12 SURFACE WATER QUALITY

Summary

RPS Objectives

- The maintenance and enhancement of the water quality in lakes, rivers and streams to be suitable, in the long term, for the following purposes as may be appropriate; aquatic ecosystems, contact recreation, water supplies, aesthetic and cultural purposes.
- The reduction in the quantity of contaminants that impact on water quality entering lakes, rivers and streams.

Pressures

- The number of consented discharges to water and to land, where it can reach water, has steadily increased in the last 10 years, with more than 2200 discharge consents in January 2007.
- The percentage of significant non-compliance for industrial discharges increased between 2003 and 2006, however there was no significant non-compliance reported out of 163 site visits in 2006/2007.
- It is estimated that there are approximately 20,000 on-site wastewater systems in Northland, servicing around 30% of the population, which can have a detrimental effect on water quality if poorly maintained or designed. There are still several community wastewater sewerage systems that require upgrades to meet consent conditions.
- People are often not aware that stormwater is usually discharged directly to our water bodies without treatment and even a very small quantity of some pollutants in stormwater can drastically alter the quality of the receiving waters.
- Non-point source pollution including animal excreta, sediments, nutrients and other pollutants from the surface of the land during rainfall. With 50% of Northland land area in pasture, agricultural land use is a major source of non-point source pollution.
- An increase in the use of higher intensity farm practices in the dairy industry such as feed pads and imported supplementary feed has allowed the number of cows per hectare to increase.

State

- In most summers, at least a quarter of the freshwater swimming spots sampled are generally safe for recreational use, while at least a quarter have typically poor water quality that is frequently not safe for swimming. The River Water Quality Monitoring Network (RWQMN) sites are similar to the recreational bathing sites, with approximately a third often not suitable for swimming.

- Only one of the 21 RWQMN sites comply with the guideline range for dissolved oxygen on more than 50% of sampling occasions.
- Mangere Stream has the highest nutrient levels of the 21 RWQMN sites for 2006. Sites with mostly native forest or exotic forest in their upstream catchments have the lowest nutrient levels such as Victoria, Waipapa, Waipoua and Opouteke River sites and Mangahahuru Stream at Main Road.
- Sediment sampling in a Whangarei urban catchment shows that for most heavy metals there is very little difference between upstream and downstream of the urban area. However, both lead and zinc have been slightly higher downstream.
- Macroinvertebrate monitoring indicated clean water at two of 24 sites monitored in 2007, the two native forest sites: Waipapa at Puketi forest and Waipoua at SH12, while five sites had macroinvertebrate communities indicative of severe organic pollution: Waitangi at Watea, Mangahahuru at Apotu Rd, Mangere, Waiotu and Kaihu
- Several RWQMN sites have shown positive trends such as decreasing nutrient levels or increasing water clarity, which suggests there have been improvements in point source discharges. However some RWQMN sites have also shown negative trends such as increasing dissolved oxygen, bacterial and nutrient levels.
- The bacterial levels only meet the recommended guidelines for stock drinking water at four of 37 different recreational bathing and RWQMN sites.

Doing well

- The Regional and District Councils have several initiatives underway to improve wastewater treatment and minimise the effects on Northland's environment, such as treatment plant upgrades and the development of risk maps for the region.
- State of the Environment monitoring and analysis to assess the state and changes of freshwater quality through time.
- Public awareness and education through workshops and field days with school, environmental care, industry, iwi and landowner groups.

Areas for improvement

- Investigations into areas identified as having water quality problems, including the use of more advanced water quality monitoring techniques.
- The region's knowledge of freshwater biodiversity, particularly the extent of native and pest fish.

12.1 Introduction

Northland has a dense network of rivers and streams, many of which are relatively short with small catchments. The Wairoa is Northland's largest river, draining a catchment area of 3650 square kilometres.

Most of the major rivers flow into harbours, rather than discharging directly to the open coast. This has significant implications for coastal water quality. Flows in rivers vary considerably with rainfall, high intensity storm events causing flash floods and prolonged dry spells leading to very low flows in many smaller catchments. Overall, Northland's rivers are generally characterised as being slow flowing and muddy.

The Northland region also has a large number of small and generally shallow lakes. They are predominantly dune lakes, although there are also a few volcanic and man-made lakes. For more information on the state of Northland's lakes refer to the lake quality chapter of this SOE report.

Regional Policy Statement objectives

The Regional Policy Statement contains a range of objectives relating to the quality of Northland's surface freshwater resources. These objectives seek to maintain, and where possible improve, surface water quality in the Northland region.

The Regional Policy Statement objectives are:

- The maintenance or enhancement of the water quality of natural water bodies in Northland to be suitable, in the long term, for the following purposes as may be appropriate: Aquatic ecosystems, contact recreation, water supplies, aesthetic and cultural purposes.
- The reduction in the quantity of contaminants that impact on water quality entering lakes, rivers and streams.

Environmental results anticipated

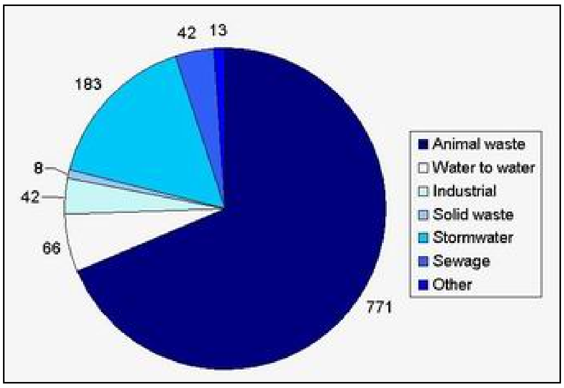
The following is the anticipated environmental results after the implementation of the water quality policies in the Regional Policy Statement:

- Water quality suitable for desired purposes.
- Contaminants in water bodies reduced.
- The adverse effects of contaminants in water bodies and coastal waters be 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.

12.2 What are the pressures on streams and rivers in our region?

Point source discharges

As of 1 January 2007 there was about 1100 discharges to water and a further 1150 discharges to land authorised by resource consents in Northland. These have the potential to contaminate surface water and include farm dairy effluent discharges, municipal sewage discharges, stormwater and other agricultural and industrial discharges. Figures 1 and 2 (below) show the approximate number and type of consented discharges to surface water and land in Northland at 1 January 2007.



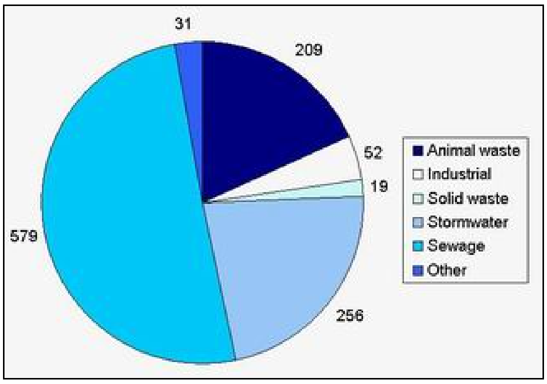


Figure 1: Type and number of discharge consents to water as at 1 January 2007 (left). Figure 2: Type and number of discharge consents to land as at 1 January 2007(right).

Although the number of consents to discharge is much higher for animal waste (predominantly farm dairy effluent), the actual volume discharged and associated contaminated load is much greater for sewage (human) discharges.

Potentially toxic blue green algae in a point source discharge from an oxidation pond treating municipal sewage (right).

The number of consents to discharge to land and surface water in Northland has steadily increased over the last 10 years as shown in figure 3 (below). Many of the new consents granted from 2001 to 2005 were for existing farm dairy effluent discharges.

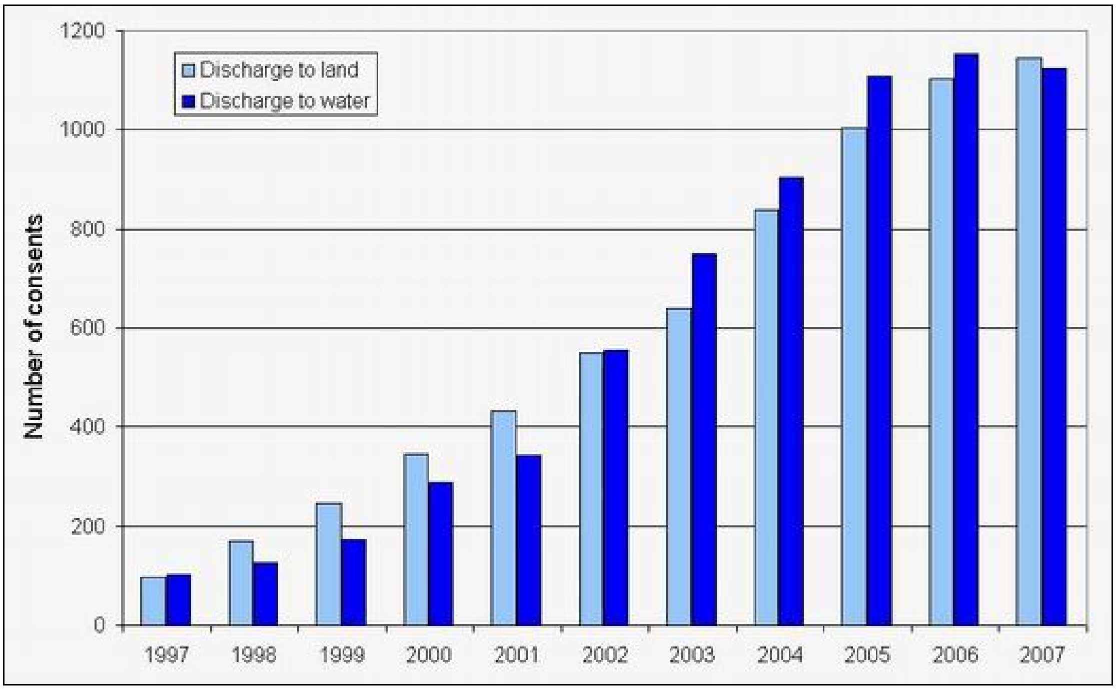


Figure 3: Number of discharge to surface water and land consents at 1 January each year.

Farm dairy effluent discharges

Dairy farm numbers have consistently decreased over the last seven years as shown in figure 4 (right), due to farm amalgamations for efficiency reasons and conversion to other land use such as subdivision for housing, horticulture and beef farming. A drive for higher production has in the main caused higher intensity farm practices with feed pads and imported supplementary feed resulting in increased cow numbers per hectare.

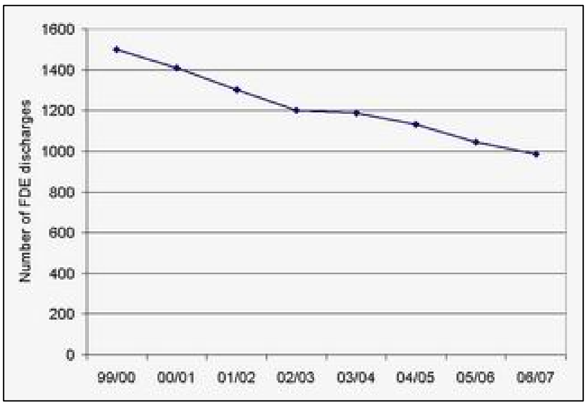


Figure 4: Approximate number of FDE discharges in Northland by milking season.

At the commencement of the 2006/07 dairy season there were 985 farm dairies in Northland. This included those milking cows for calf rearing but not supplying a milk processor. Of these, 711 were authorised by resource consent to discharge treated farm dairy effluent to water. The other 274 farms had undertaken to comply with the "Permitted Activity" criteria for land disposal (as documented by Rule 16.1 of the *Regional Water and Soil Plan for Northland*).

Potential adverse affects from dairy effluent discharges include:

- Increased nutrient loadings promoting nuisance biological growths.
- High ammonia levels which are toxic to fish species.
- Microbial contamination rendering the water unsuitable for human or stock

drinking, contact recreation and/or shellfish collection from downstream estuaries.

- Increased suspended solids reducing water clarity and smothering aquatic life.
- Decreased oxygen concentration, which is required by aquatic life for respiration.

The objective of the Farm Dairy Effluent monitoring programme is to minimise and reduce the impacts of farm dairy effluent on water quality in Northland.

All consented farms are monitored annually. Where a discharge to water is identified, water quality field tests are done and samples taken for laboratory analysis. Non-consented farms are visually inspected annually. Monitoring is timed to coincide with seasonal peak effluent loadings.

Based on the visual inspections and water quality test results all systems are assessed and assigned a compliance category as either:

- Full compliance - Meets all the criteria for a permitted activity or complies with all the conditions of resource consent.
- Minor non-compliance - Some maintenance or improved management required.
- Significant non-compliance - Improved maintenance/management required and potential for or obvious pollution.

Where significant non-compliance is identified, NRC officers arrange on-farm meetings to discuss the non-compliance, assess options for improvement and agree on timeframes for system upgrades. Formal enforcement action is taken in cases where negligence has caused pollution or when agreed works have not been done and repeat significant non-compliance occurs.

There has been a steady improvement in compliance as demonstrated by the monitoring results from the 2003/04 to 2006/07 seasons in figure 5 (below).

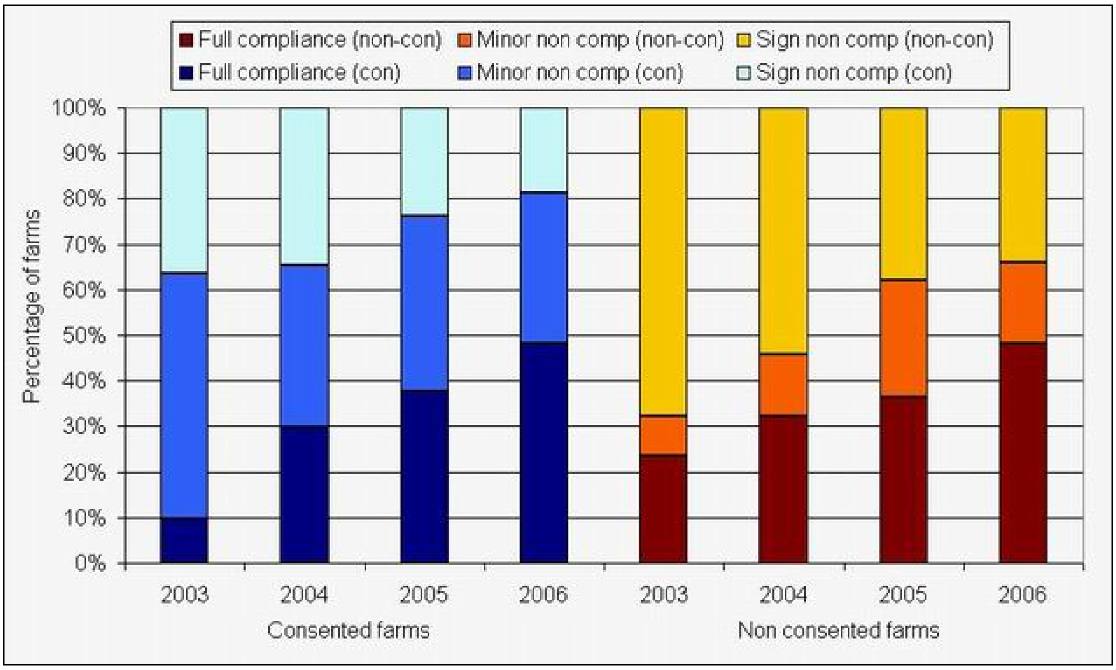


Figure 5: Percentage of compliance for both consented and non consented FDE discharges from 2003 to 2006.

Treatment ponds

Pond systems consist of a minimum of two ponds with the first being typically three to five metres deep and the second being shallow, normally around 1 m depth. In the first pond solids settle to the bottom and microbes digest the organic matter reducing the loading by up to 70%. The microbes in the first pond thrive in anaerobic conditions (that is, with no oxygen) and release gases such as methane and carbon dioxide. In the second pond algae produce oxygen in excess of their own requirements. Microbes use the oxygen to further breakdown the organic matter in the effluent. The microbes in the second pond thrive in aerobic conditions (that is, with oxygen).

With increasing use of feed pads, larger herds and more cows per hectare many treatment/disposal systems have required major upgrades and high capital input. Multiple pond systems with constructed wetlands are more common. Land application from high volume treatment or storage ponds is also being widely practised. Where receiving water volumes are low, land application is the only practicable option to consistently achieve compliance.

Land application

Land application only works where the storage volume is large enough to enable effluent application to be deferred when weather and soil conditions are unsuitable.

Herd homes

About 20 farms in Northland have installed Herd Homes™ over the last few years. These consist of a slatted concrete floor over a sealed concrete basement. The homes are roofed and set up for feeding of supplements and for standoff.

The environmental benefits of the system include that the effluent is collected and stored in the basement as a semi-solid for application to land, replacing solid fertilisers and reducing nutrient run-off and leaching. There are also additional benefits associated with reduced water usage and reduction of pasture and soil damage.

Currently a similar system (Dairy Yard™) is being trialled at several dairies to replace traditional concrete holding yards, with the aim of reducing water use and effluent volumes, while increasing nutrient recycling.

Industrial discharges

Historically, industrial discharges (such as dairy factories and meat-processing industries) have been a major contributor to localised contamination of surface water quality in Northland. Some still existing industrial works were sited and constructed at a time when little importance was placed on water quality.

However, through industry amalgamations there are now few major discharges from industry to water or land in Northland and those that remain have been substantially improved over time.

As of January 2007 there were 94 consented industrial discharges in Northland, of which 52 are discharge to land consents and 42 are discharge to water consents.

Figure 6 (below) shows the percentage of site visits for industrial discharge consents in the different compliance categories of full compliance, minor and significant non-compliance. This includes stormwater discharges to both land and water from timber treatment plants and landfills. Most of the compliance monitoring for industrial discharges include self monitoring by the consent holder and audit monitoring by the Regional Council either on a quarterly or monthly basis. Minor operators are usually only monitored once a year.

The percentage of significant non-compliance increased between 2003 and 2006 but there was no significant non-compliance reported out of 163 site visits in 2006/2007.

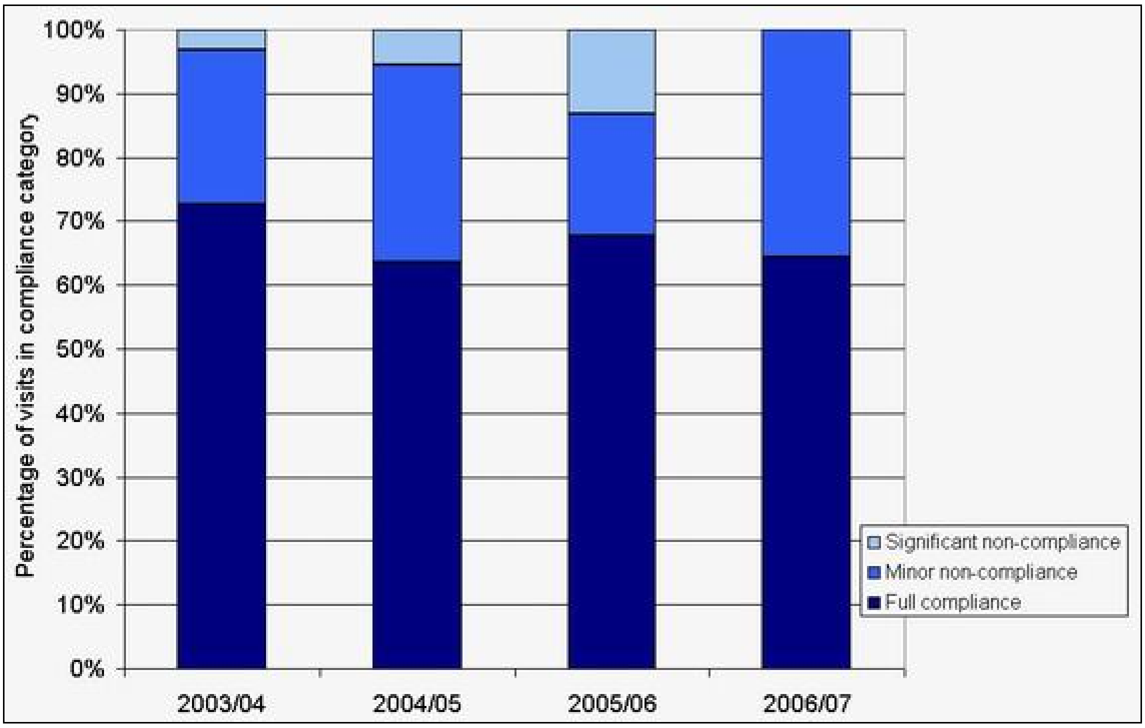


Figure 6: Percentage of site visits for industrial discharge consents in the different compliance categories of full compliance, minor and significant non-compliance.

