

Northland River Water Quality Monitoring Network Report – 2008-2009



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Rivers and Streams

Introduction

Northland has an abundance of rivers and streams, many of which are relatively short with small catchments. The Wairoa River is Northland's largest river, draining a catchment area of 3650 km² (29% of Northland's land area). Most of the major rivers in the region flow into enclosed harbours, rather than discharging to the open coast, which has significant implications for coastal water quality.

The Northland Regional Council (NRC) carries out State of the Environment (SOE) monitoring on a number of rivers and streams throughout Northland to measure water quality, identify significant environmental issues and to monitor trends in water quality over time.

The **River Water Quality Monitoring Network (RWQMN)** involves the monitoring of water quality and macroinvertebrate biota in an increasing number of rivers around Northland. During 2008-09, 35 sites were included in the network, of which four are part of the National River Water Quality Network. Water quality at each site is monitored monthly for a range of parameters and stream macroinvertebrates are surveyed annually. The majority of sites in the network now have sufficient data for long-term trend analysis. The 2008-09 results and long-term trends in water quality are presented in the River Water Quality section below.



Photo: Waipoua River in Waipoua Forest

In 2008-09, the network included 35 sites spread across the region. These sites are shown on the map below. Four of these sites are part of the National River Water Quality Network, which is monitored by staff from the National Institute of Water and Atmospheric Research (NIWA) (Waipapa River in Puketū Forest, Waitangi River at Watea, Mangakahia River at Titoki and Wairua River at Purua).

One new site, Hātea River at Mair Park, was added to the network in 2008-09. This site was added to improve coverage over a range of river types, based on geology, source and land cover/catchment type.



Map: RWQMN Sites in Northland.
 (Pink = sites monitored by NIWA, Purple = site added in 2008-09)

Sampling regime

Monthly water quality sampling is carried out at each site in the network and samples are analysed for a range of chemical and physical parameters. These are shown in the table below. The purpose of the network is to provide information about the current state of Northland's rivers, and to look at long-term trends in water quality over time.

Most results are compared to the New Zealand trigger values for the protection of aquatic environments, found in the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality' (ANZECC 2000). It is important to note that the trigger values are used to assess the risk of adverse effects on an ecosystem and when results are outside trigger values, further investigation may still be required to determine whether or not this is having an adverse effect on the aquatic environment.

Two sets of trigger values are used by NRC to analyse results; one for upland rivers, which only includes one site in the network (Waipoua River), and one for lowland rivers (as shown in the table below). Levels of the indicator bacteria *E. coli* are compared to the '*Microbiological Water Quality Guidelines for Marine and Freshwater Recreational areas*' (see the **Recreational Bathing Water Quality** section above).

Parameter	Guideline trigger values (NZ lowland rivers)	Guideline trigger values (NZ upland rivers)
Temperature (Degrees Celsius)	-	-
Dissolved oxygen (% Saturation)	98 - 105	99 – 103
Conductivity (mSm)	-	-
Water clarity (m)	> 0.6	> 0.8
Turbidity (NTU)	< 5.6	< 4.1
<i>E. coli</i> (n/100mL)	< 550 [^]	< 550 [^]
Dissolved reactive phosphorus(mg/L)	< 0.01	< 0.009
Total phosphorus (mg/L)	< 0.033	< 0.026
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

[^] *E. coli* guideline for recreational bathing in freshwater

The results for each river from 2008-09 are detailed in the following sections. Over half of the rivers in the network now have enough data to begin long-term trend analysis. Some of the trends are discussed in more detail later in this report ([Trends in Water Quality](#)).

River Water Quality Results

Rivers have been ranked from best to worst using the 2008-09 median results for all parameters (i.e. highest to lowest water clarity, or least to most nitrogen).

There have been some changes in the order of sites from overall best water quality to worst has changed in the last financial year. The Waipoua River was again ranked the best however the Ruakaka River outranked the Manganui River this year as the worst.

As in previous years, the ranking of sites is linked to catchment land use. The best sites have catchments dominated by native forest, moving through to sites with a mix of forestry, native forest and agriculture. The worst sites have catchments dominated by intensive agricultural land use. Some sites have been shown with equal ranking, as it was difficult to differentiate between them.

