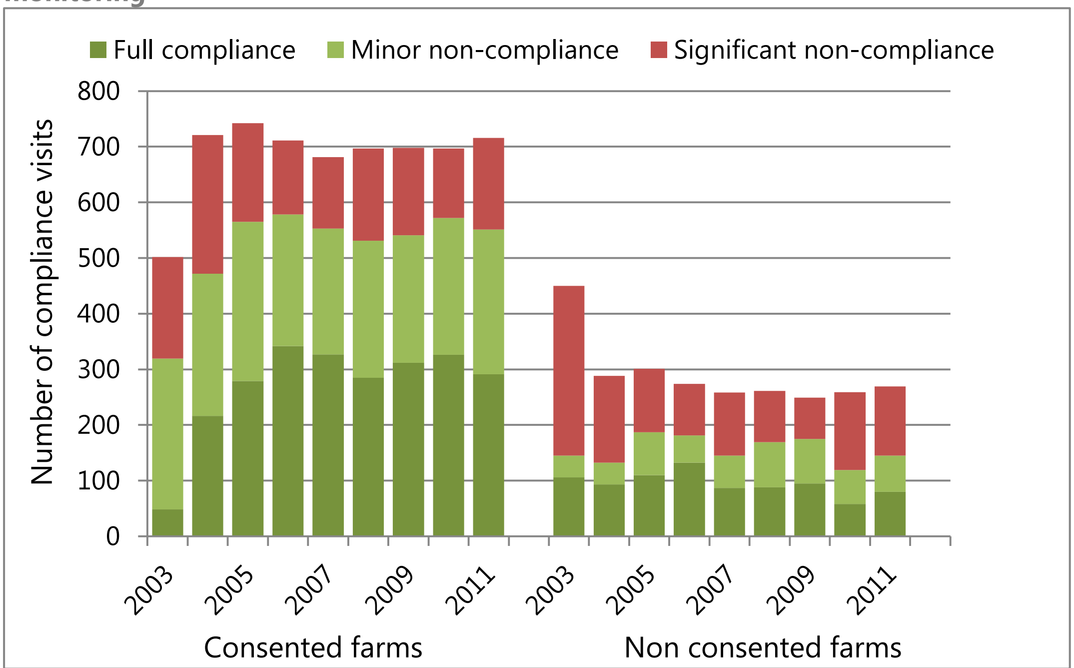


Farm dairy effluent discharges

Dairy farm numbers have remained relatively constant over the last five years. At the start of the 2011 dairy season there were 985 farm dairies being used in Northland. This included those milking cows for calf rearing but not supplying a milk processing plant. Of these, 716 were authorised by resource consent to discharge treated farm dairy effluent to water, although over 50% of these use land disposal as their primary method of disposal and only discharge to water for short periods of time in very wet conditions. The other 269 farms discharge effluent to water under the permitted activity critieria for land disposal in accordance with rule 16.1 of the *Regional Water and Soil Plan for Northland.*

The council monitors dairy farms annually under its Farm Dairy Effluent Monitoring Programme. Figure 57 shows farm dairy effluent compliance rates for the last nine years.

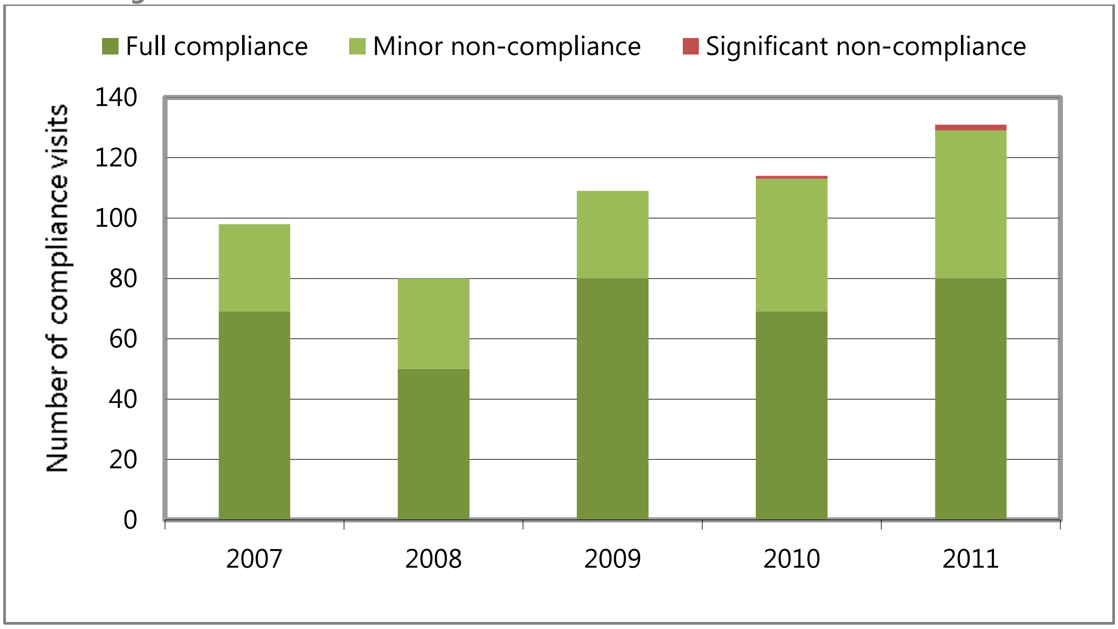
Figure 57: Farm dairy effluent compliance statistics based on Northland Regional Council monitoring



Industrial discharges

There are few major industrial discharges to water or land in Northland. At the end of December 2011 there were about 70 consented discharges (40 to water and 30 to land). Compliance rates for industrial discharges are shown in Figure 58.

Figure 58: Compliance rates for industrial discharges based on Northland Regional Council monitoring



Sewage waste discharges

The majority of sewage wastewater generated in Northland is collected and treated in community wastewater treatment plants. Across Northland, the Far North District Council, Kaipara District Council and Whāngārei District Council are responsible for 32 community wastewater treatment plants. All 32 treatment plants are operated under resource consents from Northland Regional Council. Twenty-four of these consents are for discharges to water; the remaining six are for discharges to land. Far North District Council has the most treatment plants with a total of 17, Whāngārei District Council has nine and Kaipara District Council has six. A number of the district council wastewater treatment plants have undergone upgrades in the last five years, including Kaeo, Kaitāia, Kawakawa, Whatuwhiwhi, Hikurangi, Ngunguru, Oakura, Whāngārei, Mangawhai and Maungaturoto.

As at 31 December 2011, there were also about 400 consents for the discharge of sewage to land from domestic "on-site" systems. If properly maintained, the environmental effects from septic tanks and other on-site systems are usually minimal. However, potential problems exist where the density of on-site systems is high, effluent soakage is poor and/or on-site systems are poorly maintained.

Over the last five years the council has recorded 564 incidents associated with sewage spills or non-compliances related to consented discharges. These incidents range from failing septic tanks to major sewage pump station discharges.

Stormwater

Stormwater discharges resulting from rain accumulates many different contaminants, including trace metals, hydrocarbons, nutrients, sediment, pathogens and faecal bacteria.

Most stormwater is discharged directly into water bodies without treatment. It is not uncommon for car washing detergent, traces of fuel, paint and other products to get washed directly into the stormwater systems.

At 31 December 2011 there were 61 resource consents for the discharge of stormwater to land (21) or to freshwater (40).

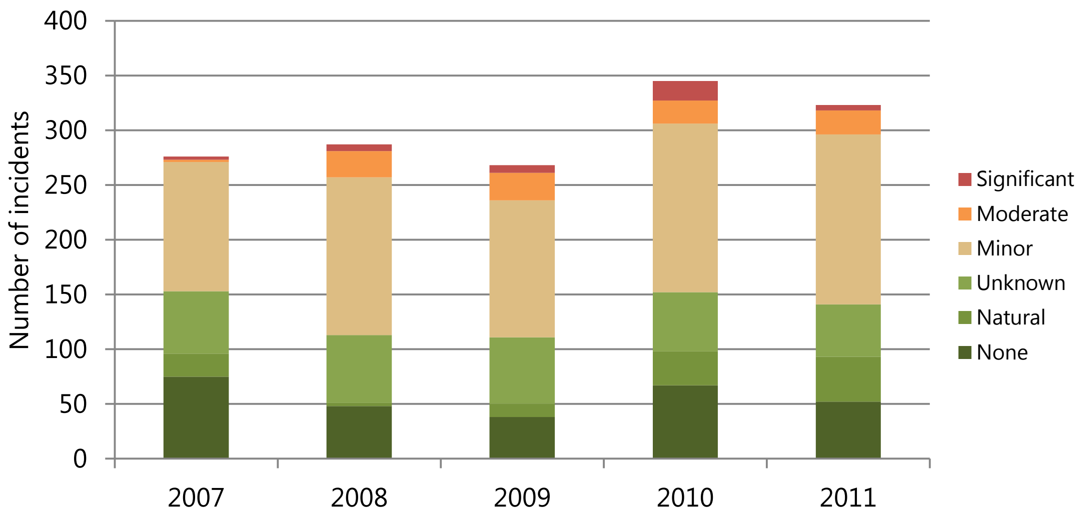
Compliance with these consents has generally been very good with only three recorded instances of significant non-compliance over the past five years. The bulk of stormwater point source discharges are unconsented.

Detergent from a stormwater pipe discharging to the Waiarohia Stream

Environmental incidents

Environmental incidents such as oil or sewage discharges can have an adverse impact on surface water quality in Northland. The council has operated its 24/7 Environmental hotline service since November 1993. The number of incidents reported to the council potentially affecting inland surface waters and their recorded impact are shown in Figure 59. The number of incidents reported over the five years is reasonably consistent, ranging from 268 in 2009 up to 345 in 2010. 2010 also saw the most incidents with significant adverse effects.

Figure 59: Adverse effects of environmental incidents in Northland from 2007-2011



What is our river water quality like?

Northland Regional Council operates a region-wide River Water Quality Monitoring Network to assess the health of Northland's rivers and streams over time. There are 36 monitoring sites which were chosen to provide a representation of water quality across catchments of different geology and land use throughout the region.

Guidelines

Key physico-chemical and microbiological monitoring data collected monthly from each monitoring site over the period 1 January 2007 to 31 December 2011 was summarised and compared, where available, against appropriate national water quality guidelines to provide an overview of the state of water quality at each site (Table 15).

In most instances the guideline values used were the Australian and New Zealand Environment and Conservation Council 'default' trigger values for lowland aquatic ecosystems (cited here as ANZECC: 2000).

There were some exceptions, as outlined in Table 15. In terms of microbiological water quality, the main *E. coli* trigger values relate to livestock drinking water, not contact recreation because the council has a separate monitoring programme to assess the suitability of popular river sites for contact recreation (see section "What is our freshwater recreational water quality like?"). The ANZECC (1992) stock water trigger values recommend a season median of 126 *E.coli*/100mL.

These trigger values are not legal standards and exceedances do not necessarily mean an adverse environmental effect would result (that is, they are not effects-based). Rather, they can be considered 'nominal thresholds' (Ballantine et al.: 2010), where an exceedance is an 'early warning' mechanism to alert resource managers to a potential problem or emerging change that may warrant site-specific investigation or remedial action (ANZECC: 2000).

Table 15: Water quality parameters and guideline values summarised in this report

Identifier (+unit)	Reference	Guideline value
Dissolved Oxygen	RMA 1991 Third Schedule	≥80 (% saturation)
Turbidity	ANZECC (2000)	≤5.6 (NTU)
Ammoniacal Nitrogen	ANZECC (2000)	≤0.021 (mg/L)
Nitrite-Nitrate Nitrogen	ANZECC (2000)	≤0.444 (mg/L)
Dissolved Reactive Phosphorus	ANZECC (2000)	≤0.010 (mg/L)
Escherichia coli	ANZECC (1992)	≤126 (cfu/100 mL)

Water Quality Index

A water quality index is used to facilitate inter-site comparisons of the state of water quality in the region's rivers and streams. This approach has been used at both a regional (for example, Piere *et al.*: 2012; Ozane: 2012) and national level (Larned *et al.*: 2005). The water quality index is calculated using the median values for the following six variables: dissolved oxygen (% saturation), turbidity, ammoniacal nitrogen, nitrite-nitrate nitrogen, dissolved reactive phosphorus, and *Escherichia coli* (Table 15).

The application of the water quality index enables water quality at each site to be classified into one of four categories:

- Excellent: median values for all six variables are within guideline values.
- Good: median values for five of the six variables are within guideline values, of which dissolved oxygen is one variable that must be met.
- Fair: median values for three or four of the six variables are within guideline values, of which dissolved oxygen is one variable that must be met.
- Poor: median values for <3 of the six variables comply with guideline values.

Sites with a grade of good, fair or poor represent degraded sites as the median value of at least one of the six key water quality variables is not within the guideline values. The degree of degradation is relative, with good sites having the least degraded water quality and poor sites the most degraded water quality.

Macroinvertebrate Community Index

Macroinvertebrate monitoring is undertaken to detect changes in the aquatic macroinvertebrate communities resulting from human-induced stresses, for example, contaminants entering the waterway. Macroinvertebrates are normally abundant in lotic (running water) ecosystems, and are commonly used in the assessment of water quality as their diverse communities provide varied responses to changing environmental conditions (Boothroyd & Stark: 2000). They are good indicators of local conditions because they tend to be limited in their in-stream movements, thus are affected by the environmental conditions over an extended period of time, unlike water quality measurements, which are snapshots of the waterway at that point, at that moment.

Initial macroinvertebrate monitoring in New Zealand was carried out following the procedures of Stark (1985), and have been revised several times (Stark: 1993; Stark: 1998; and Stark *et al.*: 2001). More recent publications added revised tolerance scores for taxa collected from soft-bottomed sites (Stark and Maxted: 2004, 2007); the resulting macroinvertebrate community index scores being labelled MCI-sb. The council uses soft-bottomed tolerance scores for *naturally* occurring soft-bottomed sites. All soft-bottomed sites that are deemed to be '*human induced*' are calculated using the conventional macroinvertebrate community index, that is, derived from hard-bottomed tolerance scores.

Table 17 and Table 18 provide the quality class and median scores from each monitoring site over the period 2007-2011.

Table 16: Interpretation of Macroinvertebrate Community Index (MCI) type scores

Quality class	MCI and MCI-sb
Excellent	≥120
Good	100-119
Fair	80-99
Poor	<80

For more information on the macroinvertebrate community index scores refer to the full reports on the Regional Council website at www.nrc.govt.nz/riverdata

Habitat assessments

In general, water quality, habitat and biological diversity in rivers are closely linked. To provide a fuller picture of river health the council undertakes habitat assessments at all river water quality monitoring sites. The habitat assessment involves assigning scores to the following stream characteristics: aquatic habitat abundance, aquatic habitat diversity, hydrologic heterogeneity, channel alteration, bank stability, channel shade, and riparian vegetation.

Habitat quality for aquatic biota is broken down into four categories: optimal, sub-optimal, marginal and poor. Results for each site are presented alongside the water quality index and macroinvertebrate community index scores in Table 17.

For more information on the habitat assessments refer to the full report available on the council's website at www.nrc.govt.nz/riverdata

Table 17: Water Quality Index grades (2007-2011) for River Water Quality Monitoring Network sites. Sites are graded by comparing median values with ANZECC guidelines. Main catchment land cover(s) are listed in order of most dominant to least dominant. Harvest is forest that has recently been harvested. The Macroinvertebrate Community Index scores for both hard (MCI) and soft bottomed (MCI-sb) sites are based on the median value over the period 2007-2011. The habitat scores are based on habitat assessments undertaken in 2012.

Catchment	Geology	Main land cover	Habitat score	MCI and MCI-sb Score	Water quality index
Mangakāhia @ Twin Bridges	Volcanic acidic	Agriculture, native forest, forestry	Sub-Optimal	Fair	Excellent
Waipapa @ Forest Ranger	Soft sedimentary	Native forest, forestry	Optimal	Good	Excellent
Waipoua @ SH12 Rest Area	Volcanic acidic	Native forest, agriculture	Optimal	Excellent	Excellent
Hātea u/s Mair Park Bridge	Volcanic acidic	Agriculture, urban, forestry, harvest, native forest	Sub-Optimal	Fair	Good
Kaihū @ gorge	Volcanic acidic	Agriculture, native forest, forestry	Sub-Optimal	Fair	Good
Kerikeri @ Stone Store bridge	Volcanic acidic	Agriculture, native forest, crops	Sub-Optimal	Poor	Good
Ngunguru @ Waipoka Rd	Hard sedimentary	Agriculture, native forest	Marginal	Fair	Good
Opouteke @ suspension bridge	Volcanic acidic	Forestry, native forest	Marginal	Fair	Good
Waiarohia @ Whau Valley	Hard sedimentary	Native forest, urban	Sub-Optimal	Fair	Good
Waiarohia @ Rust Avenue	Hard sedimentary	Native forest, urban, agriculture	Marginal	Good	Good
Waimamaku @ SH12	Volcanic acidic	Native forest, agriculture	Sub-Optimal	Good	Good
Waipapa @ Waipapa Landing	Volcanic acidic	Agriculture, crops, native forest	Sub-Optimal	Good	Good
Waitangi @ Watea	Hard sedimentary	Agriculture, native forest, forestry	Marginal	Poor*	Good
Waitangi @ Waimate Road	Volcanic acidic	Agriculture, native forest, forestry	Marginal	Fair	Good

* Calculated using Macroinvertebrate Community Index soft bottom (MCI-sb)

Table 17: continued

Catchment	Geology	Main land cover	Habitat score	MCI and MCI-sb Score	Water quality index
Awanui @ FNDC watertake	Soft sedimentary	Agriculture, native forest	Marginal	Fair	Fair
Awanui @ Waihue Channel	Soft sedimentary	Agriculture, urban	Marginal	Fair*	Fair
Hakaru @ Topuni Creek Farm	Soft sedimentary	Agriculture, native forest	Sub-Optimal	Fair	Fair
Kaeo @ Dip Road	Soft sedimentary	Agriculture, native forest, forestry	Poor	Fair	Fair
Mangahahuru @ Apotu Road	Hard sedimentary	Agriculture, forestry	Poor	Poor*	Fair
Mangahahuru @ Main Road	Hard sedimentary	Forestry, harvest, native forest	Sub-Optimal	Good	Fair
Mangakāhia @ Titoki Bridge	Volcanic acidic	Agriculture, native forest, forestry	Marginal	Good*	Fair
Mangamuka @ Iwiatua Road	Volcanic acidic	Native forest, agriculture	Marginal	Good	Fair
Manganui @ Mitaitai Road	Soft sedimentary	Agriculture, forestry, native forest	Marginal	Poor*	Fair
Oruru @ Oruru Road	Volcanic acidic	Agriculture, native forest	Marginal	Poor*	Fair
Otaika @ Otaika Valley Road	Soft sedimentary	Agriculture, native forest	No data	No data	Fair
Paparoa @ walking bridge	Soft sedimentary	Agriculture, forestry, native forest	Poor	Fair	Fair
Punakitere @ Taheke Recorder	Soft sedimentary	Agriculture, native forest, forestry	Sub-Optimal	Fair	Fair
Utakura @ Okaka Road Bridge	Hard sedimentary	Agriculture, forestry, native forest	Marginal	Poor*	Fair
Victoria @ Thompsons Bridge	Volcanic acidic	Native forest, agriculture	Sub-Optimal	Good	Fair
Waiharakeke @ Stringers Road	Soft sedimentary	Agriculture, native forest, forestry	Marginal	Good*	Fair
Waiotu @ SH1	Hard sedimentary	Agriculture, native forest	Marginal	Poor*	Fair
Waipao @ Draffin Road	Volcanic acidic	Agriculture	Marginal	Good*	Fair
Wairua @ Purua	Hard sedimentary	Agriculture, native forest	Marginal	Poor*	Fair
Whakapara @ cableway	Hard sedimentary	Agriculture, native forest, forestry	Marginal	Fair*	Fair
Mangere @ Knight Road	Soft sedimentary	Agriculture, native forest	Marginal	Poor*	Poor
Ruakaka @ Flyger Road	Soft sedimentary	Agriculture, native forest	Sub-Optimal	Excellent*	Poor

* Calculated using Macroinvertebrate Community Index soft bottom (MCI-sb).

Table 18: Water Quality Index grades for river water quality monitoring sites sampled at monthly intervals over the period 2007-2011, based on comparisons of median values with guideline values for six key variables (see Table 15). A green tick indicates the median falls within the guideline, while a cross indicates the median is not within the guideline.

Site	DO (% sat)	DRP (mg/L)	*E.coli* (MPN/100ml)	NH4 (mg/L)	NNN (mg/L)	Turbidity (NTU)	MCI	Water Quality Index
Mangakāhia @ Twin Brdgs.	109 ü	0.003 ü	121 ü	0.005 ü	0.032 ü	2.7 ü	95	Excellent
Waipapa Rv @ Forest	96 ü	0.005 ü	78 ü	0.003 ü	0.013 ü	1.8 ü	118	Excellent
Waipoua @ SH12	101 ü	0.003 ü	63 ü	0.005 ü	0.022 ü	2.3 ü	129	Excellent
Hātea u/s Mair Park	105 ü	0.008 ü	397 û	0.010 ü	0.385 ü	4.1 ü	95	Good
Kaihū @ Gorge	100 ü	0.005 ü	153 û	0.005 ü	0.226 ü	3.2 ü	87	Good
Kerikeri @ Stone Store	101 ü	0.007 ü	240 û	0.010 ü	0.410 ü	2.1 ü	77	Good
Ngunguru @ Waipoka Rd	97 ü	0.010 ü	305 û	0.010 ü	0.093 ü	5.5 ü	90	Good
Opouteke @ Suspension	107 ü	0.004 ü	174 û	0.005 ü	0.036 ü	2.7 ü	93	Good
Waiarohia @ Whau Valley	96 ü	0.010 ü	504 û	0.010 ü	0.402 ü	5.6 ü	92	Good
Waiarohia @ Rust Ave	107 ü	0.010 ü	414 û	0.010 ü	0.365 ü	2.5 ü	80	Good
Waimamaku @ SH12	103 ü	0.005 ü	393 û	0.005 ü	0.012 ü	3.3 ü	102	Good
Waipapa Stm @ Waipapa Ldg	96 ü	0.005 ü	173 û	0.010 ü	0.324 ü	2.2 ü	81	Good
Waitangi @ Watea	101 ü	0.005 ü	140 û	0.007 ü	0.248 ü	3.7 ü	61*	Good
Waitangi @ Waimate Rd	98 ü	0.006 ü	454 û	0.010 ü	0.407 ü	5.0 ü	99	Good

* Calculated using Macroinvertebrate Community Index soft bottom (MCI-sb).

Table 18. Continued

Site	DO (% sat)	DRP (mg/L)	*E.coli* (MPN/100ml)	NH4 (mg/L)	NNN (mg/L)	Turbidity (NTU)	MCI	Water Quality Index
Awanui @ FNDC watertake	82 ü	0.017 û	301 û	0.010 ü	0.039 ü	6.0 û	95	Fair
Awanui @ Waihue Channel	87 ü	0.043 û	309 û	0.020 ü	0.053 ü	9.1 û	85*	Fair
Hakaru @ Topuni Creek	103 ü	0.047 û	302 û	0.017 ü	0.260 ü	9.5 û	82	Fair
Kaeo @ Dip Road	95 ü	0.005 ü	627 û	0.010 ü	0.045 ü	6.4 û	96	Fair
Mangahahuru @ Apotu Rd	97 ü	0.027 û	572 û	0.020 ü	0.350 ü	6.9 û	77*	Fair
Mangahahuru @ Main Rd	96 ü	0.010 ü	227 û	0.010 ü	0.069 ü	6.0 û	102	Fair
Mangakāhia @ Titoki Brdg	95 ü	0.006 ü	237 û	0.011 ü	0.062 ü	5.9 û	100*	Fair
Mangamuka @ Iwiatua Rd	94 ü	0.030 û	272 û	0.005 ü	0.007 ü	1.0 ü	107	Fair
Manganui @ Mitaitai Rd	82 ü	0.039 û	135 û	0.012 ü	0.173 ü	9.4 û	69*	Fair
Oruru @ Oruru Rd	84 ü	0.021 û	292 û	0.010 ü	0.026 ü	6.7 û	73*	Fair
Otaika @ Otaika Valley Rd	84 ü	0.016 û	596 û	0.027 ü	1.268 û	5.1 ü	No data	Fair
Paparoa @ walking bridge	89 ü	0.020 û	573 û	0.020 ü	0.094 ü	8.9 û	80	Fair
Punakitere @ Taheke	100 ü	0.017 û	419 û	0.010 ü	0.407 ü	6.2 û	95	Fair
Utakura @ Okaka Rd Bridge	88 ü	0.011 û	327 û	0.014 ü	0.136 ü	18.4 û	71*	Fair
Victoria @ Thompsons	94 ü	0.016 û	170 û	0.010 ü	0.008 ü	2.0 ü	111	Fair
Waiharakeke @ Stringers	95 ü	0.016 û	357 û	0.014 ü	0.117 ü	8.6 û	103*	Fair
Waiotu @ SH1	93 ü	0.020 û	377 û	0.020 ü	0.250 ü	8.3 û	75*	Fair
Waipao @ Draffin Road	102 ü	0.030 û	620 û	0.010 ü	2.600 û	2.7 ü	101*	Fair
Wairua @ Purua	92 ü	0.016 û	84 ü	0.019 û	0.342 ü	8.4 û	76*	Fair
Whakapara @ cableway	97 ü	0.020 û	187 û	0.010 ü	0.262 ü	6.2 û	91*	Fair
Ruakaka @ Flyger Rd	80 û	0.087 û	542 û	0.038 ü	0.385 ü	18.3 û	120*	Poor
Mangere @ Knight Rd	84 ü	0.054 û	691 û	0.040 ü	0.596 û	6.9 û	76*	Poor

* Calculated using Macroinvertebrate Community Index soft bottom (MCI-sb)

Based on monthly monitoring over the period January 2007 to December 2011, three (8%) of the 36 sites monitored had a water quality index grade of 'excellent, (Table 17). Two of the sites that were assigned this grade were located in catchments dominated by native forest. The remaining site, "Mangakāhia River at Twin Bridges" is located in a catchment composed of agriculture, and native and plantation forestry. All three sites are located in the upper reaches of the region's rivers and have a mix of volcanic and soft sediment geology.