Sewage waste discharges

The disposal of wastewater generated from Northland residents, visitors and industry places pressure on surface water resources. Inadequate wastewater management can create risks for the following:

- Public health, via contamination of recreational, food gathering and drinking waters with disease-causing microbial pathogens (including bacteria, viruses and potentially toxic algae).
- Environmental health, via discharge of nutrients and toxic chemicals.
- The local economy, via effects on commercial shell fisheries and tourism.

The majority of wastewater generated in Northland is collected and treated in communal wastewater treatment systems that are owned and operated by the three district councils. These systems generally consist of a sewer system, with pumps, which discharge into an oxidation pond, such as Ruakaka oxidation pond shown in the photograph (right). The treated effluent is then discharged into a wetland prior to entering natural water bodies.

These communal wastewater treatment systems range from simple pond systems such as the Kaipara District Council's Maungaturoto system, from which the discharge often contains relatively high bacterial levels of several thousand faecal coliforms to the Far North District Council's Kawakawa system which uses mechanical treatment, including disinfection, that meets the resource consent condition of less than 200 faecal coliforms on most occasions.

Treated effluent is then discharged to land or into rivers or estuaries, with the potential for contamination of surface water. Possible effects on water quality include:

- Increased nutrient levels (leading to proliferation of algal growth).
- High bacteria numbers (increased human health risk).
- High levels of ammonia (toxic to fish).
- Lowered dissolved oxygen.
- Discoloration of surface waters.
- Degraded macroinvertebrate communities.
- Trace metals and chemical contaminants from Trade Waste Consents, which can be toxic to fish and macroinvertebrate communities.

Over recent years there has been a trend of increasing the level of treatment including disinfection to deal with pathogens entering into water. For more information on the different systems in Northland refer to table 1 (below).

Table 1: Municipal sewage discharges in 2007, including treatment and receiving environment of treated effluent.

Community	Treatment method	Receiving environment
Far North		
Ahipara	Oxidation ponds, then constructed wetland	Catchment drain
Awanui	Activated sludge, UV disinfection then constructed wetland	Awanui River
Hihi	Activated sludge, then constructed wetland	Catchment stream
Kaeo	Oxidation ponds, then constructed wetland	Kaeo River
Kaitaia	Oxidation ponds	Awanui River
Kaikohe	Oxidation pond, then constructed wetland	Natural wetland being a tributary of the Wairoro Stream
Kawakawa	Oxidation ponds, bioreactor and clarifier, sand filter and UV disinfection	Kawakawa River
Kerikeri	Fixed film rotating biological contactors, UV disinfection	Natural wetland, Kerikeri inlet
Kohukohu	Septic tank effluent collected then piped to an oxidation pond, then to constructed wetland	Hokianga Harbour
Opononi	Oxidation ponds, then constructed wetland	Hokianga Harbour
Paihia	Oxidation ponds, then to modified natural wetland	Natural wetland, Kerikeri inlet
Rawene	Oxidation ponds, then to constructed wetland	Hokianga Harbour
Russell	Treatment system, UV disinfection to deep bores	Russell Groundwater
Taipa	Aerated ponds then Oxidation ponds, then to constructed wetland	Catchment drain, Parapara R
Whatuwhiwhi	Aerated pond, wetland to dispersal drain	Karikari swampland
Whangarei		
Hikurangi	Oxidation ponds, then constructed wetland	Mangahahuru Stream
Ngunguru	Oxidation ponds, then constructed wetland and UV disinfection	Unnamed stream
Oakura *(excluding proposed expansion)*	Septic tanks with up-flow rock filter and constructed wetlands	Oakura bay
Portland	Oxidation ponds, wetland	Tokotoki creek, Whangarei H.
Rangiputa	Oxidation ponds to ground via soakage pond	Lake Rotokawau catchment
Ruakaka	Oxidation ponds, then constructed wetlands	Land (sandhills)
Tutukaka	Recirculating sand filter system denitrification and, UV disinfection	Trib of Tutukaka Harbour
Waipu	Aerated pond, then constructed wetland	Land (sandhills)
Whangarei	Trickling Filters, Activated sludge, filtration with disinfection, then to constructed wetland	Limeburners Creek, Whangarei Harbour
Kaipara		
Kaiwaka	Aerated ponds, then to wetland	Kaiwaka River
Mangawhai (proposed)	Activated sludge with filtration and disinfection, then to storage ponds.	Irrigation on farm land.
Maungaturoto	Aerated pond	Otamatea estuary, Kaipara H.
Te Kopuru	Aerated pond, then constructed wetlands	Wairoa R, Kaipara Harbour
Dargaville	Aerated pond, then constructed wetland	Wairoa R, Kaipara Harbour

Figure 7 (below) shows the percentage of site visits for sewage discharge consents in the different compliance categories of full compliance, minor and significant non-compliance. This includes sewage discharges to land and water from domestic on-site, communal and municipal systems. The municipal sewage discharge consent compliance monitoring include self monitoring by the consent holder and audit monitoring by the Regional Council either on a quarterly or monthly basis, while communal systems for small communities, marae, schools, camping grounds, cafes and motels are monitored every one to three years at the time of peak loads. Domestic on-site systems for households are usually only inspected once, after being in operation for one to two years.

The compliance rate for site visits for sewage discharge consents has remained reasonably static over the last four years, with the percentage of site visits reported as significantly non-compliant ranging from 2.5% in 2005/2006 to 6.7% in both 2003/2004 and 2004/2005, as shown in figure 7 (below).

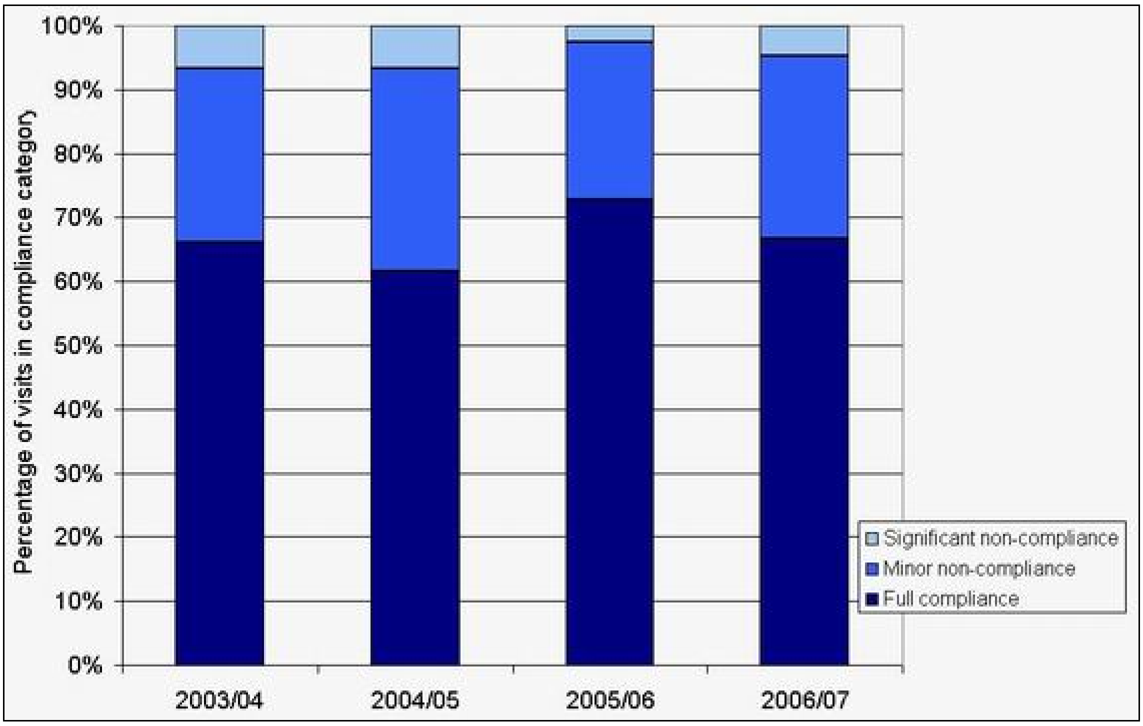
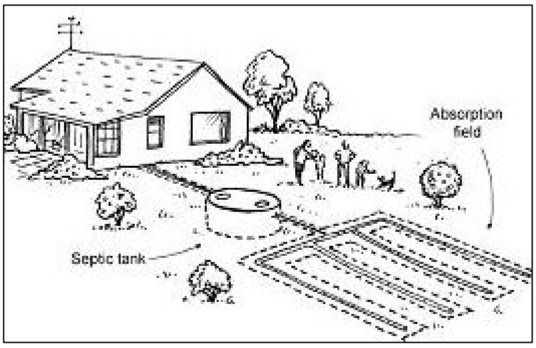


Figure 7: Percentage of site visits for sewage discharge consents in the different compliance categories of full compliance, minor and significant non-compliance.

A significant proportion of domestic wastewater, particularly in the Far North and Kaipara District, is discharged "on-site" on individual properties. It is estimated that there are approximately 20,000 on-site systems in Northland, servicing around 30% of the population. The majority of onsite systems involve septic tanks and soakage fields, although there has been a recent trend to use more advanced treatment systems which produce a better effluent quality.



If properly maintained, the environmental effects of septic tanks are usually minimal. However, potential problems exist where the density of septic tanks is high, or where effluent soakage is poor or excessive. There are some coastal areas where sandy soils allow effluent to contaminate groundwater. Areas with clay soils or hard pans may prevent adequate soakage, resulting in surface discharges and effluent runoff.

As of 1 January 2007 there were 620 wastewater discharges authorised by Northland Regional Council resource consent, 93% of those discharges being to land and the remaining 7% to water. The vast majority of onsite wastewater discharges are covered by the permitted activity rules of the RWSP.

A number of resource consents have been issued in recent years to provide for wastewater discharges from subdivisions where the wastewater is treated and disposed of collectively. A number of these subdivisions have allowed development to occur in areas prior to provision of reticulated sewerage services (e.g. Mangawhai and Ruakaka).

In the last five years the Council has recorded 432 incidents associated with sewage spills in addition to non-compliance issues associated with consented discharges.

The incidents have ranged from break down of major sewage pump stations or pipes through to failure of individual on-site systems. During this same period the Council has undertaken formal enforcement on 32 occasions to address wastewater issues.

Stormwater

When it rains stormwater run-off picks up and carries many different contaminants that have accumulated during dry periods on roads, car parks, footpaths and roofs, usually without – or with very little – treatment into nearby streams, rivers or estuaries. This includes contaminants such as trace metals, hydrocarbons, nutrients, sediment and pathogens from faecal material.

Many people are not aware that stormwater is often discharged directly to our water bodies without treatment. It is not uncommon for car washing detergents, paints and other products to get washed directly into stormwater systems. Even a very small quantity of some pollutants in stormwater can drastically alter the quality of a stream. Fish, insects and plant life can be killed and habitats destroyed.

Stormwater discharges for urban areas are typically authorised by discharge consents based on a stormwater management plan. These management plans have historically tended to focus on the capacity of the stormwater system to receive runoff, with little attention given to stormwater quality.

As of 1 January 2007 there were approximately 440 stormwater consented discharges in Northland, of which 58% were for discharges to land. These include discharge consents for urban areas, industrial sites and quarries as well as shorter term discharge consents for earthworks associated with subdivision development, forest clearing and road works. The discharge consents for quarries and earthworks are at least 60% of the 440 stormwater consents, with the main pressure from these consents being erosion and sediment run-off.

Compliance monitoring for stormwater discharge consents held by the District Councils for urban areas, includes self-monitoring by the District Councils and audit monitoring by the Regional Council one to four times a year. All monitoring is carried out in first flush events. Figure 8 (below) shows the percentage of Regional Council site visits for urban stormwater discharge consents in the different compliance categories of full compliance, minor and significant non-compliance.

The percentage of significant non-compliance has increased over the last three years for stormwater discharges, as shown in figure 8 (below). However, this is likely to be related to the increase in audit monitoring by the Regional Council (the number of site visits per year has almost doubled in the last four years), which has increased the opportunity of detecting significant non-compliance.

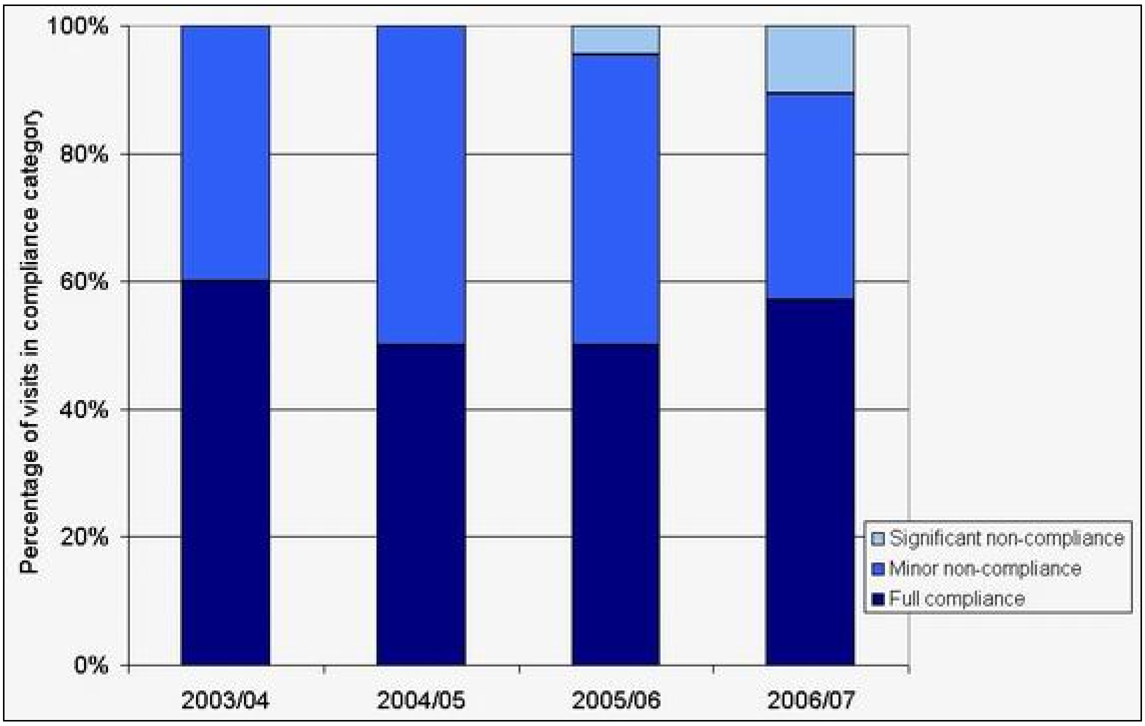


Figure 8: Percentage of site visits for stormwater discharge consents in the different compliance categories of full compliance, minor and significant non-compliance.

For more information on stormwater monitoring, refer to case study 1 in this chapter.

Diffuse surface run off

Non-point source discharges are diffuse sources of contaminants that originate from large areas of land, and cannot be traced to one single fixed point of origin. Non-point source pollution occurs when rainfall washes animal excreta, sediments, nutrients and other pollutants from the surface of the land into streams, rivers and lakes. Pollution of groundwater can also occur when contaminants are leached through the soil into groundwater. Non-point source discharges include:

- Stormwater runoff (not pipe outlets).
- Sediment from earthworks and vegetation clearance.
- Stock excreta.
- Residue from fertiliser and agrichemicals.
- Leachate from contaminated sites.
- On-site wastewater systems.

Most non-point source discharges don't require or have resource consent. Of those that do require resource consent, such as quarries, significant earthworks and vegetation clearance. With the application of the TP90 erosion and sediment control guidelines (ARC 1999) in Northland, the diffuse surface run-off from many of these sites is collected into ponds and discharged from a particular point, therefore becoming a point source discharge. These are mostly consented activities, for which compliance is presented below.

Figure 9 (below) shows the percentage of site visits for land use consents in the different compliance categories of full compliance, minor and significant non-compliance. This includes consents for vegetation clearance, earthworks, quarries and bridge/culvert construction. As discussed above, these consents, in most cases, involve the collection of diffuse surface run-off for treatment, thus leading to a point source discharge.

Compliance monitoring for forest harvesting, roading and stripping is done once or twice a year based on the activities. For example, harvesting is usually monitored in winter, while stripping is monitored in summer. Compliance monitoring for quarries is one to two times a year, while compliance monitoring for earthworks and bridge/culvert construction depends on the activity but is usually once or twice while the work is being carried out and a final inspection at the completion of the work.

The percentage of significant non-compliance has decreased over the last four years for land use consents, as shown in figure 9 (below). This is likely to be due to an increase in environmental awareness among consent holders, forestry companies and earthworks operators, as a result of the Regional Council taking formal enforcement action on non-compliance and education through workshops, field days and site visits.

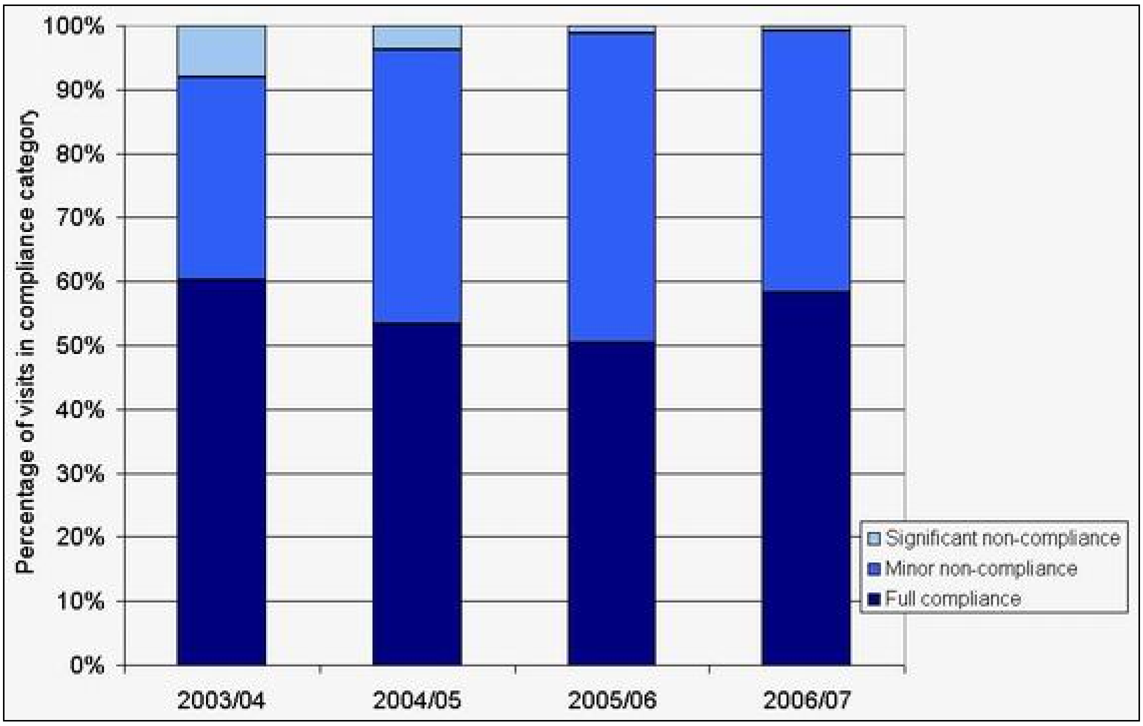


Figure 9: Percentage of site visits for land use consents in the different compliance categories of full compliance, minor and significant non-compliance.