Ranking 2008/09	Ranking 2007/08	Site	River system	Land use
1	-	Waipoua River	Waipoua	Native forest
2	↑ (4)	Waipapa at Forest Ranger	Waipapa	Native forest
3	↑ (5)	Kaihu River at gorge	Wairua	Agriculture/forestry
4	↓ (3)	Mangakahia at Twin Bridges	Wairua/Mangakahia	Agriculture/forestry
5	↑ (7)	Waimamaku River	Waimamaku	Agriculture
6	↓ (2)	Opouteke River	Wairua/Mangakahia	Forestry/native forest
7	↑ (8)	Victoria River	Victoria/Awanui	Agriculture/native forest
8	↑ (12)	Waitangi at Watea	Waitangi	Agriculture/native forest
9	-	Kerikeri River	Kerikeri	Agriculture
10	-	Waipapa Stream at Kerikeri	Waipapa	Agriculture
11	-	Mangamuka River	Mangamuka	Agriculture/native forest
12	↓ (6)	Mangahuru at Main Road	Wairua	Forestry
13	↑ (14)	Waiarohia at Second Ave	Waiarohia	Urban
14	↓ (12)	Waitangi at Waimate North	Waitangi	Agriculture/native forest
15	↑ (20)	Kaeo River	Kaeo	Agriculture
16	ND	Hātea River	Hātea	Agriculture/urban
17	↑ (21)	Punakitere River	Punakitere	Agriculture
17	↓ (15)	Whakapara River	Wairua	Agriculture
19	↓ (17)	Waipao Stream	Wairua	Agriculture
20	↓ (18)	Mangakahia at Titoki	Wairua/Mangakahia	Agriculture
21	↓ (16)	Waiarohia at Whau Valley Rd	Waiarohia	Agriculture/native forest
22	↓ (18)	Ngunguru River	Ngunguru	Agriculture/forestry/native
23	↑ (28)	Hakaru River	Topuni	Agriculture/forestry
24	↑ (29)	Wairua River at Purua	Wairua	Agriculture
25	-	Waiharakeke Stream	Kawakawa	Agriculture
26	↓ (23)	Waiotu River at SH 1	Wairua	Agriculture
27	↓ (22)	Oruru River	Oruru	Agriculture
28	↓ (23)	Awanui at FNDC water take	Victoria/Awanui	Agriculture
29	↓ (30)	Utakura River	Utakura	Agriculture
30	↓ (25)	Mangahuru at Apotu Rd	Wairua	Agriculture
31	↓ (27)	Paparoa Stream	Paparoa	Agriculture
32	-	Mangere River at Knights Rd	Wairua	Agriculture
33	↑ (34)	Manganui River	Manganui	Agriculture
34	↓ (31)	Awanui at Waihue Channel	Victoria/Awanui	Agriculture
35	↓ (33)	Ruakaka River	Ruakaka	Agriculture

Results

Waipoua River

The Waipoua River originates in and flows through Waipoua Forest, on the West Coast of Northland. The river cuts through volcanic soils and has a predominantly native forest catchment. The Waipoua River site is the only site in the network that is classified as “hill elevation” by the ‘*River Environment Classification*’ (NIWA & MfE 2004) and therefore the results have been compared to the trigger values for an upland river. The Waipoua River is the closest to pristine condition of all the rivers in the network.

Results for 2008-09 for the Waipoua River site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines for the 12 sampling occasions. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% compliance with guideline
Temperature (deg. cel.)	12.9	9.8 - 19.3	
Dissolved oxygen (% Sat.)	99.4	91 - 104.9	50
Conductivity (mSm)	8.7	6.2 - 10.8	
Water clarity (m)	2.54	1.54 - 3.2	100
Turbidity (NTU)	2.2	1 - 5.8	67
<i>E. coli</i> (n/100mL)	57.5	5 - 134	83
Dissolved reactive phosphorus (mg/L)	0.005	0.005	67
Total phosphorus (mg/L)	0.005	0.005 - 0.02	67
Ammoniacal nitrogen (mg/L)	0.005	0.005	92
Total nitrogen (mg/L)	0.173	0.052 - 0.301	83
pH	7.4	6.9 - 7.6	50

The Waipoua River has been ranked as the best river in Northland based on the eleven parameters in the above table. The medians of all parameters were within the relevant guideline for an upland river. However, compliance with trigger values for single samples has been an issue this year, with half of the parameters not complying on four or more sampling occasions. Water clarity was the only parameter to comply with the trigger value of >0.8 cm on all sampling occasions. The range for total nitrogen is within the range typically found in New Zealand rivers in catchments dominated by indigenous forestry (Ballantine et al, 2010).

As the Waipoua River is classified as an upland river, the trigger values are stricter than the lowland trigger values, which is why compliance is poorer when comparing it to other Northland Rivers.

Trend analysis for this site shows that there is a decreasing trend in dissolved oxygen (mg/l). Further sampling and analysis is required to determine the reason for this trend.

Waipapa River

The Waipapa River originates in and flows through Puketi forest in central Northland, meandering through farmland until it reaches the upper Hokianga Harbour. The sampling site is in the upper reaches and therefore the catchment above it is predominantly indigenous forest, with some small areas of exotic forest in the headwaters. The geology of the Waipapa River is soft sedimentary (siltstones and mudstones). Similarly to the Waipoua River site, this site is in near pristine condition. The Waipapa site is one of four sites in Northland that are part of the National River Water Quality Network administered by NIWA.

Results from 2008-09 for the Waipapa River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. Note: Dissolved reactive phosphorus and ammoniacal nitrogen results were only available for six sampling occasions (July 2008 – December 2008). An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	14.3	10.4 - 20.3	
Dissolved oxygen (% Sat.)	97.1*	90.3 - 99.4	25
Conductivity (mSm)	11.7	10.38 - 13.4	
Water clarity (m)	2.78	0.19 - 7.48	83
Turbidity (NTU)	2.4	0.92 - 5	83
<i>E. coli</i> (n/100mL)	85.4	21.61 - 203.31	92
Dissolved reactive phosphorus (mg/L)	0.005	0.003 - 0.007	100
Total phosphorus (mg/L)	0.008	0.005 - 0.035	90
Ammoniacal nitrogen (mg/L)	0.005	0.001 - 0.006	100
Total nitrogen (mg/L)	0.085	0.066 - 0.298	100
pH	7.5	7.4 - 7.68	100

Results for 2008-09 show that the Waipapa River remains in a relatively pristine state as dissolved reactive phosphorus, ammoniacal nitrogen, total nitrogen and pH complied with their relevant trigger values on all sampling occasions. Water clarity and turbidity values exceeded their trigger values on two sampling occasions.