Eleven sites (31%), draining a mixture of agriculture, native, and plantation forestry received a water quality grade of 'good', indicating that median values for five of the six water quality variables in the water quality index were within their respective guideline values. The guideline value that the good sites did not meet was the indicator bacteria *E.coli* guideline for stock drinking water (≤126/100mL) (Table 18). The guideline value for stock drinking water is considered conservative and the council is unaware of any major issues regarding livestock health and water quality in the region. It should also be noted that while the sites exceeded the stock drinking water guideline, they were still within the higher trigger value for contact recreation (*E.coli* >550/100mL) indicating they are generally suitable for swimming.

Twenty sites (56%) were assigned a 'fair' water quality grade. These sites are located in predominately agricultural catchments (Table 18), with one site in plantation forest, and two sites in a mix of native forest and agriculture. The guideline values for dissolved reactive phosphorus, *E.coli*, and turbidity were the variables 'fair' sites most commonly exceeded (Table 17).

Two sites received a water quality grade of 'poor' because median values for less than half of the six water quality variables in the water quality index were within their respective guidelines (Table 17), and in the case of the Ruakaka River, the median DO% value exceeded the guideline. Both poor sites exceeded the dissolved reactive phosphorus, *E.coli* and turbidity guidelines, and the Mangere River also exceeded the Nitrite-Nitrate Nitrogen guideline.

A summary of chemical water quality data at the 36 river water quality monitoring sites and a comparison with guideline values can be found in Appendix A.

Mangere River – poor water quality

Waipoua River – excellent water quality

Figure 60: Percentage breakdown of overall water quality grade at river water quality monitoring sites

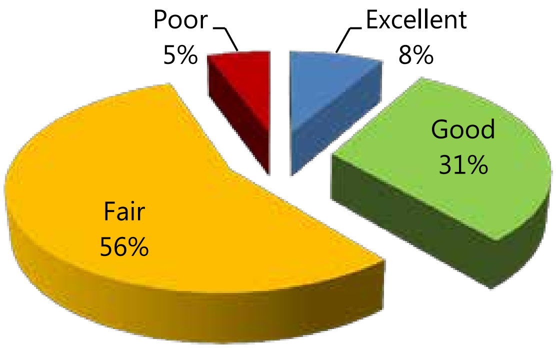
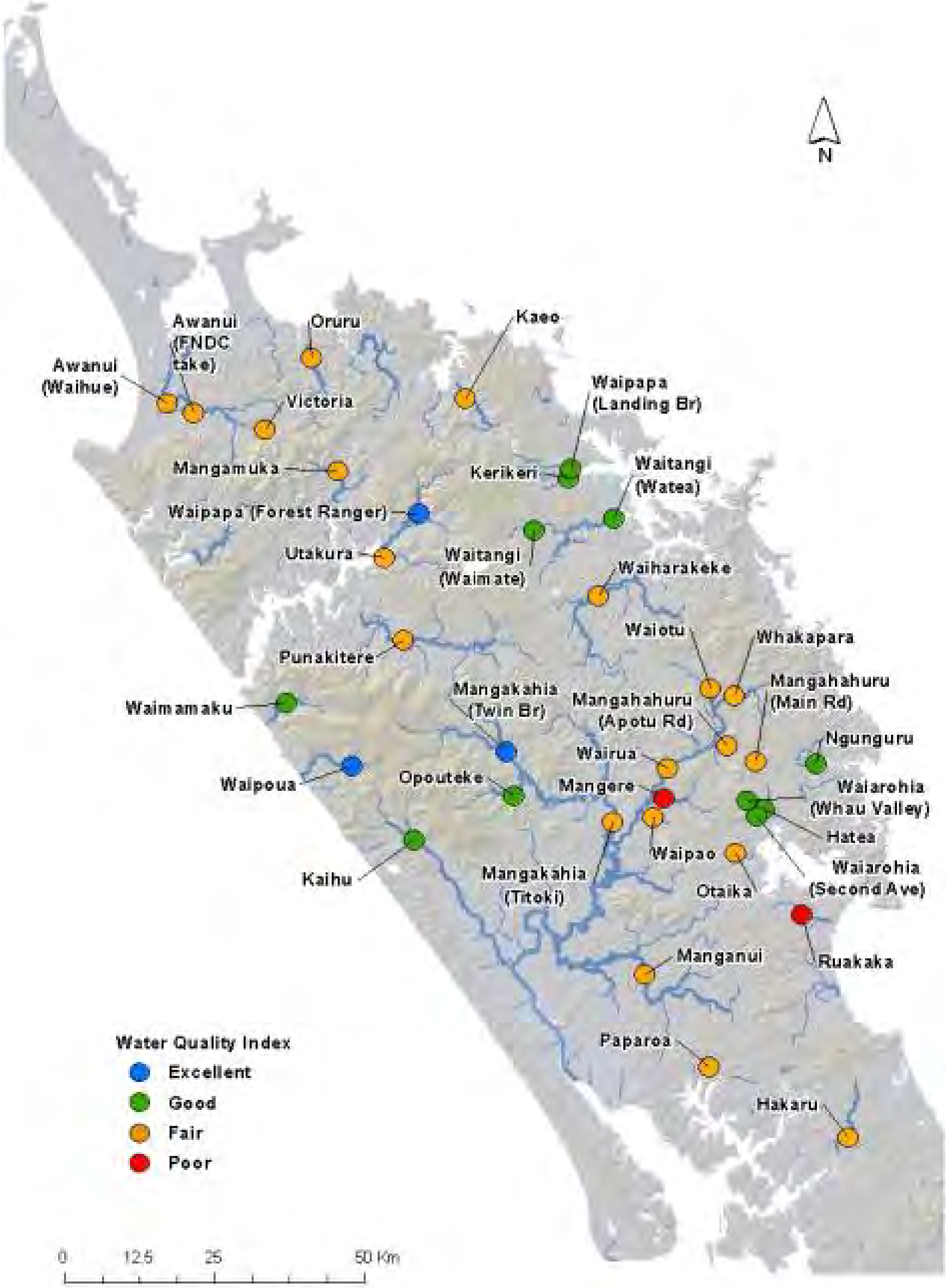


Figure 61: Surface freshwater quality classifications for the Northland region based on the River Water Quality Monitoring Network



Long-term water quality trends

Long-term trend analysis was carried out on River Water Quality Monitoring Network sites with more than five years of water quality data (24 sites). The data period used for the trend analysis was from January 2003 or when sampling began to the end of 2011. A summary of the results can be found in Table 19.

Overall there were several positive changes in water quality between 2003 and 2011. Improvements were seen across all nutrient parameters in particular total phosphorus with 13 out of the 24 sites recording a decreasing trend in concentration. Several sites exhibited decreasing trends across several nutrient parameters including Kaihū River, Mangakāhia River at twin bridges, Mangere River, Opouteke River, Punakitere River, Waipapa River and Waipoua River.

Fencing to exclude livestock has contributed to a number of improving trends in water quality on the Punakitere River

Decreasing trends in ammoniacal nitrogen at several sites is a good indication of improvements in point source discharges in the catchments. Many of the sites are situated in agricultural catchments and include the Kaeo, Mangere, Opouteke and Ruakaka rivers.

Positive trends in water clarity have been recorded at six sites with two of those sites having a corresponding positive trend in turbidity.

Degrading trends in turbidity have been observed at four sites; Mangahahuru Stream at Main Road and Apotu Road, Victoria River and Waitangi River at Waimate North.

Table 19: Trends for 24 River Water Quality Monitoring Network sites from 2003 or when records began to 2011. A green "smiley face" indicates an improving trend and a red "unhappy face" a deteriorating trend. An empty cell indicates no significant trend.

Site	Dissolved Oxygen %	*E.coli*	Clarity	Turbidity	Temperature	pH	Ammoniacal Nitrogen	Nitrate/Nitrite Nitrogen	Total Nitrogen	Dissolved Reactive Phosphorus	Total Phosphorus
Awanui River Waihue channel									J		J
Awanui River FNDC take											
Kaeo River					L		J	J		J	
Kaihū River	L						J	J		J	
Mangahahuru Stream Apotu Rd				L							J
Mangahahuru Stream Main Rd		L		L	L						
Mangakāhia River Titoki bridge	L		J			J					
Mangakāhia River Twin Bridges			J				J	J	J	J	J
Manganui River						L					
Mangere River							J			J	J
Opouteke River							J			J	J
Punakitere River			J				J		J	J	J
Ruakaka River							J			J	J
Victoria River			L	L						J	
Waiarohia Stream Second Ave			J	J		L				J	J
Waiarohia Stream Whau Valley			J	J		L					J

Site	Dissolved Oxygen %	*E.coli*	Clarity	Turbidity	Temperature	pH	Ammoniacal Nitrogen	Nitrate/Nitrite Nitrogen	Total Nitrogen	Dissolved Reactive Phosphorus	Total Phosphorus
Waiharakeke Stream											J
Waiotu River											J
Waipapa River			J					J	J		J
Waipoua River		L						J		J	J
Wairua River										J	
Waitangi River Waimate North				L		J	J				
Waitangi River Watea											
Whakapara River											

What is our lake water quality like?

The overall health of a lake can be determined by measurements of four key parameters (chlorophyll *a*, water clarity, total nitrogen and total phosphorus) to create a Trophic Level Indicator score. This score is then used to determine the trophic level of a lake, which falls into one of seven categories (Table 20).

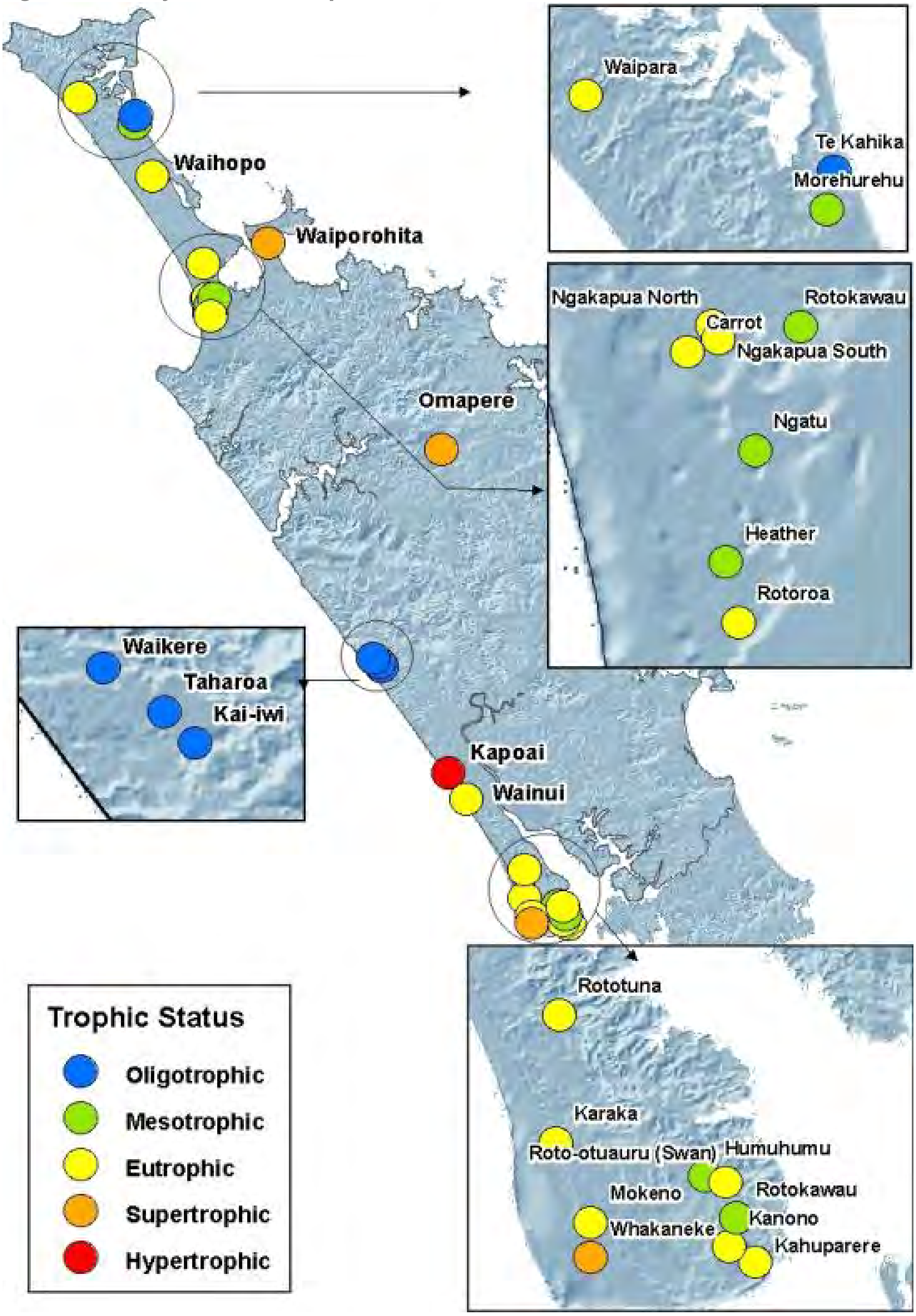
Table 20: Values of variables that define the boundaries of different trophic levels (Burns et al.: 2000)

Lake type	Trophic level	Chlα (mg/m^3)	Clarity (m)	TP (mg/m^3)	TN (mg/m^3)
Ultra-microtrophic	0.0 - 1.0	0.13 - 0.33	33 - 25	0.84 - 1.8	16 - 34
Microtrophic	1.0 - 2.0	0.33 - 0.82	25 - 15	1.8 – 4.1	34 - 73
Oligotrophic	2.0 - 3.0	0.82 - 2.0	15 - 7.0	4.1 – 9.0	73 - 157
Mesotrophic	3.0 - 4.0	2.0 - 5.0	7.0 - 2.8	9.0 - 20	157 - 337
Eutrophic	4.0 - 5.0	5.0 - 12	2.8 - 1.1	20 - 43	337 - 725
Supertrophic	5.0 - 6.0	12 - 31	1.1 - 0.4	43 - 96	725 - 1558
Hypertrophic	6.0 - 7.0	> 31	< 0.4	> 96	> 1558

Lake Te Kahika on the Aupōuri Peninsula

The five-year median Trophic Level Indicator scores for the 28 monitored lakes show that 64% of the lakes are eutrophic or worse, meaning that they have poor water clarity and high nutrient levels. Of these lakes, the majority are located in agricultural catchments. The lake that has the highest Trophic Level Indicator score (poorest water quality) was Lake Kapoai which is located just south of Dargaville. Four of the lakes are classed as oligotrophic (excellent water quality), including the three Kai Iwi lakes and Lake Te Kahika (Figure 62).

Figure 62: Five-year median trophic status for the 28 monitored lakes



Long-term lake water quality trends

Long-term trend analysis was carried out on the 28 lakes and showed that four of the lakes had significant improvements in trophic level indicator scores: these include Lakes Kahuparere, Ōmāpere, Waiporohita and Wainui. Five lakes had significant degrading trends in trophic level indicator scores, which includes Lake Kai Iwi (Table 21).

Table 21: Trends for the 28 monitored lakes from December 2005 to June 2011. Note: lakes with trends calculated over a ten year period. A green "smiley face" indicates an improving trend and a red "unhappy face" indicates a deteriorating trend. An empty cell indicates no significant trend, ND = no data, BD= below detection, ID= insufficient data.

		Temperature	Dissolved Oxygen	Conductivity	Chlorophyll a	pH	Clarity (Secchi)	Dissolved Reactive Phosphorus	Ammoniacal Nitrogen	Total Nitrogen	Total Phosphorus	Suspended Solids	Trophic Level Index
Aupōuri lakes	Carrot			J			J	BD	J	J	J		
	Heather		J	J			L						
	Morehurehu						L		L	L			
	Ngakapua north								L	L		L	
	Ngakapua south						L		L				
	Ngatu		J		L	L	L		J			L	L
	Rotokawau		J						L				
	Rotoroa						L	BD		L			
	Te Kahika		J										
	Waihopo												
	Waipara		L		L		L	BD		L		L	L
	Waiparera							BD					
Karikari/ Central lakes	Ōmāpere (east site)*		L	L	J	J	J		J	J		J	J
	Ōmāpere (west site)*		L	L	J	J	J	ND	ND	J			J
	Waiporohita								J			J	J
Kai iwi lakes	Kai Iwi*				L		L			L			L
	Taharoa*				L								
	Waikare*												

		Temperature	Dissolved Oxygen	Conductivity	Chlorophyll a	pH	Clarity (Secchi)	Dissolved Reactive Phosphorus	Ammoniacal Nitrogen	Total Nitrogen	Total Phosphorus	Suspended Solids	Trophic Level Index
Poutō lakes	Humuhumu					L							
	Kahuparere												J
	Kanono			L									
	Kapoai												
	Karaka				L	L	L			L			
	Mokeno		J										
	Rotokawau			J									
	Rototuna			J	L					L			L
	Swan		L	L	ID					L			L
	Wainui						J					J	J
	Whakaneke												

Twelve lakes (43%) recorded a significant trend in water clarity; four of which were improving trends and eight were deteriorating trends. Six of the lakes which had deteriorating water clarity also had corresponding trends in increasing algae concentrations.

What is our recreational freshwater quality like?

The Northland Regional Council, in conjunction with the district councils and Northland Health, survey the water quality at a number of the region's most popular freshwater swimming spots every summer. Up to 30 sites in lakes and rivers throughout Northland have been sampled weekly over the five summers in the 2007-2011 period to check whether the microbiological water quality meets guidelines for suitability for swimming (Table 22).

The bathing water quality is assessed according to concentrations of indicator bacteria: these do not cause disease themselves, but signal the potential presence of disease-causing pathogens. A high concentration of the indicator bacteria means that it is more likely that disease-causing organisms are present, therefore a potentially higher health risk. However, it does not mean that anyone swimming in the water at that time will actually be affected. Councils do not measure the pathogens directly because the technology to do this is not cost-effective or is unreliable.

Escherichia coli (*E.coli*) is used as an indicator for assessing health risk in freshwater for humans and livestock. The levels of *E. coli* are compared to the microbiological water quality guidelines for recreational users (less than 550 *E. coli*/100mL (Ministry for the Environment: 2003)), to determine whether the water is suitable for recreational use.

Table 22: Single sample guidelines for fresh water sites (Ministry for the Environment: 2003)

***Escherichia coli* count**	**Category**	**Response**
Sample < 260 per 100 ml	Surveillance (considered suitable for swimming)	§ No response necessary – weekly sampling continues
260 < Sample < 550 per 100 ml	Alert (considered potentially unsuitable for swimming)	§ Situation monitored and further sampling undertaken if levels remain elevated
Sample > 550 per 100 ml	Action (considered unsuitable for swimming)	§ Follow-up samples taken within 24 hrs to confirm high result § Warning signs erected if result confirmed § Public informed through the media that a public health risk exists § If results remain above action threshold, site investigation undertaken

For more information visit the council website: www.nrc.govt.nz/swimmingWQreports

Otamure Bay Stream

Table 23: Freshwater grading system broken down into four categories

Category
95-100% samples <550/100 ml *E.coli*
90-95% samples <550/100 ml *E.coli*
75-90% samples <550/100 ml *E.coli*
<75% samples <550/100 ml *E.coli*

Table 24: Statistics for the freshwater recreational bathing programme sites from 2007/08 to 2011/12

Site name	Total No. of samples	Median Value (*E.coli*/100mL) Compared to guidelines listed in Table 22	Percentage of samples within guidelines listed in Table 23
Aurere River at SH10 bridge	12	194	75.0
Coopers Beach Stream at Below SH10 bridge	21	2481	14.3
Hikurangi Lake	25	20	100.0
Kaihū River at swimming hole	37	98	81.1
Kaikou River	25	309	72.0
Kapiro Stream at Purerua Road bridge	39	341	71.8
Kerikeri Stone Store	44	264	68.2
Lake Ngatu at south end	17	10	100.0
Lake Rotopokaka (CocaCola)	12	20	100.0
Lake Taharoa at Pump house	30	10	100.0
Lake Waro at Launching Area, Hikurangi	29	52	86.2
Langs Beach Stream at mid-beach ponding area	26	948.5	30.8
Langs Stream below toilets	28	314	64.3
Mangakāhia River above Twin Bridges	38	217	73.7
Ocean Beach Stream	22	1081	31.8
Omamari Beach Stream	35	145	85.7
Otamure Stream	44	1182.5	27.3
Otaua Stream	36	386	66.7
Pacific Bay Stream at footbridge	2	10086	50.0
Raumanga Stream	48	284.5	77.1
Tirohanga Stream	40	263.5	85.0
Victoria River	38	249.5	78.9
Waiharakeke	12	568.5	41.7
Waipapa River (Puketi)	35	63	94.3
Waipapa Stream at swimming hole	12	204	75.0
Waipapa Basin	27	110	85.2
Waipoua River at Swimming hole at DOC HQ	40	85.5	90.0
Waipū Beach at Stream at beach	20	220.5	80.0
Waitangi at Lily Pond	39	262	82.1
Whāngārei Falls	51	512	52.9

Out of the 30 freshwater sites that have been sampled in 2007-2011, four sites (all lakes) were within guidelines on all sampling occasions. Two sites were within guidelines 90-95% of the time, 11 sites 75-90% of the time, and 13 sites were within the guidelines less than 75% of the time.

The council investigates poor water quality at problem sites within the region. This includes identifying the source(s) of contamination, sanitary surveys at sites where there is human contamination, and additional monitoring after rainfall to determine when sites are suitable for swimming again.

A total of 17 sites have now been investigated. Source tracking to isolate the sources of contamination at these sites has shown that 14 are intermittently contaminated by wildfowl, for example, ducks and/or gulls. Ten sites are contaminated by ruminant (herbivore) faecal material; five sites with dog faecal material and two sites by a human source of contamination.

Follow-up sampling and sanitary surveys at the two sites with human contamination found no evidence of human faecal contamination.

Where the source of faecal contamination is natural (that is, from birds), little can be done to reduce the problem and permanent signage warning people of the potential health risk is used in some situations. In areas where the source of contamination is livestock, council staff work with landowners to implement land management options to ultimately reduce contamination.

It should be noted that even in rivers which originate in pristine forested catchments (for example, Waipapa and Waipoua rivers), high counts of the indicator bacteria *E.coli* have been observed after rainfall. The likely source of contamination is plant decay, or possibly wild animals like possums, pigs or goats. As a general rule, the council recommends that swimming should be avoided for two to three days after heavy rainfall.

How are we measuring up against our objectives?

The following are environmental results anticipated listed in the operational Regional Policy Statement.

Water quality suitable for desired purposes

- The majority of recreational bathing sites are generally acceptable for swimming and other freshwater recreational activities during dry weather. However, after heavy or prolonged rain, the waterways become unsuitable for several days.
- Water quality for aquatic ecosystems is highly variable. Guidelines are regularly exceeded in catchments with high intensity land use, whereas ecosystem health in native forested catchments is excellent. Lowland streams, especially in agricultural and urban areas, have poor ecosystem health.
- No freshwater body in Northland or New Zealand is likely to meet the NZ drinking water standard of less than 1 *E. coli*/100ml (Ministry of Health: 2005) without treatment.
- Water taken from most Northland freshwater bodies for stock drinking water is likely to exceed the stock water guidelines. However, the stock water guideline is considered overly stringent and to the council's knowledge the quality of stock drinking water in Northland is not a major problem.

Contaminants in water bodies reduced

- Overall there has been a reduction in contaminants at river water quality monitoring network sites. Reporting shows that the 2010/11 annual compliance with water quality guidelines of the sites was greater than the 2006/07 baseline for the five key parameters. This is supported by the results of trend analysis calculated for the sites with more than five years' worth of data (Table 17) here are improving trends for: total phosphorus at 54% of sites; dissolved reactive phosphorus at 46% of sites; total nitrogen at 25% of sites; and ammoniacal nitrogen at 33% of sites. However, there are a few declining trends; bacterial contamination is increasing at two sites and turbidity increasing at four sites.
- Poor water quality in Northland lakes is still being recorded with state and trend analysis indicating an increase in eutrophication. In 2010/11, 64% of lakes monitored were found to be eutrophic or worse (high nutrient and algal biomass with low water clarity). Trend analysis indicates that overall water quality is declining in lakes as there are more declining trends than improving trends. There are declining trends for: total nitrogen at 29% of sites; water clarity at 29% of sites; algal biomass at 21% of sites; and trophic level index scores at 18% of sites. However, improving trends in ammoniacal nitrogen, total nitrogen and trophic level index have been observed at 14% of sites.
- Farm dairy effluent treatment systems are by far the most numerous point source discharges to surface waters and land in Northland. There remains a significant level of non-compliance particularly by unconsented farms (Figure 57). Presently, 51% of systems discharge to land and 49% to surface water. Agricultural land use is the most significant source of non-point source pollution in Northland. However, the full extent that agricultural runoff contributes to the total pollution loading of the region's rivers and streams is not known.
- Over the last few decades, through industry amalgamations and improvements in wastewater treatment, pressures on Northland's waterways from industrial discharges have decreased significantly.

The adverse effects of contaminants in water bodies and coastal waters are avoided, remedied or mitigated

- As outlined above, although there are signs of improvement, the adverse effect of contaminants in water bodies and coastal waters remains a problem.