Agricultural land use

Approximately 50% of land in Northland is in pastoral land use (Land Cover Database, 2002) and presumably grazed by stock. As a result agriculture is the most significant source of non-point source pollution. Major contaminants of concern include:

- Organic matter (sourced from faecal contamination).
- Sediment (as a result of deforested slopes converted to pasture and bare land).
- Nutrients (sourced from dung and urine, excess fertiliser).
- Pathogens (disease-causing organisms sourced from dung and urine).

These are largely washed off the land during rainfall, but direct livestock access to streams can also degrade water quality by both damaging stream banks and directly excreting in waterways.

Beef and dairy cattle farming are a major component of the Northland agricultural base, with around 869,000 head of stock at June 2006 (Statistics New Zealand, 2006). Dung and urine from livestock are a major source of nutrients (nitrogen and phosphorous), pathogens and oxygen-consuming organic matter. Stock numbers provide an indication of the effluent loading into surface water.

As shown in figure 10 (below), total numbers of sheep decreased significantly from about 1.3 million in 1990 to 522,000 in 2002. Since 2002 the sheep numbers have fluctuated around 520,000. The trend for beef cattle numbers is not quite so obvious. There have been several small increases and decreases in beef cattle numbers over the last 16 years with an overall decrease of about 100,000. However, beef cattle numbers have actually been on the increase for the last two years.

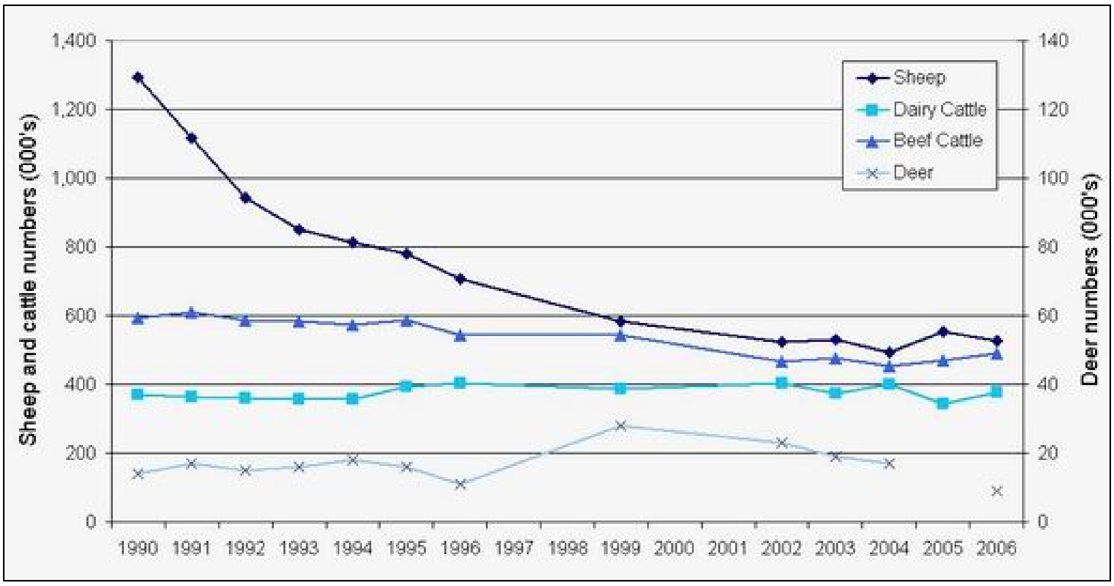


Figure 10: Livestock numbers (000's) from 1990 to 2006, including sheep, dairy and beef cattle (left axis) and deer (right axis).

Deer numbers peaked in 1999 at 28,000 and have since dropped to 9,000 on 30 June 2006, the lowest numbers since 1990.

As discussed in the farm dairy effluent section, the number of dairy farms in Northland has decreased over the last eight years. However, this is not the case for the number of dairy cows. Unfortunately there are some gaps in the data between 1996 and 2002 but there is no obvious trend in dairy cattle numbers in Northland for the last 10 years, fluctuating between 343,000 and 405,000. In recent years there has been a trend towards fewer herds, but with larger herd sizes and therefore increased localised concentrations in livestock numbers.

Greater numbers of livestock per hectare can lead to greater dung and urine loading on pasture with an increased possibility for organic matter, nutrients and pathogens to enter surface and groundwater.

Fertiliser application also poses a threat to surface water quality if applied incorrectly. If excess fertiliser is applied the nutrients not taken up by plants can easily leach into ground and surface water. Fertiliser usage in Northland has fluctuated over the last five years. For example, 216,000 tonnes of urea, lime and Diammonium phosphate (DAP) was applied in Northland in 2004 compared to 235,000 tonnes (of urea, lime and DAP) applied in 2002 (Statistics NZ).

For more information on fertiliser usage in Northland refer to the land and soils chapter of this report.

Most of Northland's lowland rivers typically exhibit elevated levels of phosphorous and nitrogen. All river water quality monitoring network sites with catchments dominated by agricultural land use often have elevated nutrient levels. These sites are shown to the right of figure 11 (below). The percentage of each land use type with the total catchment area for each Regional Water Quality Monitoring Network (RWQMN) site is presented in table 9 in appendix A.

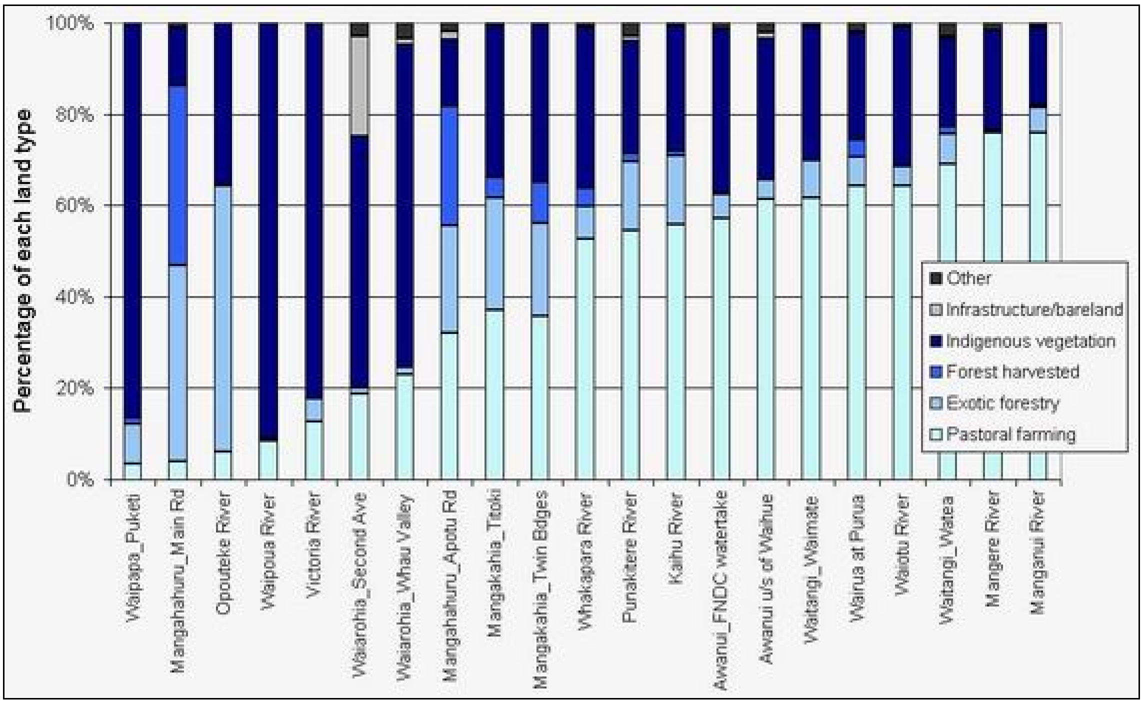


Figure 11: Percentage of different land use types for the RWQMN sites.

The results from a survey of spray contractors and horticulturalists in Northland in 2007 were used to assess the risk of surface water in Northland being contaminated with agrichemicals (pesticides and herbicides). The limited results found that there is a localised but high risk of surface water potentially being contaminated with some agrichemicals, in some areas of Northland (Stewart 2008). The report recommends initial sampling that targets surface water at high risk of contamination to determine the extent of the problem and whether a long term routine monitoring programme is required.

The detailed report "*A Risk Assessment of potential contamination of Surface Water by Agrichemicals in Northland*" is available on the Regional Council website at the following link:

http://www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Rivers-and-streams/

Environmental incidents

Environmental incidents – such as oil or sewage spills, contaminated stormwater, illegal water takes or dead stock – can have a detrimental impact on surface water quality in Northland. The regional council has operated a 24/7 Environmental Hotline service since November 1993, where people can report environmental pollution.

The number of incidents reported to the council affecting inland waters and their recorded impact on the environment is shown in figure 12 (below). The numbers of incidents was highest in 1994 and 1995, decreasing from 1996 to 2002 and has been increasing since 2003, with 266 incidents being reported to the council in 2006. Every year less than 20% of the incidents are recorded as having a significant or large impact on the environment.

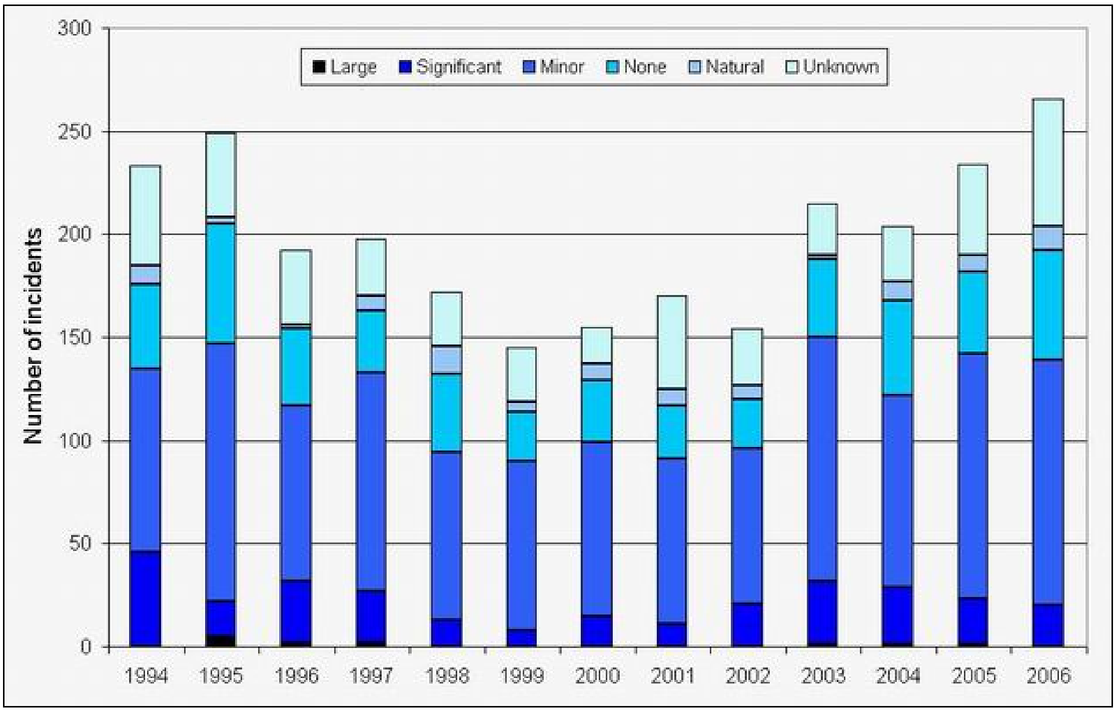


Figure 12: Number of environmental incidents affecting inland waters and their impact on the environment.

This more recent increase in the number of incidents being reported to the council is most likely as a result of a combination of factors such as an increased awareness of environmental quality by the public and increased development, including higher intensity farming and subdivision developments. This can be seen in figure 13 (below), with an increase in the proportion of stormwater and other contaminated discharge incidents over the last three years and an increase in the proportion of earthworks and vegetation clearance incidents over the last five years.

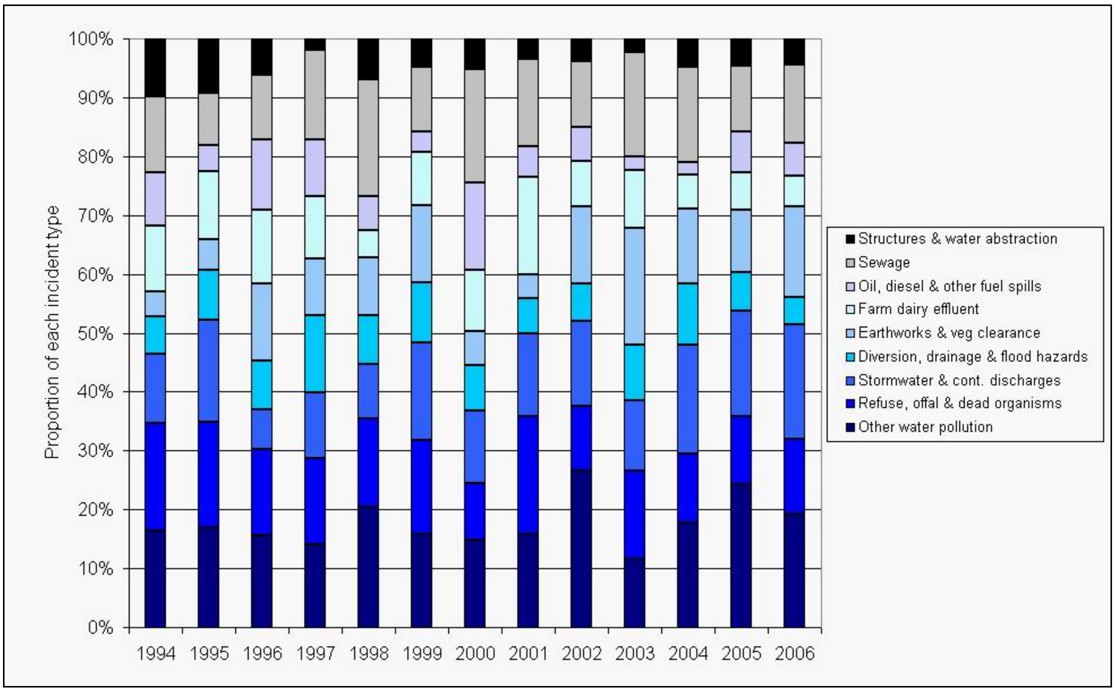


Figure 13: Proportion of the different types of environmental incidents affecting inland waters.

Climate change

In August 2006, the National Institute of Water and Atmospheric Research Ltd (NIWA) carried out a comprehensive assessment on the impact of climate change and climate variability on Northland's water resources based on all available literature. The assessment considered natural climate variability in the Northland region and the potential effects of predicted climate changes over the next 50 to 80 years.

The main points of the assessment were:

- All predictions suggest an increase in temperature, particularly during the winter.
- Overall annual rainfall may not change. However, rainfall trends for the next 30 to 80 years are for increased dry periods (droughts) and more frequent high-intensity rainfall events (floods).
- The influence of a potential increase in droughts causing more frequent, extended and more significant low flow events in our rivers and the effect on water quality and freshwater ecosystems.
- The effect of more frequent and intense rainfall events on erosion, affecting water quality and freshwater ecosystems.

Additional work is required to assess the potential effects of increased drought frequencies and extreme rainfall events on surface water flows such as the environmental response to increased low flows and increased sediment loadings as a result of more extreme rainfall events.

12.3 What is the state of our rivers and streams?

One of the objectives as set out in the Regional Policy Statement and Regional Water and Soil Plan for Northland is to maintain and enhance water quality of lakes, rivers and streams to be suitable, in the long term, and after reasonable mixing of any contaminant with the receiving environment and disregarding the effect of any natural events, for the purposes below as may be appropriate;

- Aquatic ecosystems.
- Contact recreation.
- Water supplies.
- Aesthetic and cultural purposes.

The classification of water bodies in Northland will be carried out in the future as more information and data becomes available, as resources within the Council increase and when community support is gained. Therefore, in this report the water quality of many rivers, streams and lakes that are already monitored is compared to the most relevant guidelines to establish the proportion of monitored water bodies that are suitable for each purpose. This includes sites sampled as part of the National and Regional River Water Quality Monitoring Networks and the Recreational Bathing Water Quality Monitoring Programme and annual macroinvertebrate monitoring. Also where possible this report will cover whether this water quality is improving, stable or deteriorating.

Water quality for contact recreation

Waterways are not always safe for recreational activities, as they can sometimes become contaminated with human or animal effluent, which contains large numbers of organisms capable of causing illness. The most common sources of bacterial contamination are human sewage, stormwater and rural run-off, which can include bacteria from stock and feral animals.

Samples are analysed for the pollution indicator bacteria, *Escherichia coli* (*E. coli*) following the recommended methods in the '*Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas'* (MFE 2002). In this report the results are compared to the action mode guideline of 550 E. coli/100mL (MFE 2002).

Recreational bathing sites

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.

Twenty-one sites on lakes and rivers throughout Northland have been sampled weekly for the past five summers to check whether the microbiological water quality is safe for swimming.

Popular swimming spot - Kapiro Stream (right).

The results for these 21 sites is presented in table 2 (below) including the number of samples, median, Hazen 95^{th} percentile (as recommended by the MFE guidelines) and the percentage of samples that comply with the 550 E. coli/100mL action mode guideline. Note: Six sites have been sampled for less than five years, which is indicated in brackets next to the site.

Table 2: Statistics for recreational bathing programme sites for the last five seasons (unless stated otherwise in brackets next to the site).

Site	Number of samples	Median	Hazen 95th percentile	% of samples that comply with 550 E. coli/100mL
Lake Ngatu at launch site	50	5	134	98%
Lake Taharoa at Promenade Point	54	5	39	100%
Lake Taharoa at pump house	53	5	104	100%
Lake Ngatu at South end	50	10	110	98%
Waipoua River (2)	24	41	719	96%
Kaihu River	52	121	4884	81%
Waipapa Stream	53	122	779	94%
Omamari Beach Stream (4)	46	167	1168	85%
Waitangi River	55	193	2106	89%
Kerikeri River	54	211	2504	76%
Kapiro Stream (4)	42	222	803	88%
Mangakahia River at Twin Bridges	54	246	3879	72%
Raumanga Stream	55	250	3719	71%
Tirohanga Stream	55	272	1586	85%
Otaua Stream (3)	36	282	5138	69%
Hatea River at Whangarei Falls	54	352	3836	72%
Lake Waro, Hikurangi	51	770	6317	31%
Wairoa Stream	51	770	6317	31%
Ocean Beach Stream (3)	35	794	6867	40%
Langs Beach Stream (3)	36	1194	4543	31%
Otiria Stream	54	1211	4097	11%

The sites can be split into compliance categories based on how many samples comply with the recreational bathing guidelines in each year, following the national reporting methods (MFE 2007). Table 3 (below) shows the number of sites in each category as a percentage of the total number of sites sampled in that summer, which was 14 sites in 2003-04, 20 in 2004-05, 22 in 2005-06 and 25 in 2006-2007.