Dissolved oxygen appears to be an issue as values fell outside the trigger value range of 98 to 105% on nine sampling occasions.

Long-term trends indicate improvements in the Waipapa River. Trend analysis shows increasing water clarity and decreasing nitrite/nitrate nitrogen, ammoniacal nitrogen and total phosphorus concentrations. Further investigation is required to determine what is causing these trends.

Kaihu River

The Kaihu River originates in native forest to the west of Trounson Kauri Park and drains into the Wairoa River in Dargaville. The catchment is a mix of exotic and indigenous forestry, agriculture and horticulture but dairy farming is the predominant land-use. Kaihu River is one of six sites in the network that have volcanic acidic geology.

The results from 2008-09 for the Kaihu River site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	14.5	11 - 20.5	
Dissolved oxygen (% Sat.)	101.1	91.1 - 108.2	67
Conductivity (mSm)	11.4	9 - 12.3	
Water clarity (m)	2.14	0.68 - 2.7	100
Turbidity (NTU)	3.0	1 - 14.6	75
<i>E. coli</i> (n/100mL)	86.5	41 - 638	92
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.02	73
Total phosphorus (mg/L)	0.011	0.005 - 0.036	92
Ammoniacal nitrogen (mg/L)	0.005	0.005 - 0.04	92
Total nitrogen (mg/L)	0.307	0.147 - 1.224	67
pH	7.5	7.1 - 7.7	75

The results from 2008-09 are very similar to the previous year with most water quality parameters falling outside the trigger values on some sampling occasions. However, all medians were within their trigger values.

Water clarity exceeded the trigger value of 1.6 m on all sampling occasions. The yearly median was 2.14 m which is above the National Rivers Network median of 2.01 m (MfE, 2009). Trend analysis on six years of water quality data collected for the Kaihu River shows that there is an improving trend in water clarity.

Dissolved oxygen (mg/l) is decreasing however it is not yet known if decreasing dissolved oxygen is a positive or negative trend.



Photo: The Kaihu River sampling site

Mangakahia River at Twin Bridges

The Mangakahia River originates from Matarua Forest and flows southwest until it reaches the Wairua River. There are two sites on the Mangakahia River in the network; one at Twin Bridges and the other at Titoki Bridge, in the lower reaches. The Twin Bridges lie at the confluence of the Awaroa and Mangakahia Rivers. The sampling site is directly downstream of this confluence. The upstream catchment is a mixture of plantation forestry, and beef and sheep farming, with an acidic, volcanic underlying geology.

Results for 2008-09 for Twin Bridges on the Mangakahia River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.5	10.9 - 22.6	
Dissolved oxygen (% Sat.)	105.6*	91.9 - 121	8
Conductivity (mSm)	11.3	8.2 - 14	
Water clarity (m)	1.82	0.46 - 3.26	91
Turbidity (NTU)	3.3	1 - 36	67
<i>E. coli</i> (n/100mL)	109.0	20 - 880	75
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.012	91
Total phosphorus (mg/L)	0.010	0.005 - 0.049	83
Ammoniacal nitrogen (mg/L)	0.005	0.005 - 0.02	100
Total nitrogen (mg/L)	0.209	0.076 - 0.492	100
pH	7.9*	7.2 - 8.5	50

Results from 2008-09 indicate that nitrogen levels are excellent with total nitrogen and ammoniacal nitrogen concentrations well below their trigger values of 0.021 and 0.614 mg/l respectively on all sampling occasions. Phosphorus levels in the Mangakahia River were also good with the median for total and dissolved reactive phosphorus complying with their trigger values. Trend analysis shows that there is a significant decreasing trend in total phosphorus in this river.

The median of dissolved oxygen and pH were above their trigger values. The high dissolved oxygen levels occur in summer during lower flows, when photosynthesis rates by plants are greater.

Waimamaku River

The Waimamaku River begins north of the Waipoua forest and flows west through Waimamaku township, eventually reaching the West Coast south of the Hokianga Harbour. The catchment is dominated by indigenous forest in the upper reaches and is mainly pastoral in the lower catchment. The sampling site is located in the lower reaches of the river, after it passes through Waimamaku.

The results for 2008-09 are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.2	10.1 - 22.6	
Dissolved oxygen (% Sat.)	100.5	90.8 - 109.5	50
Conductivity (mSm)	11.0	8.4 - 14.1	
Water clarity (m)	1.78	0.86 - 2.75	100
Turbidity (NTU)	3.1	1 - 12.2	83
<i>E. coli</i> (n/100mL)	237.5	74 - 2755	92
Dissolved reactive phosphorus (mg/L)	0.005	0.005	100
Total phosphorus (mg/L)	0.011	0.005 - 0.026	100
Ammoniacal nitrogen (mg/L)	0.005	0.005 - 0.02	100
Total nitrogen (mg/L)	0.289	0.058 - 0.782	92
pH	7.7	7.2 - 7.8	100

The results from 2008-09 for the Waimamaku River indicate that water quality is good as water clarity is high and nutrient and bacteria levels are low. Water clarity, dissolved reactive phosphorus, total phosphorus, total nitrogen and pH concentrations were all within their trigger values on all sampling occasions. The dissolved reactive phosphorus median of 0.005 mg/l was just above the National Rivers Network median of 0.004 mg/l (MfE, 2009).

There is not yet sufficient data to undertake trend analysis for this site.