That all existing discharges of organic contaminants be via the best practicable option for treatment and disposal by the year 2004

- Some 740 farm dairy effluent resource consents were issued in the 2007-2011 period. All of the associated effluent systems have been rigorously assessed using a suite of criteria for "best practicable option". The criteria included industry guidelines, cow numbers, milking regime, local rainfall, soil types, land contour and financial considerations. Where systems were identified as needing upgrade, the upgrade and timeframes were included as conditions of consent.

That all new discharges of organic contaminants be via the best practicable option for treatment and disposal

- The same process as above has been followed with all new discharges.

Improved aquatic habitat

- Habitat quality at the majority of sites is marginal with 51% of river water quality monitoring network sites falling into this category, although more positive trends in habitat quality are apparent from the data than negative. Nine percent of sites fall into the poor category and two sites classed as optimal in 2012. Trends in habitat quality observed over five samples (taken in 2005, 2007, 2008, 2010 and 2012) indicate that habitat quality has improved at 10 sites, declined at two sites and remained stable at 15 sites. Sites with declining trends are lowland pastoral and urban sites and include the Ruakaka and Awanui rivers. Some of the changes since 2005 were inconclusive due to insufficient data and/or the subjectivity of the assessor.

What is being done?

Waiora Northland Water

Access to freshwater is essential for the well-being of people, the environment, and our economy. Effective management of freshwater means having the right qualities and quantities of water available, to support each of these wellbeings.

The Northland Regional Council has a broad programme for improving water quality, quantity and management in the region - Waiora Northland Water. Through Waiora Northland Water, we will protect and maintain freshwater quality in Northland to suit a range of needs and values.

In particular, Waiora Northland Water will implement the National Policy Statement for Freshwater Management in Northland. The national policy statement is about facilitating the setting of community objectives for freshwater management that will help us tailor our efforts, identify appropriate water standards, and monitor our progress towards completing our goals.

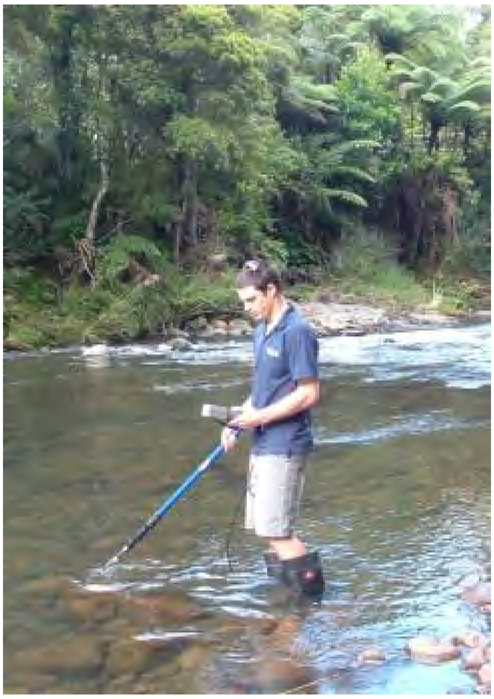
We know freshwater quality has a major influence on our coastal environment, so we are also taking an integrated approach. Our work on implementing the national policy statement will link to our work in the region's harbours, estuaries and coast. As part of the Northland Regional Council's development of its Long Term Plan 2012-2022, it adopted a staged programme to implement the national policy statement in the region. Water improvements will take time, will involve new approaches, and will not necessarily be achieved in one step. We will focus first on:

- Our outstanding water bodies (the Waipoua catchment and Kai Iwi Lakes);
- High priority water bodies (Waitangi, Mangere, and upper Whāngārei Harbour catchments);
- All the other water bodies will also have interim or default limits, but these will be progressively reviewed and made more specific on a priority basis.

The range of freshwater management tools we'll use is likely to be as diverse as Northland's water bodies. For example, we'll continue to encourage good practice and promote it through our Environment Fund. In terms of policy, we've already set an overarching framework for implementing the national policy statement through our Proposed Regional Policy Statement for Northland. We have existing rules set out in our Regional Water and Soil Plan. Where necessary, we will introduce plan changes to update regulations and enforce rules to achieve the agreed objectives.

The council's Environmental Management Committee will maintain an overview of the coordinated efforts of many who will be involved in Waiora Northland Water. We will work with key stakeholders, including iwi, hapū and communities to identify values and interests in freshwater and management options. Where possible we will use existing groups and information.

For further information about the council's implementation programme for the Freshwater National Policy Statement you can download a copy of the full programme from the council's website at www.nrc.govt.nz/waiora. You can also access the National Policy Statement for Freshwater Management at the Ministry for the Environment's website: www.mfe.govt.nz



Council staff measuring water quality

State of the Environment Monitoring

Regional Water Quality Monitoring Network

Thirty-six sites are sampled on a monthly basis for physico-chemical parameters (four of these are part of the National River Water Quality Network and are sampled by NIWA) so that baseline levels and water quality trends can be assessed.

In addition, all sites are monitored annually for macroinvertebrates and assessed for habitat quality and quantity (ecosystem health) every second year.

Investigations are carried out at sites which show a decreasing water quality trend in order to identify the cause of the deteriorating water quality and resolve the problem.

Freshwater Recreational Bathing Programme

Since 1999/2000 the council has assessed water quality at several of Northland's popular freshwater swimming sites every summer between November and March. The sites are reviewed every year and changed as required. Sites are sampled weekly for *E. coli* to check whether the microbiological water quality is suitable for recreational use. Elevated results are passed on to the district councils and Northland Health to be followed up. Sites which have consistently poor water quality are investigated further using faecal source tracking, catchment mapping, and sanitary surveys where appropriate.

For more information go to www.nrc.govt.nz/swimmingWQreports

Lake Water Quality Monitoring Network

Thirty-one lakes are monitored four times a year for a range of parameters including total and dissolved nutrients, chlorophyll α, suspended solids, water clarity, pH, temperature and dissolved oxygen. Lake Ōmāpere is also sampled at least every two months. Lake condition monitoring and weed surveillance is also carried out, the majority surveyed on an annual basis.

Reconnaissance surveys and occasionally water quality sampling is carried out on lakes not currently in the network to establish their ranking based on the presence of indigenous and exotic flora and fauna and water quality status. If a high ecological ranking is given to a lake and/or issues concerning the lake have been raised then the lake may be added to the lake water quality monitoring network or a separate monitoring programme set up for the lake.

Farm Dairy Effluent Monitoring Programme

All dairy farms are monitored annually. Where a discharge to water is identified, water quality field tests are done and samples taken for laboratory analyses. Monitoring is timed to coincide with seasonal peak effluent loadings. All systems are assessed and assigned a compliance grade of full compliance, non-compliant or significant non-compliant. Where significant non-compliance is identified, council officers arrange on-farm meetings to discuss the non-compliance and to reach agreements on options for improvement/upgrade.

Forestry Earthworks and Harvesting Guidelines for Northland

Plantation forestry earthworks and harvesting are permitted under the council's Regional Water and Soil Plan for Northland, subject to conditions. New guidelines have been developed by the council and the RMA Forestry Development Group to help foresters meet those conditions. Free workshops have been held to help landowners better manage plantation forest.

For more information go to www.nrc.govt.nz/forestry

Plantation forest harvesting on the Brynderwyn Range

Environmental care groups

There are many environmental care groups throughout Northland that are taking action to enhance the environment. The overall aim of most of these groups is to enhance environmental quality, whether this is biodiversity or water quality, through a range of work such as pest and weed control, riparian planting and fencing off waterways and coastal areas, and raising public awareness about the environment.

Environment Fund

The Northland Regional Council Environment Fund has provided more than $4.2 million to help people improve and protect Northland's natural environment since 1996. The Environment Fund is used to assist with funding projects to restore and enhance the natural environment, including the fencing of native bush and waterways, including rivers, lakes and wetlands, and coastal dune management and restoration work, including planting of riparian vegetation and pest control.
For more information refer to the indigenous biodiversity chapter of this report or got to www.nrc.govt.nz/environmentfund

Earthworks workshops

The council offers a series of day-long sediment control workshops for developers, earthwork contractors and planners, during winter months. The aim of the workshops is to increase understanding on best management practices to reduce adverse effects on the environment from earthworks and introduce the latest sediment control methods. Sediment is one of the most serious and common contaminants of Northland's waterways because of the region's high rainfall, soil types and topography.

Education and public awareness

The council provides information to the general public and schools on environmental issues, environmental management and the role of the council, including surface water quality. This is carried out through exhibits at field days and shows, media releases, newsletters, council publications and workshops on regional environmental matters for the general public. At least 40 school visits by regional council environmental educators, teacher workshops and a youth summit are also carried out every year for teachers and school students.

Many schools, stream care groups and landowners have learnt how to check the quality of streams using the Stream Health and Monitoring Assessment Kit, which can be purchased from NIWA.

Students monitoring stream health

Site investigations

Lake Ōmāapere

Lake Ōmāpere is Northland's largest lake at 1160ha however it only has an average depth of 2m. The lake is situated in a relatively small catchment (2110ha), which is a mix of dairying, drystock farming and lifestyle properties.

The lake became highly enriched with nutrients as a result of runoff from surrounding land use over the last century. In the 1970s, oxygen weed (*Egeria densa*) was accidently introduced and thrived in the nutrient rich waters. The weed quickly spread throughout the lake forming dense surface-reaching beds. The weed collapsed in 1985 causing severe blue-green algae blooms which reduced water clarity, formed surface scums, reduced oxygen levels and created unpleasant odours.

Historical blue-green algal scums around the eastern edge of Lake Ōmāpere

Silver carp were introduced into the lake in 1986 to control algal blooms and oxygen weed, however these were unsuccessful. By 1999, oxygen weed had increased again and covered the entire lake. The weed collapsed again in 2001/2002 and the algal blooms returned. Grass carp were released into the lake to control oxygen weed in 2000 and 2002 and had completely eradicated the weed from the lake by 2003. However, the lake was still highly enriched and suffered from severe algal blooms, particularly over summer.

The poor water quality in Lake Ōmāpere has affected the Utakura River and upper Hokianga Harbour since the weed collapsed in 1985. The poor water quality has made:

- The lake and river unsuitable as a water supply;
- Affected food resources, such as tuna from the lake and fish and shellfish, from the river and upper harbour; and
- Restricted recreational uses such as swimming and waka ama.

The Lake Ōmāpere Restoration and Management Project

The Lake Ōmāpere Restoration and Management Project was a joint initiative between the council and the Lake Ōmāpere Trust. The overall aims of the project were to develop and implement a voluntary Lake Management Strategy that would work towards improving the health of the lake and establish the Lake Ōmāpere Trustees in their role as kaitiakitanga. A number of management initiatives have been undertaken around the lake and include riparian planting and fencing, farm planning, and weed and pest control.

It is estimated that over 54 kilometres of streams, drains, wetlands and lake edge has been fenced to exclude stock over the duration of the project. Approximately 84% of the lake edge is now fenced with only two landowners that have not fenced their lake margin.

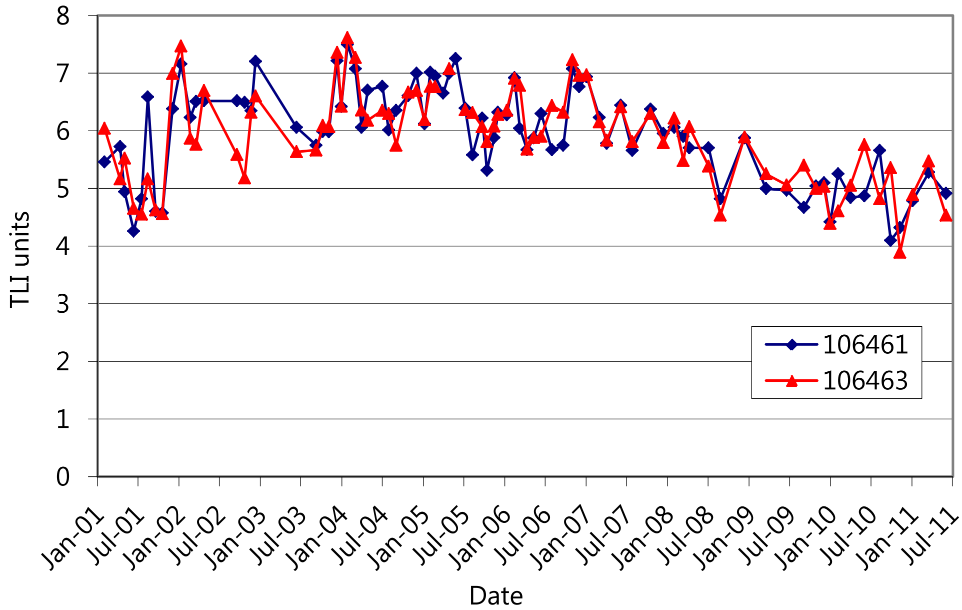
From 2005 to 2008, there were at least 11 planting days held with over 10,000 plants being put in the ground around the lake's margin, with many more planted outside of planting days. Planting days were carried out by volunteers, school groups, landowners, Conservation Corps, Corrections Department Community Service Workers and Lake Ōmāpere Trustees.

Lake water quality

Water quality monitoring has been undertaken by the council in the lake since 2001 and prior to this, it had been sampled by NIWA since 1992. Monitoring was usually carried out on a bimonthly basis however during summers when algal blooms were severe monitoring was carried out every month.

Trend analysis on the past 10 years of data (2001 to 2011) indicates that water quality is improving in Lake Ōmāpere. Significant improving trends have been recorded in chlorophyll a, clarity, total nitrogen, trophic level index and suspended solids (Figure 64).

Figure 63: Trophic level indicators for both Lake Ōmāpere sites from 2001 to 2011



It is difficult to determine the extent to which restoration efforts around the lake have contributed to the improvements in lake quality and whether these improvements will be long lasting as similar improvements have been seen in the past and the internal nutrient load is still significant. However, a significant decline in nutrients has occurred in the lake and it is likely that a proportion of these nutrients have been flushed out via the outlet. It has also been suggested that a proportion of the nutrients have been retained by the freshwater mussel population in the lake. Planktonic algae use the nutrients and the mussels filter algae from the water.

Continuing work preventing aquatic weed incursions will further improve water quality and prevent the lake from transitioning between macrophyte dominated and algae dominated phases.

Other research projects

Investigative sampling has been undertaken at three Northland rivers that have on-going water quality problems; Mangere, Otiria and Waipū rivers. Monitoring programmes were set up in these catchments to try to identify the potential sources of contamination. Monitoring was carried out on a fortnightly or monthly basis and involved sampling at a number of sites in the catchment to help identify problem areas. Findings from these programmes will be used by the council to promote improvements in the problem areas of these catchments to improve water quality.

For more information go to www.nrc.govt.nz/riverdata

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Appendix A

Table 25: Summary of chemical water quality data and comparison with guideline/trigger values at 36 River Water Quality Monitoring Network sites between January 2007 and December 2011. Median values that do not comply with a guideline value are shown in bold font.

Site name	Ammoniacal nitrogen (mg/L)					Nitrate nitrite nitrogen (mg/L)					Dissolved reactive phospohorus (mg/L)					Water Quality Index
	Median	Min	Max	*n*	Results ≤0.021	Median	Min	Max	*n*	Results ≤0.444	Median	Min	Max	*n*	Results ≤0.010	
Mangakāhia @ Twin Brdgs.	0.005	0.0025	0.016	41	100.0%	0.032	0.001	0.56	41	97.6%	0.00325	0	0.096	40	92.5%	Excellent
Waipapa R @ Forest	0.003	0.0005	0.023	66	98.5%	0.0125	0.0005	0.163	66	100.0%	0.005	0	0.011	66	98.5%	Excellent
Waipoua @ SH12	0.005	0.0025	0.27	60	98.3%	0.0225	0.002	0.131	60	100.0%	0.0025	0	0.106	59	96.6%	Excellent
Hātea u/s Mair Park	0.01	0.007	0.57	45	80.0%	0.385	0.083	1.25	42	59.5%	0.008	0	0.068	40	80.0%	Good
Kaihū @ Gorge	0.005	0.005	0.42	60	91.7%	0.226	0.001	0.938	60	83.3%	0.005	0	0.02	59	88.1%	Good
Kerikeri @ Stone Store	0.01	0.008	0.21	53	84.9%	0.41	0.045	1.41	53	60.4%	0.007	0	0.06	51	72.5%	Good
Ngunguru @ Waipoka Rd	0.01	0.006	0.08	51	80.4%	0.093	0.003	0.46	51	96.1%	0.01	0	0.28	49	71.4%	Good
Opouteke @ Suspension	0.005	0.0025	0.1	60	98.3%	0.036	0.001	0.382	60	100.0%	0.004	0	0.037	59	94.9%	Good
Waiarohia @ Whau Valley	0.01	0.01	0.21	62	91.9%	0.402	0.002	1.64	60	61.7%	0.01	0	0.02	58	67.2%	Good
Waiarohia @ Rust Ave	0.01	0.008	0.27	60	93.3%	0.3645	0.029	1.12	60	60.0%	0.01	0	0.037	58	67.2%	Good
Waimamaku @ SH12	0.005	0.0025	0.06	51	96.1%	0.012	0.001	0.652	51	98.0%	0.005	0	0.03	50	96.0%	Good
Waipapa Str @ Waipapa Ldg	0.01	0.007	0.16	53	96.2%	0.324	0.01	0.91	53	75.5%	0.005	0	0.03	51	94.1%	Good
Waitangi @ Watea	0.007	0.001	0.087	66	90.9%	0.248	0.0005	0.935	66	78.8%	0.005	0	0.026	66	89.4%	Good
Waitangi @ Waimate Rd	0.01	0.01	0.15	60	83.3%	0.407	0.053	0.82	60	58.3%	0.006	0	0.025	57	89.5%	Good
Awanui @ FNDC watertake	0.01	0.008	0.104	60	83.3%	0.0385	0.002	0.722	60	98.3%	**0.0165**	0	0.076	58	12.1%	Fair
Awanui @ Waihue Channel	0.02	0.01	0.39	104	58.7%	0.053	0.002	0.708	59	96.6%	**0.043**	0.01	1.5	90	2.2%	Fair
Hakaru @ Topuni Creek	0.0165	0.01	0.2	52	69.2%	0.2595	0.003	0.861	52	88.5%	**0.047**	0.02	0.174	51	0.0%	Fair
Kaeo @ Dip Road	0.01	0.009	0.051	59	93.2%	0.045	0.002	0.613	59	98.3%	0.005	0	0.197	57	93.0%	Fair
Mangahahuru @ Apotu Rd	0.02	0.01	0.137	60	63.3%	0.35	0.004	1.71	60	66.7%	**0.027**	0.01	0.111	58	8.6%	Fair
Mangahahuru @ Main Rd	0.01	0.01	0.05	60	88.3%	0.069	0.006	0.44	60	100.0%	0.0095	0	0.06	58	79.3%	Fair
Mangakāhia @ Titoki Brdg	0.0105	0.001	0.081	66	92.4%	0.062	0.0005	0.504	66	98.5%	0.006	0	0.031	66	86.4%	Fair

Mangamuka @ Iwiatua Rd	0.005	0.0025	0.014	53	100.0%	0.007	0.001	0.652	53	98.1%	**0.03**	0.01	0.04	51	0.0%	Fair
Manganui @ Mitaitai Rd	0.012	0.01	0.086		68.3%	0.173	0.002	0.648		90.0%	**0.039**	0.01	0.076		3.4%	Fair
Oruru @ Oruru Rd	0.01	0.008	0.05	53	88.7%	0.026	0.002	0.592	53	96.2%	**0.021**	0.01	0.145	51	2.0%	Fair
Otaika @ Otaika Valley Rd	**0.0265**	0.013	0.165	6	33.3%	**1.2675**	0.416	1.483	6	16.7%	**0.016**	0.01	0.026	6	16.7%	Fair
Paparoa @ walking bridge	0.02	0.01	0.7	52	65.4%	0.0935	0.002	0.942	52	94.2%	**0.02**	0	0.051	51	17.6%	Fair
Punakitere @ Taheke	0.01	0.005	0.08	60	80.0%	0.407	0.001	0.78	60	55.0%	**0.017**	0	0.071	59	32.2%	Fair
Utakura @ Okaka Rd Bridge	0.0135	0.005	0.05	52	88.5%	0.136	0.01	0.432	52	100.0%	**0.011**	0	0.16	51	49.0%	Fair
Victoria @ Thompsons	0.01	0.005	0.017	60	100.0%	0.008	0.002	0.642	60	98.3%	**0.016**	0	0.024	58	12.1%	Fair
Waiharakeke @ Stringers	0.0135	0.01	0.17	60	73.3%	0.117	0.004	1.007	60	95.0%	**0.016**	0	0.113	58	29.3%	Fair
Waiotu @ SH1	0.02	0.01	0.15	60	58.3%	0.2495	0.002	2.2	60	73.3%	**0.02**	0.01	0.121	58	5.2%	Fair
Waipao @ Draffin Road	0.01	0.007	0.443	65	83.1%	**2.6**	0.017	3.7	65	1.5%	**0.03**	0.01	0.07	64	1.6%	Fair
Wairua @ Purua	0.019	0.001	0.234	54	53.7%	0.342	0.0005	3.291	54	63.0%	**0.016**	0	0.114	54	16.7%	Fair
Whakapara @ cableway	0.01	0.01	0.134	60	78.3%	0.262	0.002	1.47	60	78.3%	**0.02**	0.01	0.054	58	6.9%	Fair
Ruakaka @ Flyger Rd	**0.0375**	0.01	0.241	60	25.0%	0.3845	0.056	1.5	60	60.0%	**0.087**	0.03	0.149	59	0.0%	Poor
Mangere @ Knight Rd	**0.04**	0.01	0.35	109	28.4%	**0.596**	0.013	2	109	37.6%	**0.054**	0.01	0.373	108	0.9%	Poor

Table 26: Summary of physical and microbiological water quality data and compliance with guideline/trigger values at 36 River Water Quality Monitoring Network sites between January 2007 and December 2011. Median values that do not comply with a guideline value are shown in bold font.

Site name	Dissolved oxygen (% saturation)					Turbidity (NTU)					*E. Coli* (MPN/100mL)					Water Quality Index
	Median	Min	Max	*n*	Results ≥80%	Median	Min	Max	*n*	Results ≤5.6	Median	Min	Max	*n*	Results ≤126	
Mangakāhia @ Twin Brdgs.	108.9	68.1	127.6	41	97.6%	2.7	1	90	38	73.7%	121	10	4884	41	56.1%	Excellent
Waipapa Rv @ Forest	96.4	89.1	101.5	66	100.0%	1.825	0.42	27.3	66	83.3%	77.7	6.3	1203	66	68.2%	Excellent
Waipoua @ SH12	101	69.4	106.2	63	96.8%	2.3	1	26	57	86.0%	67.5	5	1720	60	73.3%	Excellent
Hātea u/s Mair Park	105.35	35.7	146.7	46	93.5%	4.1	2	75	47	70.2%	**396.5**	74	12997	48	6.3%	Good
Kaihū @ Gorge	100	0.83	109.2	64	93.8%	3.2	1	120	57	68.4%	**153**	20	19863	60	40.0%	Good
Kerikeri @ Stone Store	101.15	61.5	203	52	92.3%	2.1	0.8	100	118	85.6%	**240**	10	24192	121	28.1%	Good
Ngunguru @ Waipoka Rd	97.3	68.5	131	51	92.2%	5.5	2.3	102	48	52.1%	**305**	121	11199	51	5.9%	Good
Opouteke @ Suspension	107.3	0	120.2	60	95.0%	2.7	1	50	57	70.2%	**174**	10	3873	60	31.7%	Good

Waiarohia @ Whau Valley	95.7	60	138	67	91.0%	5.6	2.1	42	61	52.5%	**504**	10	12997	61	6.6%	Good
Waiarohia @ Rust Ave	107	73.5	138.5	65	93.8%	2.5	1.7	39	57	73.7%	**413.5**	30	24192	60	8.3%	Good
Waimamaku @ SH12	103.3	65.7	113.8	51	96.1%	3.3	1	65	48	79.2%	**393**	63	6488	51	9.8%	Good
Waipapa Str @ Waipapa Ldg	95.9	61.8	113.7	53	92.5%	2.15	2	28	50	84.0%	**173**	10	8664	53	32.1%	Good
Waitangi @ Watea	101	82.6	112.7	66	100.0%	3.65	0.8	42.3	66	69.7%	**140.1**	48.8	2419	65	43.1%	Good
Waitangi @ Waimate Rd	97.5	68.8	121.9	60	95.0%	5	1.8	200	57	56.1%	**453.5**	148	7701	60	0.0%	Good
Awanui @ FNDC watertake	81.65	62.6	121	60	56.7%	**6**	2	90	57	43.9%	**301**	20	24192	60	13.3%	Fair
Awanui @ Waihue Channel	87.1	37.7	134.3	93	68.8%	**9.05**	2.4	130	56	23.2%	**309**	10	24192	180	11.7%	Fair
Hakaru @ Topuni Creek	103.4	72.2	131.7	53	98.1%	**9.5**	4.3	160	49	8.2%	**302**	52	12997	52	7.7%	Fair
Kaeo @ Dip Road	95.4	69.8	145.1	57	91.2%	**6.35**	2	140	56	44.6%	**627**	10	8664	59	5.1%	Fair
Mangahahuru @ Apotu Rd	97.4	55.9	126.8	61	88.5%	**6.9**	2	65	57	29.8%	**572**	10	24192	60	5.0%	Fair
Mangahahuru @ Main Rd	95.7	64	126.8	61	96.7%	**6**	2.8	39	57	36.8%	**227**	52	3873	60	18.3%	Fair
Mangakāhia @ Titoki Brdg	94.7	73.3	110	66	98.5%	**5.875**	1.7	250	66	48.5%	**237.95**	75.9	3448	64	15.6%	Fair
Mangamuka @ Iwiatua Rd	93.8	72.9	153.7	53	92.5%	1	1	280	49	81.6%	**272**	41	4884	53	20.8%	Fair
Manganui @ Mitaitai Rd	82.4	41.8	144.3		57.4%	**9.4**	2.5	114		19.3%	**135**	10	11199		48.3%	Fair
Oruru @ Oruru Rd	84.2	9.5	120.5	52	67.3%	**6.65**	2	180	50	42.0%	**292**	63	17329	53	15.1%	Fair
Otaika @ Otaika Valley Rd	84.35	73.1	102.8	6	66.7%	5.1	4.5	330	3	66.7%	**596**	148	12997	6	0.0%	Fair
Paparoa @ walking bridge	89.1	33	129.8	53	75.5%	**8.9**	2	100	49	20.4%	**573**	108	6131	52	3.8%	Fair
Punakitere @ Taheke	99.7	58.6	119	61	95.1%	**6.2**	1	160	57	43.9%	**419**	120	17329	60	1.7%	Fair
Utakura @ Okaka Rd Bridge	87.55	53.3	97.3	52	78.8%	**18.4**	1	240	49	6.1%	**327**	30	19863	52	7.7%	Fair
Victoria @ Thompsons	94.25	62.4	123	60	93.3%	2	0.5	180	57	86.0%	**170**	41	3448	60	35.0%	Fair
Waiharakeke @ Stringers	94.8	50.5	242.7	60	85.0%	**8.6**	2.2	70	57	24.6%	**357**	52	4106	60	8.3%	Fair
Waiotu @ SH1	93	61.3	119.3	61	86.9%	**8.3**	3.7	90	57	22.8%	**376.5**	74	6488	60	3.3%	Fair
Waipao @ Draffin Road	102.3	66.3	135.1	65	93.8%	2.7	1.5	65	62	82.3%	**620**	109	12033	65	3.1%	Fair
Wairua @ Purua	92.1	56.3	126.7	53	79.3%	**8.4**	1.7	65	54	22.2%	84	25.6	17329	52	73.1%	Fair
Whakapara @ cableway	96.5	69.1	124.2	61	83.6%	**6.2**	2.4	119	57	36.8%	**187**	20	14136	60	33.3%	Fair
Ruakaka @ Flyger Rd	**79.8**	51	110.9	61	47.5%	**18.3**	8.2	85	56	0.0%	**541.5**	148	15531	60	0.0%	Poor
Mangere @ Knight Rd	83.8	38.3	119.2	111	68.5%	**6.9**	2	90	97	34.0%	**691**	74	24192	111	0.9%	Poor

Surface water quantity

The quantity of water available in a specific water resource (for example, groundwater, springs, rivers, lakes and wetlands) is a key attribute with respect to its values and the actual and potential use of that resource.