In all summers, except 2005-2006, at least a quarter of the sites sampled were generally safe for recreational use. However, every year at least a quarter of the sites have typically poor water quality that is frequently not safe for swimming.

This is slightly worse than nationally, with 40 to 50% of the sites sampled throughout New Zealand having typically good water quality (95 to 100% sample compliance) and less than 15% having poor water quality (MFE 2007).

Table 3: Percentage of the recreational bathing sites in each compliance category for the four summers from 2003 to 2007.

Compliance category	What does this mean?	Proportion of sites in each compliance category			
		03-04	04-05	05-06	06-07
95-100% samples comply	Between 95% and 100% of samples taken over the bathing season complied with guidelines. Sites in this category have typically good water quality and are generally safe for recreation.	29%	40%	14%	32%
90-94% samples comply	Between 90% and 95% of samples taken over the bathing season complied with guidelines.	21%	10%	9%	8%
75-89% samples comply	Between 70% and 90% of samples taken over the bathing season complied with guidelines.	21%	20%	32%	28%
0-74% samples comply	More than 25% of samples taken over the bathing season did not comply with guidelines. Sites in this category have typically poor water quality and are often not safe for recreation.	29%	30%	45%	32%

Many of the recreational bathing sites in Northland now have sufficient data to assess their suitability for recreation grade (SFRG) following the guidelines (MFE 2002). Other than the two lakes, Ngatu and Taharoa, all sites in Northland have an interim SFRG of poor or very poor, as shown in figure 14 (below).

A few of these sites have consistently high bacterial levels regardless of rainfall such as Otiria Stream near Moerewa, Wairoa Stream in Ahipara and two small streams flowing on to beaches (one at Ocean Beach and one at Langs Beach) and these grades are due to contamination mostly as a result of run-off during rainfall. The Council and Northland Health recommend that you do not swim for several days after heavy rain or if the water is turbid.

The majority of the recreational bathing sites are generally acceptable for swimming and other freshwater recreational activities during dry weather, but after heavy or prolonged rain, the waterways become unsuitable for several days. The exceptions to this are Langs and Ocean Beach Streams, Otiria and Wairoa Streams, which are all generally unsuitable for freshwater contact in all conditions.

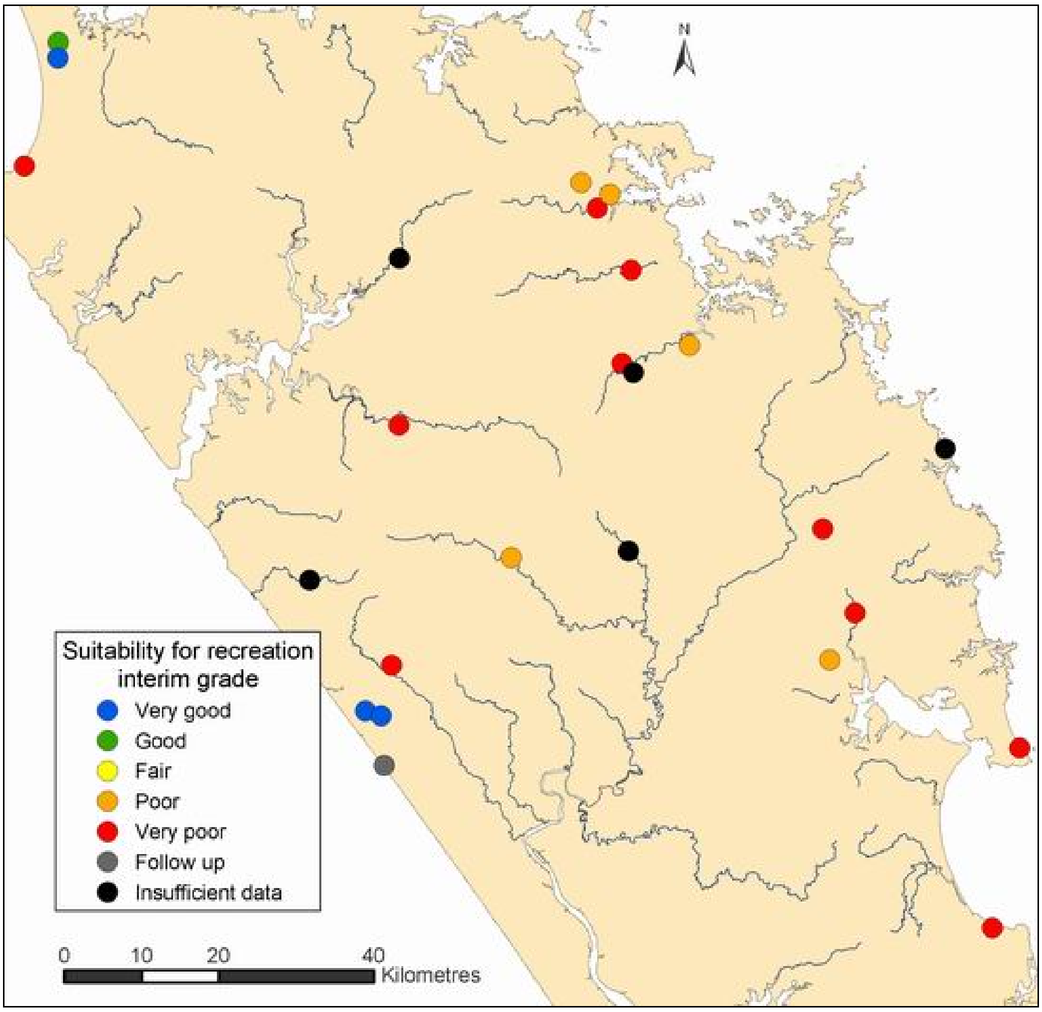


Figure 14: Suitability for recreation interim grade (SFRG) for the 25 bathing sites sampled in 2006-2007. Note: Grades can only be calculated for sites with at least three summers of data.

River Water Quality Monitoring Network sites

The bacteriological water quality results from 21 sites in our region's River Water Quality Monitoring Network (RWQMN) can also be assessed against the recreational bathing guideline of 550 *E. coli*/100mL to check their suitability for swimming. The following three sites are in both the RWQMN and recreational bathing programme; Waipoua River, Waipapa River and Mangakahia at Twin Bridges.

The results for the bathing season (November to March), as recommended by the MFE guidelines, for these 21 sites is presented in table 4 (below), including the number of samples in November to March since analysis for *E. coli* started in December 1999, median, Hazen 95th percentile (as recommended by the MFE guidelines) and the percentage of samples that comply with the action mode guideline.

Two of the 21 RWQMN sites have 95% or more of their summer (November to March) samples in compliance with the recreational bathing guideline – Waipoua and Kaihu Rivers. A further two sites have at least 90% of their summer samples in compliance with the guideline – Waipapa at Puketi Forest and Mangahahuru at Main Road.

Table 4: Statistics for RWQMN sites for the bathing seasons between December 1999 and March 2007. Note: Sampling started after December 1999 for some sites, as shown in brackets below.

Site	Number of samples	Median	Hazen 95th percentile	% of samples that comply with 550 E. coli/100mL
Waipoua River (Jul 02)	25	74	673	96
Waipapa River at Puketi Forest	32	91	1632	94
Wairua River at Purua	35	130	1480	83
Opouteke River	38	146	1587	84
Manganui River (Aug 01)	28	128	6760	82
Kaihu River (Jul 02)	25	108	556	96
Waitangi River at Watea	35	122	1160	89
Victoria River	38	261	2513	79
Mangakahia River at Twin Bridges	38	212	1821	82
Mangahahuru Stream at Main Rd (Jul 05)	10	384	836	90
Mangakahia River at Titoki	34	195	1460	77
Whakapara River	39	147	3969	82
Awanui River at FNDC water take (Mar 02)	26	276	1420	85
Waiotu River at SH1 (Mar 00)	36	318	9384	69
Punakitere River (Aug 01)	30	321	3076	77
Awanui River upstream of Waihue channel	39	374	2206	72
Waiarohia Stream at Second Ave (Jul 05)	10	567	24193	50
Mangahahuru Stream at Apotu Rd	39	780	5978	33
Waitangi River at Waimate	39	816	3306	36
Mangere River	39	519	14200	54
Waiarohia at Whau Valley Rd (Jul 05)	10	1318	3654	0

Seven of the 21 sites (33%) have less than 75% of their summer samples compliant with the guidelines, as shown in table 5 (below), which indicates that these sites are often not safe for swimming.

Table 5: Percentage of the 21 RWQMN sites in each compliance category

Compliance category	What does this mean?	Proportion of sites in each compliance category Jan 00 to Dec 06
95-100% samples comply	Between 95% and 100% of samples taken over the bathing season complied with guidelines. Sites in this category have typically good water quality and are generally safe for recreation.	9.5%
90-94% samples comply	Between 90% and 95% of samples taken over the bathing season complied with guidelines.	9.5%
75-89% samples comply	Between 70% and 90% of samples taken over the bathing season complied with guidelines.	47.6%
0-74% samples comply	More than 25% of samples taken over the bathing season did not comply with guidelines. Sites in this category have typically poor water quality and are often not safe for recreation.	33.3%

The RWQMN sites are similar to the recreational bathing sites, with approximately a third often not suitable for swimming, as shown in red in figure 15 (below). There are slightly more recreational bathing sites than RWQMN sites in the category of 95% to 100% of samples compliant with guidelines because the recreational bathing sampling includes relatively pristine lake sites, which have better microbiological water quality than the river sites.

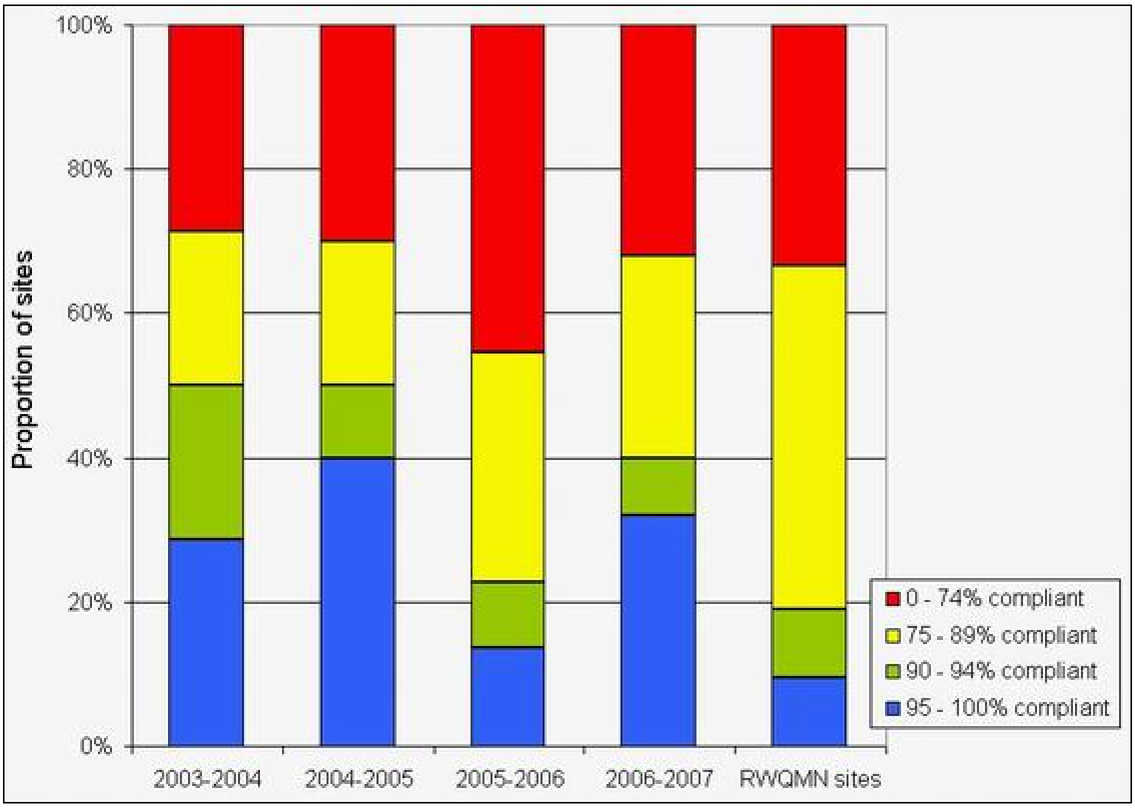


Figure 15: Proportion of recreational bathing sites every summer from 2003-2004 to 2006-2007 and proportion of RWQMN sites for summer results from 1999 to 2007 in each compliance category.

RWQMN sites in native forest or mostly native or exotic forest catchments have fewer samples that exceed the 550 E. coli/100mL action mode level such as Waipoua, Waipapa (Puketi) and Kaihu Rivers, and Mangahahuru Stream at Main Road, than sites in agricultural land use as shown in figure 16 (below).

Of the 14 RWQMN sites with sufficient data to analyse long term trends, only one had a significant trend. Mangere Stream showed a meaningful increase in *E. coli* of 118 MPN/100mL from 2000 to 2006 (NRC 2007). This consistently elevated and increasing trend in *E. coli* will be investigated further, see case study 3 for more information.

Another indicator which can be used to assess the suitability of a site for contact recreation is water clarity. Elevated bacterial levels are typically associated with turbid water (low clarity). Aesthetics of swimming in clear water is important as most people perceive clear water as being unpolluted. The Regional Water and Soil Plan (RWSP) for Northland (NRC 2004), in section 7.6.8, states that visual clarity should not fall below 1.6 metres for contact recreation purposes. Only five of the 21 RWQMN sites have water clarity greater than 1.6 m on at least 50% of sampling occasions, as shown in figure 17 (below). Based on this many of the RWQMN sites do not meet swimming suitability guidelines, which is consistent with the *E. coli* results.

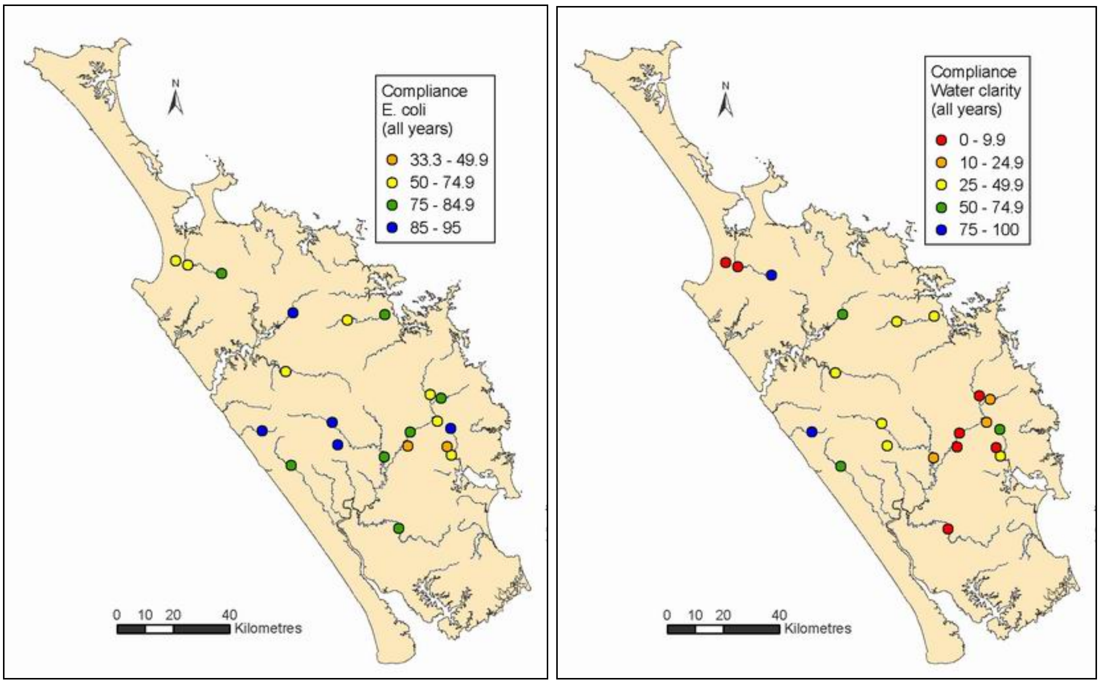


Figure 16: Percentage of samples for each site that meet the suitability for swimming guideline of 550 *E. coli*/100mL (MfE 2002) for 21 RWQMN sites (left). Figure 17: Percentage of samples for each site that meet the water clarity guideline of 1.6 m (NRC 2007) for 21 RWQMN sites (right).

Water quality for aquatic ecosystems

The medians for all parameters at each site for 2006 and all years are in tables 11 and 12 respectively in appendix B.

The data from the last 10 years for all our RWQMN sites can be compared to the ANZECC trigger values for the protection of aquatic ecosystems in New Zealand (ANZECC 2000).

It is important to note that the trigger values are used to assess the risk of adverse effects on the ecosystem and when results are outside trigger values further investigation is required to determine whether there are adverse effects on the environment and to what extent. There are two sets of trigger values; one for upland rivers, which only includes one site in the network (Waipoua River), and one for lowland rivers as shown in table 6 (below).

Table 6: Trigger values for NZ lowland and upland rivers (ANZECC 2000)

Parameter	Trigger values for lowland rivers	Trigger values for upland rivers
Dissolved oxygen (% Saturation)	98 - 105	99 – 103
Water clarity (m)	> 0.6	> 0.8
Turbidity (NTU)	< 5.6	< 4.1
Dissolved reactive phosphorus (mg/L)	< 0.01	< 0.009
Total phosphorus (mg/L)	< 0.033	< 0.026
Nitrate, nitrite nitrogen (mg/L)	<0.444	<0.167
Ammoniacal nitrogen (mg/L)	< 0.021	< 0.01
Total nitrogen (mg/L)	< 0.614	< 0.295
pH	7.2 – 7.8	7.3 – 8.0

Dissolved oxygen

Only one of the 21 RWQMN sites comply with the ANZECC trigger value range for dissolved oxygen (DO) on more than 50% of sampling occasions as shown in figure 19 (right). This is Waitangi River at Watea, which complies with the DO guideline range on 71% of sampling occasions.

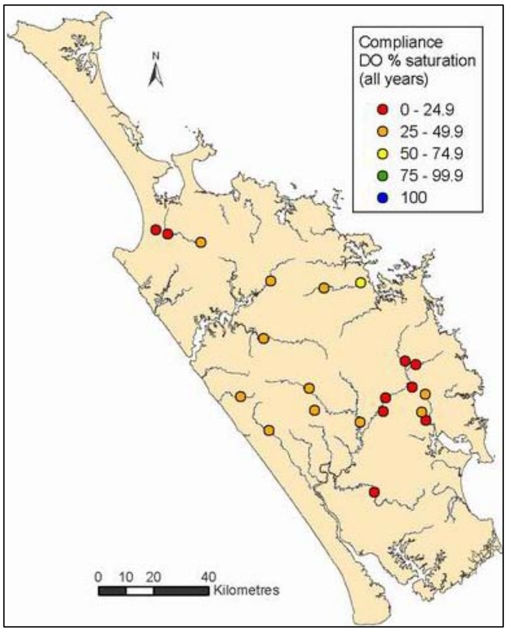


Figure 18: Percentage of samples that comply with the ANZECC trigger values for dissolved oxygen (% saturation) for each of 21 RWQMN sites (right).

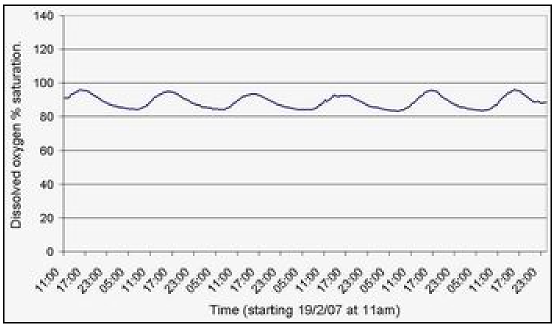
The Awanui River site above Waihue channel has the lowest dissolved oxygen with a median of 85% for 2006. However sites with high dissolved oxygen are as much of a concern as those with low because DO often has strong diurnal cycles. Super-saturated oxygen conditions during the day are usually followed by low oxygen (anoxic) levels at night (refer to diurnal patterns below). This has been found in other areas of New Zealand (NRC 2007).