Opouteke River

The Opouteke River drains from predominantly exotic forestry (pine forest), through a small area of pasture, before reaching the Mangakahia River. The only pastoral land use upstream of the sampling site is a sheep and beef farm, although dairy farms do occur further downstream. Acidic volcanic rocks make up the underlying geology.

Results for 2008-09 for the Opouteke River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.6	10.6 - 23.2	
Dissolved oxygen (% Sat.)	105.3*	90.4 - 119.1	33
Conductivity (mSm)	13.0	10.4 - 14.8	
Water clarity (m)	2.00	0.73 - 3.25	100
Turbidity (NTU)	2.5	1 - 11.6	75
<i>E. coli</i> (n/100mL)	145	10 - 3873	75
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.011	91
Total phosphorus (mg/L)	0.012	0.005 - 0.027	100
Ammoniacal nitrogen (mg/L)	0.005	0.005 - 0.01	100
Total nitrogen (mg/L)	0.233	0.059 - 0.432	100
pH	8.0*	7.3 - 8.8	25

Nutrient and water clarity results for the Opouteke River are good this year with three nutrient parameters and water clarity complying with their respective trigger values on all sampling occasions. The total nitrogen median of 0.233 is below the National Rivers Network median of 0.264 (MfE, 2009).

As in previous years, dissolved oxygen concentrations are often elevated in Opouteke River which is most likely due to high algae growth in the river. Like other RWQMN sites, pH compliance is poor with 75% of samples falling above the trigger value range for aquatic life. Further investigations are needed to determine what is causing this increase in pH.

Over the last two years phosphorus compliance has improved with 11 or more samples falling below their trigger values each year. In previous years, they exceeded guideline trigger values on 5 or more occasions. Trend analysis on the 14 years data available for Opouteke River shows that total phosphorus levels are decreasing. There is also a significant decreasing trend in nitrite/nitrate nitrogen.

Victoria River

The Victoria River begins in native forest in the Mangamuka Ranges, and runs north through pasture before joining the Awanui River near Kaitāia. The site is located approximately two kilometres downstream of the forest, in pastoral land use; however the upstream catchment is dominated by indigenous forest. The geology of this site is classified as volcanic acidic.

The results for 2008-09 for the Victoria River site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	13.6	10.7 - 19.5	
Dissolved oxygen (% Sat.)	92.5*	83.9 - 103.1	17
Conductivity (mSm)	16.2	12.6 - 17.8	
Water clarity (m)	1.25	0.9 - 1.6	100
Turbidity (NTU)	1	1 - 7.2	92
<i>E. coli</i> (n/100mL)	140	86 - 246	100
Dissolved reactive phosphorus (mg/L)	0.017*	0.01 - 0.02	9
Total phosphorus (mg/L)	0.021	0.014 - 0.05	83
Ammoniacal nitrogen (mg/L)	0.005	0.005	100
Total nitrogen (mg/L)	0.107	0.007 - 0.335	100
pH	7.6	7.3 - 7.8	100

Results for 2008-09 for the Victoria River indicate that water clarity, bacterial and nitrogen levels are good. The medians for the majority of parameters comply with their trigger values. Dissolved oxygen (%) and dissolved reactive phosphorus are the parameters of most concern as trigger values were not met on 10 or more sampling occasions.

Long-term trend analysis of data for the Victoria River site shows an increasing trend in dissolved oxygen and decreasing trends in both dissolved reactive and total phosphorus levels. It is likely that the increased trend in dissolved oxygen is positive as current values are often below the acceptable range for aquatic life.

There are significant long term trends indicating that water clarity is decreasing. Further investigation is required to identify the cause of this negative trend.

Waitangi River at Watea

The Waitangi River originates in the middle of Northland and flows east, where it joins the coast at Waitangi. There are two sites on the Waitangi River that form part of the RWQMN; one at Waimate North and the other at Watea near Waitangi. The catchments of both sites are dominated by pastoral farming. However, the geology of the upstream site at Waimate North is predominantly volcanic acidic, while the site at Watea is dominated by hard sediments.

Unlike many of Northland's rivers, a buffer strip of riparian vegetation exists along the banks of the majority of the Waitangi River. The Watea site on the Waitangi River is one of four sites in Northland that are part of the National River Water Quality Network administered by NIWA.

The results from 2008-09 for this site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. Note: Dissolved reactive phosphorus and ammoniacal nitrogen results were only available for six sampling occasions (July 2008 – December 2008). An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.6	11.2 - 23.6	
Dissolved oxygen (% Sat.)	104.3	96.5 - 112.7	42
Conductivity (mSm)	11.9	10.6 - 13.3	
Water clarity (m)	1.74	0.24 - 3.85	83
Turbidity (NTU)	3.0	1.71 - 25.1	75
<i>E. coli</i> (n/100mL)	127	59.1 - 1986.28	92
Dissolved reactive phosphorus (mg/L)	0.006	0.004 - 0.011	83
Total phosphorus (mg/L)	0.021	0.009 - 0.062	90
Ammoniacal nitrogen (mg/L)	0.006	0.002 - 0.026	83
Total nitrogen (mg/L)	0.385	0.183 - 0.847	70
pH	7.6	7.3 - 7.95	75

This year results for the Waitangi River (Watea site) shows that all medians complied with their relevant trigger values, however, single sample compliance was average for some parameters. Like other rivers in the network, dissolved oxygen (percentage) compliance was poor with only five samples falling inside the trigger value range of 98 to 105 percent saturation.