Natural river and stream flows and lake and wetland levels are driven by rainfall. However, other variables such as catchment geology, soils, vegetation cover, and land uses have an influence. When rains fall onto land some seeps into the ground and becomes part of the groundwater system, while most of the rest flows over land into our lakes, wetlands, streams and rivers, and eventually to the ocean. However, some water will also be taken up by plants and some will evaporate before it flows into a water body. Most of Northland's major river systems drain to estuaries and harbours.

Mangakāhia River near Twin Bridges

What do we want for our surface water quantity?

The operative Regional Policy Statement for Northland details existing council and community objectives for each natural and physical resource in our region. The objectives relating to surface water quantity are:

- The maintenance of the flows and levels in significant streams, rivers and wetlands to preserve their natural character and to protect high ecological, cultural or scenic values.
- The maintenance of water flows and levels in natural water bodies that are sufficient to preserve their life-supporting capacity, natural character, intrinsic values and any associated or dependent values.
- The maintenance of groundwater levels to the extent that the use of groundwater is sustainable.
- The efficient use and conservation of water resources.

- To protect property and other values from adverse effects due to the diversion of water from its natural drainage pattern.

The operative Regional Policy Statement also states anticipated environmental results as a consequence of implementing the policies and methods for achieving the water quantity objectives:

- Protection of important freshwater habitats, particularly wetlands from reductions in surface water and groundwater levels;
- Preservation of the natural character, intrinsic, ecosystem and amenity values of water bodies to the extent that these depend on water levels and flows;
- Protect the values of water bodies held by tangata whenua;
- Sustainable and efficient use of the water resources in Northland;
- Increased awareness of water conservation and the greater implementation of water; and
- Minimisation of actual and potential damage to property from damming, diversion and discharge of runoff.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

Council staff at Waipoua River measuring low water flows

What are Northland's surface water resources?

Rivers

Northland has a dense network of rivers and streams, many of which are relatively short with small catchments. Catchments on the east coast tend to be smaller than those on the west coast. Most of the major rivers have their outlets into harbours with few discharging directly to the coast.

Differences in flows between catchments can be attributed to rainfall patterns, catchment size and geology. In Northland, catchment geology greatly influences low flow during drought conditions. Fractured basalt rock readily absorbs rainfall and slowly releases it through springs. This slow release sustains the flow during dry periods at more than 3.5 litres per second per square kilometre. Examples of rivers flowing through basaltic and greywacke geology are the Punakitere, Waipao, Waipapa and Ngunguru rivers.

Catchments with less pervious geology absorb less rain and therefore have less water available in storage. Flows from these catchments tend to recede quickly during dry summers, with little sustaining base flow. Many streams in the Aupōuri Peninsula have little or no base-flow and in catchments where there is underlying mudstone-sandstone geology, less than 1l/s per km^2 is released during drought months. Examples of rivers in Northland that flow through catchments of mudstone-sandstone geology are Selwyn Swamp and the rivers of the Awanui catchment.

Water level and flow trends in Ngunguru River, east of Whāngārei for the period January 2007 to December 2011 are shown in Figure 64 and Figure 65. This flow monitoring station is an original Northland representative basin (catchment) with records starting in 1969. There are no known water takes upstream of this station. The plots in the graph show extremes in water levels and flows ranging from extreme high flows to extreme low flows.

Figure 64: River level trends in the Ngunguru River 2007-2011

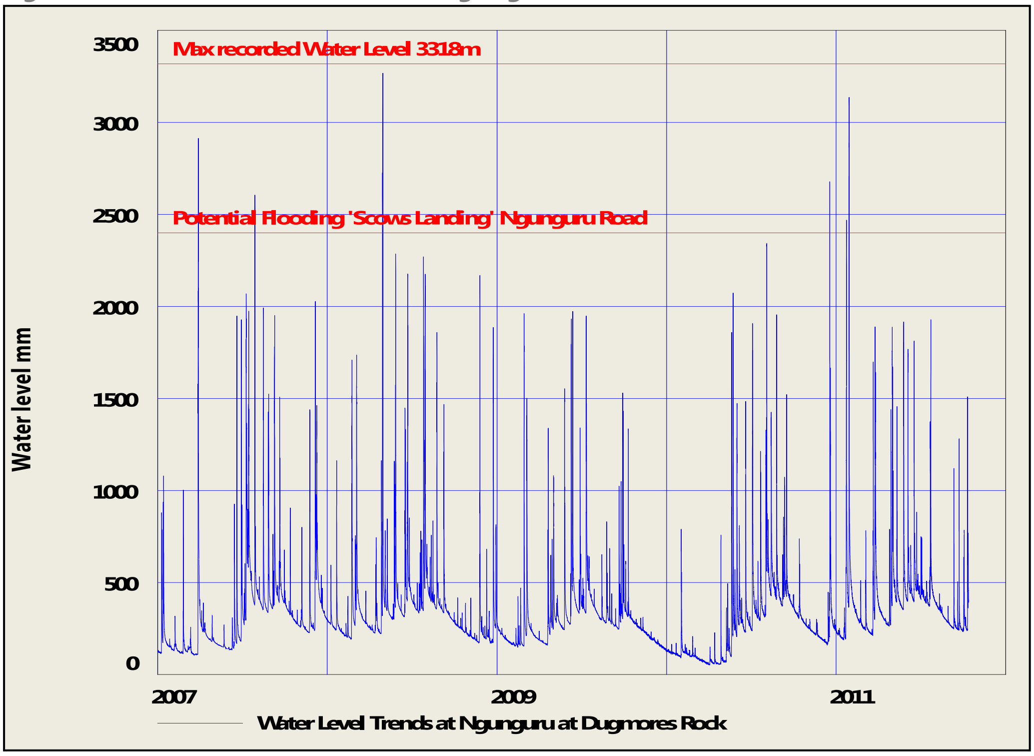
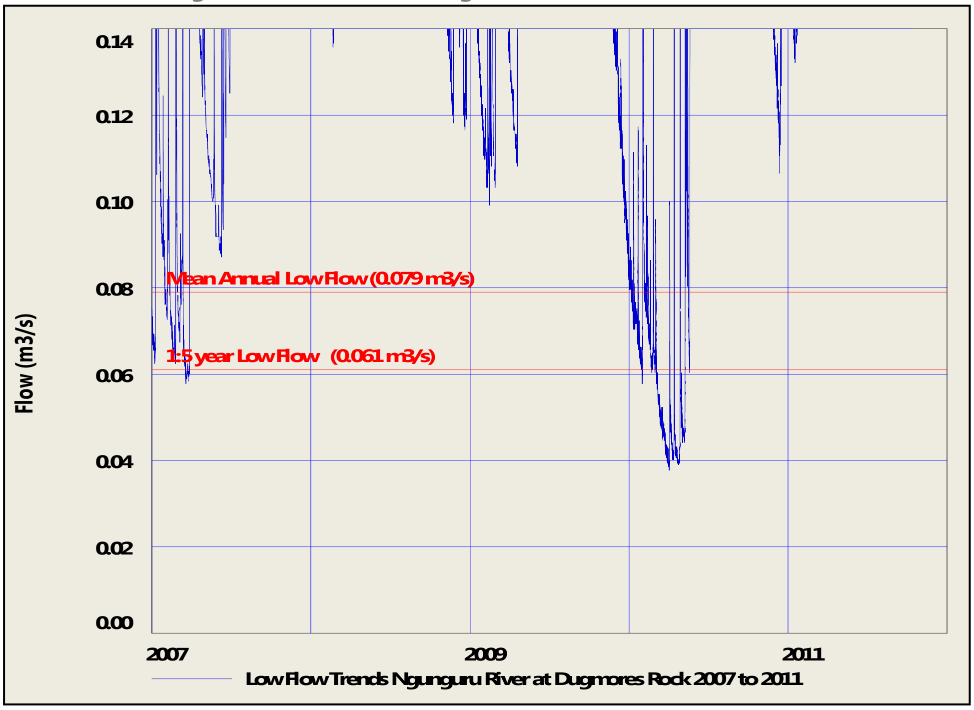


Figure 65: Low flow limits in the Ngunguru River 2007-2011 show significant dry periods in 2007 and during the Northland drought in 2009/2010



Lakes and wetlands

Northland has a large number of small and generally shallow lakes and associated wetlands, most of which have been formed between stabilised sand dunes along the west coast. These dune lakes generally have little or no continuous surface in-flows or out-flows, being primarily fed by rainfall directly on to their surfaces and surrounding wetlands. As a result, their levels fluctuate considerably with climatic patterns. The council monitors water levels in 16 lakes monthly in the Poutō and Aupōuri peninsulas and also at one inland lake near Kaikohe, Lake Owhareiti.

Groundwater base-flows

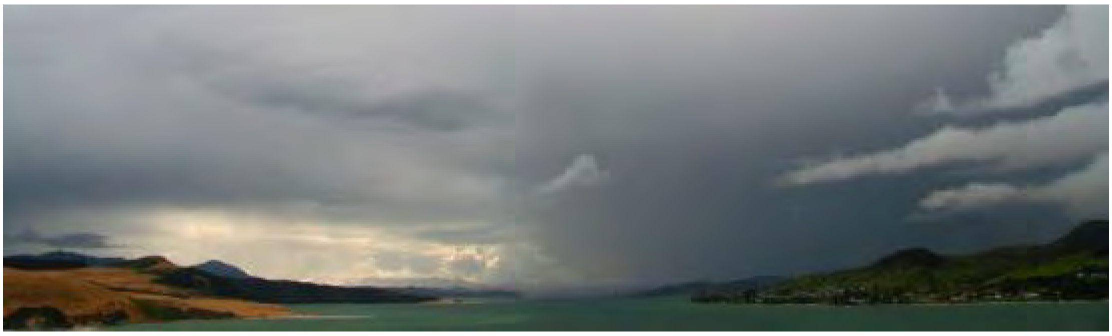
In some areas of Northland, groundwater discharges to the surface as discrete springs and/or along the base of streams. During periods of low rainfall these groundwater discharges are particularly important as they maintain flows within the streams and rivers. These are referred to as groundwater base-flows.

The main areas in Northland where groundwater base-flow is an important component of surface water flows are the areas surrounding fractured basalt fields such as Whāngārei, Kaikohe and Kerikeri. In such areas, low groundwater levels result in low groundwater base-flows in streams and rivers.

Investigations have been undertaken to calculate the effects of stream depletion as a result of groundwater abstractions. For more information refer to the groundwater resources chapter of this report.

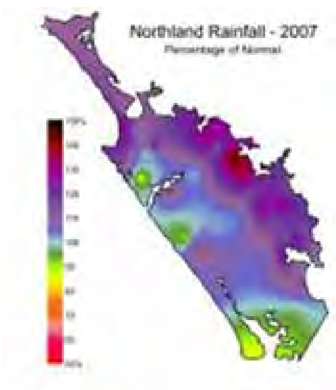
Rainfall

Northland's weather during the period 2007 to 2011 was influenced by a series of extreme rainfall events and severe droughts.

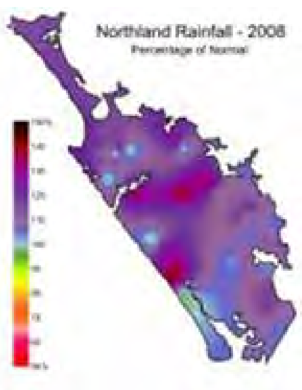


Isolated rain storm over the Hokianga Harbour (©: Bee Scene Photography)

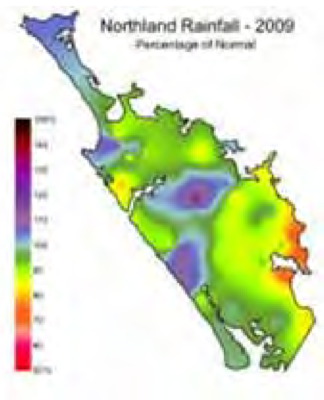
Annual rainfall for Northland ranges from 900mm in low-lying coastal areas to over 2900mm at higher altitudes. Rainfall patterns in Northland over the five-year period January 2007 to December 2011 were quite variable. In 2007, 2008, and 2011 the region experienced average to above average rainfall (mainly attributed to a series of significant rainfall events). On the other hand, 2009 and 2010 were characterised by below normal rainfall for most of the region, particularly in the Far North and eastern areas. This was due to strong dry weather patterns during late 2009 to April 2010 and November 2010 to January 2012. Annual rainfall plots for the five-year period January 2007 to December 2011 are shown below.



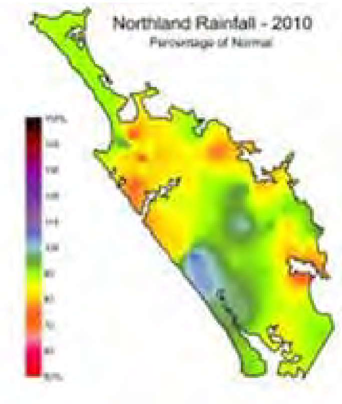
2007



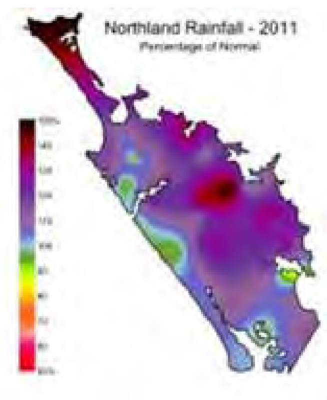
2008



2009

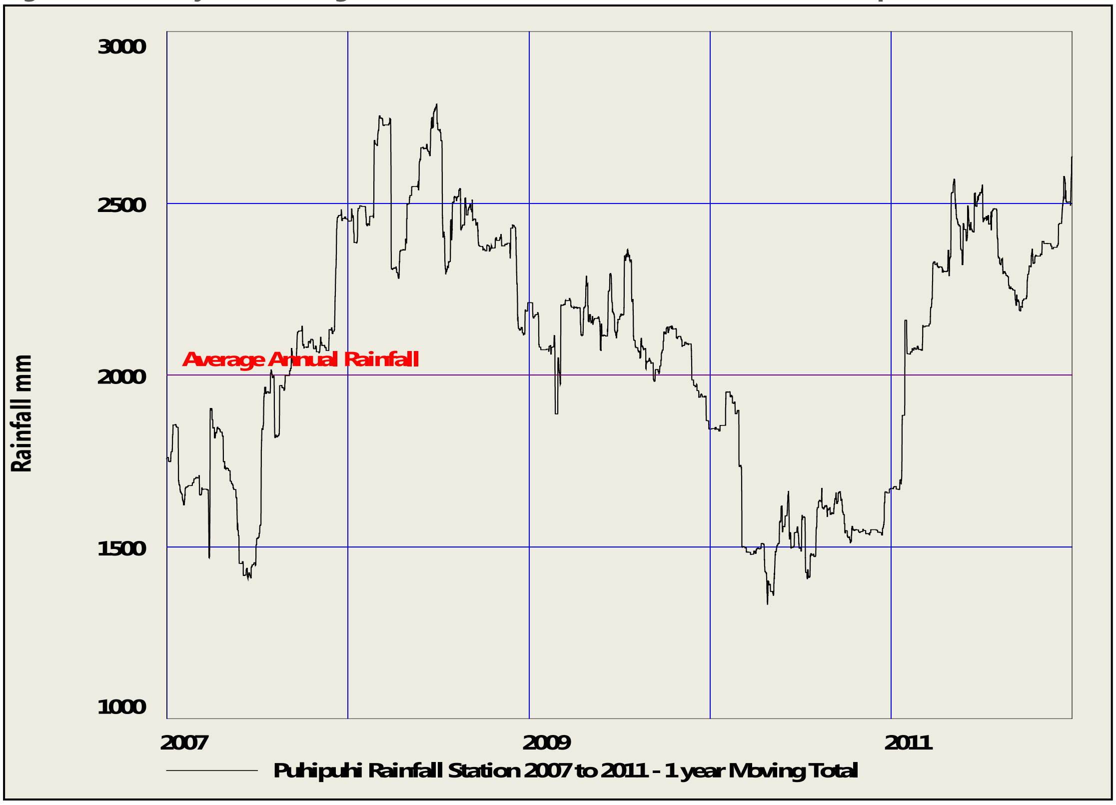


2010



2011

Figure 66: One-year moving mean rainfall trends 2007 to 2011 at Puhipuhi rainfall station



Droughts

Northland experiences two types of drought; regional and localised. A regional drought, on average, occurs once every three years at east coast and inland locations, and once every four years at west coast and higher altitude locations.

Lake Owhareti during the 2009/2010 drought (©: Bee Scene Photography)

The major effects of low rainfall resulting in drought conditions include:

- Reduced stream habitat caused by lower water quantity and quality.
- Elevated rates of evaporation depleting soil moisture and affecting plant growth.
- Minimal grass cover, early drying off of dairy herds, low milk production, loss of income from selling stock.
- Very little recharge of groundwater resulting in low spring flows (base-flows to rivers) and low groundwater levels.
- Major storage dams and lakes in Northland reach low levels. Water supplies from shallow bore springs and streams can dry up.
- Costly transport of water to rural residents.
- Public water use restrictions imposed by district councils.

Northland experienced two droughts in the 2007-2011 period: from November 2009 to May 2010 and November 2010 to early January 2011. On both occasions the Government declared Northland a moderate level drought zone.

For more information please refer to the technical reports entitled *'The Northland Drought of 2009-2010 Final Report'* (NIWA: December 2010) and '*NRC 2010 LA NINA December 2010.pdf*', available on request from the Northland Regional Council.

Flooding

Flooding tends to occur during winter months when flows in rivers and streams are high and soils saturated. However, it can also occur in summer when cyclones, usually down-graded to tropical depressions, make their way far enough south to the Northland Peninsula.

There are several other factors that contribute to flooding in the region, which tends to be 'flashy' and can occur at any time, including:

- Small steep catchments.
- Relatively impervious clay soils.
- Low river gradients.
- Tidal influence, particularly in some of Northland's estuaries (drowned river systems), which can back-up flood waters. This can be exacerbated by raised sea levels due to storm surge and/or low atmospheric pressure during some storms.
- Reduced extent of wetlands, and rivers being disconnected from their flood plains by stopbanks so sediment builds up in the river channel decreasing its capacity to hold water.
- Heavy exotic weed infestation and nuisance willow trees in many drainage areas.
- Reduced vegetation cover and urban impervious surfaces.

Another factor to consider is that land use and development in Northland is often situated in flood prone areas and flood plains.

Flooding is the most common reason for civil defence emergencies in Northland. Major floods have been recorded in Northland, by various sources, since 1917.
The following table lists significant rainfall events during 2007-2011.

Table 27: Significant rainfall events during 2007-2011

Year	% mean annual rainfall variance	Significant events
2007	86% – 146%	Floods: • 17 severe weather warnings. • 3 severe weather warnings produced events that resulted in significant flooding. • 5-7 February (Waitangi Day) – major rainfall event. Maximum rainfall totals of 160mm to 212mm with maximum intensities of 31.5mm/hr. • 29 March – over 40 hour's duration, rainfall amounts exceeded 400mm and were in excess of 1:100 Annual Exceedance Probability (AEP) estimates. • 10-11 July 2007 – up to 240mm of rain was received over a 12 hour period. Severe gale force winds.
2008	94% – 143%	Floods: • 14 severe weather warnings. • 3 severe weather warnings produced significant flooding events. • Severe rain event 23 February over 37 hours. Maximum rainfall amounts from 200mm to 250mm. • 21 January – remnants of Cyclone Funa downgraded to a sub-tropical depression. • 13-15 April – severe thunderstorm activity recorded at Opononi/Ōmāpere 55mm/hour and over three hours 94mm recorded.
2009	64% – 121%	Floods: • 7 severe weather warnings. • 3 severe weather warnings produced significant flooding. • 27-28 February – intense thunderstorm activity with maximum intensities 20 to 30mm/hour and maximum rainfall amounts over 12 hours of 100 to 150mm. • 5-6 March – moderate event resulting in minor wind and flood damage. Droughts: • Severe drought conditions staring from November 2009 to end of year. Rainfall totals for the six-month period November 2009 to April 2010 were the lowest on record for four long-term rain gauges (see drought section below).
2010	67% – 106%	Floods: • 11 severe weather warnings. • 5 severe weather warnings issued after May. Droughts: • Continued drought conditions from January-May. • Return to drought conditions October to December.

2011	83% - 151%	Floods • 28-29 January – significant rain event resulting from ex-Tropical Cyclone Wilma. Major flooding and infrastructure damage. Droughts: • Drought conditions continued through until mid January.

Further information can be sourced from the following technical documents, which are available on request from the Northland Regional Council: *'NIWA Report Northland Storms March and July07.pdf'*, *'NRC Storm 29 March 2007 FINAL.pdf'*, *'MetService Wind Report Storm 10 July07.pdf'* and *'NRC Ex Cyclone Wilma January 2011.pdf'*.

What are the issues affecting surface water quantity in Northland?

Demand for surface water – pressures

While the quantity of freshwater in Northland's water bodies fluctuates naturally, climate change, land uses, extraction, damming, and diversion can impact on natural flows and levels.

Several of Northland's catchments have relatively high levels of allocation for a variety of consumptive uses. Abstraction of the full allocation has the potential to cause environmental issues during prolonged dry periods because demand during this time is the highest. Uses include agriculture, horticulture, water supply to towns and cities and industry sectors.

Northland Regional Council is required to balance demand for water resources with the need to safeguard the life-supporting capacity of aquatic ecosystems, protect the natural character of water bodies, and provide for other important environmental bottom lines.

Environmental effects of reduced flows and levels include, but are not limited to, elevated water temperatures, depleted oxygen levels, increased algal growth and general degradation of water quality. Less water in rivers, streams, wetlands, and lakes can reduce their ability to assimilate waste. Reduced flows and levels also mean smaller habitats for aquatic organisms.

A water take for pasture irrigation on the Mangakāhia River

Of particular concern in Northland is the impact of land uses on water levels in lakes and wetlands. It is important that water is used efficiently so that maximum value and enjoyment can be gained from its use.

The Regional Water and Soil Plan for Northland contains rules that control the use of land, extraction, damming, and diversion for the purposes of managing water quantity.

Consented surface water takes

Under the Regional Water and Soil Plan for Northland most small surface water takes are permitted provided that certain standards and terms are met. Permitted activities include taking water for domestic and stock drinking needs however most larger takes require resource consent.

As at 31 December 2011 there were 268 consents that allocated up to a total of 542,700m^3 of water per day to be taken from surface water bodies and dams. This volume however does not include the Wairua Power Station take, as this consent is to take, divert and discharge 30m^3 per second back into the river, that is, it's a non-consumptive take. It is also important to note that the total allocation does not necessarily represent the actual volume of water taken per day.

The number of consents has decreased by 113 since the 2007 State of the Environment report, while the volume of water allocated has increased slightly (500,000m^3/d: 2007 State of the Environment report). This is a result of consents being surrendered and a number of new consents for larger takes being obtained, and some expiring and not being replaced.

There are more consents to take groundwater than surface water from rivers, lakes, and springs. However surface water takes, including those from dams account for 92% of the total water allocated as shown in Table 28.

Table 28: Source of water allocated in Northland (note: figures are approximate)

	Rivers, lakes, springs	Dams	Groundwater
Percentage of consents	40	11	49
Percentage of allocated daily volume	46	46	8

'Permitted' surface water takes

The Resource Management Act allows for freshwater to be taken and used "as of right" for stock drinking water and domestic purposes provided the take or use does not, or is not likely to, have an adverse effect on the environment and it is a "reasonable" volume (Resource Management Act, section 14(3)(b)).