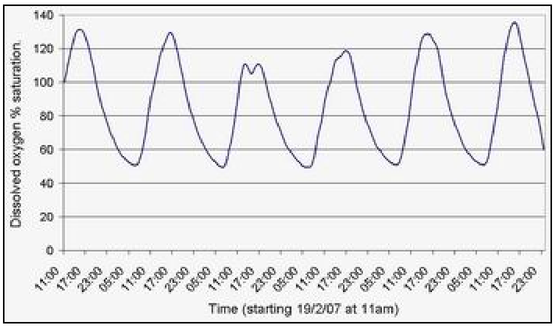
Diurnal patterns

Dataloggers (datasonde) were deployed at the two RWQMN sites on the Mangahahuru Stream: Main Road in the headwaters and Apotu Road further downstream. The dataloggers were deployed for approximately a week at both sites simultaneously and programmed to measure and record dissolved oxygen every 30 minutes.

NRC staff member checking calibration of datasonde for DO with handheld meter (right).

Both sites showed a clear diurnal cycle in dissolved oxygen with peaks between 3 and 4pm and lows between 6 and 7am as shown in figures 19 and 20 (below). More importantly these results highlight the difference in DO cycles between the two sites. The less impacted Main Road site has a small range with its dissolved oxygen fluctuating by about 10% throughout the cycle, while the Apotu Road site has a much greater range of about 75%. This is most likely a result of the large mats of oxygen weed at the Apotu Road site, which produce copious amounts of oxygen during the light (day time) phase of photosynthesis but consume oxygen during the dark (night time) phase of photosynthesis.





Figures 19: Dissolved oxygen (% saturation) from 11am on 19 February 2007 at Mangahahuru Stream at Main Rd (left). Figure 20: Similarly dissolved oxygen (% saturation) at Apotu Rd (right).

Nutrients

Mangere Stream has the highest nutrient levels of the 21 RWQMN sites, with the highest median ammoniacal nitrogen, nitrate nitrite nitrogen, total nitrogen, dissolved reactive phosphorus and total phosphorus for 2006. Sites with predominantly native forest or exotic forest in their upstream catchments have the lowest nutrient levels such as Victoria, Waipapa, Waipoua and Opouteke River sites and Mangahahuru Stream at Main Road.

Ammoniacal nitrogen

Three headwater sites complied with the ammoniacal nitrogen ANZECC trigger value on all sampling occasions as shown in figure 21 (right); Waipapa River, Waiarohia Stream at Whau Valley and Mangahahuru Stream at Main Road. Mangere River only complied with the guideline on 13% of sampling occasions. Note the Waipoua River site does appear to perform as well as the other headwater sites because it is the only site that has been compared to the stricter ANZECC trigger value for upland rivers.

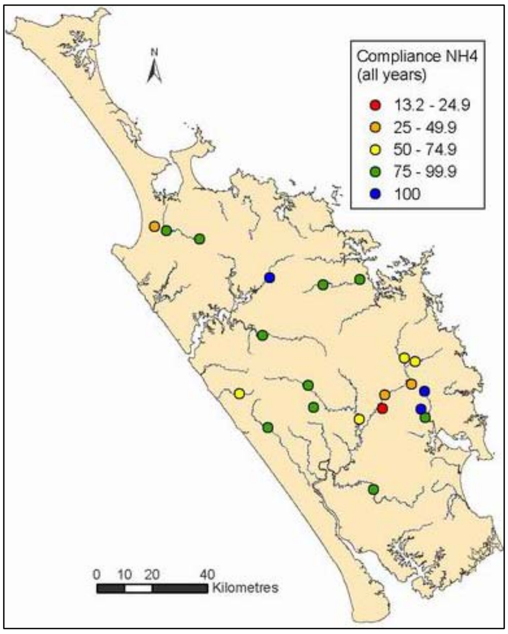
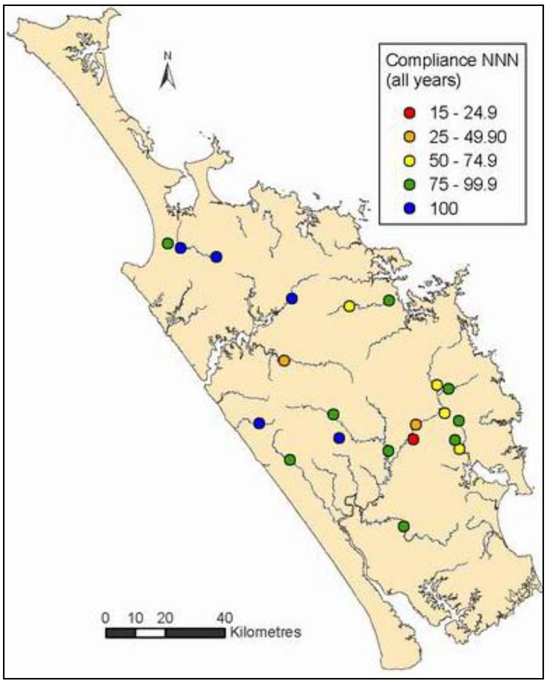


Figure 21: Percentage of samples that comply with the ANZECC trigger values for ammoniacal nitrogen for each of 21 RWQMN sites (right).

Nitrogen

Five sites comply with the ANZECC trigger value for oxides of nitrogen (or otherwise known as nitrate nitrite nitrogen - NNN) on all sampling occasions as shown in figure 22 (below). They are Victoria, Waipoua, Waipapa and Opouteke River sites and the site at the FNDC water take on Awanui River. Mangere River complied with the NNN trigger value on 15% of sampling occasions.

Mangahahuru Stream at Main Road is the only site that complies with ANZECC trigger value for total nitrogen (TN) on all sampling occasions as shown in figure 23 (below). Three sites exceeded the trigger value for TN on over 75% of sampling occasions; Punakitere River, Mangere Stream and Waiarohia Stream at Whau valley.



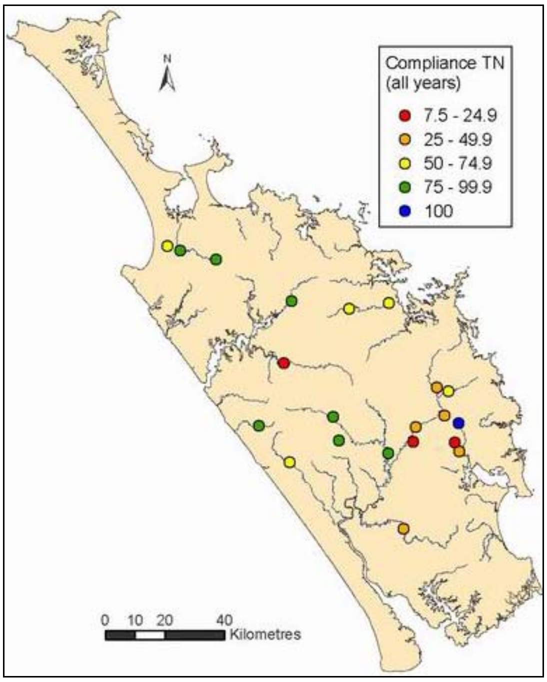
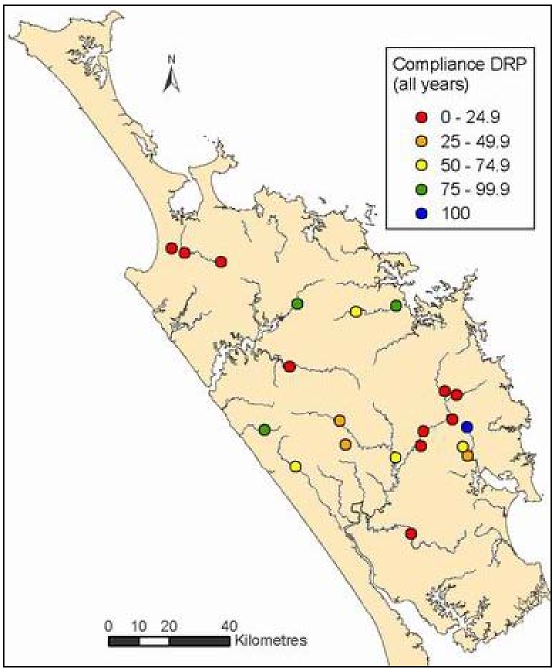


Figure 22: Percentage of samples that comply with the ANZECC trigger values for nitrate, nitrite nitrogen for 21 RWQMN sites (left) Figure 23: Similarly total nitrogen for 21 RWQMN sites (right).

Phosphorus

The 21 RWQMN sites had similarly poor compliance with both the dissolved reactive phosphorus (DRP) and total phosphorus (TP) trigger values as shown in figures 24 and 25 (below). One site (Mangahahuru Stream at Main Road) complied with the DRP trigger value on all sampling occasions and no sites complied with the TP trigger value on all sampling occasions.



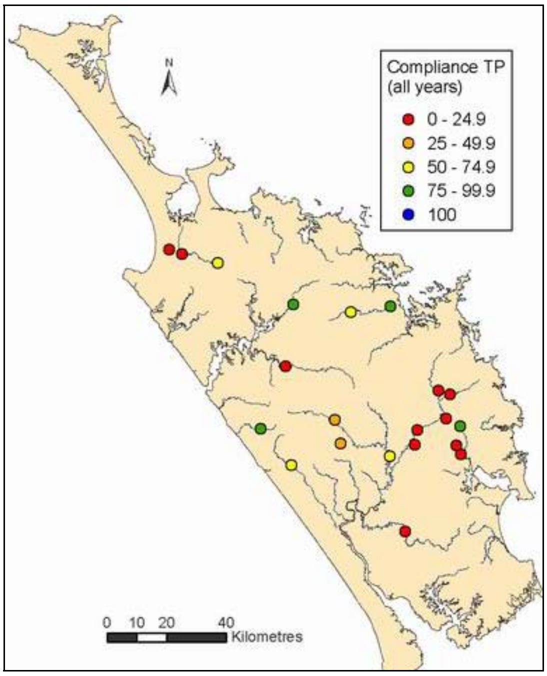


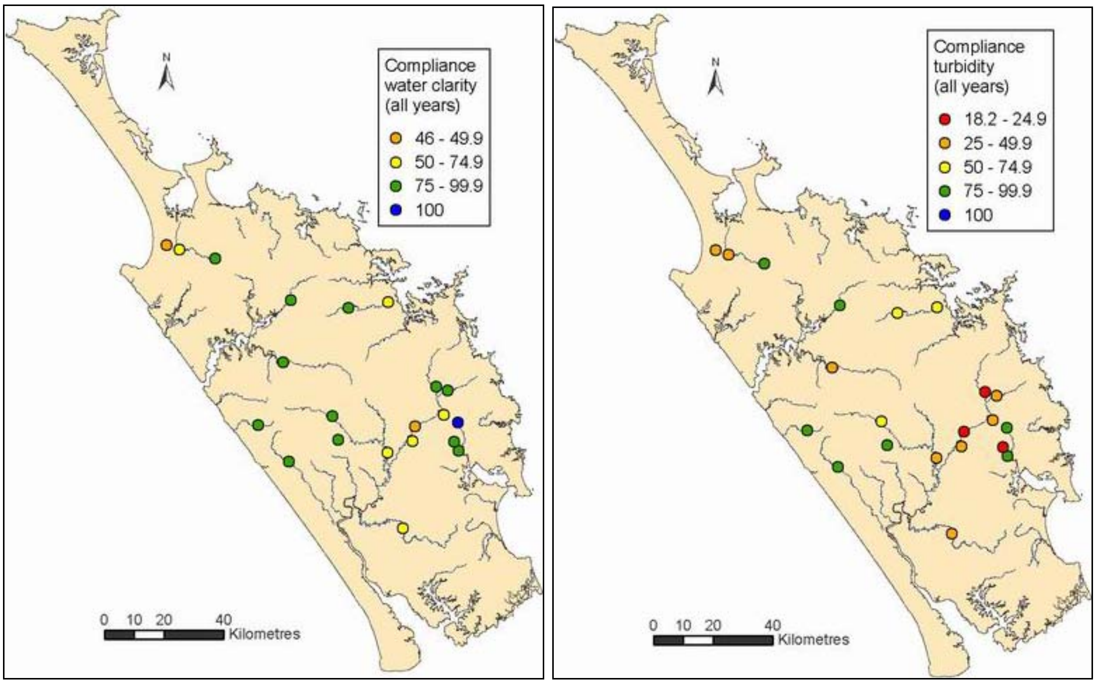
Figure 24: Percentage of samples that comply with the ANZECC trigger values for dissolved reactive phosphorus for 21 RWQMN sites (left). Figure 25: Similarly total phosphorus for 21 RWQMN sites (right).

There were 10 and 11 sites that complied with the DRP and TP trigger values respectively on less than 25% of sampling occasions. Three sites complied with both DRP and TP trigger values on less than 5% of sampling occasions: Mangere, Awanui at Waihue Channel and Wairua at Purua.

Water clarity and turbidity

Thirteen of the 21 RWQMN sites comply with the ANZECC guidelines for water clarity for the protection of aquatic ecosystems on over 75% of sampling occasions, as shown in figure 26 (below). Only two sites comply with the guideline on less than 50% of sampling occasions; Awanui above Waihue channel and Wairua at Purua. However, tighter water clarity guidelines are used for waters classified for the purpose of contact recreation (WASP) as discussed above, which includes many of Northland's rivers.

Less then 25% of sampling occasions for Waiotu River, Wairua at Purua and Waiarohia at Whau Valley comply with the ANZECC guideline for turbidity, as shown in figure 27 (below), while seven sites comply with the ANZECC guidelines over 75% of the time.



Figures 26: Percentage of samples that comply with the ANZECC trigger values for water clarity for 21 RWQMN sites (left) Figure 27: Similarly turbidity for 21 RWQMN sites (right).

Suspended solids

An investigation is being carried out to determine if forest harvesting is increasing sediment loads in the Opouteke River. An extra sample has been collected at three of the RWQMN sites for the last two years and analysed for suspended solids. The sites include Opouteke River which has significant areas of forest being felled and two reference sites: Waipoua River (native forest) and Mangakahia River at Twin Bridges (native and exotic forest with some pasture).

The initial two years of results suggest that Opouteke River does not have a higher sediment load than Mangakahia or Waipoua, as shown in figure 28 (below). However, this first two years of data has not captured any significant storm events, which is when you would expect to get particularly high sediment loadings.

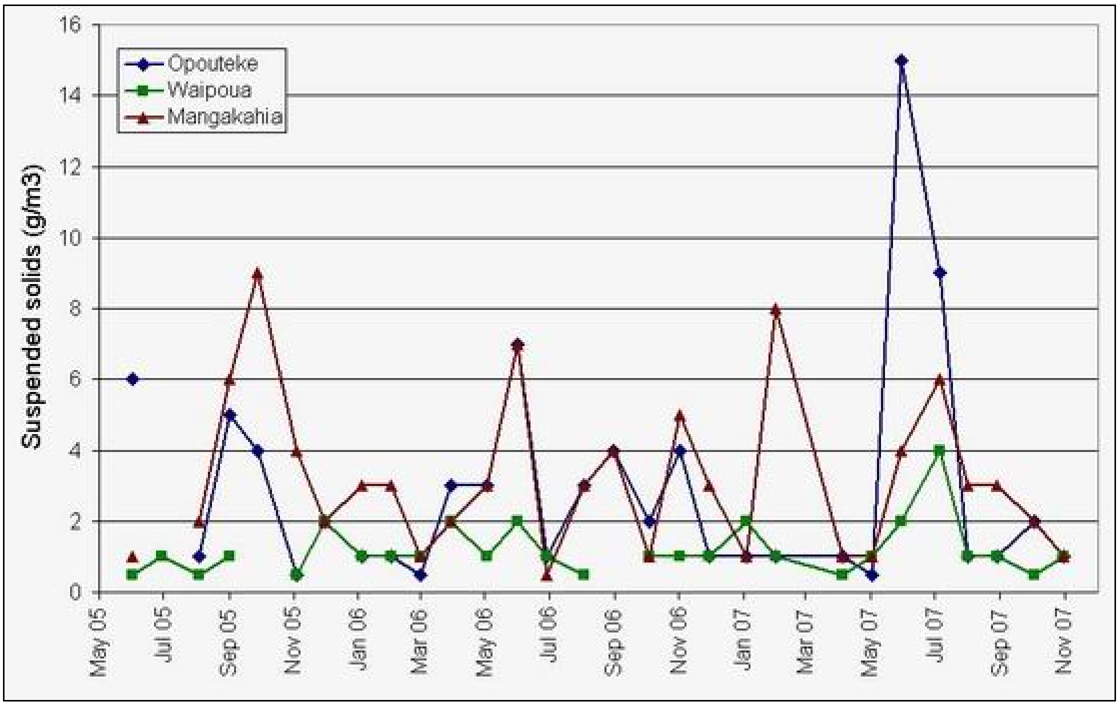


Figure 28: Suspended solid levels (g/m3) in Opouteke, Waipoua and Mangakahia Rivers.

Heavy metals in Waiarohia Stream

Sampling for heavy metals in stream sediments was established in November 2006 from the Waiarohia Stream in Whangarei, to investigate the effects of urban land use. Two sites are sampled; one at Whau valley, which is the upstream or background site and the other at Second Avenue, which is the downstream site. The Waiarohia Stream between these two sites is heavily influenced by road run off and urban stormwater. Sediment samples are collected every three months and analysed for heavy metals.

The results for the first five sampling occasions are presented in table 7 (below). The results are compared to the ANZECC sediment quality guidelines for the protection of aquatic ecosystems (also in table 7). None of these initial results exceed the high trigger values for the protection of aquatic ecosystems. However a few results (shown in italics and red) exceed the low trigger values.

Table 7: Heavy metal levels (mg/kg) in stream sediments from two Waiarohia Stream sites, compared to the ANZECC trigger values

	Second Ave site					**Whau valley site**					**ANZECC values**	
	Nov 06	**Feb 07**	**May 07**	**Aug 07**	**Nov 07**	**Nov 06**	**Feb 07**	**May 07**	**Aug 07**	**Nov 07**	**Low**	**High**
Arsenic	8	5	6	6	7.8	10	9	12	13	7.5	**20**	**70**
Cadmium	0.2	0.1	0.1	<0.08	0.1	0.1	0.3	0.1	0.09	0.07	**1.5**	**10**
Chromium	21	21	18	<30	<22	13	20	18	<30	<22	**80**	**370**
Copper	42	26	27	22	25	18	33	23	21	16	**65**	**270**
Mercury	***0.3***	<0.1	<0.1	***<0.3***	***<1.1***	***0.3***	***0.4***	***0.2***	***<0.3***	***<1.1***	**0.15**	**1**
Nickel	15	17	15	14	11	10	15	13	14	9.6	**21**	**52**
Lead	***50.5***	31.9	35.2	20	26	19.3	31	23.1	19	15	**50**	**220**
Zinc	***338***	***242***	161	<200	180	99	189	98	<200	<30	**200**	**410**

These initial results show that for most heavy metals there is very little difference between the upstream and downstream site. However, both lead and zinc have been slightly higher at the downstream site.

It is likely that the slightly elevated mercury levels are of natural origin, especially as they are higher at the upstream site. The elevated zinc levels at the downstream site are possibly a result of leaching from galvanised steel in the stream or runoff from roads and roofs, while the slightly elevated lead levels are most likely a result of road runoff.