E. coli compliance levels have improved this year with only one sample exceeding the trigger value of 550 *E. coli*/100ml. Last year four out of 12 samples exceeded the trigger value.

Based on 13 years of data, trend analysis shows that there is a significant increasing trend in total kjeldahl nitrogen (the sum of organic nitrogen, ammonia and ammonium) but not ammoniacal and total nitrogen. More information on land use changes in the catchment is required to understand why this is occurring.

Kerikeri River, Stone Store Bridge

The Kerikeri River originates to the east of the Puketi Forest, and flows east into the Kerikeri Inlet. The catchment contains a range of land use, including pastoral, horticulture (orchards), agriculture (crops) and forestry (pine plantations). There are small areas of indigenous forest in the headwaters.

The results from 2008-09 are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.6	11 - 22.2	
Dissolved oxygen (% Sat.)	103.5	70.1 - 203	25
Conductivity (mSm)	8.2	2.5 - 98.1	
Water clarity (m)	1.52	0.45 - 2.43	91
Turbidity (NTU)	2.6	2 - 25	75
<i>E. coli</i> (n/100mL)	280.5	86 - 2382	75
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.02	55
Total phosphorus (mg/L)	0.032	0.005 - 0.59	58
Ammoniacal nitrogen (mg/L)	0.015	0.005 - 0.04	92
Total nitrogen (mg/L)	0.717*	0.392 - 1.084	42
pH	7.2	6.8 - 7.4	67

Water quality results for the Kerikeri River indicate that single sample compliance was poor for the majority of parameters. Dissolved reactive and total phosphorus compliance was poor with both failing to meet their trigger values on five sampling occasions. Dissolved oxygen levels are an issue at this site as only three samples fell within the trigger value range. Further sampling is required to investigate this issue.

Bacterial levels (*E. coli*) exceeded the trigger value for recreational bathing of 550/100ml on three out of the 12 sampling occasions which is an improvement on last years results.

This is the second year this river has been monitored as part of the RWQMN. There is not yet sufficient data to undertake trend analysis for this site.

Waipapa Stream at Kerikeri Inlet

The Waipapa Stream is fed by Lake Manuwai and flows east out into the Kerikeri Inlet. The stream passes through a mixture of land use types, including pastoral, horticulture (orchards) and lifestyle blocks. The underlying geology is predominantly acidic volcanic.

The results from 2008-09 are summarised in the table below. These include the median, range and percentage of sampling occasions that comply with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.5	11.3 - 23.1	
Dissolved oxygen (% Sat.)	95*	70.1 - 108.3	25
Conductivity (mSm)	7.9	7.2 - 8.3	
Water clarity (m)	1.68	0.49 - 2.62	91
Turbidity (NTU)	2.7	1 - 28	92
<i>E. coli</i> (n/100mL)	181	41 - 884	83
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.012	91
Total phosphorus (mg/L)	0.019	0.005 - 0.111	58
Ammoniacal nitrogen (mg/L)	0.008	0.005 - 0.03	92
Total nitrogen (mg/L)	0.477	0.312 - 0.855	58
pH	7.0*	6.8 - 7.1	0

Results for the Waipapa Stream site indicate that most of the parameters meet their trigger values during normal river flows. Total nutrients and *E. coli* generally exceed their trigger values in times of high flows. pH fell below its trigger value range of 7.2 to 7.8 on all sampling occasions. Water clarity and turbidity results were good with both exceeding their trigger values on only one sampling occasion.

There is not yet sufficient data to undertake trend analysis for this site.

Mangamuka River

The Mangamuka River begins in the Mangamuka Forest. The river then flows south into the upper reaches of the Hokianga Harbour. In the lower reaches, the river passes through pastoral land however the upper catchment is dominated by indigenous forest. The sampling site is located upstream of the confluence between the Mangamuka and Iwitaua Stream.

Results for 2008-09 are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	13.6	10.7 - 19.7	
Dissolved oxygen (% Sat.)	92*	74 - 98.6	8
Conductivity (mSm)	16.9	13.1 - 22	
Water clarity (m)	1.25	0.7 - 1.7	100
Turbidity (NTU)	2.0	1 - 7.6	83
<i>E. coli</i> (n/100mL)	159	41 - 3873	92
Dissolved reactive phosphorus (mg/L)	0.029*	0.02 - 0.03	0
Total phosphorus (mg/L)	0.035*	0.028 - 0.053	50
Ammoniacal nitrogen (mg/L)	0.005	0.005 - 0.01	100
Total nitrogen (mg/L)	0.115	0.052 - 0.429	100
pH	7.5	7.1 - 7.7	92

Water quality results for 2008-09 are very similar to last years with only three parameters meeting their relevant trigger values on all sampling occasions (water clarity, ammoniacal and total nitrogen). Dissolved reactive phosphorus did not meet its trigger value of <0.01 mg/l on any occasion, which is very concerning as the majority of the catchment is native forest. This may be a result of land use changes in the catchment which needs to be investigated. Dissolved oxygen is also often below the trigger value range for lowland rivers.

This is the second year this river has been monitored as part of the RWQMN. There is not yet sufficient data to undertake trend analysis for this site.

Mangahuru Stream at Main Road

The Mangahuru Stream, which begins in *Pinus radiata* forest to the southeast of Hikurangi, is a small tributary of the Wairua River. The sampling site is located in the upper catchment and therefore the predominant land use in this area is exotic forestry. The site was added to the RWQMN in 2005-06 as a representative of a river system on hard, sedimentary rock surrounded by exotic forestry. It provides a good comparison to the Mangahuru Stream site at Apotu Road.