This is reflected in the Regional Water and Soil Plan for Northland, which allows for a small volume of water to be taken per water user. However, there is the possibility of adverse effects on the environment where a large number of water users are extracting freshwater from the same water body over a period of time or when water users take more than is permitted, which is highly likely in some areas.

The council currently has limited information about the locations and volumes of water taken as permitted takes. To help understand the pressures on surface water resources the council has estimated permitted water use based on dairy herd numbers and land use (including dry stock rate from land use inventory). These figures were then added to consented allocation to provide an indication of total water allocated within a catchment (see Figure 67).

Northland Regional Council will review its water allocation rules in the near future to ensure that they are effective, and where necessary will make changes to existing rules or include new rules.

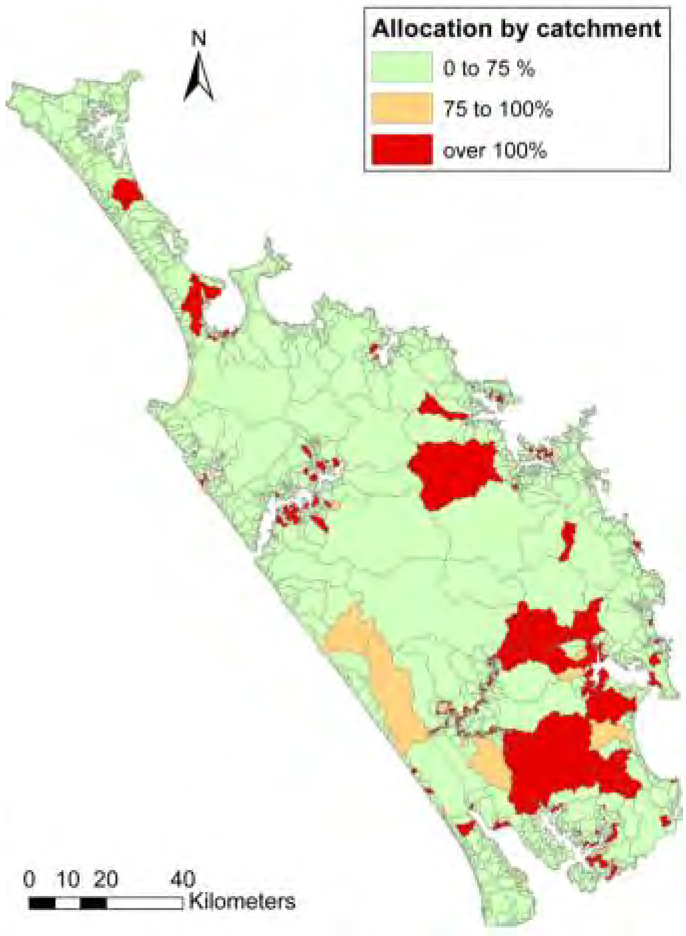
Allocation

The Regional Water and Soil Plan currently contains minimum flows for rivers but does not contain minimum levels for lakes or wetlands, or any allocation limits (the amount of water that can be extracted above a minimum flow or level).

The council has assessed the likely level of allocation in the region's catchments using the methodology of the Proposed National Environmental Standard and Ecological Flows and Water Levels 2008.

Identifying areas of high allocation helps prioritise catchments for the establishment of freshwater objectives and the setting of associated water quantity limits required by the National Policy Statement for Freshwater Management 2011.

Figure 67: Likely level of allocation for Northland catchments



When interpreting Figure 67, it is important to consider:

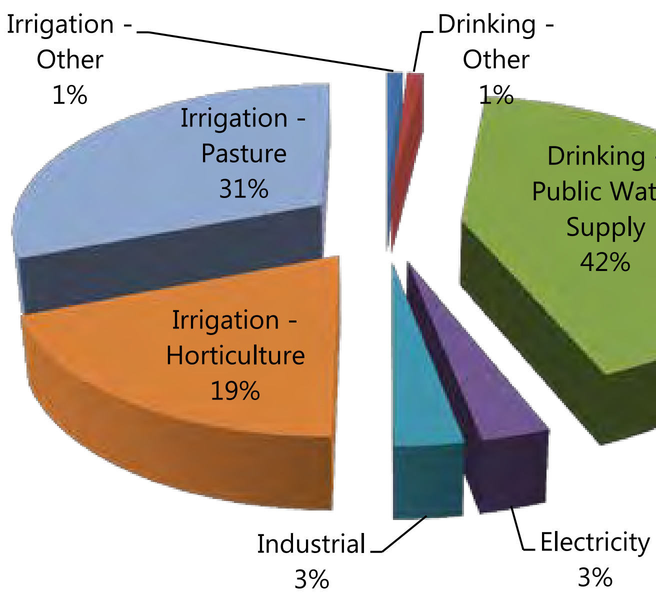
- Full allocation is expressed as 30% of Mean Annual Low Flow for rivers and streams with mean flows less than or equal to $5m^3/s$; and, 50% of Mean Annual Low Flow for rivers and stream with mean flows greater than $5m^3/s$.
- There are no total allocation limits for catchments set in the current Regional Water and Soil Plan applications for water

take consents are assessed on an individual basis.
- The Mean Annual Low Flow for many catchments has a large degree of uncertainty due to limited data.
- Allocation is based on both consented water takes from rivers and dams and an estimate of permitted water use.
- Actual takes are likely to be less than allocation.

A recent review of the flow criteria relating to Mean Annual Low Flows and design minimum flows (one in five-year, seven day low flow Daily Mean Flows) in Northland rivers, with long-term records, is shown in Appendix B.

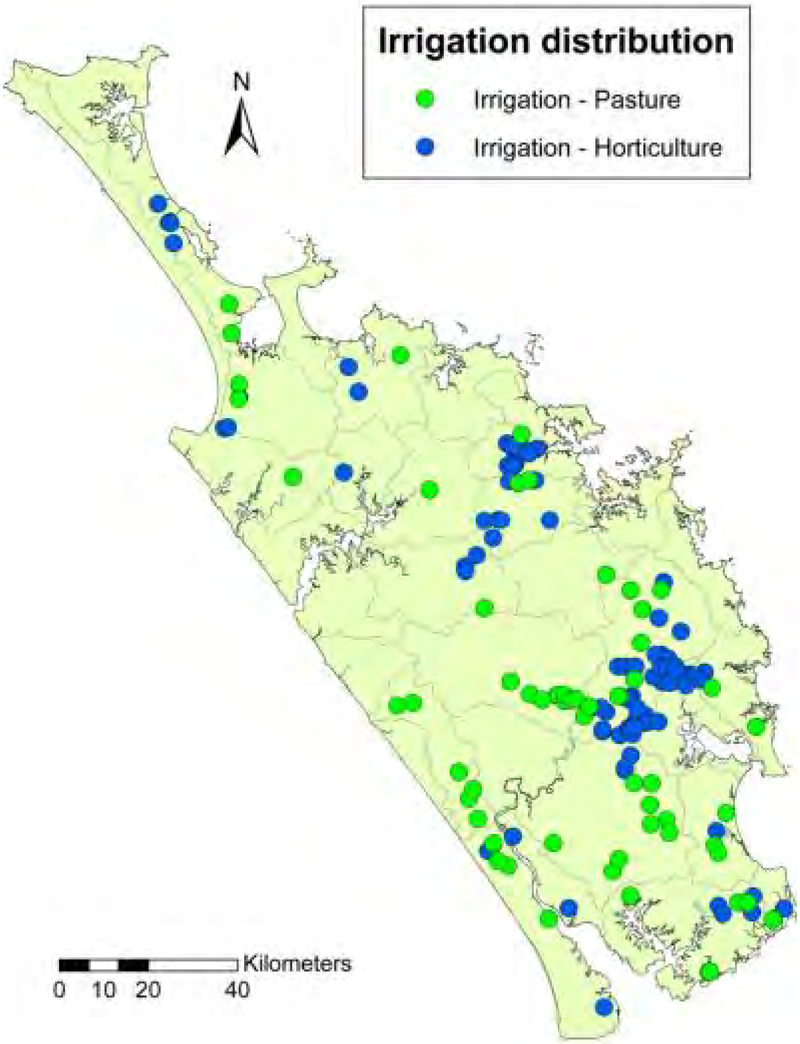
Irrigation is the main water use in Northland, with pasture irrigation accounting for 31% and horticultural irrigation 19% of total volume of water allocated. Water supplies to towns and cities account for 42% of total volume allocated whereas water use for industrial purposes is low, comprising only 6% of allocation (Figure 68).

Figure 68: Total water takes by volume



Most horticultural activities take place on the fertile volcanic soils near Maungatapere, Maungakaramea and Kerikeri, while pasture irrigation is present in the Wairua catchment (refer Irrigation Distribution map Figure 69).

Figure 69: Irrigation distribution in Northland



Lakes and wetlands

There are only a few surface water takes for lakes in Northland. However, as most lakes are relatively small and shallow they are sensitive to changing land uses and water extractions. They are also prone to nutrient enrichment from stock and fertiliser, particularly where lake-side vegetation has been grazed or removed, and where there is direct stock access to the lake, as they have a limited capacity to assimilate contaminants.

The drainage of wetlands has resulted, or contributed to, many wetland species being rare, threatened and endangered. Drainage has other adverse effects, such as loss of buffer storage for flood waters, which leads to increased flood peaks (faster and more intense flows in rivers and streams) and reduced summer flows, as well as loss in the capacity of wetlands to trap and reduce sediment, nutrients and other contaminants.

Dams and diversions

The number of dams in Northland is increasing. As at 31 December 2011, there were 155 consented dams, most of which are small. Dams that are less than 0.5m deep are primarily used on farms for stock water and rely solely on runoff for replenishment. While small dams deeper than 0.5m are generally used as storage dams for recreational parks and agricultural needs, there are some larger-scale dams that are used for a range of activities including agriculture, horticulture and public water supply.

Dams can affect fish passage, sediment transport, water quality and the natural flow regime of rivers and streams. However, they also realise many benefits including security of water supply, reduced demand for traditional takes (direct from the stream or river), and habitat for some native species.

As at 31 December 2011 there are 479 consents for diversions in Northland – diversion refers to redirecting or changing the natural course of a river or stream. Diversion activities include straightening river channels and building stopbanks to prevent water spilling into floodplains. Similar to dams, diversions can have both positive and negative effects on the environment and therefore need to be appropriately managed.

Land use

Land use changes can affect the natural flows and levels in water bodies. For example, impervious surfaces limit the amount of water that can enter groundwater and production forestry has a different water demand than pastoral farming.

As shown in the "Our land, our air" chapter, dairy farming has intensified in the last 10 years and pressures on water resources for stock drinking and dairy shed uses are likely to increase.

The total area in plantation forestry has decreased by about 12,000 hectares between 2002 and 2011. Total land in horticultural use has remained relatively constant over this period, although there has been a large increase in the area of avocado growing.

What is being done?

Policy documents

The National Policy Statement for Freshwater Management 2011 requires the Northland Regional Council to establish freshwater objectives (desired environmental outcomes) and set associated freshwater quality limits and environmental flows and levels (freshwater quantity limits) for all freshwater bodies in the region.

Freshwater objectives and limits must include an environmental bottom line to protect ecological and other intrinsic values. For freshwater quantity, this includes a minimum flow (in the case of rivers) or minimum level (in the case of lakes and wetlands) and an allocation limit (the volume of water that can be taken above a minimum flow or level). The current Regional Water and Soil Plan only contains minimum flow standards for rivers, but no minimum levels for lakes or any allocation limits.

Once included in the Regional Water and Soil Plan, the council is required to manage abstraction, drainage diversion, and use of land generally to achieve freshwater objectives and prevent and phase out the exceedance of water quality and quantity limits.

The council has prepared a staged programme by which it will implement the freshwater policy statement. The programme involves establishing freshwater objectives and setting freshwater quality and quantity limits on a prioritised basis, starting with catchments/water bodies where pressures on water are high and/or uses and values associated with water are important.

The council recently notified a proposed new (second) Regional Policy Statement. This document identifies the significant resource management issues for the region and includes policies and methods to address them in an integrated way. Improving the management of water quantity is a key feature of the document.

Together, the national freshwater policy and the proposed Regional Policy Statement will drive improvements in the way freshwater quantity is managed in Northland.

Sustainable Water Allocation Project

The Sustainable Water Allocation Project was adopted in the Long Term Council Community Plan 2009 to update and implement a more rigorous water allocation regime, to ensure Northland's water resources are managed in a sustainable way and not over allocated. This project underpins Northland Regional Council's programme to implement the national freshwater policy statement.

To date the project has/is:

- Reviewed the way consented water take information is stored to provide consistency.
- Assessed the level of allocation at a regional scale against proposed National Environmental Standards on ecological flows and water levels.
- Investigated methodologies for assessing integrated ground/surface water resources.
- Undertaking an ecological flow assessment in the Otaika catchment to determine minimum flows and allocatable volumes for ecological values.
- Identifying and filling gaps in low flow data.
- Investigating suitability of using modelled data to determine minimum flows and allocation limits.
- Improving data on actual water use verses consented volumes.
- Naturalising flow data (the naturalised flow is the measured river flow adjusted to take account of net abstractions and discharges upstream of the flow measuring station).

Fish survey being undertaken as part of Otaika ecological flow assessment

Water shortage and drought response

In response to a serious temporary water shortage in Northland the council can issue a water shortage direction to allow continued water takes (pursuant to Section 329 of the Resource Management Act). Compliance with resource consents, efficient use of water and voluntary reductions are important prerequisites to the implementation of a water shortage direction. The maintenance of people's health (public water supply) is given the highest priority of water use.

There were two severe droughts in Northland during the period 2007-2011: the first from November 2009 to May 2010 and the second from October 2010 to early January 2011. The Northland Regional Council provided water management advice, monitoring and reporting to major water users and the public, and managed consent compliance. District councils were responsible for public water supplies, demand management and water conservation strategies. All three district councils (the Far North, Whāngārei and Kaipara) were warned of the pending water shortage in December 2009 and encouraged to plan appropriately.

The main policy on drought response emphasises the data collection network, publicity and early warning of potential drought problems. This includes the notification of pending water shortages and dissemination of information, modifying water use, and compliance monitoring.

The Northland Regional Council issued four water shortage directions during the drought, which allowed the district councils to continue to take water from specific rivers, subject to conditions, to ensure public water supply.

Awanui River, Kaitāia, during the drought conditions

The Northland Hydrometric Network

The Northland Regional Council operates a hydrometric network consisting of 95 sites throughout Northland, which collects continuous river flow data at intervals of between one and 15 minutes. This is an increase of 35 automatic stations since the last report (Northland Regional Council: 2007).

The New Zealand Meteorological Service (MetService) and the National Institute of Water and Atmosphere (NIWA) also operate hydrometric and climate stations in Northland.

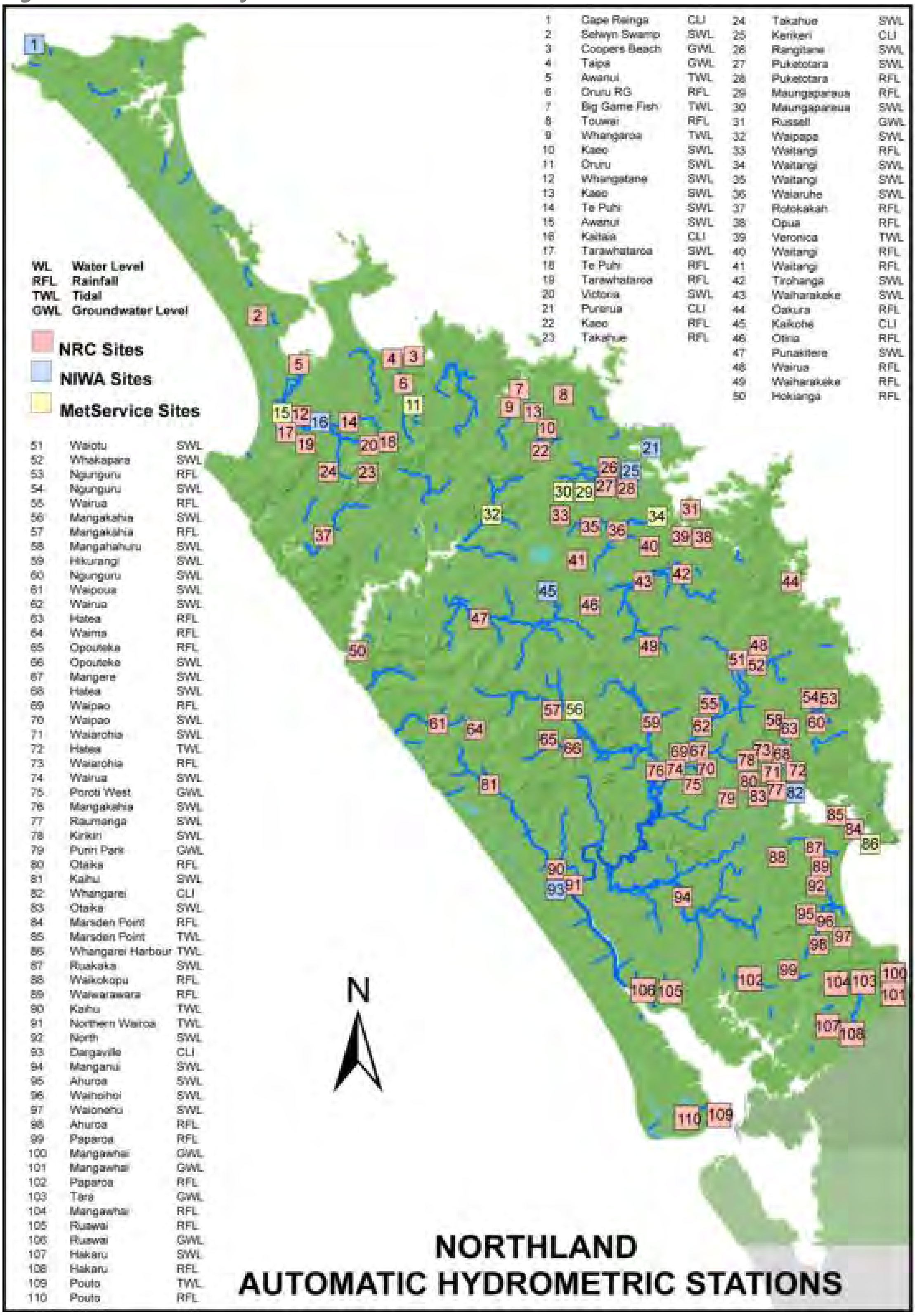
Table 29: Northland Automatic Hydrometric Stations

Northland Regional Council	· 42 river level stations · 9 tidal stations · 36 rainfall stations · 9 groundwater stations
NIWA	· 1 rainfall station
MetService	· 7 climate stations

Understanding river flows is vital for establishing freshwater objectives and water quality and quantity limits.

Of the 96 continuous data recording sites, 95 are part of a telemetry system where data can be sent via radio or cellular phone to a base station at the council office in Whāngārei. These telemetered sites provide a real-time picture of the flow state of the region's water resources.
Telemetered data from the hydrometric stations is captured and updated on the council's website hourly: www.nrc.govt.nz/riversandrain

Figure 70: Northland Hydrometric Station locations



How we are measuring up against our objectives?

The operative Regional Policy Statement states the anticipated environmental results as a consequence of implementing policies and methods to achieve the water quantity objectives.

Protection of important freshwater habitats, particularly natural wetlands from reductions in surface water and ground water levels

- As at 31 December 2011, 926 wetlands have been recorded on the council's database and linked to Geographic Information System points. There are many others that have yet to be identified.
- Over 300 of the best wetlands on the database have been scored and ranked as Northland's "Top Wetlands". A mail-out to the landowners of the highest ranked 150 of these wetlands was due for completion in 2012. So far 150 landowners of 46 wetlands in the Kaipara and Whāngārei districts have been contacted offering advice, information and possible assistance to maintain them.
- Factsheets for the main wetland types with guidelines for protection have been produced and included in the package.
- Guidelines for identifying wetlands and Significant Indigenous Wetlands under the Regional Water and Soil Plan are currently being developed. These will be helpful for staff and practitioners in the field, when interpreting rules about wetlands.

Preservation of the natural character, intrinsic, ecosystem and amenity values of natural water bodies to the extent that these depend on water levels and flows

- Current policy within the Regional Water and Soil Plan provides for the recognition of rivers and lakes deemed to have outstanding values and protection of their flows and levels. It also provides for minimum flow requirements in rivers to protect life-supporting capacity – however there is the ability to go below these minimum flows in exceptional circumstances. Rules in the plan are currently very restrictive around Significant Indigenous Wetlands, dune lakes, and rivers (or sections of rivers) and lakes deemed to have outstanding values, with many activities affecting flows and levels being non-complying.
- Because of this policy and subsequent rules, the majority of consents issued to take and use water will have conditions specifying maximum quantities, and minimum flows at which time the take must cease. Permitted activity rules for water takes also specify maximum quantities for certain periods of the year, that is, less water may be taken over the drier summer months, in order to reduce negative effects on flows and levels because of seasonal fluctuations.
- Finally, the council now has much better information and tools/modelling available in order to more accurately predict and map allocation within Northland based on current government direction. This allows the council to prioritise those catchments that are considered highly allocated, in order to direct resourcing at these first.

Protection of the values of water bodies held by tangata whenua

- As part of managing freshwater quantity in the region, the Resource Management Act (ss 6(e), 7(a), and 8) requires the Northland Regional Council to:
  - provide for the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu and other taonga;
  - have particular regard to kaitiakitanga; and
  - take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

  These were undertaken as part of drafting the operative Regional Water and Soil Plan for Northland and are undertaken as part of resource consenting processes.

- The Regional Water and Soil Plan also identifies rivers and lakes that have outstanding values, including Māori cultural values.
- The Freshwater National Policy Statement (Policy D1) requires Northland Regional Council to take reasonable steps to:

  - involve iwi and hapū in the management of freshwater and freshwater ecosystems in the region;
  - work with iwi and hapū to identify tangata whenua values and interests in freshwater and freshwater ecosystems in the region; and
  - reflect tangata whenua values and interests in the management of, and decision-making regarding, freshwater and freshwater ecosystems in the region.

  These matters will be addressed through the council's programme for implementing the Freshwater National Policy Statement – Waiora Northland Water.

Sustainable and efficient use of the water resources of Northland

- In general, the region's freshwater quantity is used sustainably and efficiently, however improvements are likely to be required in some catchments, particularly those with high levels of allocation. Improvements in efficiency will also likely be driven by the market.

Increased awareness of water conservation and the greater implementation of water conservation practices

- There is increasing understanding about the need to implement water conservation practices as part of sustainably and efficiently using water during dry weather. This has been driven by repeated droughts over the past several years.

Minimisation of actual and potential damage to property from damming, diversion, and discharge of runoff

- The Regional Water and Soil Plan currently contains rules relating to damming, diversion and discharge of runoff. The effects resulting from damming and diversion are largely managed through the consenting process. However, discharge of runoff is harder to manage. This is because it can be provided for as a permitted activity, provided that criteria are met including minimisation of adverse effects. However, this has proven difficult to monitor and enforce, particularly where there are multiple such discharges within a catchment.
- The council is currently undertaking flood mapping to identify areas at risk in priority river catchments. New policy is also being developed in conjunction with the new Regional Policy Statement, which has a chapter dedicated to natural hazards, including earthworks and land development/subdivision policy around avoiding natural hazards. Council is also progressing flood schemes, such as Kaeo, Whāngārei, Kaitāia and Kerikeri.

References

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- National Policy Statement – *Freshwater Management 2011* *http://www.mfe.govt.nz/publications/rma/nps-freshwater-management-2011/index.html*
- *Resource Management Act (Measuring and Reporting of Water Takes) Regulations 2010.* *http://www.mfe.govt.nz/publications/water/measuring-and-reporting-water-takes/index.html* (October 2010 Updated July 2011)

Technical documents referenced in text available on request from the Northland Regional Council:

- NIWA Report Northland Storms March and July07.pdf
- NRC Storm 29 March 2007 FINAL.pdf
- MetService Wind Report Storm 10 July07.pdf
- NIWA Report Northland Drought 2009_2010.pdf
- NRC 2010 LA NINA December 2010.pdf
- NRC Ex Cyclone Wilma January 2011.pdf

Appendix B

Table 30: Estimated Design Drought Flows (DDF), Mean Annual Low Flows (MALF), Mean Flows and Median Flows in various Northland rivers

Site No.	River	Site name	1:5 year DDF 7 day l/s	MALF 1 day l/s	MALF 7 Day l/s	Mean l/s	Median l/s
802	Selwyn Swamp	Big Flat Rd	2	4	4	31	30
1316	Awanui	School Cut	474	571	600	6084	2751
1351	Victoria	Victoria Valley Rd	237	251	269	907	550
1342	Te Puhi	Meffin Rd	58	97	112	1445	865
1903	Oruru	Dangen Rd	435	480	506	2417	1294
3432	Rangitane	Stirling	52	92	100	683	406
3503	Puketōtara	Backblocks	127	197	219	1462	847
3506	Maungapareura	Tyrees Ford	23	34	38	456	201
3707	Waiaruhe	Puketona	392	479	517	4221	2056
3722	Waitangi	Wakelins	674	940	1019	8253	4170
3819	Waiharakeke	Willowbank	45	131	159	5070	1985
4901	Ngunguru	Dugmores Rock	59	78	80	408	210
5527	Waiarohia	Lovers Lane	37	58	62	346	150
5528	Raumanga	Bernard St	67	81	86	341	195
6007	Waionehu	McLean Rd	16	28	32	467	165
6014	Ahuroa	Durham Rd	50	79	85	598	298
6015	North	Applecross Rd	71	98	109	912	394
6016	Waihoihoi	St Marys Rd	61	87	94	540	275
6018	Ahuroa	Braigh	99	130	137	1254	562
46609	Mangere	Kara Weir	48*	62*	67	329	181
46611	Kaihu	Gorge	631	700	742	4002	2406
46618	Mangakāhia	Gorge	1191	1423	1512	9652	4995
46625	Hikurangi	Moengawahine	256	354	410	5083	1703
46626	Mangakahia	Titoki Br	2427	3000	3300	25976	13017
*46627	Waiotu	SH1 Br	197*	233*	331	4365	1553
*46632	Whakapara	Cableway	653*	851*	932	6154	2450
*46641	Waipao	Draffins Rd	208*	239*	na	674	483
*46644	Wairua	Purua	1450*	1850*	na	18400	7756

*4664 6	Mangere	Knights Rd	102*	119*	na	1570	607
*4664 7	Wairua	Wairua Br	1780*	2250*	na	20976	11056
46651	Mangonui	Permanent Station	155	259	283	8058	2627
*4667 4	Mangahahuru	County Weir	80*	105*	130	500	326
46902	Waipoua	SH 10 Bridge	409	531	551	3156	1550
47595	Punakitere	Taheke	565	690	732	6852	3255
47804	Waipapa	Forest Ranger	539	682	714	4750	2175
10466 51	Opouteke	Suspension Br	497	577	610	3919	2057

Note: * indicates flows that have been naturalised for the Wairua Catchment Report (NIWA: 2000), that is, water abstraction added to recorded flow values. All other values are not naturalised and are the best estimates provided by the flow information.