The dataset is limited, so care should be taken with this interpretation of the results. Sampling will continue at these two sites and other sites will be investigated in the future.

Macroinvertebrates

Stream macroinvertebrates can be used as an indicator of stream health and are monitored annually at each RWQMN site. A summary of the 2007 results for the 24 RWQMN sites sampled is in table 13 in appendix C. Some of the key findings are presented below.

Collecting macroinvertebrate sample from Waipoua River (right).

For detailed information on the methods used and the results see the following report available on the Regional Council website: *'Northland Macroinvertebrate Monitoring Programme – 2007 Monitoring Report'* (Pohe and Hall 2007) at the following link:

http://www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Rivers-and-streams/

The Macroinvertebrate Community Index (MCI) and Semi-Quantitative Macroinvertebrate Community Index (SQMCI) scores can be used as an indicator of organic pollution based on the interpretation of Boothroyd and Stark (2000), shown in table 8 (below).

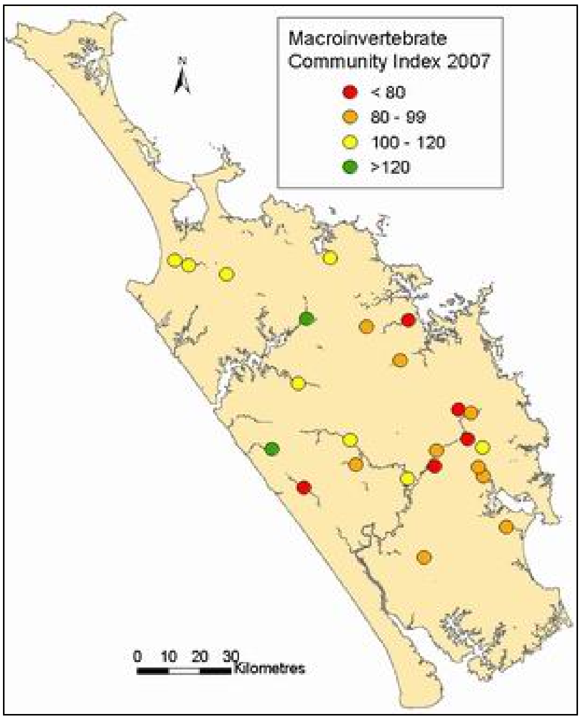
Table 8: Interpretation of MCI and SQMCI (adapted from Boothroyd and Stark 2000)

Interpretation	**MCI**	**SQMCI**
Clean water	> 120	> 6.0
Possible mild pollution	100 – 119	5.0 – 5.9
Probable moderate pollution	80 – 99	4.0 – 4.9
Probable severe pollution	< 80	< 4.0

Of the 24 sites only two had MCI scores indicative of clean water in 2007. These were two native forest sites: Waipapa at Puketi forest and Waipoua at SH12, as shown in figure 29 (below). Five sites had MCI scores less than 80 in 2007 indicative of severe organic pollution: Waitangi at Watea, Mangahahuru at Apotu Rd, Mangere, Waiotu and Kaihu.

The SQMCI takes into account the number of individuals in each taxon and therefore is considered to be a more accurate reflection of stream health than the MCI. Of the 24 sites four had SQMCI scores indicative of clean water: Waipapa at Puketi forest, Waipoua, Victoria and Waitangi at Waimate, as shown in figure 30 (below). Six sites had SQMCI scores less than four in 2007 indicative of severe organic pollution: Waitangi at

Watea, Mangahahuru at Apotu Rd, Waiotu, Mangakahia at Twin Bridges, Opouteke and Kaihu.



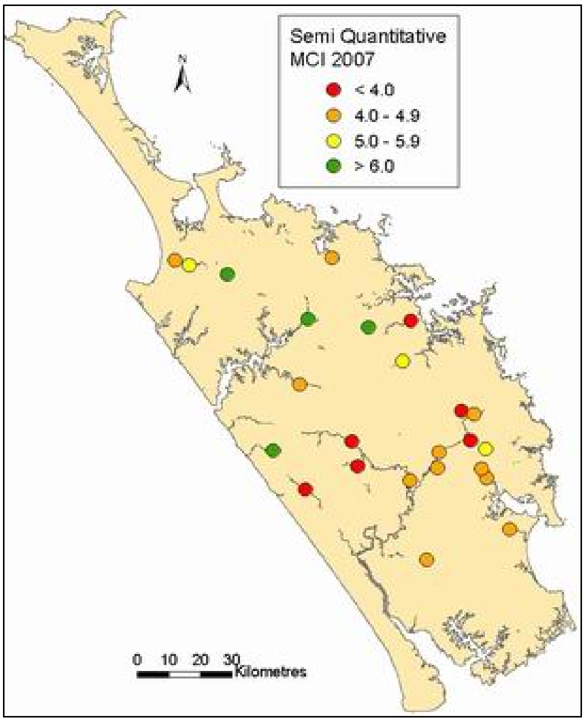


Figure 29: Macroinvertebrate Community Index (MCI) scores for the 24 RWQMN sites sampled in February and March 2007 (right). Figure 30: Semi Quantitative MCI scores for the 24 RWQMN sites sampled in 2007 (left).

Macroinvertebrate monitoring has been carried out since 1997 at most of these RWQMN sites. Of the 22 sites with sufficient data, three have shown an overall decrease in stream health during this time: Waiarohia at Whau Valley, Waiotu (only sampled since 2004) and Opouteke, while only one has shown an overall improvement in stream health during this time: Waipoua River.

Stream habitat assessments

Every second year quantitative and qualitative habitat assessments are carried out at all RWQMN sites. The qualitative assessment involves assigning scores based on aquatic habitat abundance and diversity, variation in flow (hydrologic heterogeneity), channel alteration, bank stability, percentage of shade and integrity of the riparian vegetation. The results for each of these parameters for each site is presented in table 13 in appendix C.

Waipoua River has optimal quality stream habitat, with mature native riparian vegetation.

The overall habitat quality for each RWQMN site in 2007 is presented in figure 31 (right). Only two of the 21 sites had optimal stream habitat quality: Waipapa River in Puketi forest and Waipoua River.

No sites have poor habitat quality overall, although many have poor habitat for some of the parameters, particularly riparian vegetation and channel shade (refer to table 13 in appendix C).

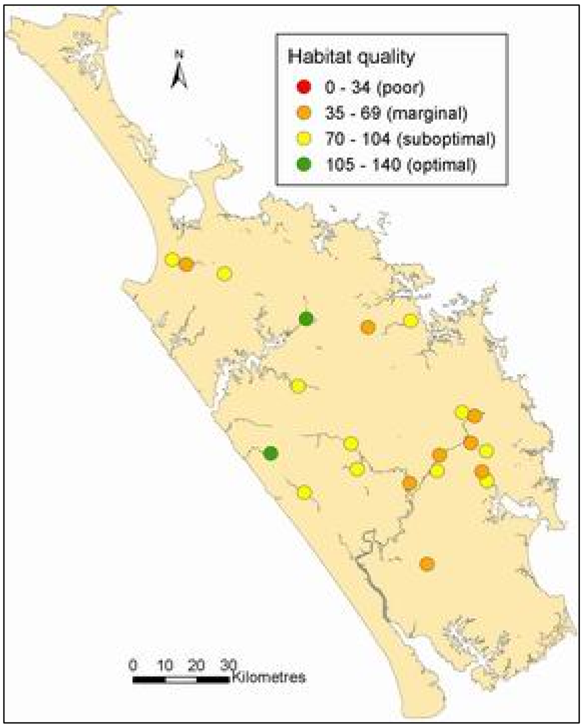


Figure 31: Overall stream habitat quality for the 21 RWQMN sites assessed in 2007 (right). Note: The results for Victoria and Manganui Rivers are from 2005.

For more information on the quantitative and qualitative habitat assessments refer to the full report available on the Regional Council website at the following link:

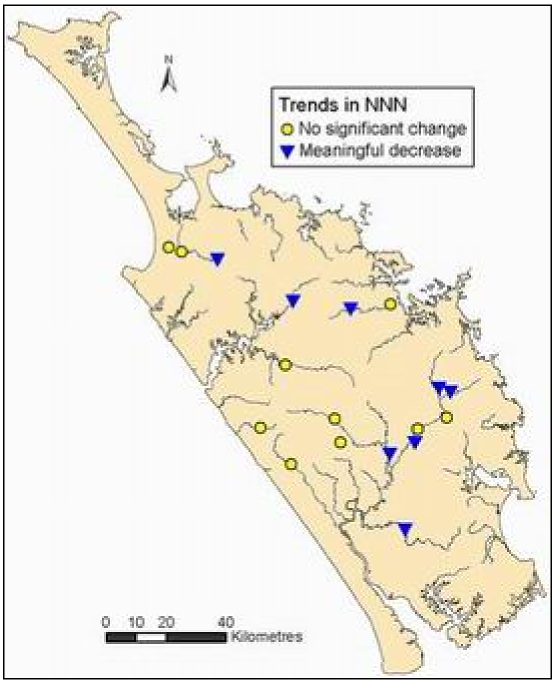
www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Rivers-and-streams/

Long-term trends in water quality

Trend analysis was carried out on all available data for 18 of the RWQMN sites. Some of the key trends are presented below. For detailed information on the methods used and the results, see the following report available on the Regional Council website: *'Northland River Water Quality Monitoring Network: 2006 State and Trends'* (NRC 2007) at the following link:

www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Rivers-and-streams/

Eight sites show a meaningful decrease in nitrate/nitrite nitrogen levels as shown in figure 32 (below), while the following four sites show meaningful decreasing trends in total nitrogen: Waipoua, Manganui, Mangere and Wairua at Purua as shown in figure 33 (below).



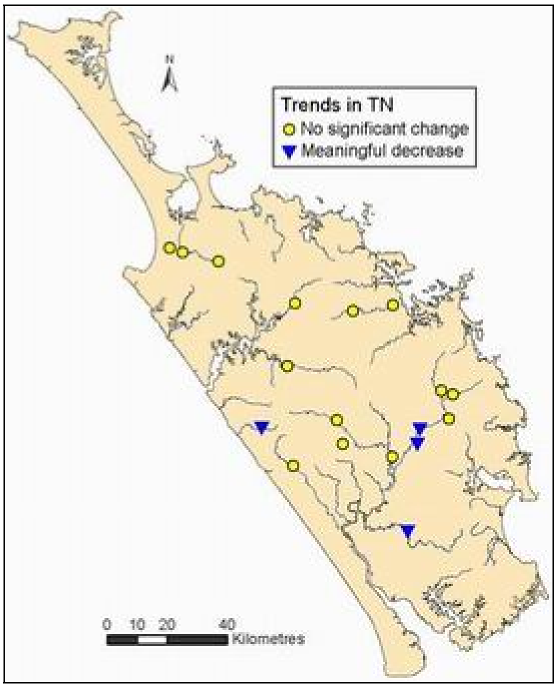
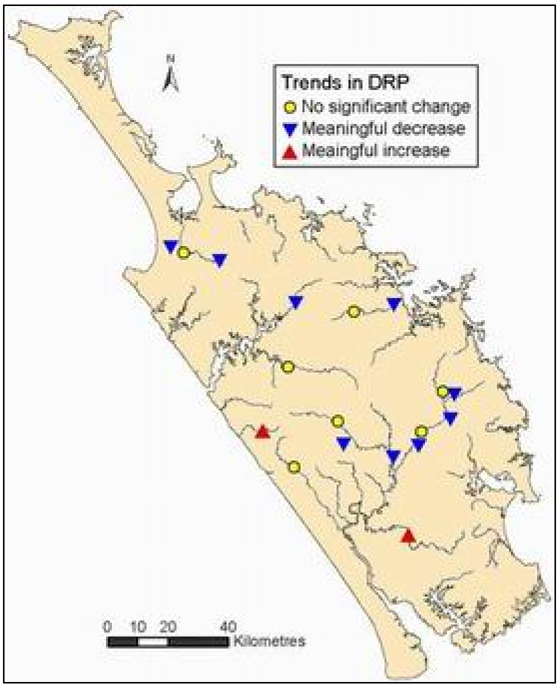


Figure 32 (left): Significant and meaningful trends in nitrate/nitrite nitrogen for all data for 18 RWQMN sites. Figure 33 (right): Significant and meaningful trends in total nitrogen for all data for 18 RWQMN sites.

Nine of the 18 sites show meaningful decreasing trends in dissolved reactive phosphorus, while two sites show meaningful increasing trends (Waipoua and Manganui Rivers) as shown in figure 34 (below). Total phosphorus exhibited meaningful decreases at six sites and meaningful increases at three sites, as shown in figure 35 (below).



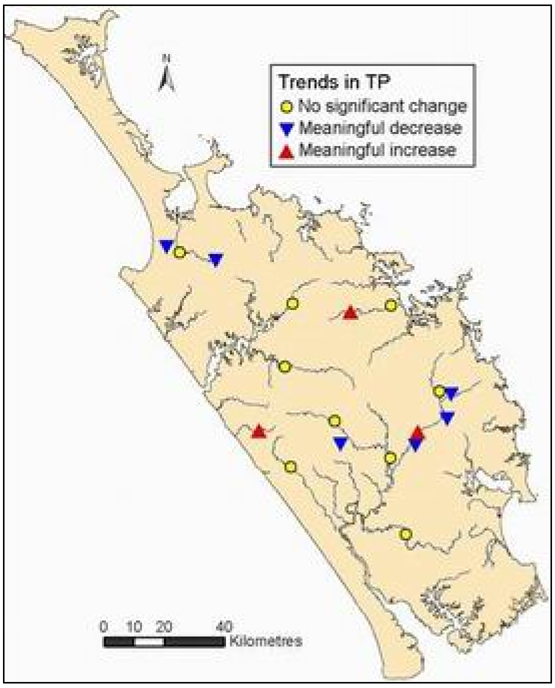


Figure 34 (left): Significant and meaningful trends in dissolved reactive phosphorus for all data for 18 RWQMN sites. Figure 35 (right): Significant and meaningful trends in total phosphorus for all data for 18 RWQMN sites.

With over 90% of the Waipoua River catchment in native forest, results suggest the slightly elevated phosphorus levels are likely to be natural, as a result of catchment geology (NRC 2007). However, it is currently unknown why the phosphorus levels have increased in Waipoua River over the last five years. This trend will be re-assessed next year and investigated further if it persists.

There were several other positive trends detected at some sites during the trend analysis such as decreasing trends in ammoniacal nitrogen at several sites and increasing trends in water clarity at three sites that had a corresponding decreasing trend for turbidity: Waipapa River, Mangahahuru at Apotu Road and Mangere Stream (NRC 2007). These positive trends for ammoniacal nitrogen and water clarity/turbidity, suggest improvements have occurred in point source discharges upstream of these sites. It is also encouraging that overall many of these positive trends were found in the rivers ranked as having the worst water quality (NRC 2007).

Other than the increasing trends in *E. coli* and nutrients already discussed above, the other most noteworthy negative trends found were: Increasing dissolved oxygen at five sites, increasing conductivity at three sites and increasing pH at nine sites (NRC 2007). The cause of this increasing pH is currently unknown and is not consistent with elsewhere in New Zealand. All of these negative trends will be investigated further.

Water quality for water supplies

Water quality for human drinking water

Some Northlanders in rural areas use untreated water from rivers and streams for their domestic supply – including drinking water. Based on the results from the RWQMN and recreational bathing programme there would be no rivers in Northland, including rivers in pristine native forested catchments, which have microbiological water quality that meets the NZ drinking water standard of less than 1 *E. coli*/100mL (MoH 2005). Note this standard is the maximum acceptable value for microbiological contamination for drinking water leaving a treatment plant. Therefore water taken directly from rivers and streams in Northland is not suitable for human drinking water without treatment.

Water quality for stock drinking water

Again based on the results from the RWQMN and recreational bathing programme very few rivers and streams have microbiological water quality that meets the guidelines for stock drinking water. We have used the most recent guideline relevant to NZ from the ANZECC guidelines (ANZECC 2000). The guideline states “drinking water for livestock should contain less than 100 thermotolerant (faecal) coliforms per 100mL (median value). The assumption has been made that the faecal coliform levels will be greater in a sample than *E. coli* and therefore if the median number of *E. coli* exceed this trigger value then it can be assumed that the number of thermotolerant coliforms would also exceed the value.

The medians of all *E. coli* data only meet the trigger value for four of the 37 different recreational bathing and RWQMN sites (shown in tables 2 and 4). They are Lakes Ngatu (Far North) and Taharoa (one of the Kai Iwi Lakes) and Waipoua River at SH12 and Waipapa River in Puketi Forest.

12.4 What is being done?

Policy documents

The Northland Regional Council has produced two policy documents for the management of Northland's freshwater resources. The Regional Policy Statement (RPS) provides an overview of resource management issues in Northland, including those with regard to surface water quality. It contains objectives, policies and methods to achieve the integrated management of Northland's environment.

The RPS for Northland is available on the Regional Council website at the following link:

http://www.nrc.govt.nz/Resource-Library-Summary/Plans-and-Policies/Regional-Policy-Statement/Regional-Policy-Statement/

The Regional Water and Soil Plan (RWSP) for Northland has specific water quality guidelines for different purposes, including aquatic ecosystems, contact recreation, fisheries, water supply, stock water and irrigation.

The Plan also includes rules that control the extent and type of discharges to freshwater and land, rules pertaining to land disturbance activities and streamside management areas. Plan change 1 to the RWSP was made operative on 30 August 2007 and included changes to the rules for water takes, damming and diversions.

The RWSP for Northland is available on the Regional Council website at the following link:

http://www.nrc.govt.nz/Resource-Library-Summary/Plans-and-Policies/Regional-plans/Regional-Water-and-Soil-Plan/

Dairying and Clean Streams Accord

The Accord aims to promote sustainable dairy farming in New Zealand. It focuses on reducing the impacts of dairying on the quality of New Zealand streams, rivers, lakes, groundwater and wetlands.

The six priorities for actions and national targets outlined in the Accord are:

- Fonterra and Regional Councils to develop Regional Action Plans for the main dairying regions to implement this Accord by June 2004.
- Dairy cattle excluded from 50% of streams, rivers and lakes by 2007, 90% by 2012.
- 50% of regular crossing points to have bridges or culverts by 2007, 90% by 2012.
- 100% of farm dairy effluent discharges to comply with resource consents and

Regional Plans immediately.

- 50% of regionally significant wetlands to be fenced by 2005, 90% by 2007.
- 100% of dairy farms to have in place systems to manage nutrient inputs and outputs by 2007.

The Regional Council and Fonterra co-signed the Dairying and Clean Streams Accord regional action plan for Northland in May 2004. The purpose of the regional action plan is to identify local commitments and to support the national Accord principles of developing actions that are adapted for local conditions, practical, cost effective (whilst recognising the practical and financial constraints of implementing timeframes) and that will make a real difference.

For more information on the regional action plan, refer to the following link on the Regional Council website:

http://www.nrc.govt.nz/upload/2238/Dairy%20&%20Clean%20Streams%20Accord.pdf

For more information on progress towards meeting the targets in the Regional action plan refer to the land and soils chapter of this SOE report.

National direction

The Sustainable Water Programme of Action was launched by the Ministry for the Environment and the Ministry of Agriculture and Forestry in 2006. The purpose of the Programme is to achieve the following six broad goals:

- Achieve greater strategic planning for water at national and regional levels;
- Provide clearer direction and guidance from central government;
- Ensure greater consistency in the way increasing demands on water resources are managed across the country;
- Develop a better framework for deciding between conflicting demands for water;
- Enable increased effectiveness of Maori participation in water management;
- Provide for more effective management of the impacts of diffuse or unintended discharges on water quality.