Results from 2008-09 are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	14.3	10.7 - 20.4	
Dissolved oxygen (% Sat.)	96.3*	66.3 - 108.9	33
Conductivity (mSm)	9.8	9.1 - 12.4	
Water clarity (m)	1.11	0.92 - 1.6	100
Turbidity (NTU)	6.0*	3.6 - 14.6	25
<i>E. coli</i> (n/100mL)	213.5	52 - 862	83
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.014	73
Total phosphorus (mg/L)	0.079*	0.014 - 0.204	33
Ammoniacal nitrogen (mg/L)	0.015	0.005 - 0.04	75
Total nitrogen (mg/L)	0.250	0.097 - 0.442	100
pH	7.0*	6.8 - 7.2	33

Water clarity and total nitrogen levels are good at the Mangahuru Stream at Main Road site as they both complied with trigger values on all sampling occasions. Total phosphorus levels are an issue again this year with concentrations exceeding the trigger value on eight out of 12 sampling occasions. Last year, total phosphorus concentrations exceeded the guideline value of 0.033 mg/l only four times during the season. Turbidity compliance was also poor this year with only three samples falling below the trigger value of 5.6 NTU. Higher total phosphorus and turbidity levels may be due to erosion caused by harvesting pine plantations in the catchment.

Macroinvertebrate community index data indicates that the Mangahuru Stream (Main Rd) is mildly polluted (Pohe, 2009).

There is not yet sufficient data to undertake trend analysis for this site.

Waiarohia Stream at Second Ave

Waiarohia Stream is a small stream originating from Pukenui Forest and the Western Hills in Whāngārei. The upper catchment is mainly indigenous forest with some exotic forestry. The stream flows through a small area of low intensity farmland and lifestyles block, before it reaches residential housing and the central business area of Whāngārei. This site is located in the central business area and was added to the RWQMN in 2005-06 to look at urban influences on water quality. Results for this site can be compared to the upstream site in Whau Valley.

The results from 2008-09 for the Waiarohia Stream site at Second Ave are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	18.1	12.5 - 24.9	
Dissolved oxygen (% Sat.)	101.2	73.5 - 135.4	33
Conductivity (mSm)	24.3	17.6 - 30.7	
Water clarity (m)	2.08	0.85 - 3.1	100
Turbidity (NTU)	2.5	1 - 12.2	92
<i>E. coli</i> (n/100mL)	520.5	143 - 1095	58
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.015	64
Total phosphorus (mg/L)	0.019	0.005 - 0.03	100
Ammoniacal nitrogen (mg/L)	0.010	0.005 - 0.02	100
Total nitrogen (mg/L)	0.658*	0.079 - 1.122	42
pH	7.5	7.2 - 7.8	100

All medians, except total nitrogen, met their respective trigger values for lowland rivers at this site. Bacteria levels are often elevated at this site with levels higher than the recreational bathing guideline of 550 *E. coli*/100 ml on five occasions. Dissolved reactive phosphorus and total nitrogen are often elevated and did not meet their relevant trigger values on four or more sampling occasions. The source of nutrient and bacterial contamination in this stream is likely to be from surrounding, small scale pastoral farming and is probably related to stock access to the stream. The overuse of fertiliser in residential gardens could also contribute to the increase in nitrogen.

The highest temperature of all the RWQMN sites was recorded at this site during summer (24.9°C). It is commonly accepted that water temperatures of greater than 25°C are potentially harmful or even lethal for aquatic life.

There is not yet sufficient data to undertake trend analysis for this site.

Waitangi River at Waimate North

The Waitangi River originates just east of Lake Omapere, and flows into the Bay of Islands. There are two sites on Waitangi River in the RWQMN; one in the upper to mid reaches at Waimate North and the other in the lower reaches at Watea. At the Waimate North site, the catchment is a mix of beef, sheep and dairy farming, with significant areas of indigenous forest in the headwaters. The underlying geology is predominantly acidic volcanic.

The results for 2008-09 for the Waitangi River at Waimate North are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	14.7	10.8 - 21.1	
Dissolved oxygen (% Sat.)	97.2*	69.7 - 108.6	17
Conductivity (mSm)	10.0	9.2 - 11	
Water clarity (m)	0.87	0.51 - 2.15	91
Turbidity (NTU)	6.1*	3 - 21	50
<i>E. coli</i> (n/100mL)	359.5	175 - 2359	67
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.012	91
Total phosphorus (mg/L)	0.023	0.005 - 0.179	75
Ammoniacal nitrogen (mg/L)	0.015	0.005 - 0.04	92
Total nitrogen (mg/L)	0.622*	0.372 - 1.004	50
pH	7.0*	6.3 - 7.1	0

Results from 2008-09 indicate that water quality in the Waitangi River at Waimate North has deteriorated as nutrient and turbidity levels are higher than previous years. This year median for turbidity is double what it was three years ago (3.05 NTU in 2005-06) and compliance has dropped to only half of the samples falling below the trigger value of <5.6.

Trend analysis on 10 years of data for this site shows that there is a significant decrease in dissolved reactive phosphorus. However, there are significant increasing trends in total kjeldahl nitrogen, nitrate nitrogen and total nitrogen. The increase in nitrogen species may be a result of further intensification of land use in the catchment.