Groundwater

What do we want for our groundwater?

The operative Regional Policy Statement for Northland details existing council and community objectives for each natural and physical resource in our region. The objectives relating to groundwater management are:

- The maintenance or enhancement of the water quality of natural water bodies and coastal waters to be suitable, in the long-term, for specified purposes;
- The reduction and minimisation of the quantities of contaminants entering water bodies and coastal waters;
- Avoid, remedy or mitigate the adverse effects of discharges of contaminants on the traditional, cultural and spiritual values of water held by tangata whenua;
- The maintenance of water flows and levels in natural water bodies;
- The sustainable use of groundwater resources; and
- The efficient use and conservation of water resources.

The operative Regional Policy Statement also states the anticipated environmental results, as a consequence of implementing the policies and methods to achieve the groundwater management objectives:

- Water quality suitable for desired purposes;
- Contaminants in water bodies reduced;
- Adverse effects of contaminants in water bodies and coastal waters are avoided, remedied or mitigated;
- Protection of important freshwater habitats, particularly wetlands from reductions in surface water and groundwater levels;
- Sustainable and efficient use of water resources of Northland;
- Preservation of the natural character, intrinsic, ecosystem and amenity values of natural water bodies to the extent that these depend on water levels and flows; and
- Increased awareness of water conservation and greater implementation of water conservation practices.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

What are the issues affecting groundwater?

Reduction in quantity and quality of groundwater by pumping, land use and climatic changes, and inappropriate bore construction are the major pressures on groundwater resources in Northland.

Groundwater use

The use and pressures on groundwater are continually changing in line with land use changes from traditional farming to horticulture and subdivision for lifestyle blocks, along with increased demand on public water supply due to population growth and increasing tourism. Groundwater takes that meet the permitted activity rules set out in the Regional Water and Soil Plan do not require resource consent. The majority of these water takes are for domestic and stock drinking requirements.

Resource consents to take groundwater and to install bores are monitored to provide information on the cumulative allocation in aquifers. A summary of resource consents to take water; bores registered with the council;

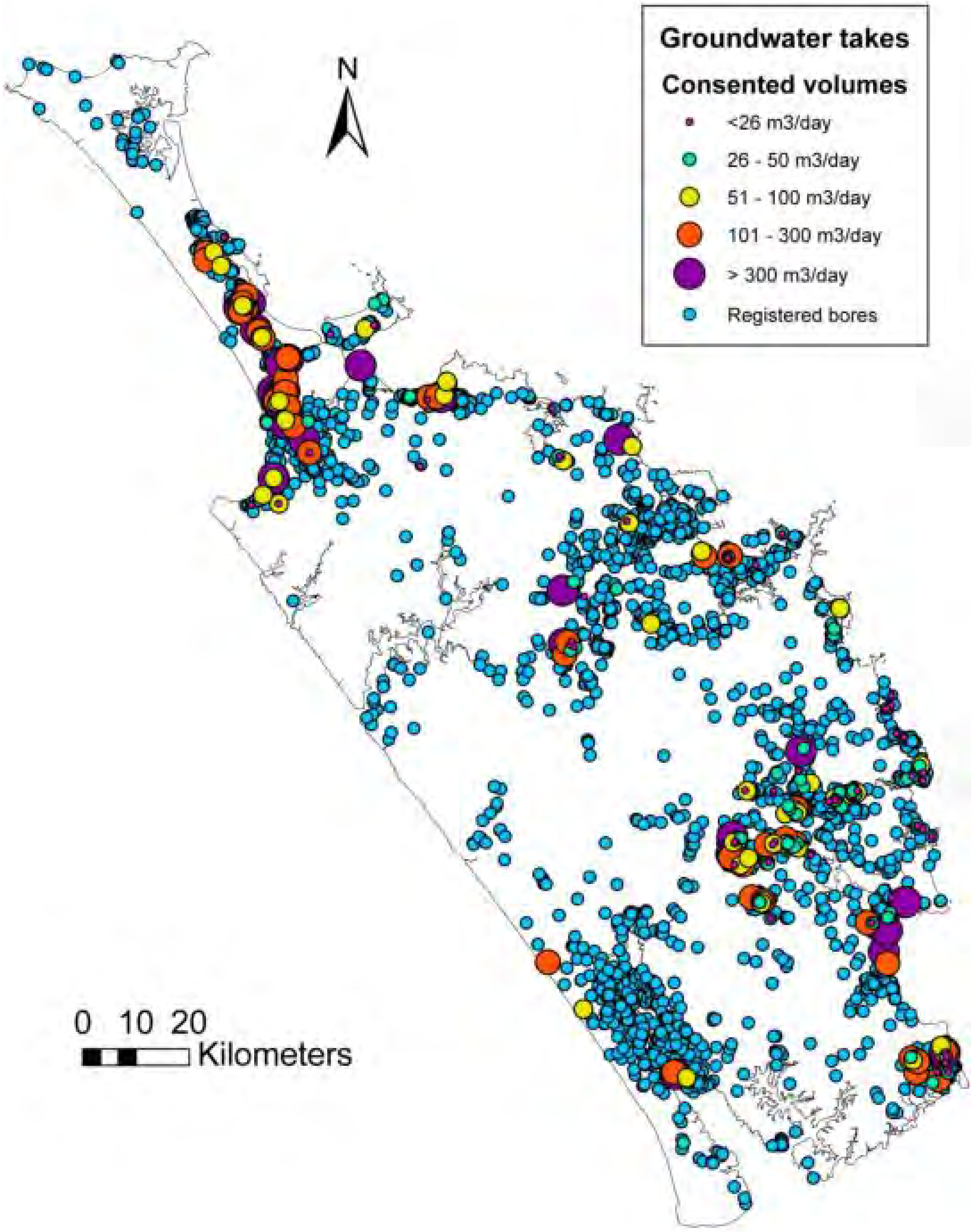
and volumes allocated per aquifer are provided in Table 29. There are currently no allocation limits set for groundwater resources (aquifers) within the Regional Water and Soil Plan.

Table 29: Groundwater take consents, registered bores and water allocated by consent (cubic metres per day) for Northland aquifers

Aquifers	***Number of consents***	***Number of bores***	***Allocation (m^3/day)***
Aupōuri	60	583	19,762
Coopers/Cable	5	89	815
Taipā	2	59	80
Russell	7	176	186
Kaikohe	8	48	1519
Matarau	4	38	153
Other small coastal aquifers	20	444	708
Glenbervie	17	72	743
Three Mile Bush	8	99	750
Maunu	33	198	3204
Maungakaramea	8	35	737
Ruāwai	3	178	710
Mangawhai	12	103	658
Tara	5	13	612
Outside "at risk" aquifers	60	2338	17,920
Total	252	4473	48556
Change since 2007 SOE report	*-27*	*+726*	*-1046*

Figure 71 shows registered bores and the volume allocated (m^3/day) by groundwater take consents, however prior to 1999, bore logs were submitted to the council on an informal basis. Accordingly, not all existing bores are registered with the council.

Figure 71: Registered bores and the volume allocated (m^3/day) by groundwater take consents



Groundwater in Northland is taken for a variety of uses, with the two major uses being horticultural irrigation and industry.

Fifty-three percent of consents are for horticultural irrigation and 8% of consents are for industrial purposes. By volume, horticultural irrigation accounts for 50% whereas industrial purposes account for 26%.

Climate and land use changes

The National Institute of Water and Atmospheric Research Ltd (NIWA) predicts likely increases in temperature and changes in rainfall trends as a result of climate change. This is likely to lead to a reduction in aquifer recharge rates and increased potential for saltwater intrusion in coastal aquifers.

Changes in land use can affect the recharge, abstraction and quality of the groundwater. This effect may also vary over time. For example, the development of forestry over an aquifer recharge area may not result in any changes to the recharge in the initial few years but when the canopy is closed, a significant amount of precipitation is intercepted by the trees and this reduces the recharge to the underlying aquifer. This can lead to a decline in the groundwater level and the amount of water flowing through the aquifer.

Northland's east coast has a large number of small coastal aquifers. Housing development in these areas can result in saltwater intrusion into the aquifer, due to reduced recharge and increased use. Unreticulated housing development above aquifers can also increase the risk of groundwater contamination due to inappropriate or poorly maintained onsite effluent disposal systems.

Inappropriate bore construction and maintenance of bores can result in deterioration of groundwater quality and quantity by:

- Aquifer cross contamination , that is, mixing of aquifers of different water quality; and
- Contamination from the surface due to open, unsealed or poorly sealed bores.

What is our groundwater resource?

Groundwater quantity

Groundwater is a valuable resource to Northland being used mainly for irrigation, industrial and drinking water supplies. Groundwater also contributes to the recharge and base flow of rivers and lakes through seeps, springs and wetlands.

In Northland, groundwater resources vary in both quantity and quality, depending on the geology, soils, land use and rainfall. Geologically, the aquifer systems of Northland can be grouped into four main types:

- Jurassic greywacke;
- Cretaceous sandstone;
- Cainozoic basalt; and
- Quaternary sand, shell and/or gravel.

The majority of groundwater in the region is abstracted from basalt aquifers around Whāngārei and Kaikohe and from a sand/shell aquifer in the Far North. Small shallow sand/gravel aquifers and less productive greywacke aquifers are also contributing to the total groundwater abstraction in the region. In general, the basalt aquifers are semi-confined and the shallow sand aquifers are unconfined. Information on the basic characteristics of groundwater resources has been gathered from drilling and pumping test programmes carried out throughout Northland. A summary of aquifer characteristics for the principal groundwater resources is shown in Appendix C.

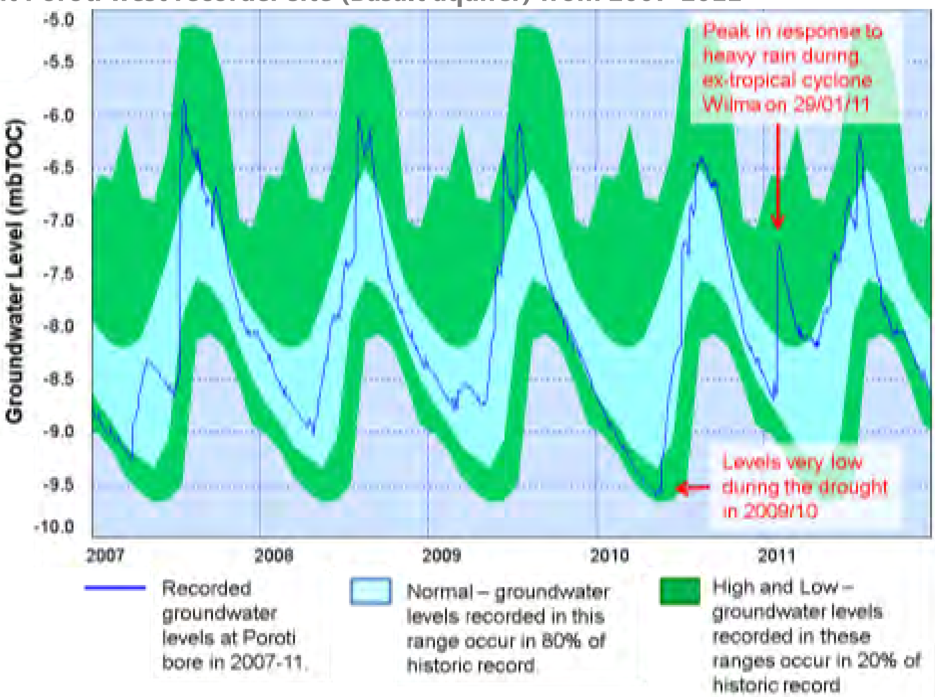
Rainfall is considered to be the main source for groundwater recharge to the aquifers in the region. Lake water loss is considered to be a minor source of recharge in some areas of Northland (for example, Pakaraka and Aupōuri).

Basalt aquifers

The basalt aquifers in Northland generally have relatively rapid infiltration due to the fractured nature of the geology and the existence of scoria cones. The majority of the recharge occurs at the scoria cones due to the presence of clay/ash or weathered layers above the basalt. Groundwater discharge from the basalt aquifers is largely by spring flow originating on the edge of the basalt fields. These aquifers have considerable storage and the spring flow generally remains during dry periods. Spring flow is a major contribution to stream base flow in the basalt areas.

The groundwater levels in the basalt aquifers generally show seasonal variation with higher levels recorded in late winter to early summer and lower levels in late summer to early autumn. Groundwater levels for the monitoring bores located in basalt areas range between 0.5 to 23 metres below ground level. Seasonal variations in the range of 2-14m have been recorded. The seasonal variations in groundwater levels in the basalt aquifers are a direct result of the rainfall variation. During 2007-2011, groundwater levels were at their lowest in May 2010 due to summer drought conditions together with high water demand.

Figure 72: Typical groundwater levels and envelope plots (metres below top of casing) recorded at Poroti west recorder site (Basalt aquifer) from 2007-2011



Sand/shell or gravel and alluvial aquifers

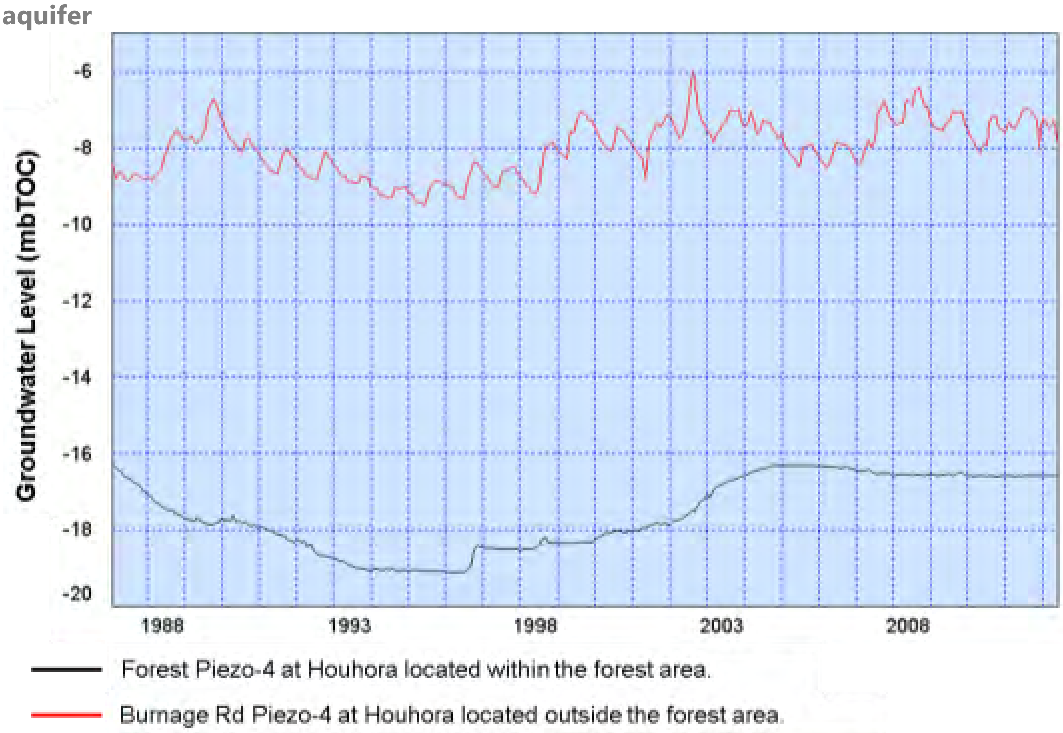
In unconfined sand aquifers recharge from rainfall is generally rapid and intense. There is a minimal rainfall runoff contributing to stream flows in the areas where these aquifers occur. In the Aupōuri Peninsula, the sand aquifer contributes little to the stream base flow as the groundwater level is typically below the stream bed level. The sand aquifers predominantly discharge at or near the coast.

Monitoring bores located in the Mangawhai sand aquifer and Ruāwai alluvial aquifer indicate that the groundwater levels oscillate seasonally with highest levels in the spring and lowest levels toward the end of autumn. The groundwater level response to the rainfall events is relatively fast while groundwater level recession is quite slow, lasting for a few months, similar to the basalt aquifer response.

In general, most of the monitoring bores in the Aupōuri aquifer show a delayed response to rainfall ranging from a few months to more than six months depending on the aquifer hydraulic properties at the site and depth to water table.

The results of groundwater level monitoring for two piezometer sites from 1987-2011 are shown in Figure 73. Both sites respond differently to rainfall recharge. Burnage Road Piezo-4, located outside the forest area, shows a strong seasonal rainfall recharge response whereas Forest Piezo-4 at Houhora located within the forest area, shows long-term rainfall variations with only minimum seasonal change. The difference in the groundwater levels in forested and non-forested areas suggests that afforestation has had a noticeable effect on the groundwater levels and recharge into the aquifer.

Figure 73: Groundwater levels (metres below top of casing) at two different sites in the Aupōuri aquifer



Based on various studies undertaken in Northland, the most likely range of rainfall recharge rates for the different type of aquifers have been estimated. These estimates are given in Table 32.

Table 32: Summary of recharge rates by aquifer type

Aquifer type	Recharge estimate	Reliability
Basalt	5-49%	Low - High
Scoria cone	55-65%	Low
Alluvium	4.2-40%	Low - Moderate
Sand	10-30%	Low
Gravel	26-52%	Moderate
Sandstone	1-10%	Low
Greywacke	1-5%	Low - Moderate

Groundwater quality

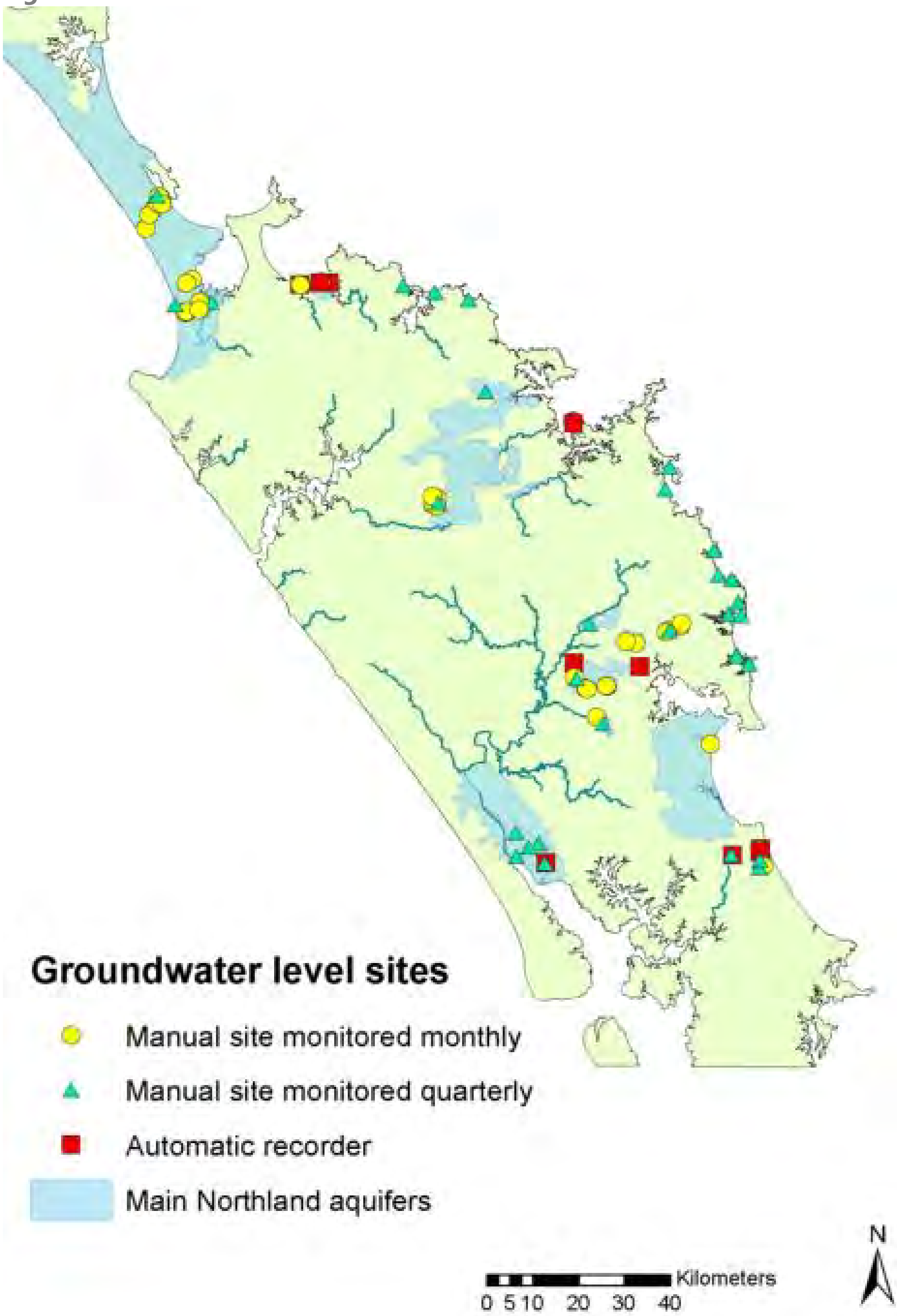
The quality of groundwater can be described through the analysis of physical, chemical and microbiological parameters. Groundwater quality can be influenced by a number of human factors such as land use (for example, effluent disposal and increased use of nutrients for agriculture or horticulture) and groundwater abstraction in some areas. Natural parameters such as the source of the recharge (rainfall or river), the aquifer geology and residence time of water in the aquifer also influence groundwater quality.

The council monitors a total of 57 bores across the region (Figure 74) for a range of variables, including electrical conductivity, pH, *E. coli*, major ions, nutrients, and trace metals. This is done at quarterly intervals at 39 sites; seven of them as part of the National Groundwater Monitoring Programme and 32 as part of the Regional Groundwater Quality State of Environment Programme. Six specific groundwater investigations are also carried out on six aquifers – Ruāwai, Russell, Taipā, Whatitiri, Maungakaramea and Mangawhai, where a total of 18 sites are monitored monthly or quarterly.

Groundwater quality is generally good throughout Northland with the majority of samples meeting the national standards for drinking water (Ministry of Health: 2005).

A Northland Regional Council Monitoring Officer measuring the groundwater level at Russell

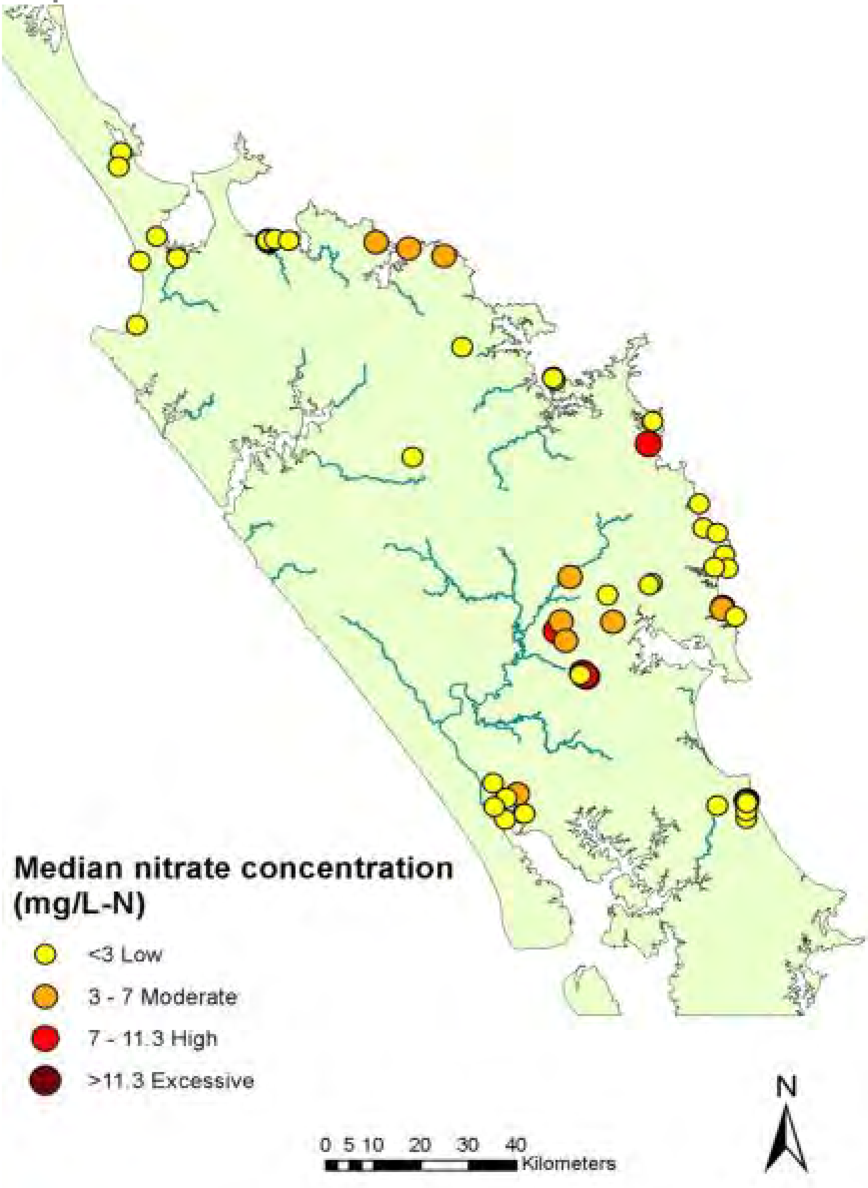
Figure 74: Groundwater water level sites monitored across Northland.