Proposed initiatives from central government include:

- National Environmental Standards for drinking water sources.
- National Environmental Strategy for water measuring devices.
- National Environmental Strategy for environmental flows.
- National Policy Statement for managing freshwater.

For further information visit the Ministry for the Environment website at the following link:

http://www.mfe.govt.nz/issues/water/prog-action/

Resource consent monitoring

Major point source discharges to water and land require resource consent from the Northland Regional Council. Included in the resource consent are conditions. These conditions may include provisions for effective waste treatment systems, management plans for the use of treatment systems, limits for the concentration of contaminants that are allowed to be discharged and/or effects on the receiving environment and monitoring programmes that assess the effect of the discharges on the environment.

Sewage waste discharges

Central Government, under the Sanitary Works Subsidy Scheme, has been able to provide a proportion of the capital funding for sewerage services in a number of Northland communities, including Ngunguru, Kawakawa, and Russell. This along with the significant amount spent by District Councils has led to upgrades of sewerage systems in several communities.

More than 20 other communities are also working towards using this funding under the Sanitary Works Subsidy Scheme, particularly in the Far North. Future construction under this programme would increase the number of communities with sewerage systems in Northland. However ongoing funding under the Subsidy scheme is uncertain, as its continuation is currently under review by Central Government.

Other major medium future developments are likely to include sewerage schemes in Mangawhai, expansion of the Ruakaka and Bay of Islands sewerage schemes and upgrade of the Maungaturoto sewerage system. The planned wastewater infrastructure budget for this year is several million dollars for the region, which is identified in each of the three District Councils' 2007/2008 Annual Plan.

The Council has been part of a number of initiatives to improve wastewater services in Northland. This has included the development of a sewage accord which sets goals for the regional and district councils to meet in relation to improving wastewater management. This is yet to be finalised between the parties. The Council is also in the process of developing a GIS based risk model to determine which sites in Northland may be more at risk from failure of onsite wastewater treatment systems.

State of the Environment monitoring

It is also recognised that some activities are permitted (no consent required), provided the effects do not compromise the objectives of the Regional Policy Statement and Water and Soil Plan or cause any significant adverse effects.

State of the Environment monitoring programmes have been implemented to assess the state of river water quality and ecology and how that changes with time.

Northland Regional Council has the following ongoing surface water monitoring projects:

Regional Water Quality Monitoring Network (RWQMN)

The RWQMN was established in 1996 to provide information on river water quality in the Northland Region, so that baseline levels and water quality trends can be assessed. The RWQMN now includes 34 sites sampled on a monthly basis for physico-chemical parameters (four of these 34 sites are part of the National River Water Quality Network and are sampled by NIWA).

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

In 2007 investigative sampling at RWQMN sites with ongoing water quality problems was started. This involves more detailed sampling within the catchment to try to identify the potential sources of contamination. Initially fortnightly sampling has been carried out at six sites in the Mangere catchment, which has helped to identify problem areas. The findings from this sampling will be used by Regional Council land management officers to promote sustainable land management practices in the problem areas of the catchment, with the overall aim of improving water quality. Other RWQMN sites to be investigated in the future will be Punakitere, Waiotu and Opouteke Rivers, Waiarohia Stream and Mangahahuru Stream at Apotu Rd.

Freshwater recreational bathing programme

During the summer of 1999/2000 the Council initiated a survey to assess the baseline water quality at several of Northland's popular freshwater swimming sites. Sampling has continued every summer between November and February. The sites are reviewed every year and changed as required.

In the 2006-2007 summer 25 freshwater sites throughout Northland were sampled weekly for *E. coli* to check whether the microbiological water quality was safe for recreational use. Elevated results are passed on to the district councils and Northland Health to be followed up.

For more information refer to the following link on the Regional Council website:

http://www.nrc.govt.nz/Living-in-Northland/At-the-beach/Swimming-water-quality/

In 2006 and 2007 investigative sampling was carried out at recreational bathing sites that have had ongoing poor microbiological water quality. This involves collecting extra samples to be analysed using investigative techniques such as testing for fluorescent whitening agents (originating from washing detergents) and faecal sterols (can be used to distinguish the source of faecal contamination e.g. human, cows, pigs). This sampling will be more frequently used in the future at both problem recreational bathing and RWQMN sites. It will also be used to investigate environmental incidents and consented discharges as required.

Specific catchment projects

Otarao catchment study

Otarao catchment project is a joint project between the NRC, Mangakahia Landcare Group, NZ Landcare Trust and the landowners in the catchment, which was started in 2002. Otarao Stream is approximately 2500ha in size and a sub-catchment of the Mangakahia River. The catchment has varying land uses including one dairy farm and dairy run-offs, forestry, sheep and beef farms, native bush and lifestyle blocks.

The purpose of the water quality-monitoring component of the project is to characterise the existing water quality of the catchment, and to identify any issues that may exist. Restoration work has started in the catchment with the overall aim of improving water quality in the Otarao Stream. Restoration work and sampling will continue in the future.

For more information refer to case study 2 – Otarao catchment study.

Puwera catchment study

Puwera catchment was one of a number of dairy farming catchments throughout NZ selected to be part of a study funded by the Ministry for the Environments' Sustainable Management Fund. In July 2006 the 12-month base-line monitoring commenced in the

Puwera Stream catchment, near Whangarei. The purpose of the study is to collect a comprehensive body of environmental information that enables the benefits of implementing the Clean Streams Accord to be identified over time.

The Puwera Stream is located in a predominantly dairy farming catchment (at least 70% of the catchment land use is dairy farming). The balance is drystock farms with the recent addition of some “lifestyle” blocks.

The results from the first year of sampling show that both flows and water quality vary considerably throughout the year at the two sites sampled. Otherwise it is too early to draw further conclusions with regard to water quality and implementation of the Clean Streams Accord. The fact that many of the tributaries of the Puwera Stream are smaller than the Accord definition of a ‘stream’, which is “deeper than a ‘Red Band’ (ankle depth), wider than a stride and permanently flowing”, means that they will not require stock exclusion under the Accord. This may impact on the amount of improvement in water quality seen in the Puwera catchment.

For more information refer to the detailed report on the Regional Council website at the following link:

http://www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Rivers-and-streams/

Other responses

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 of waterways and coastal areas and raising public awareness about the environment.

Some examples of environmental care groups are the Bushland Trust, which has done significant amounts of restoration work around the Sweetwater Lakes on Aupouri Peninsula and the Mangakahia Landcare Group which has been working in the Mangakahia River catchment. For more information on some of the work that the Mangakahia Landcare Group has been carrying out, refer to case study 2.

Regional Council Environment Fund

The Northland Regional Council Environment Fund has provided more than $1.5 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 off of native bush and waterways, including rivers, lakes and wetlands, 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 the following page on the Regional Council website:

http://www.nrc.govt.nz/Your-Council/Awards-and-funding/Environment-Fund/

Earthworks Workshops

The Regional Council has held eight erosion and sediment control workshops for developers, earthwork contractors and planners in 2006 and 2007. The aim of the workshops was to increase understanding on best management practices to reduce adverse effects on the environment from earthworks.

The workshops covered the erosion and sediment control standards required by the Resource Management Act and Regional Council plans, the skills needed to ensure staff and subcontractors meet these standards and how contractors can improve their site compliance record. Some of the many topics covered during the course include:

- The extent of sediment run off and erosion in Northland.
- What impact sediment has on the environment.
- Tactics and tools for dust, erosion and sediment control.
- Legal requirements and potential penalties.
- Overall site management.

So far a total of about 200 people from 50 different companies/organisations have attended. Very positive feedback has been received from attendees and there is still significant interest from contractors who have not yet been able to attend due to courses being fully booked. More workshops will be held in the future as required.

Education and public awareness

The Regional 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. Also at least 40 school visits by NRC environmental educators, teacher workshops and a youth summit are 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 (SHMAK), which can be purchased from NIWA.

Students learning how to test water clarity using the clarity tube from the SHMAK kit (right).

12.5 Where to from here?

Policy documents

Regional Water and Soil Plan changes

The council is currently reviewing rules in the RWSP pertaining to discharges and land disturbance. This review will lead to 'proposed plan change 2'. This will incorporate rules for stock exclusion from water bodies of significance, including selected rivers and lakes. The council was intending to notify 'proposed plan change 2' in early 2008 for submissions.

Stormwater monitoring and management

As a region we need to improve the management of stormwater and increase the amount of stormwater monitoring. Integrated management of stormwater has not been successfully achieved across the region. A key focus of stormwater management is for the Regional Council to issue catchment resource consents (i.e. for the stormwater discharge out of a catchment) and for District Councils to issue resource consents for the management of stormwater within that catchment (i.e. for the collection, storage and treatment of stormwater through subdivision and development consents). This approach has not yet been fully implemented.

The Regional and District councils are increasing the incorporation of low impact design and best management practices such as TP10 (Technical Publication for Stormwater Management Design) as part of subdivision and development consents.

There is a need for more stormwater monitoring by both Regional and District Councils, to identify and prioritise areas that need improvement and to investigate the effects of land use changing from agricultural to lifestyle and development of subdivisions. However, as stormwater sampling needs to be carried out in a first flush event it is very dependent on weather conditions and is resource intensive. For more information on stormwater monitoring, refer to case study 1.

State of the Environment monitoring

The NRC will continue to analyse state and trends data collected through our freshwater state of the environment monitoring and review programmes as needed. From this analysis continue to identify issues or catchments requiring further investigation such as sites with ongoing poor water quality or sites detected to have negative trends.

Monitoring programmes will be reviewed in light of the findings in this report and national and international trends, as well as developments in monitoring techniques and technology. Some significant gaps in current monitoring programmes include:

- Using more advanced sampling techniques to look at temporal changes in water quality due to diurnal patterns and weather conditions i.e. using datasondes and automatic samplers to detect the peak in suspended solids during heavy rain.

- Sampling for agrichemicals (pesticides and herbicide) and other potential pollutants. Currently no routine monitoring for agrichemicals in surface water is carried out. A risk assessment in 2007 found that there is a high but localised risk of surface water being contaminated with some agrichemicals in some areas of Northland.

- Using faecal discriminant source tracking to identify source of faecal contamination such as faecal sterol analysis, fluorescent whitening agents (ingredient of laundry detergents) and PCR markers (genetic analysis).

- Fish monitoring. There is limited knowledge of the extent of both native and pest fish in Northland. There is nationwide concern that eel populations may be being over fished. We are the only region with surviving populations of the two native fish species: Dune lake galaxiids and Northland mudfish. The council needs to work with other relevant organisations in Northland to collect and record more baseline data on the extent of both native and pest fish.

- Monitoring of ecosystem function, which has recently been adopted by other councils throughout NZ.

- Increasing water quality awareness and sampling by groups outside of the council including iwi groups, landowners and environmental car groups using tools such as the SHMAK kit and '*A Cultural Health Index for Streams and Waterways*' (MFE 2003).

- Biological monitoring and recording. The council will continue with and enhance as required its biological monitoring, including macroinvertebrates, aquatic vegetation, fish, periphyton/algae and habitat assessments in Northland's freshwaters, including both lakes and rivers. Biological monitoring collects valuable information that can be used for assessing the state of biodiversity, detecting biosecurity risks and as an indicator for water quality and ecosystem health.

12.6 What can you do to help?

Here are some tips on how you can help maintain and improve water quality in Northland.

At home:

- Get involved with a landcare or streamcare group in your area and/or help at a community planting day near you. If you would like to improve the water quality of a neighbouring stream, you could up start a streamcare group. For more information contact the Regional Council on 0800 002 004.
- Keep the drain for the rain: Make sure that you do not tip anything down the stormwater. Wash your car on a permeable surface such as grass, so that detergents do not enter the stormwater.
- If you have an onsite wastewater system for your household, marae, school or business, ensure that your system is maintained and regularly emptied.
- Conserve water. For more information refer to the "Conserve water" brochure on the Regional Council website at the following link:

http://www.nrc.govt.nz/upload/1798/Conserve%20water.pdf

At work:

- Reduce and minimise sediment run-off and erosion from construction sites. For more information refer to the information sheet on the Regional Council website at the following link:

http://www.nrc.govt.nz/upload/1790/Erosion%20&%20Sediment%20Control%20for%20Construction%20Sites.pdf

On the farm:

- Exclude all stock from waterways including rivers, streams, drains, lakes and wetlands and, where suitable, establish a buffer strip of riparian vegetation.
- Prepare a nutrient budget. Develop and implement a nutrient management plan to reduce nutrient losses from your pasture.

For more information on riparian management contact a land management officer at the Regional Council on 0800 002 004 or refer to the following brochures on the Regional Council website:

Clean Streams – A guide to riparian management in Northland

http://www.nrc.govt.nz/upload/2219/Clean%20Streams%20Guide.pdf

A beginner's guide to wetland restoration

http://www.nrc.govt.nz/upload/2217/Wetland%20Restoration%20Guide.pdf

12.7 Case study 1 – Stormwater monitoring

Northland Regional Council monitors a variety of stormwater discharges in the region. We mainly monitor stormwater runoff from industrial businesses, earthworks and construction sites, urban and rural catchment areas and quarries. In certain, circumstances the RWSP requires that resource consent is needed to discharge stormwater from a site, area or activity.

Whangarei urban catchment

The Whangarei urban catchment is divided up into 10 different catchment areas with all apart from one ending up in the Whangarei Harbour. Whangarei District Council holds consents for approximately half of these systems, which have individual management plans. The Northland Regional Council and Whangarei District Council monitor and take samples of stormwater being discharged from these.

In catchment stormwater monitoring, samples need to be collected in a first-flush event. This is ideally in the first hour of significant rainfall after at least a week of no rainfall. This gives results that are for the worst-case scenario. However, first flush is not needed for sediment sampling, which is carried out as well as the water sampling.

Sampling sites include an upstream location not influenced by stormwater discharges from the Whangarei urban area which is the background site, and a downstream location, which is the compliance site. Stormwater from these sites are mainly tested for metals such as zinc, lead and copper. The results from the downstream (compliance) site are compared to the results from the upstream (background) site to determine whether there are any environmental impacts resulting from the Whangarei urban stormwater.

Samples taken from urban catchment monitoring have shown results that are consistently exceeding guidelines or resource consent conditions. Copper, lead and zinc are the most common metals found to exceed guidelines and consent conditions.

Earthworks/construction sites and industrial businesses

Most earthworks and construction sites and quarries, do not need to be sampled or inspected during first-flush conditions but significant rainfall is necessary for testing. These sites are usually sampled or inspected for sediment discharges and most should have some kind of adequate sediment and erosion control measures in place during rainfall.

Industrial businesses are usually monitored in first-flush conditions and sampled for products and chemicals, which are stored or located on site. For example, fertiliser plants get monitored for nutrients such as ammonia, nitrates and phosphorus, while asphalt plants are sampled for petroleum products.

Occasionally industrial businesses or earthworks sites are also found to exceed consent conditions or breach a rule in the RWSP for Northland, for samples taken from their stormwater runoffs or stormwater pond discharges. These issues can usually be resolved by means of correspondence with the consent holder or business/earthworks site manager. Failure to resolve the issue in this way then usually results in formal warnings and, if necessary, formal enforcement.

Overview

Some of the larger issues the Regional Council is currently facing with stormwater discharges in Northland include sediment runoff from inadequate controls on earthworks sites, high results for some metals from urban catchment sampling and contaminant runoff from industrial businesses.

As it can be very expensive, time consuming and difficult to locate the exact source and areas causing contamination, it is important that the public and businesses are aware that typically stormwater is not treated before it discharges into our rivers, lakes and harbours, meaning it can have a detrimental effect of aquatic life and water quality.

Northland Regional Council now includes the TP10 stormwater design guidelines (ARC 2003) and low impact design into resource consents for subdivisions. The Regional Council and District Councils will continue to work together to improve stormwater management and awareness in Northland.

12.8 Case study 2 – Otarao catchment study

Otarao catchment project is a joint project between the NRC, Mangakahia Landcare Group, NZ Landcare Trust and the landowners of the catchment. Otarao catchment is approximately 2500ha in size and is a sub-catchment of the Mangakahia Catchment. Located about 30 minutes west of Whangarei, the catchment has varying land uses including a dairy farm and dairy run-offs, forestry, sheep and beef farms, native bush and lifestyle blocks.

The purpose of the water quality-monitoring component of the project is to characterise the existing water quality of the catchment, and to identify any issues that may exist. These first few years of monitoring are also important to establish background pre-restoration data that can be compared with post-restoration data.

Five sites have been sampled from 2002 to 2006. The results show that the native forest "unimpacted" site in the headwaters of the catchment has excellent water quality and stream ecological health. On the other hand the bottom site in the catchment, where the Otarao joins the Mangakahia River, frequently has poor water quality because of the cumulative affects of land use throughout the catchment. This bottom site in the catchment has high water temperatures and low dissolved oxygen levels in summer and high nutrient and bacterial levels for most of the year and poor water clarity.

Several landowners have fenced off the Otarao Stream and its tributaries. Also several landowners have had farm management plans mapped for them to improve their farm management, while reducing the environmental effects of farming. Mangakahia Landcare Group, landowners, the local community, NRC and Landcare Trust have held several community planting days to plant native riparian buffers next to the stream. This will enhance biodiversity in the area, as well as improving water quality.

Restoration and enhancement work will continue in the catchment. Currently water quality monitoring is continuing monthly at the bottom site in the catchment to assess long term trends in water quality. However, once more restoration work has been implemented the original sampling programme will be repeated to detect improvements in water quality throughout the catchment.

For more detailed information on the results from the first four years of monitoring refer to the following report available on the Regional Council website:

http://www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Rivers-and-streams/

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12.10 Appendix A: RWQMN site information

Table 9: Percentage of different land use types and total catchment area (hectares) for each RWQMN site, including new sites added to the network in 2006 and 2007.