Kaeo River

The Kaeo River begins north of Waipapa and flows north into the Whangaroa Harbour. Approximately half of the catchment is indigenous forest and scrub, with the remainder in pine forestry or pastoral farming. The underlying geology of the river is soft sediments. The site is located below the township of Kaeo, just before the influence of salt water.

The results from 2008-09 for the Kaeo River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	17.6	10.5 - 24.6	
Dissolved oxygen (% Sat.)	96.4*	78.2 - 109.6	25
Conductivity (mSm)	13.8	11.7 - 14.9	
Water clarity (m)	0.90	0.5 - 1.5	75
Turbidity (NTU)	6.1*	2.6 - 16.4	50
<i>E. coli</i> (n/100mL)	538.5	86 - 2613	50
Dissolved reactive phosphorus (mg/L)	0.005	0.005	100
Total phosphorus (mg/L)	0.016	0.01 - 0.025	100
Ammoniacal nitrogen (mg/L)	0.005	0.005 - 0.02	100
Total nitrogen (mg/L)	0.254	0.064 - 0.502	100
pH	7.2	6.9 - 7.3	67

The results from 2008-09 indicate that water quality in the Kaeo River is better than the previous year with all nutrient parameters meeting their trigger values on all sampling occasions. However, like last year *E.coli* and turbidity compliance is still poor with only half the samples meeting the trigger value of 550 *E. coli*/100ml.

pH compliance has improved with levels falling within the trigger range of 7.2 -7.8 on eight out of 12 sampling events. In 2007-08, only three samples fell within this range.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Hātea River

The Hātea River begins as the Waitaua River which originates from Springs Flat area just north of Kamo and flows southeast through Tikipunga and Mair park then out into the Whāngārei Harbour. There is a mix of urban, native forest and pastoral land in the catchment.

The results for 2008-09 for the Hātea River site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.5	11.3 - 23.4	
Dissolved oxygen (% Sat.)	102.6	73.5 - 112.8	27
Conductivity (mSm)	52.4	15.4 - 2339.4	
Water clarity (m)	1.21	0.87 - 2.6	100
Turbidity (NTU)	4.0	2.6 - 11.2	73
<i>E. coli</i> (n/100mL)	464	145 - 677	64
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.068	64
Total phosphorus (mg/L)	0.023	0.01 - 0.25	73
Ammoniacal nitrogen (mg/L)	0.010	0.005 - 0.57	82
Total nitrogen (mg/L)	0.633*	0.392 - 0.884	36
pH	7.7	7.4 - 8	73

The first year of results indicate that there are moderately high nutrient and bacterial levels in the Hātea River. Water clarity was the only parameter to meet the trigger value on all sampling occasions. Total nitrogen compliance was poor with only 36% of the samples meeting the lowland trigger value of <0.614 mg/l. Like many other RWQMN sites, dissolved oxygen compliance was also poor with only three samples falling within the trigger value range during the season.

As this is the first year of monitoring at this site, trend analysis cannot yet be undertaken.

Punakitere River at Taheke

The Punakitere River originates from a wetland to the southwest of Kaikohe and is a major tributary of the Waima River (which flows into the Hokianga Harbour). The catchment is predominantly agricultural land use with an underlying geology of soft sediments.

The results from 2008-09 for the Punakitere River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.4	10.9 - 22.4	
Dissolved oxygen (% Sat.)	100.6	85.7 - 119	33
Conductivity (mSm)	12.7	10.9 - 15.4	
Water clarity (m)	1.38	0.41 - 2.37	82
Turbidity (NTU)	6.4*	2 - 62	42
<i>E. coli</i> (n/100mL)	320	160 - 1723	83
Dissolved reactive phosphorus (mg/L)	0.017*	0.005 - 0.038	36
Total phosphorus (mg/L)	0.033	0.015 - 0.082	50
Ammoniacal nitrogen (mg/L)	0.01	0.005 - 0.04	92
Total nitrogen (mg/L)	0.826*	0.112 - 1.134	25
pH	7.8	7 - 8.4	50

The results from 2008-09 indicate that the Punakitere River suffers from significant nutrient overloading, with medians for turbidity, dissolved reactive phosphorus and total nitrogen all exceeding their respective trigger values. Run-off from surrounding land-use is the most likely source of nutrient and bacterial contamination in the Punakitere River.

However, phosphorus compliance is better than the previous year with dissolved reactive and total phosphorus meeting their respective guideline values on four or more sampling occasions. Last year both dissolved reactive and total phosphorus only met their recommended guideline on one occasion.

Trend analysis on eight years data shows that there is an increasing trend in water clarity and decreasing trends in total nitrogen and total phosphorus. The increasing water clarity trend is consistent with national findings (Ballantine & Davies-Colley, 2009).



Photo: Punakitere River

Whakapara River

The Whakapara River originates from the ranges east of Hikurangi and Whakapara, eventually joining the Waiotu River, forming the headwaters of the greater Wairua River. The river cuts through hard sediments formed from faulted greywacke, along a relatively low gradient. The site is located in a beef and sheep farm near State Highway one, with an upstream catchment dominated by forested hills and pastoral farming.