Nitrate

Based on median values recorded over 2007/11 (Figure 75), 26 of 39 (66.7%) monitoring bores had low concentrations of nitrate (<3 mg/L-N). Ten monitoring bores (25.6%) had moderate concentrations of nitrate (3–7 mg/L-N). A further three bores, located in the Maungakaramea and Whatitiri basalt aquifers and the Oakura coastal aquifer, show median nitrate concentrations in the relatively high range (7-11.3 mg/L-N). However, none of the median nitrate concentrations for the monitoring bores were above the Drinking Water Standards for New Zealand, (Ministry of Health: 2005) maximum acceptable value of 11.3 mg/L-N.

Figure 75: Median nitrate concentrations recorded in groundwater quality monitoring bores sampled over 2007/11



Nitrate levels in several of the basalt aquifers fluctuate seasonally. Higher nitrate concentrations occur during winter when higher seasonal rainfall exacerbates leaching of nitrogen to the water table. The elevated nitrate levels measured in Maungakaramea and Whatitiri basalt aquifers are likely to be caused by animal waste, discharge of dairy effluent to land and/or fertiliser use.

The absence of organic material in these basalt aquifers means that nitrates are likely to be persistent as there is little potential for reduction through de-nitrification. Recent age analysis indicates that these aquifers have a mean resident time of 45 years. This suggests that the nitrates present in the groundwater may largely be a result of historic land use activities that occurred around 45 years ago. However, seasonal fluctuations suggest nitrate levels are also influenced by recent nitrate sources. Further age distribution analysis of groundwater is required to assess the risk of nitrate levels in the aquifers exceeding drinking water standards in the future.

Microbiological indicator – Escherichia coli (*E. coli*)

Escherichia coli is used as an indicator organism for contamination of drinking water by faecal material. The drinking water maximum acceptable value for *E. coli* is less than one *E.coli* per 100mL, so a positive sample indicates exceedance of the standard.

Sources of *E.coli* in groundwater include effluent disposal and agricultural land use activities such as dairying and livestock farming. Soil can act as a barrier and reduce the risk of microbial contamination of groundwater. However, direct contamination can occur due to poorly constructed bores and inappropriate or poorly maintained sewage effluent disposal systems.*E. coli* was detected in 18 bores on three or more occasions during the 20 rounds of water sampling over the period 2007-2011.

Most of the exceedances of the drinking water standards occurred in bores of coastal areas where small communities rely on septic tanks for sewage disposal or on onsite wastewater treatment systems for effluent disposal.

Iron and manganese

Iron and manganese occur naturally in groundwater depending on the geology. Elevated concentrations of iron and manganese found in different aquifers are commonly the result of natural processes, for example, interaction with iron-rich sediments. Excessive iron and manganese concentrations in groundwater gives water a rusty brown appearance, and can result in staining, irrigation system blockages and a general bad taste. The national drinking water standards (Ministry of Health: 2005) sets out the guideline values for iron and manganese for aesthetic purposes, and also the maximum acceptable value (standard) for health purposes for manganese, as shown in Table 33.

During the monitoring period 2007-2011, 21% and 33% of the sites had median levels of iron and manganese above their aesthetic guidelines for human consumption, and one site at Whananaki North had median manganese levels above the health-related standard.

The majority of sites that exceed the guidelines for iron and manganese are fed mainly from sand and gravel aquifers. There were no specific increasing trends in iron and manganese at these sites over the 2007-2011 monitoring period.

Table 33: Compliance of median iron (mg/L) and median manganese (mg/L) with standards (Drinking Water Standards New Zealand, Ministry of Health: 2005) in 39 Northland groundwater monitoring bores from 2007-2011

Guideline/standard	Compliance level	Iron (Fe)		Manganese (Mn)	
		No. of sites	%	No. of sites	%
Aesthetic guidelines Fe (0.2mg/L) - Mn (0.04mg/L)	Non-compliance	8	21	13	33
	Full compliance	31	79	26	67
Drinking standards Mn (0.4mg/L)	Non-compliance	n/a	n/a	1	3
	Full compliance	n/a	n/a	38	97

Sodium, chloride and conductivity (saltwater intrusion)

Monitoring of groundwater level, chloride, sodium and electrical conductivity is undertaken to check for seawater intrusion. The majority of coastal bores monitored have higher electrical conductivity, chloride and sodium levels than inland basalt aquifers, due to leaching of salts from marine sediments. One site, located at Pataua South, had median levels above the aesthetic guidelines for human consumption (Drinking Water Standards of New Zealand, Ministry of Health: 2005).

There is greater potential for seawater intrusion of coastal aquifers during summer when groundwater levels decline due to increased abstraction and/or decreased recharge caused by below average rainfall.

For more information refer to the New Zealand Guidelines for the Monitoring and Management of Sea Water Intrusion Risks on Groundwater (PDP Ltd: 2011).

Pesticides

The council participates in the national surveys of pesticides in groundwater conducted by the Institute of Environmental Science and Research at four-yearly intervals. In 2010, pesticides were analysed from 12 bores, most of which were located on horticultural land. Although pesticides were detected at four bores, levels of concentrations were well below the maximum acceptable value for national drinking water standards (Ministry of Health: 2005).

For more information refer to the National Survey of Pesticides in Groundwater 2010 (Close and Skinner: 2011).

Age testing

Understanding the mean age of groundwater (mean residence time) is important for interpreting the water quality results and the potential effects of land use on groundwater quality. Twenty-five bores were sampled in the 2007-2011 period in order to determine the mean age of groundwater. All these samples were collected from the state of the environment water quality monitoring network bores and analysed for tritium, chlorofluorocarbon and sulphur hexafluoride isotopes.

Preliminary results of sampling indicate that the mean residence time for different Northland aquifers range from three years to more than 225 years. Re-sampling for tritium is required for most of the sites to ensure accurate interpretation of the results.

What is being done?

Monitoring

Monitoring of groundwater resources in Northland can be divided into three main areas:

- State of the Environment monitoring – monitoring of groundwater levels and groundwater quality;
- Compliance monitoring: monitoring of drilling activities and groundwater takes; and
- Specific groundwater investigations.

The primary objectives of the state of the environment monitoring is to gain a regional perspective on baseline water quantity and quality of different aquifers and trends in groundwater quantity and quality over time as a result of climate, land use and groundwater abstraction. Monitoring also ensures the management of the groundwater resources in Northland is sustainable and consistent with the objectives and policies of the operative Regional Policy Statement and regional plans. Identification of any issues in particular aquifers through monitoring would lead to specific groundwater investigations.

Groundwater quantity

Long-term groundwater level data are essential to evaluate and forecast changes over time in groundwater resources. At present, groundwater levels are monitored at 10 sites by automatic recorders and at a further 78 sites manually. Out of the 78 manual sites, 41 are monitored at monthly intervals and the rest of the sites are measured at quarterly intervals. All monitoring sites are shown in Figure 74. The records collected from these sites are used to identify the groundwater level responses to seasonal and long-term changes in groundwater resources.

The Northland Regional Council groundwater automatic recorder at Coopers Beach

Groundwater quality

The current regional network for groundwater quality involves the sampling from a total of 39 State of the Environment and National Groundwater Monitoring Programme sites, as described in "What is our groundwater resource?"

Specific groundwater investigations

The council undertakes specific groundwater investigations where a potential issue has been identified, for example, elevated nitrate or increased risk of saltwater intrusion in coastal areas. The following six aquifers are the subject of current investigations – Taipā, Ruāwai, Russell, Whatitiri, Maungakaramea and Mangawhai (Table 34).

The reports on these aquifers and other groundwater investigations are available on the council's website: www.nrc.govt.nz/groundwaterReports

Table 34: Summary of groundwater investigations in specific Northland aquifers

Aquifer and use	Issue	Comments and Compliance with New Zealand drinking water standards
Taipā Domestic	Saltwater intrusion and nitrate	Nitrate is still elevated but did not exceed standards during 2007/11. Saline indicators were well below standards.
Ruāwai Domestic, stock, public drinking water	Saltwater intrusion and iron	Chloride, sodium and iron concentrations remain elevated. Median chloride and sodium levels exceeded the standards at two sites and the median iron concentrations at all six sites have exceeded the standards during 2007/11. The high iron is a result of natural processes. Sampling has been reduced from 2012.
Russell Domestic	Saltwater intrusion and bacterial	Saline indicators are well below standards. The standards for *E.coli* were not exceeded frequently during 2007/11 – this is likely to be a result of the sewage reticulation system. Sampling has been reduced from 2012.
Whatitiri Domestic, horticultural, irrigation, stock drinking	Nitrate	Nitrate is still elevated but has not exceeded standards during 2007/11.
Maungakaramea Domestic, horticultural, irrigation, stock drinking	Nitrate	Nitrate is still elevated and exceeded standards on two occasions at one site and nine occasions at a second site during 2007/11. Seasonal trends are evident and potential sources are being investigated.
Mangawhai Domestic	Nitrate	Nitrate is occasionally elevated and exceeded standards on one occasion during 2007/11. Potential sources are being investigated.

Groundwater/surface water interaction

Understanding groundwater/surface water interaction where groundwater feeds the base flow to streams is critical for the sustainable management of the water bodies.

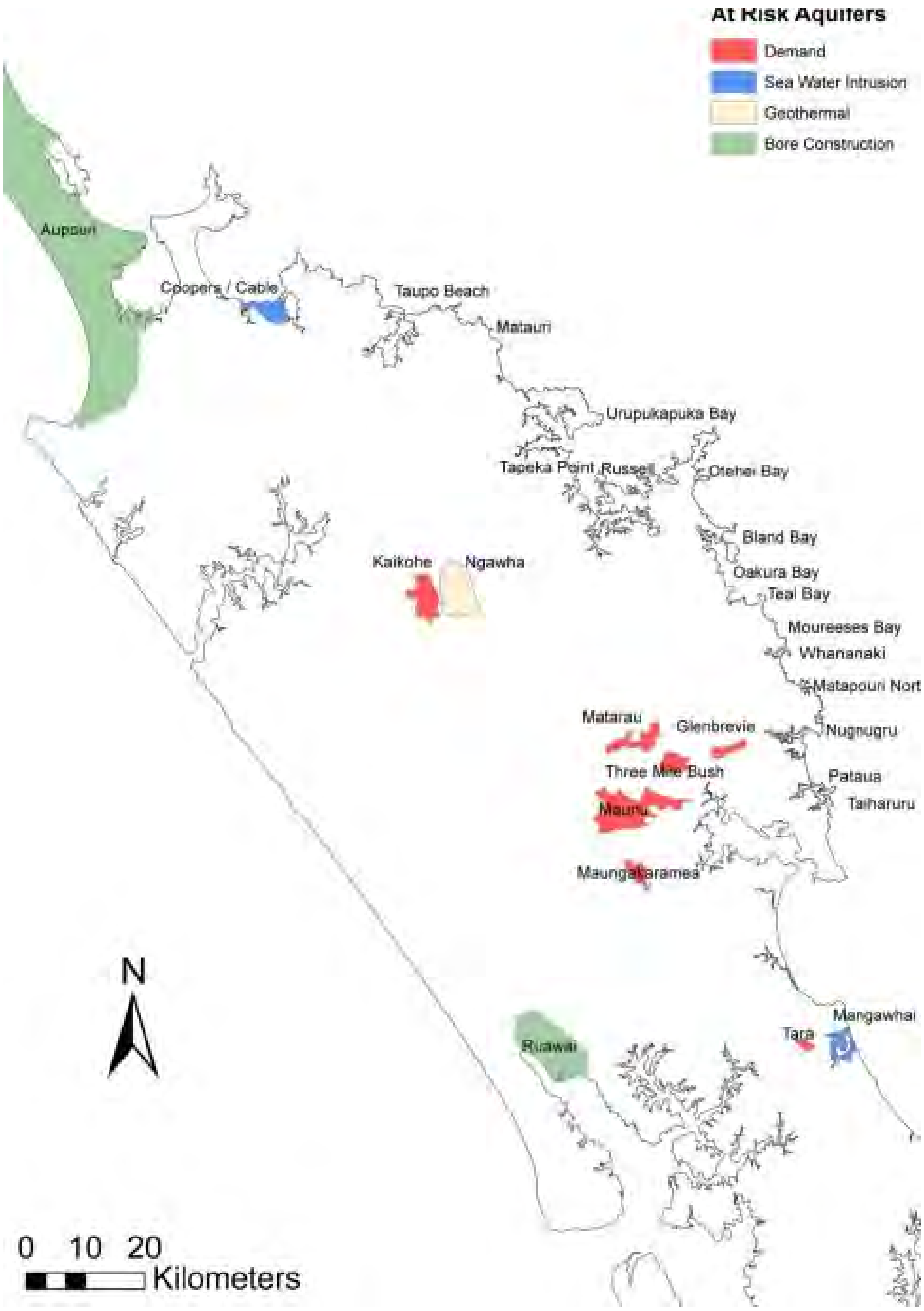
A review of mathematical approaches for calculating the effects of groundwater abstraction on stream depletion was undertaken to assess their appropriateness for use in Northland. A tool was then developed to predict stream depletion rates in the Northland basalt and to help assess level of allocation in combined groundwater/surface water catchments.

For more information refer to the report 'Groundwater/surface water integrated management: Maunu-Maungatapere-Whatitiri basalt aquifers.pdf' available on the council's website: www.nrc.govt.nz/groundwaterReports

Policy documents

The Regional Soil and Water Plan for Northland details the objectives, policies and rules associated with groundwater management in the region. The plan recognises 36 basalt and coastal aquifers, and a geothermal aquifer as potentially 'at risk' due to high water demand, surrounding land use, surface water interaction or proximity to seawater and septic tank discharges. Aupōuri sand/shell aquifer and Ruāwai alluvial aquifer have also been classified in the plan as sensitive to bore construction. The locations of these aquifers are shown in Figure 76.

Figure 76: Aquifers identified as "at risk"



The rules in the Regional Water and Soil Plan restrict groundwater takes, use, diversions and drilling activities depending on the potential effects of the activities.

The rules permit groundwater takes for reasonable stock and domestic requirements provided specific criteria are met. The criteria, among other things, limit the daily volume of groundwater that can be taken depending on the location and the potential for adverse effects as a result of the take. For example, smaller volumes are permitted to be taken from coastal 'at risk' aquifers. In the event the permitted criteria specified in the rules cannot be met, then resource consent to take groundwater is required from the council.

The plan also formulates specific conditions and standards for bore construction, bore closure and alteration to avoid or minimise potential adverse effects. It is a requirement that, within one month of final completion of a bore, a bore completion report (driller's bore log) is submitted to the council so that the bore can be registered in the council's GIS-integrated bore database.

Education and advice

The council provides information on Northland's groundwater resources to the public by way of media releases, pamphlets and publishing all available reports on its website.

The council also provides advice on the importance of appropriate construction and proper maintenance of bores to prevent groundwater pollution. The council's bore and groundwater quality databases are frequently updated. Data on these databases are available to the public upon request.

How are we measuring up against our objectives?

The following are the anticipated environmental results relevant to groundwater quality listed in the operational Regional Policy Statement:

Water quality suitable for desired purposes

Objectives 17.3.1 of the RPS and 7.4.1 of the Regional Water and Soil Plan state that groundwater be potentially usable for water supply and protection of uses of receiving water bodies. The following points demonstrate the current situation and steps taken to avoid groundwater quality degradation:

- In general, groundwater in Northland is of a high enough quality to allow it to be consumed without treatment. The results from groundwater quality monitoring indicate that the majority of determinants analysed for each sample are well below New Zealand drinking water standards/guidelines, however elevated concentrations of nitrates, manganese, iron, sodium and chloride (saline intrusion) and bacteria have occurred at some sites.
- The council undertakes appropriate groundwater quality investigations where potential issues have been identified from groundwater quality monitoring, for example, elevated nitrate or increased risk of saltwater intrusion in coastal areas. There are currently six aquifers in Northland that are subject to specific investigation – Ruāwai, Taipā, Maungakaramea, Mangawhai, Russell and Whatitiri.

Contaminants in water bodies reduced

The main threats to groundwater in terms of contaminants are nitrate, saline intrusion and faecal bacteria. The following points demonstrate the outcomes and efforts made by the council to reduce the contaminants in groundwater:

- The median nitrate-nitrogen concentrations in all aquifers sampled during 2007-2011 are below the NZ drinking water standard of 11.3 mg/L nitrate-nitrogen.
- Poor bore-head construction can result in groundwater contamination. All new bores require a consent which ensures that bore heads are constructed to a certain standard to prevent contamination occurring.
- As part of the renewal of existing discharge consents, an assessment is undertaken on the actual effect of the discharge on water quality and whether the treatment process needs to be improved to reduce the concentration of contaminants being discharged.

The adverse effects of contaminants in water bodies and coastal waters are avoided, remedied or mitigated

- The council undertakes regional groundwater quality monitoring programmes to assess baseline water quality of the different aquifers in Northland and to identify any trends in groundwater quality over time as a result of the climate, land use and groundwater abstraction.
- Groundwater take consents that could potentially result in seawater intrusion are required to have groundwater samples analysed twice per year for chloride concentration.
- A number of saline indicator recorder sites have been established to monitor the risk of saline intrusion.

Protection of important freshwater habitats, particularly wetlands from reductions in surface water and groundwater levels

- Section 25 of the Regional Water and Soil Plan specifies the rules for the taking, use and diverting of groundwater. A groundwater take will be considered likely to cause an adverse effect on the environment where it changes the seasonal or annual range in water level of any indigenous wetland to an extent and manner that may adversely affect the wetland's natural ecosystem. Through these provisions and the consenting process, council can ensure protection of important freshwater habitats is occurring.

Sustainable and efficient use of water resources of Northland

- The Regional Water and Soil Plan outlines management practices aimed at sustainable and efficient use of groundwater resources in Northland. Some of the tools used in this regard are:
  - recognition of "at risk aquifers";
  - groundwater level and spring flow monitoring;
  - control of taking groundwater through the resource consent process; and
  - investigations to better understand the resources.
- Resource consents for taking groundwater generally specify the volumes and rates permitted to ensure the resource is allocated in a sustainable manner.
- Water allocation is not currently provided for within the Regional Water and Soil Plan as no allocation limits have been set for the use of water resources. The plan currently only includes ecological flows.
- Those with permitted water takes are being encouraged to provide their take information to the council. This enables the council to start to understand the cumulative effects of permitted water takes within a catchment and give some level of protection for the individual existing water takes.

Preservation of the natural character, intrinsic, ecosystem and amenity values of natural water bodies to the extent that these depend on water *levels and flows*

- Results of groundwater level monitoring show that there are no groundwater deteriorating trends in Northland aquifers.

Increased awareness of water conservation and greater implementation of water conservation practises

- Resource consents to take groundwater generally have conditions imposed that require the maintenance of water systems to minimise or avoid water loss by leakage. Every effort is made to have a meter installed on groundwater takes so that accurate measurements of water can be recorded.
- The council promotes efficient irrigation methods by assessing the water volumes applied for against industry standards and best practice guidelines.

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Summary table and reports of the different groundwater investigations, the area/aquifer covered, the key findings and recommendations in Northland are available on the council's website: www.nrc.govt.nz/groundwaterReports

Appendix C

Table 35: Summary of the aquifer characteristics for principal aquifers in Northland

Aquifer (zone)	*Broad lithologic description*	*Status*	*Saturated thickness (m)*	*Transmissivity (m^2/day)*	*Storativity*
Aupōuri (Lower Aupōuri peninsula)	Predominantly quartz and feldspar sands overlying limestone/ sandstone/mud stone	Semi-confined to confined	12-90	12-850	0.01-0.00002
Coopers Beach	Tangihua volcanic overlain with sandstone/mud stone	Semi-confined to confined	26-97	12-25	0.0016-0.0000034
Kerikeri/ Kaikohe	Basalt overlying cretaceous siltstone	Semi confined	50	50-175	0.025-0.00072
Whāngārei (Matarau)	Basalt flows, cones and dikes overlying sandstone/mud stone	Semi unconfined	5-70	108-430	
Whāngārei (Glenbervie)	Taheke basalt overlying greywacke/ interbeded sandstone and mud stone	Semi confined	30-80	2-39	0.002
Whāngārei (Maunu)	Taheke basalt overlying sandstone/mud stone	Semi unconfined	8-58	30-89	0.002-0.0006
Whāngārei (Maungatapere)	Basalt with scoria overlying sandstone/mud stone	Semi confined	11-58	25-45	
Whāngārei (Whatitiri)	Taheke basalt overlying sandstone	Confined	4-30	25-4000	0.00004-0.0003
Whāngārei Maungakaramea	Basalt overlying Micaceous sandstone	Semi unconfined	18-36	2-400	0.027

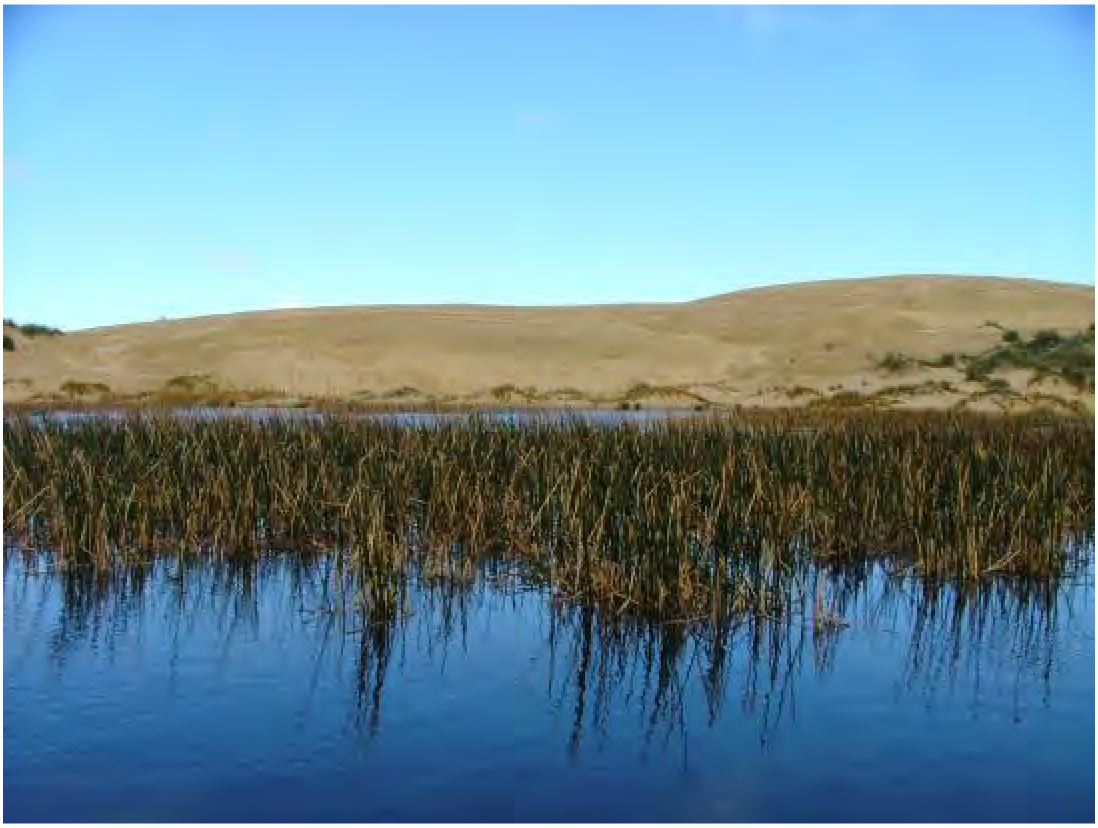
Whāngārei (Three mile bush)	Basalt with scoria overlying sandstone/mud stone	Semi unconfined	12-46	2-489	0.038
Mangawhai	Consolidated unweathered sands with quartz alluvial mud and gravel	Unconfined	5-9	250-700	0.04
Mangawhai	Non-calcareous sandstone thinly or thickly bedded with mud stone	Confined	9-99	1-27	0.0016-0.00015
Taipā	Sand feldspathic with some quartz	Unconfined	6 -7	90 – 150	0.085-0.2
Tara	Basalt flow with underlying sedimentary rocks	Semi unconfined	4-20	38-66	
Russell	Gravels overlying Waipapa group greywacke	Unconfined to semi unconfined		148-176	
Russell	Waipapa group greywacke	Semi-confined to confined		0.1-170	0.0018-0.0003
Ruāwai	Alluvium/sand and gravel	Unconfined to confined	3-6	14-132	
Other shallow coastal aquifers	Predominantly sands/alluvial mud and gravel.	Unconfined			

Freshwater biodiversity and biosecurity

Freshwater is one of Northland's most precious resources. It is vital to life, including people, plants, and animals, it is a component of our social and cultural well-being, and it is vital to our region's industries.

Northland's lakes, rivers and streams provide habitat for native birds, fish, invertebrates and a wide range of aquatic and wetland plants. However, not all are healthy, and many have problems caused by increases in nutrient levels, sedimentation, stock access, invasive weeds, recreational use and land development. Coastal dune lakes are regarded as 'globally imperilled' (at risk worldwide) because many are severely impacted by development and invasive weeds.