Site	Site No.	X (NZTM)	Y (NZTM)	Indig	Forestry	Harvest	Exotic	H prod past	L prod past	Crops	Water	Other	Total (ha)
Awanui at FNDC pumpstation	100363	1625095	6113439	36.0	5.5	0.1	1.2	56.9	0.2	0.0	0.1	0.0	21701.5
Awanui u/s of Waihue Channel	100370	1620713	6114952	31.1	4.2	0.1	1.4	61.2	0.1	0.3	0.5	1.2	31361.6
Hakaru at Topuni Creek farm	109021	1734330	5992416	21.8	6.7	0.1	0.2	69.5	0.0	1.3	0.4	0.0	8311.5
Kaeo at Dip Rd bridge	102674	1670326	6115833	55.6	13.5	2.1	0.2	24.4	3.9	0.1	0.1	0.3	9933.6
Kaihu at gorge	102256	1661946	6042161	27.6	15.3	0.9	0.4	55.5	0.2	0.0	0.0	0.0	11507.4
Kerikeri at Stone Store bridge	101530	1687631	6102447	14.8	3.8	1.0	0.7	63.0	0.1	14.5	0.6	1.5	9777.2
Mangahahuru at Apotu Rd	100281	1714117	6057720	14.6	23.4	26.3	0.5	31.7	0.4	1.1	0.2	2.0	4554.9
Mangahahuru at Main Rd	100237	1718886	6055192	12.9	42.7	39.3	0.9	3.8	0.2	0.0	0.0	0.0	2103.1
Mangakahia at Titoki bridge	101038	1694999	6045028	33.3	24.7	4.4	0.3	33.3	3.6	0.1	0.1	0.0	80685.9
Mangakahia d/s of Twin Bridges	109096	1677333	6056762	34.5	20.3	9.2	0.0	35.6	0.1	0.0	0.3	0.0	24313.5
Mangamuka at Iwiatua Rd	108978	1649247	6103622	93.0	0.1	0.0	0.0	6.8	0.0	0.0	0.0	0.0	3661.7
Manganui at Mititai Rd	102257	1700359	6019751	17.0	5.5	0.6	0.5	75.8	0.1	0.0	0.3	0.1	40866.0
Mangere at Knight Rd	101625	1703586	6048948	21.9	0.3	0.3	0.8	75.4	0.4	0.6	0.1	0.2	7586.1
Ngunguru at Waipoka Rd	109100	1729072	6054775	37.0	21.8	1.2	0.3	38.7	0.2	0.8	0.0	0.0	5060.5
Opouteke at suspension bridge	102258	1678503	6049460	35.5	58.4	0.0	0.0	5.5	0.5	0.0	0.0	0.0	10806.2
Oruru near bowling club	108979	1644740	6122563	47.5	9.9	0.3	3.2	35.3	3.7	0.1	0.0	0.0	9062.3
Paparoa in Paparoa Reserve	108977	1711218	6004190	14.6	3.6	0.1	0.9	79.9	0.1	0.2	0.1	0.5	3573.0
Punakitere Punakitere Loop Rd	105231	1660001	6075453	24.7	15.0	1.7	1.4	51.7	2.9	0.3	1.1	1.1	30268.3
Ruakaka at Flyger Rd	105008	1726626	6029623	26.3	1.3	0.3	0.4	71.5	0.0	0.0	0.0	0.1	4749.8
Utakura near 1711 Horeke Rd	109020	1656910	6089081	22.9	9.9	0.2	0.6	54.4	0.0	0.5	11.2	0.3	11697.7
Victoria at Victoria Valley Rd	105532	1637132	6110554	82.0	5.2	0.0	0.2	12.5	0.1	0.0	0.0	0.0	2669.5
Waiarohia at Second Ave	108359	1719097	6045830	55.1	1.4	0.0	0.0	18.4	0.3	1.4	1.5	21.9	1849.7
Waiarohia at Whau valley	107773	1717568	6048671	70.7	1.6	0.0	0.0	23.0	0.0	1.0	2.6	1.1	1038.3
Waiharakeke at Stringer Rd	100007	1692604	6082806	28.9	21.4	2.2	1.1	32.8	12.0	0.0	1.5	0.2	23040.5
Waimamaku at SH12	109098	1640666	6064914	61.0	2.3	2.2	0.4	21.8	12.4	0.0	0.1	0.0	10329.8
Waiotu at SH1	102248	1711381	6067240	30.5	4.4	0.1	0.7	63.9	0.3	0.0	0.0	0.1	12045.2
Waipao at Draffin Rd	108941	1701772	6045796	8.8	0.8	0.6	0.3	74.0	0.6	14.8	0.1	0.1	3511.1
Waipapa at Puketi Forest	101751	1662582	6096421	86.6	8.8	1.1	0.0	3.4	0.1	0.0	0.0	0.0	12046.5
Waipapa at Waipapa Landing	101524	1688150	6103986	14.0	4.3	0.0	1.0	46.7	0.5	28.7	3.8	1.0	3410.0
Waipoua at SH12	103304	1651633	6054443	90.9	0.4	0.2	0.0	8.2	0.3	0.0	0.0	0.0	6446.9
Wairua at Purua	101753	1704273	6053948	23.5	6.3	3.7	0.6	63.6	0.7	0.4	0.8	0.4	54301.2
Waitangi at Watea	101752	1695269	6095708	19.5	6.6	1.4	0.9	68.9	0.3	0.6	1.3	0.5	29887.2
Waitangi at Waimate Rd	103178	1681894	6093741	29.4	8.1	0.0	0.4	61.2	0.5	0.0	0.1	0.4	5043.7
Whakapara at cableway	102249	1715259	6066116	35.2	7.1	4.0	0.7	51.7	1.0	0.0	0.1	0.2	16380.2

Table 10: RWQMN site information including Land use and potential impacts on water quality, River Environment Classification (REC), and whether there is a flow record. The REC includes river source (low or hill elevation or lake), geology (SS=soft sedimentary, VA=volcanic acidic and HS=hard sedimentary) land cover (Pasture, exotic forestry or indigenous forest), river order (High=order>4, Middle=3 or 4 order) and river gradient (Low or medium).

Site	Site no.	Land use/potential impacts	Source	Geology	Cover	Order	Gradient	Flow
Awanui at FNDC pumpstation	100363	Agriculture	Low elvn	SS	Pasture	High	Low	Y
Awanui U/S of Waihue Channel	100370	Agriculture, Kaitaia oxidation pond discharge	Low elvn	SS	Pasture	High	Low	Y
Hakaru at Topuni Creek farm	109021	Pasture and exotic forestry	Low elvn	SS	Pasture	High	Low	Future
Kaeo at Dip Rd bridge	102674	Pasture, town, OP discharge, effect on harbour & marine farms	Low elvn	SS	Pasture	High	Low	Future
Kaihu at gorge	102256	Pastoral Agriculture	Low elvn	VA	Pasture	High	Medium	Y
Kerikeri at stone store bridge	101530	Pasture, horticultural and lifestyle blocks	Low elvn	VA	Pasture	High	Medium	Future
Mangahahuru at Apotu Rd	100281	Agriculture, Kauri Dairy factory, Hikurangi OP discharge	Low elvn	HS	Pasture	Middle	Low	Y
Mangahahuru at Main Rd	100237	Exotic forestry	Low elvn	HS	Exotic	Middle	Low	Y
Mangakahia at Titoki bridge	101038	Pastoral Agriculture	Low elvn	VA	Pasture	High	Low	y
Mangakahia d/s of Twin Bridges	109096	Agriculture, some exotic forestry	Low elvn	VA	Pasture	High	Low	Y
Mangamuka at Iwiatua Rd	108978	Pasture, indigenous forest, outstanding river in RWSP	Low elvn	VA	Indig	Middle	Low	N
Manganui at Mitaitai Rd	102257	Pastoral Agriculture	Low elvn	SS	Pasture	High	Low	Y
Mangere at Knight Rd	101625	Intensive dairying, cumulative effect FDE discharges	Low elvn	SS	Pasture	High	Low	Y
Ngunguru at Waipoka Rd	109100	Pasture, exotic and indigenous forest	Low elvn	HS	Pasture	Middle	Low	Y
Opouteke at suspension bridge	102258	Exotic forest, some native forest	Low elvn	VA	Exotic	High	Low	y
Oruru near bowling club	108979	Pasture	Low elvn	VA	Pasture	High	Low	Y
Paparoa in Paparoa Reserve	108977	Pasture, effect of WQ on harbour WQ & marine farms	Low elvn	SS	Pasture	High	Low	N
Punakitere at Punakitere Loop Rd	105231	Agriculture, urban (Kaikohe township)	Low elvn	SS	Pasture	High	Low	Y
Ruakaka at Flyger Rd	105008	Pasture, u/s of major watertake	Low elvn	SS	Pasture	Middle	Low	Future
Utakura near 1711 Horeke Rd	109020	Pasture, source: Lake Omapere (highly enriched/algal blooms)	Lake	SS	Pasture	Middle	Low	N
Victoria at Victoria Valley Rd	105532	Native forest, some agriculture	Low elvn	VA	Indig	Middle	Low	Y
Waiarohia at Second Ave	108359	Urban, stormwater, road run off	Low elvn	HS	Urban	Middle	Low	Y
Waiarohia at Whau valley	107773	Pasture, indigenous, exotic forestry, lifestyle blcks, water supply dam	Low elvn	HS	Pasture	Middle	Low	Y
Waiharakeke at Stinger Rd	100007	Wetland system u/s, pasture, exotic forestry, indigenous	Low elvn	SS	Pasture	High	Low	Y
Waimamaku at SH12	109098	Pasture	Low elvn	VA	Pasture	High	Low	N
Waiotu at SH1	102248	Agriculture (dairying)	Low elvn	HS	Pasture	High	Low	Y
Waipao at Draffin Rd	108941	Pasture, Main source: springs from Whatitiri aquifer	Low elvn	VA	Pasture	Middle	Low	Y
Waipapa at Puketi Forest	101751	Native forest, outstanding river in RWSP	Low elvn	SS	Indig	High	Low	Y
Waipapa at Waipapa Landing	101524	Pasture, horticultural & lifestyle blocks, Lake Manuwai (water supply)	Lake	VA	Pasture	Middle	Medium	Future
Waipoua at SH12	103304	Native forest, outstanding river in RWSP	Hill elvn	VA	Indig	High	Medium	Y
Wairua at Purua	101753	Pastoral Agriculture	Low elvn	HS	Pasture	High	Low	Y
Waitangi at Waimate Rd	103178	Native forest, moderate agriculture	Low elvn	VA	Pasture	Middle	Low	Y
Waitangi at Watea	101752	Agriculture, some native forest	Low elvn	HS	Pasture	High	Medium	Y
Whakapara at cableway	102249	Agriculture (dairying)	Low elvn	HS	Pasture	High	Low	Y

12.11 Appendix B: Median water quality data for RWQMN sites for 2006 and all years

Table 11: Medians for 2006

Site	Temp. (deg. C)	DO (% sat.)	DO (mg/L)	Cond. (mSm/cm)	pH	Turb. (ntu)	Water clarity (m)	Dissolved colour (340 nm/cm)	Dissolved colour (440 nm/cm)	DRP (g/m3)	TP (g/m3)	NNN/ NO3 (g/m3)	NH4 (g/m3)	TKN (g/m3)	TN (g/m3)	Ecoli (n/100ml)
Awanui at FNDC take	15.55	85.4	8.8	4.5	7.3	4.5	0.75	13.04	2.56	0.016	0.039	0.028	0.005	0.3	0.260	276
Awanui u/s of Waihue	16.80	85.0	8.7	7.0	7.4	5.0	0.55	13.53	3.34	0.060	0.107	0.073	0.005	0.5	0.573	323
Kaihu	14.20	105.3	10.7	3.0	7.3	3.4	1.76	7.76	2.43	0.011	0.027	0.265	0.005	0.1	0.435	128
Mangahahuru at Apotu Rd	15.20	103.7	10.5	4.5	7.2	4.7	1.55	14.64	3.36	0.038	0.086	0.386	0.030	0.2	0.694	419
Mangahahuru at Main Rd	13.75	97.6	10.2	3.4	7.2	3.5	2.13	11.41	2.68	0.005	0.018	0.028	0.005	0.1	0.124	161
Mangakahia at Titoki	16.40	96.6	9.6	5.9	7.4	6.9	0.68	9.91	1.92	0.007	0.029	0.209	0.012	0.2	0.282	120
Mangakahia at Twin Bridges	15.80	108.5	NA	2.7	7.5	3.0	1.54	7.90	1.90	0.015	0.027	0.017	0.005	0.1	0.167	148
Manganui River	15.85	85.6	8.7	6.8	7.1	8.6	0.96	20.05	3.66	0.056	0.108	0.167	0.005	0.5	0.590	91
Mangere River	14.75	86.2	8.8	5.3	7.2	5.5	1.20	16.83	3.77	0.110	0.163	0.591	0.050	0.5	1.083	821
Opouteke River	15.85	109.9	NA	3.3	7.5	3.7	1.25	7.90	2.02	0.009	0.021	0.012	0.005	0.1	0.162	179
Punakitere River	14.70	97.4	10.2	5.0	7.3	4.6	1.67	16.51	3.55	0.028	0.057	0.420	0.020	0.3	0.842	389
Victoria River	13.85	97.7	10.5	1.1	7.3	1.1	1.95	3.17	0.55	0.014	0.021	0.004	0.005	0.1	0.055	179
Waiarohia at Second Ave	17.05	111.2	11.1	2.6	7.5	3.5	1.50	8.51	1.87	0.022	0.048	0.397	0.008	0.2	0.628	453
Waiarohia at Whau Valley	16.00	97.9	9.9	7.6	7.2	8.0	0.90	12.29	2.84	0.004	0.083	0.162	0.005	0.6	0.741	812
Waiotu River at SH1	14.85	94.2	10.2	5.4	7.3	7.3	1.40	15.31	3.48	0.018	0.051	0.263	0.015	0.2	0.430	251
Waipapa at Puketi Forest	13.30	97.8	10.5	1.6	7.6	1.6	2.05	7.30	1.53	0.005	0.010	0.024	0.003	0.1	0.121	78
Waipoua River	13.15	102.0	10.9	2.0	7.4	2.1	2.13	7.22	1.78	0.021	0.029	0.016	0.005	0.1	0.078	20
Wairua River at Purua	17.10	94.2	9.7	7.6	7.1	7.6	0.76	15.63	2.99	0.024	0.062	0.532	0.039	0.4	0.759	78
Waitangi at Waimate	13.85	97.8	10.7	2.6	7.2	2.8	1.89	8.74	1.92	0.002	0.019	0.379	0.010	0.2	0.560	386
Waitangi at watea	15.30	99.7	10.3	2.6	7.5	4.0	1.69	8.71	1.69	0.006	0.023	0.357	0.006	0.2	0.479	167
Whakapara River	15.35	102.5	10.4	4.4	7.3	4.5	1.72	12.10	2.83	0.027	0.044	0.215	0.015	0.2	0.309	135

Table 12: Medians for all years

Site	Temp. (deg. C)	DO (% sat.)	DO (mg/L)	Cond. (mSm/cm)	pH	Turb. (ntu)	Water clarity (m)	Dissolved colour (340 nm/cm)	Dissolved colour (440 nm/cm)	DRP (g/m3)	TP (g/m3)	NNN/ NO3 (g/m3)	NH4 (g/m3)	TKN (g/m3)	TN (g/m3)	Ecoli (n/100ml)
Awanui at FNDC take	16.5	86.0	8.6	7.1	7.4	7.1	0.82	12.92	2.90	0.020	0.046	0.044	0.020	0.2	0.299	306
Awanui u/s of Waihue	17.1	89.2	8.7	9.4	7.5	9.4	0.55	13.67	3.18	0.167	0.150	0.073	0.040	0.5	0.583	410
Kaihu	14.4	104.6	10.8	3.5	7.5	3.5	1.70	8.90	2.11	0.008	0.020	0.275	0.005	0.2	0.435	146
Mangahahuru at Apotu Rd	16.1	95.6	9.8	7.5	6.8	7.5	0.75	14.89	3.43	0.040	0.098	0.426	0.040	0.3	0.730	494
Mangahahuru at Main Rd	13.9	97.6	10.1	3.5	7.2	3.5	2.10	12.27	2.94	0.005	0.018	0.037	0.005	0.1	0.137	181
Mangakahia at Titoki	17.1	96.6	9.4	13.5	7.4	6.8	0.65	9.69	1.90	0.008	0.028	0.106	0.015	0.2	0.320	182
Mangakahia at Twin Bridges	16.8	106.5	NA	3.6	7.4	3.6	1.38	8.09	1.99	0.044	0.072	0.064	0.010	0.1	0.261	180
Manganui River	15.8	85.3	8.2	8.6	7.2	8.6	0.73	18.54	4.01	0.035	0.092	0.250	0.020	0.5	0.712	122
Mangere River	15.3	83.2	8.5	7.2	6.9	7.2	0.81	17.72	4.05	0.110	0.175	0.720	0.100	0.5	1.341	561
Opouteke River	16.8	106.9	NA	2.6	7.5	2.6	1.58	5.96	1.56	0.036	0.078	0.043	0.020	0.1	0.215	121
Punakitere River	15.5	98.3	9.9	6.2	7.4	6.2	0.95	16.03	3.70	0.027	0.058	0.466	0.020	0.3	0.866	388
Victoria River	14.9	96.8	9.9	1.3	7.4	1.3	2.03	2.95	0.61	0.019	0.022	0.008	0.020	0.1	0.087	166
Waiarohia at Second Ave	16.4	111.2	10.9	3.0	7.4	3.0	1.49	8.51	2.09	0.022	0.051	0.397	0.005	0.2	0.643	465
Waiarohia at Whau Valley	15.8	97.5	9.6	7.3	7.2	7.3	0.90	12.03	2.95	0.007	0.076	0.235	0.005	0.5	0.784	726
Waiotu River at SH1	15.5	92.3	9.3	8.9	6.9	5.4	0.82	15.22	3.81	0.015	0.068	0.344	0.020	0.3	0.667	323
Waipapa at Puketi Forest	14.7	97.0	9.8	11.6	7.5	2.2	1.85	6.55	1.28	0.005	0.010	0.020	0.003	0.1	0.107	71
Waipoua River	12.9	103.4	10.9	2.1	7.5	2.1	2.34	6.98	1.69	0.005	0.008	0.016	0.005	0.1	0.088	63
Wairua River at Purua	17.0	89.4	8.7	11.9	6.8	8.8	0.56	17.13	3.22	0.023	0.075	0.470	0.041	0.3	0.828	111
Waitangi at Waimate	14.9	97.3	10.0	3.8	6.9	3.8	1.07	8.79	1.93	0.007	0.027	0.364	0.020	0.2	0.570	488
Waitangi at watea	16.7	100.7	9.8	11.2	7.5	3.7	1.16	9.82	1.86	0.006	0.022	0.294	0.008	0.2	0.504	164
Whakapara River	15.9	96.5	9.8	6.0	6.9	6.0	1.01	13.27	3.06	0.025	0.057	0.308	0.020	0.2	0.504	177

12.12 Appendix C: Macroinvertebrate and habitat quality assessments

Table 13: Macroinvertebrate and habitat quality assessment data for all RWQMN in 2007

Site	Macroinvertebrate data				Habitat quality assessment data							
	No. of taxa	MCI	SQMCI	% EPT	Habitat abundance	Habitat diversity	Hydrologic heterogeneity	Channel alteration	Bank stability	Channel shade	Riparian vegetation	Total
Awanui at FNDC watertake	10	100	5.3	50.0	11	14	15	7	6	2	2	57
Awanui u/s of Waihue channel	7	107	4.2	42.9	16	15	15	13	13	6	2	80
Kaeo River	4	100	4.2	25.0	6	11	12	12	16	8	4	69
Kaihu at gorge	17	79	3.6	29.4	19	16	15	15	19	3	8	95
Mangahahuru at Apotu Rd	17	76	3.8	11.8	19	9	11	8	18	1	2	68
Mangahahuru at Main Rd	24	103	5.5	41.7	14	18	15	13	16	4	6	86
Mangakahia at Titoki	8	105	4.3	37.5	12	16	12	11	8	1	3	63
Mangakahia at Twin Bridges	15	103	4.0	40.0	17	15	20	19	18	3	11	103
Manganui River	7	97	4.5	28.6	16	12	7	12	11	4	3	65
Mangere River	24	79	4.2	12.5	12	15	12	11	14	6	5	75
Opouteke River	15	88	3.3	26.7	17	13	17	11	17	0	2	77
Punakitere River	19	101	4.6	36.8	16	14	15	15	16	7	8	91
Ruakaka River	13	99	4.8	38.5	11	11	12	11	16	9	11	81
Victoria River	19	111	6.0	57.9	10	15	13	13	11	9	7	78
Waiarohia at Second Ave	18	85	4.3	27.8	12	15	14	11	10	4	5	71
Waiarohia at Whau Valley	28	91	4.1	32.1	14	13	12	3	14	3	9	68
Waiharakeke Stream	11	96	5.2	45.5	15	15	14	15	14	11	11	95
Waiotu River at SH1	12	73	3.4	25.0	10	13	14	12	13	4	4	70
Waipapa at Puketi Forest	27	127	7.1	55.6	20	18	19	20	20	6	19	122
Waipoua River	21	130	7.2	66.7	20	17	20	14	18	6	18	113
Wairua River at Purua	13	80	4.8	30.8	17	13	11	10	9	1	2	63
Waitangi at Waimate	10	78	3.2	0.0	10	15	16	13	15	3	9	81
Waitangi at watea	15	99	6.4	33.3	14	13	14	15	4	1	2	63
Whakapara River	12	91	4.2	50.0	17	13	11	9	8	1	2	61