The biodiversity of our water is measured by the abundance and health of indigenous species and their ecosystems. Introduced species can negatively impact indigenous biodiversity and can make freshwater unusable. Biosecurity, which helps to keep introduced species out of the region or reduces their numbers, is important for the health of our freshwater systems.



Te Paki dune lake, Aupōuri Peninsula

What do we want for our freshwater ecosystems in Northland?

The operative Regional Policy Statement for Northland sets out what the council and community want – the objectives – for each natural and physical resource in our region. The objectives relating to freshwater biodiversity and biosecurity management are:

- Maintenance of the biodiversity of the Northland region;
- Protection of the life-supporting capacity of ecosystems through avoiding, remedying or mitigating (in that order of priority) the adverse effects of activities, substances and introduced species on the functioning of natural ecosystems;
- The maintenance or enhancement of the water quality of natural water bodies and coastal waters in Northland to be suitable, in the long-term, and after reasonable mixing of any contaminant with the receiving environment and disregarding the effects of any natural events, for aquatic ecosystems.
- Protection of areas of significant indigenous vegetation and the significant habitats of indigenous fauna.

The following are the anticipated environmental results after the policies for freshwater biodiversity and biosecurity management in the policy statement are carried out:

- Water quality to be suitable for aquatic ecosystems.
- Improved aquatic habitat.
- An increase in the areas of significant native vegetation and the significant habitats of formally protected native fauna.
- No significant increase in the number of threatened species in the region.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

What is the state of our freshwater biodiversity?

Monitoring freshwater biodiversity is important for the management of fragile ecosystems and vulnerable species. Current monitoring carried out by the council includes macroinvertebrate sampling, fish monitoring, lake vegetation surveys, and river habitat assessments. Several new programmes are being developed to complement existing programmes.

Freshwater fish

Previous records show that 34 species of fish have been recorded in the region's waterways (see Table 36 in Appendix D), 18 of which are native species, 12 are introduced species and five are marine species venturing in freshwater habitats (NIWA: 2012).

According to the New Zealand Freshwater Fish Database, the most frequently recorded species in the region are the shortfin and longfin eels and the banded kōkopu.

Many of our native freshwater fish species are endemic to New Zealand, that is, they are not found anywhere else in the world, making them of significant importance to Northland, New Zealand and international freshwater biodiversity. For example, the Northland mudfish is only found in Northland and is classified as 'nationally vulnerable' on the New Zealand threatened species list (Allibone et al: 2010).

Native eel (© Rohan Wells, NIWA)

Ten native fish species have been recorded in Northland lakes. The most common native species are the common bully and the shortfin eel. Other species, such as dwarf inanga and other dune lake galaxiids, are only found in the Kai Iwi and Poutō lakes in Northland, and in a few lakes on the southern head of the Kaipara Harbour. The giant kōkopu and the shortjaw kōkopu are also nationally uncommon, and have been recorded in a few locations in the region. These species are all classified as 'declining' on the New Zealand threatened species list.

Banded kōkopu

Fish monitoring in Lake Ōmāpere (a volcanic lake near Kaikohe) originally started in 2005 and is routinely carried out every two years. Since 2007, results have shown that the fish population has remained relatively stable. The native fish found in the lake were shortfin and longfin eels. Sadly the last recorded observation of common smelt was in 1997 (Gray: 2012) meaning it is probably now extinct from the lake.

The remaining catches included a range of introduced species, with species increasing over time (McGlynn: 2011).

While no routine fish monitoring is carried out, surveys are regularly conducted on specific species, such as threatened species. The Northland mudfish, classified as 'nationally vulnerable', has been monitored since it was first discovered in 1998. Extensive survey work documenting the present distribution has indicated that this species may be one of New Zealand's rarest mudfish species (Department of Conservation: 2003).

Land development activities including the removal of vegetation and the draining of wetlands have restricted its distribution to a limited number of isolated wetlands in the area southwest of Kaikohe, to Kerikeri (Ling: 2009). In early 2004, a 10-year recovery plan was started by the Department of Conservation in order to reduce the decline of the Northland mudfish population.

Freshwater invertebrates

Freshwater invertebrates are animals such as insects or molluscs that have no backbone (spinal column) and can be found in both lakes and rivers. Annual monitoring at the Regional River Water Quality Monitoring Network sites is conducted, primarily as an indicator of water quality. Together with fish monitoring in Lake Ōmāpere, the survey also records the presence of freshwater crayfish. There has been no record of them in the lake since the last survey, in 2008 (McGlynn: 2011). Freshwater mussels have also been recorded in the lake in a patchy distribution in high and stable numbers since 2007 (Gray: 2012). It is likely the mussels are improving the lake water quality due to the filtering service they provide (Gray: 2012).

A study of littoral macroinvertebrates in Aupōuri lakes in 2009, carried out by NorthTec, found that the invertebrate population was diverse and species-rich, dominated by insects and molluscs. However, the overall number of species and the number of those within each, varied considerably among the different lakes in the peninsula.

Several notable records were made during the survey. The most remarkable was the number of dragonfly species living in the lakes with up to five species observed, whereas most New Zealand lakes have only one species. Two of these five species are also found only in the North Island and were the most common species in the peninsula. There were also a lot of molluscs including numerous native Pea mussels and very large native snails (Ball et al: 2009).

Invertebrates such as mayflies, stoneflies, snails, freshwater shrimps, and mosquito and sand fly larvae, occur in Northland's rivers and streams. The taxonomic richness is an indicator recorded during surveys. It can be used to measure biodiversity and how the different communities within the environment are made up, by giving us the number of different taxa (biological groups) at each sampling site and describing the community structure (Pohe: 2011). In 2011, biodiversity ranged from just five species in the highly modified Paparoa Stream to a community rich in diversity in Waipoua River, with 34 species recorded.

Freshwater crayfish or koura

Freshwater aquatic plants

Lake surveys have identified remarkable and nationally threatened native plants within Northland's largest lakes. A survey carried out by the National Institute for Water and Atmospheric Research (NIWA) in 33 lakes found a total of 65 aquatic plant species, 47 of which were native. The study also found five nationally endangered aquatic plant species (NIWA: 2002). Another survey conducted in 65 lakes found seven nationally endangered and four regionally rare plant species (Northland Regional Council: 2005).

Wetlands

A wetland is land that is covered in, or saturated by water, for at least some of the time. Wetlands occur in areas where surface water collects or where underground water seeps through to the surface. They include swamps, bogs, marshes, gumlands, saltmashes, mangroves and some river and lake edges.

In the past, wetlands in Northland covered around 258,451 hectares or 32 percent of the land area. Just 5.5% or 14,114ha of the original wetland area remains, with less than 4% remaining south of Kaitāia. Some of the wetlands being lost in Northland are unique and therefore irreplaceable (Northland Regional Council: 2011). For more information on wetlands refer to Chapter 3 – Biodiversity and biosecurity on land.

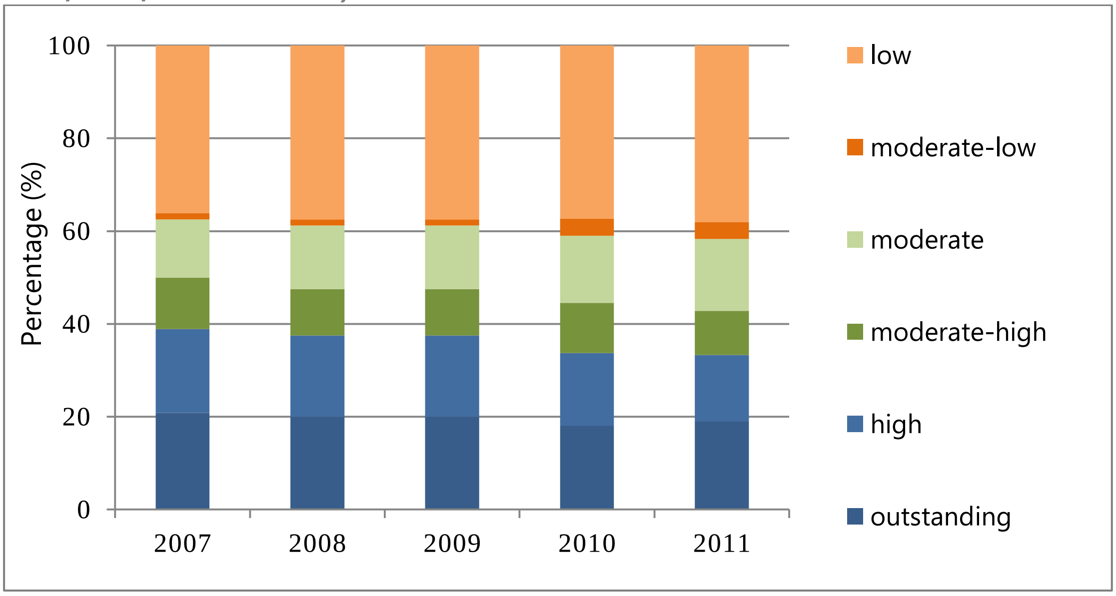
Lakes ecological value

NIWA conducts an annual survey of the major lakes in Northland to establish their ecological status. However, there are some 400 lakes recorded in Northland and therefore it is important to understand that the information reported does not intend to reflect the state of all regional lakes.

Lakes in the programme are ranked according to their ecological value, that is, how many native or endangered plant and animal species they contain, the absence of pest species and how close the lake is to its natural state (Northland Regional Council: 2011). For more information visit www.nrc.govt.nz/lakedata

Between 2007 and 2011, NIWA staff surveyed 85 lakes and ranked them based on the assessments mentioned above. The rankings from best to worst are: outstanding, high, moderate to high, moderate, low to moderate and low. Figure 77 shows the evolution over time of the percentage of lakes in the different ranks.

Figure 77: Percentage of lakes in the different ecological value rank over time (NIWA 2007, 2008, 2009, 2010 and 2011)



Results show that even if no major change is occurring over time, the number of lakes falling into the lower ecological value rankings is increasing. Between 2007 and 2011, the proportion of lakes monitored with low ecological value rank went from 36 to 38%, lakes with moderate-low rank went from 1-4%, and with moderate rank went from 12-15%. As a consequence, the number of lakes falling into the higher ecological value rank is decreasing and remarkable biodiversity features are increasingly at risk of disappearing.

It is commonly known that Northland has some of New Zealand's highest ranked examples of intact natural aquatic ecosystems with some lakes populated with totally native vegetation. Northland is also considered the region with the largest concentration of exceptional lakes in the North Island (NIWA: 2002, 2011). This highlights the need for vigilance to prevent the spread of weeds and introduced fish species into new lakes and the adequate protection of our waterways.

What are the issues affecting freshwater biodiversity in Northland?

Pollution, sedimentation, habitat loss and fragmentation

Pollution of waterways can be caused by various activities in both urban and rural areas. At a national level, farming is regarded as being the principal source of nitrogen in New Zealand waterways. Excessive levels of nitrogen and phosphorus can cause algal blooms and extensive plant growths, which impact on the aquatic ecosystem.

The two most common chemical forms of nitrogen found in water are ammonia and nitrate, whereas phosphorus mainly exists as phosphate. While both ammonia and nitrate are highly soluble in water, phosphate usually sticks to soil and sediment. High sediment volumes released in waterways are another source of pollution, which can impact freshwater biodiversity. Erosion is a natural process however some activities, such as intensive pastoral farming, activities on erosion-prone land, and inappropriately managed earthworks, can increase erosion rates.

Habitat loss is frequently associated with, but not limited to, changes in surrounding land use including land clearance, wetland drainage and reclamations. As human activities break up large connecting areas of native habitat, they become more vulnerable to damage from pests, diseases and environmental influences and their biodiversity values can decrease.

More intensive land use frequently involves clearing regenerating vegetation areas, which also act as a buffer and increase the value of neighbouring areas of more mature forest. Subdivision of land can also lead to fragmentation when properties are developed.

Pest plants and animals

Freshwater ecosystems face many pressures which can make them even more vulnerable to invasion by animal and plant pests and therefore result in habitat loss.

Aquatic pests can be hard to detect, more so than pests on land, and can easily spread throughout connected waterways. As a result, pest control is a challenging exercise, alongside the fact that a limited number of management tools are currently available to achieve this demanding task.

What are the main freshwater pest species in Northland?

Submerged aquatic weeds

Freshwater weeds can form dense mats, completely smothering waterways and badly affecting water quality. These mats can also kill native plants, block drains causing flooding, and disrupt recreation activities. Freshwater weeds are usually fast growing, robust and able to tolerate a broad range of environmental conditions and habitats. Most will grow from small pieces of stem and are easily transported to new places by people, diggers, boats, equipment, and even birds.

Four main aquatic pest plant species are present in Northland's waterways:

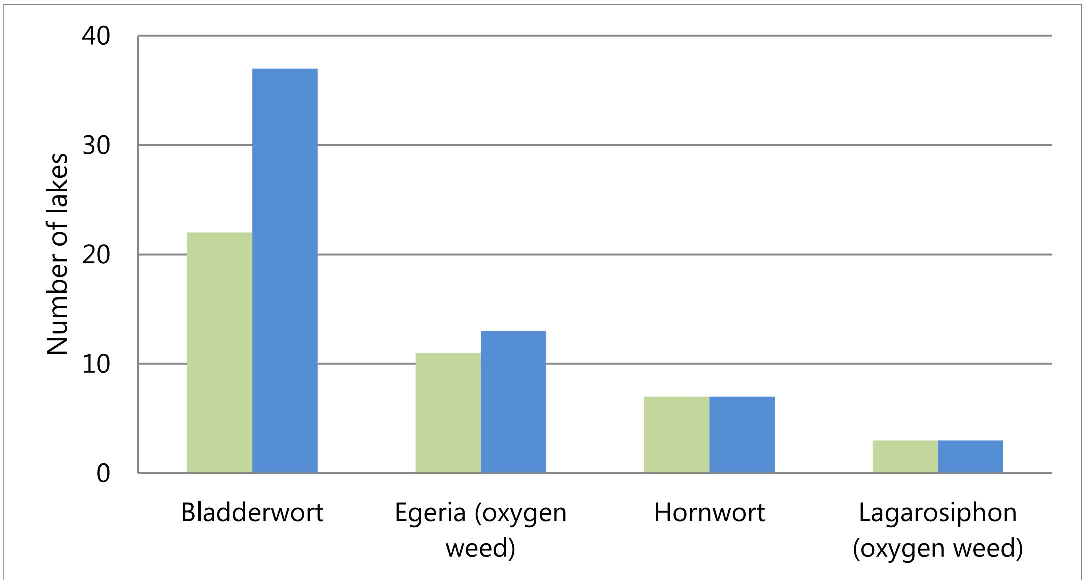
- Hornwort (Ceratophyllum demersum) is currently considered the worst submerged weed in New Zealand as it can grow from the water's edge to depths greater than 15 metres and can displace all submerged vegetation, including other weed species. Hornwort is found in seven Northland lakes, most of which are on the Aupōuri Peninsula.

- Bladderwort (*Utricularia gibba*) is the most widespread aquatic weed species in Northland. It was first recorded in one lake in 1999. By 2006, it had spread to 22 lakes, and to most of the region by 2011 (Figure 78), including the Kai Iwi lakes.

  Bladderwort is free-floating and forms thick submerged mats, covering other plant species. It rarely grows below 3m deep and prefers shallower, less exposed water bodies. In larger lakes the main impacts appear to be in the zone sheltered by emergent sedges. Unfortunately, this is also the preferred habitat of the native bladderwort (Utricularia australis), which is classified as nationally endangered. There are no control tools currently available for bladderwort.

- The oxygen weeds egeria (*Egeria densa*) and lagarosiphon (*Lagarosiphon major*), are a major threat to shallow, nutrient-rich water bodies where they can grow over the entire water body, eventually collapsing and switching the lake from a macrophyte-dominated to an algal-dominated lake. Lagarosiphon is only found in two lakes on the Aupōuri Peninsula and one lake on the Poutō Peninsula. Egeria is found in 13 Northland lakes, mainly in the Aupōuri and Poutō areas (NIWA: 2011).

Figure 78: Number of lakes with the invasive weed species bladderwort, egeria, hornwort or lagarosiphon, recorded in 2006 (green bar) and 2011 (blue bar)



A diver surveying a 4m tall hornwort in Lake Heather (©NIWA)

Animal pests

Freshwater animal pests can also have a negative effect on water quality and native plant and animal communities. They can stir up sediment and make water murky, increase nutrient levels and algal concentrations, and contribute to erosion. These pests may feed on and remove aquatic plants, or prey on invertebrates, native fish and their eggs. They also compete with native species for food and space.

There are a number of introduced pest fish species including koi carp (*Cyprinus carpio*), perch (*Perca fluviatilis*), tench (*Tinca tinca*), brown bullhead catfish (*Ameiurus nebulosus*) and rudd (*Scardinius erythrophthalmus*) that are present in Northland. Some of these have been illegally introduced, others introduced for the purposes of coarse fishing and for ornamental purposes. Rudd and catfish are the most widespread in Northland but currently are not common in the region's high value waterways.

Gambusia (*Gambusia affinis*, also known as mosquito fish) is by far the most widely distributed pest fish in Northland, and is widespread throughout the region. Gambusia populations quickly expand to out-number other fish species. Although small, they are very aggressive and attack some native species by nipping at their fins and eyes and preying on their eggs.

A brown bullhead catfish from Lake Ōmāpere

What is being done?

The council is currently seeking technical advice to develop and carry out an up to date, comprehensive regional strategy for the management of Northland's unique lakes resource. This will combine management of water quality, biodiversity values and biosecurity of Northland lakes and their catchments. A system to prioritise lakes, based on these and other key criteria, will be developed and form the basis for regional management.

Tools in the toolbox

Pest management strategies
Control methods for freshwater pests are currently very limited, and pest species are difficult to remove once established. Preventing or minimising the spread of freshwater pests is a very important part of protecting Northland's natural aquatic ecosystems.

The Northland Regional Pest Management Strategies 2010-2015 include 17 freshwater plants and 12 freshwater animals of concern. These pests fall under different classifications in the strategies, depending on whether they are currently found in the region and how widespread they are. This classification helps guide the objectives, operational plans and management programmes for each pest. The main pest management methods include education, surveillance and response.
The council aims to raise public awareness of freshwater pests by providing information about them, their impacts and management options through publicity campaigns, publications, and events, and by providing an advice and identification service. The council also works with partners from the Ministry for Primary Industries and the Department of Conservation to deliver a summer "Check, Clean, Dry" programme aimed at preventing the spread of freshwater pests.

Targeted freshwater weed surveillance is carried out in seven high priority lakes, and an additional 8-12 lakes, during the ecological assessment surveys each year. The lakes in the targeted surveillance programme have been selected based on the risks and the likely impacts of invasive species being introduced. Finding out where pest species can access the lakes allows for targeted searches of the high risk areas within each.

One of the benefits of surveillance and increased public awareness is that it increases the likelihood of early detection of pests. However, in order to respond rapidly and appropriately, plans need to be in place.

These plans will be developed as part of the new lakes' management strategy.

Other tools

Where a freshwater weed is found early, it's possible to remove small infestations by hand weeding, or covering the weeds with compression screens of weighted down weed mat. Other options currently include the use of specialised herbicides or the biological control agent, grass carp.

The council has worked closely with landowners, local communities and iwi to release grass carp into two Northland lakes, Lake Roto-otuauru (Swan) and Lake Heather. The grass carp were introduced as part of restoration programmes aimed at eradicating the aquatic weeds hornwort and egeria from the lakes and reducing the risk of these weeds spreading to nearby high-value lakes. The grass carp were introduced to Lake Roto-otuauru in May 2009 and to Lake Heather in June 2010.

Grass carp release into Lake Roto-otuauru (Swan)

Progress with the eradication of hornwort and egeria from these lakes has been rapid with nearly all traces of these weeds removed in two to three years. The risk of transfer of these weeds to neighbouring high value lakes is now near zero. The fish are expected to remain in the lakes for a total of five years. It is important that no fragments of weed remain in the lakes, as they could regrow once the fish are removed. It's expected that native aquatic plants will regrow from seed in the lake sediments once the fish are removed.

Herbicides approved for use in water are currently limited, but can be an effective control option. Endothall is the most effective herbicide permitted for aquatic use in New Zealand and is extremely selective, only killing three aquatic weed species. Native plant species are unaffected or suffer only minor damage. The council is working closely with landowners and local iwi, and will be using endothall to eradicate the oxygen weed lagarosiphon, from Lake Phoebe on the Poutō Peninsula, in 2012. The lake is the only known site of lagarosiphon in this area, and the weed eradication is part of a lake restoration programme which also aims to reduce the risk of this weed spreading to nearby high-value lakes.

Monitoring

The council – alongside other organisations and contributors – currently monitors fish, macroinvertebrates, aquatic plants and wetlands.

Fish monitoring in Northland is currently restricted to:

- Rare species such as the Northland mudfish, dwarf inanga and other dune lake galaxiids, and short jaw kōkopu, mostly by the Department of Conservation in line with recovery plans. Northtec also monitors mudfish at a few locations in Northland.
- Presence/absence monitoring by consent applicants for environmental impact assessment reports, to gather background information for resource consent applications.
- A pilot study investigating species richness at eight selected sites within the council's River Water Quality Monitoring Network. This programme is still under development.

Macroinvertebrates are monitored every year at each river quality monitoring site and primarily used as a water quality indicator. Other surveys, such as the annual survey conducted in Lake Ōmāpere, also record macroinvertebrates in regional lakes.

NIWA (with help from the council and the Department of Conservation) monitors freshwater aquatic plants in 85 lakes – on a rotational basis – every year including Aupōuri, Karikari, Kai-Iwi and Poutō areas. This survey also assesses the ecological value of each lake and provides further information on native species and therefore on lake environmental health.

The wetlands' monitoring programme uses national standards (Wetland Condition Index) and is carried out at approximately 15 wetlands, which have received funding through the council's Environment Fund.

Top wetlands project

In 2009 the council initiated the Top Wetlands Project. Since then more than 900 of Northland's remaining wetlands have been added to a Geographical Information System-linked database and 304 of the region's best and most irreplaceable wetlands were ranked and prioritised for management and protection using a scoring system based on national methods.

More than 40 of Northland's estuarine wetland systems were scored and ranked separately. The next phase of the project involves working with the landowners of high value ranked wetlands (153 sites to date) to provide information about their wetlands and to offer assistance and advice on how to care for them (Northland Regional Council: 2011). For more information about the project go to: www.nrc.govt.nz/wetlands

How are we measuring up against our objectives?

An increase in the areas of significant indigenous vegetation and the significant habitats of indigenous fauna which are formally protected

- The non-statutory approaches to biodiversity management are working well. The Northland Biodiversity Enhancement Group is a good example of inter-agency co-operation on an informal level and there are over 50 active environmental land care groups in the region. Northland has also seen a significant increase in council funds available, such as the Environment Fund and the Significant Natural Areas Fund (Far North District Council). Whāngārei District Council and Kaipara District Council also have funds available, which includes funding for freshwater restoration projects.
- The regional council is making progress with identifying the best wetlands across the region. More ecological districts have now been surveyed and most of the 19 ecological districts have published reports. There are also a large number of landowners carrying out active biosecurity management and biodiversity enhancement on their properties, throughout Northland.

No significant increase in the number of threatened species in the region

- Northland continues to lose significant indigenous wetland and species through human activities, such as land drainage. The regional council is currently completing a database of these wetlands and it is anticipated this will help us work out how much native wetland has been lost over time. The database will also help to identify and protect the existing significant native wetlands.
- The identification of biodiversity values is happening slowly. Sites of Significant Biological Interest are not yet identified across the region. The sharing of information is not always consistent between agencies. There are few rules in the regional plans to protect freshwater biodiversity, because of a lack of clear statutory role for the regional council when the plans were developed.

Appendix D

Table 36: Freshwater fish recorded in Northland on the New Zealand Freshwater Fish Database

Scientific name	Common name	No. of records
Native fish		
Anguilla australis	Shortfin eel	344
Anguilla dieffenbachii	Longfin eel	320
Cheimarrichthys fosteri	Torrentfish	90
Galaxias argenteus	Giant kōkopu	1
Galaxias brevipinnis	Koaro	24
Galaxias fasciatus	Banded kōkopu	295
Galaxias gracilis	Dwarf inanga	24
Galaxias maculatus	Inanga	218
Galaxias postvectis	Shortjaw kōkopu	17
Geotria australis	Lamprey	9
Gobiomorphus basalis	Crans bully	81
Gobiomorphus cotidianus	Common bully	263
Gobiomorphus gobioides	Giant bully	74
Gobiomorphus hubbsi	Bluegill bully	10
Gobiomorphus huttoni	Redfin bully	238
Neochanna diversus	Black mudfish	75
Neochanna heleios	Northland mudfish	51
Retropinna retropinna	Common smelt	108
	Total number of records	**2438**
Exotic fish		
Ameiurus nebulosus	Catfish	10
Carassius auratus	Goldfish	27
Ctenopharyngodon idella	Grass carp	2
Cyprinus carpio	Koi carp	11
Gambusia affinis	Gambusia	160
Hypophthalmichthys molitrix	Silver carp	1
Oncorhynchus mykiss	Rainbow trout	28
Oncorhynchus tshawytscha	Chinook salmon	1
Perca fluviatilis	Perch	1
Salmo trutta	Brown trout	9
Scardinius erythrophthalmus	Rudd	13
Tinca tinca	Tench	4
	Total number of records	**269**
Estuarine/marine species		
Aldrichetta forsteri	Yelloweyed mullet	8
Grahamina sp.	Estuarine triplefin	22
Mugil cephalus	Grey mullet	21
Parioglossus marginalis	Dart goby	3
Rhombosolea sp.	Flounders	1
	Total number of records	**26**
Paranephrops	Koura	248
No species recorded		**137**

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