The results for 2008-09 for the Whakapara River site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.4	11 - 21.6	
Dissolved oxygen (% Sat.)	98.1	69.1 - 124.2	25
Conductivity (mSm)	9.0	8.3 - 10.2	
Water clarity (m)	0.79	0.48 - 2.62	73
Turbidity (NTU)	6.5*	3.1 - 35	42
<i>E. coli</i> (n/100mL)	148.5	30 - 2098	92
Dissolved reactive phosphorus (mg/L)	0.021*	0.01 - 0.032	18
Total phosphorus (mg/L)	0.044*	0.032 - 0.154	17
Ammoniacal nitrogen (mg/L)	0.015	0.005 - 0.12	83
Total nitrogen (mg/L)	0.497	0.112 - 1.197	50
pH	7.1*	6.5 - 7.9	42

Results for 2008-09 indicate that water quality in the Whakapara River is poor with high nutrient and turbidity levels. Both total phosphorus and dissolved reactive phosphorus compliance was poor with only two samples meeting their respective guideline values during the sampling season. Turbidity, dissolved oxygen (%) and pH also failed to meet their respective guidelines on most sampling occasions.

Significant long term trends in Whakapara River include decreasing nitrate nitrogen, dissolved reactive phosphorus and total phosphorus concentrations, which are all seen as positive trends. Improved land management practices in the catchment are the likely cause of these positive changes. However, there is an increasing trend in total kjeldahl nitrogen.

Waipao Stream, Draffin Road Bridge

The Waipao Stream was added to the RWQMN in 2007-08. The Waipao Stream begins as the Kauritutahi Stream to the west of Mangatapere (the Kauritutahi Stream becomes Waipao as it flows west towards Poroti). At Poroti, a number of springs feed into the stream and the stream itself eventually feeds into the Wairua River. The catchment of the stream is largely agricultural and includes high production farmland, orchards, crops and some small lifestyle blocks.

The 2008-09 results for Waipao Stream are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.9	12.4 - 19.2	
Dissolved oxygen (% Sat.)	109.4*	90.1 - 119.6	17
Conductivity (mSm)	18.5	16.5 - 20.1	
Water clarity (m)	1.76	0.87 - 3	100
Turbidity (NTU)	2.9	1 - 9.7	83
<i>E. coli</i> (n/100mL)	337	122 - 2014	67
Dissolved reactive phosphorus (mg/L)	0.03*	0.005 - 0.07	9
Total phosphorus (mg/L)	0.045*	0.025 - 0.074	17
Ammoniacal nitrogen (mg/L)	0.008	0.005 - 0.03	92
Total nitrogen (mg/L)	3.287*	0.477 - 3.815	8
pH	7.5	7 - 7.7	83

Results for the Waipao Stream indicate that phosphorus, nitrogen, and *E. coli* levels are elevated. The median for total nitrogen is extremely high and well over the lowland river trigger value of 0.614 mg/l. Nitrogen could be entering the stream through runoff from surrounding agricultural land or could be naturally occurring, leaching from volcanic soils in the catchment. Further sampling is required to investigate this.

Both dissolved reactive and total phosphorus had poor compliance with only one and two samples, respectively, meeting their trigger values. Like other RWQMN sites dissolved oxygen also failed to meet the trigger value range on ten out of 12 sampling events.

As the site was only added to the network in 2007, there is not yet sufficient data for the site to undertake trend analysis.

Mangakahia River at Titoki

The Mangakahia River originates in native bush near Waipoua Forest and flows southwest until it reaches the Wairua River. There are two sites on the Mangakahia River; one mid catchment at Twin Bridges and the other at Titoki Bridge in the lower reaches. By the time the Mangakahia River reaches the settlement of Titoki, surrounding land use is predominantly beef and dairy farming, with an underlying geology of acidic volcanic rock. This site is one of four sites in Northland that are part of the National River Water Quality Network, administered by NIWA.

The results from 2008-09 for the Mangakahia River site at Titoki Bridge are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. Note: Dissolved reactive phosphorus and ammoniacal nitrogen results were only available for six sampling occasions (July 2008 – December 2008). An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.6	11.8 - 23.3	
Dissolved oxygen (% Sat.)	96.2*	90.6 - 100.8	17
Conductivity (mSm)	14.6	12 - 17.1	
Water clarity (m)	0.73	0.03 - 2	75
Turbidity (NTU)	5.9*	2.5 - 62.5	50
<i>E. coli</i> (n/100mL)	216.5	125.9 - 1732.9	92
Dissolved reactive phosphorus (mg/L)	0.007	0.005 - 0.012	83
Total phosphorus (mg/L)	0.022	0.013 - 0.149	70
Ammoniacal nitrogen (mg/L)	0.014	0.01 - 0.03	83
Total nitrogen (mg/L)	0.211	0.166 - 0.721	90
pH	7.4	7.1 - 7.8	92

The results from 2008-09 indicate that the water quality in the lower Mangakahia River (Titoki site) is worse than the upper Mangakahia River (Twin bridges site), which ranked 4th this year. Water clarity results for the two sites appear to be the main difference with the median for the lower site significantly lower compared to the upper site, 0.73 and 1.82cm, respectively. Nutrient and turbidity compliance is also better at the upper Mangakahia River site. Nutrient concentrations tend to be higher and water clarity tends to be lower in pastoral catchments (Ballantine et al, 2010).

Bacterial levels at this site are lower than the upper Mangakahia River site. *E. coli* levels only complied with the trigger value on nine sampling occasions at the upper site compared to 11 at the lower site. This is probably a result of dilution in the river.

Trend analysis on data from for the Mangakahia River indicates there is decreasing trends in ammoniacal nitrogen, nitrite/nitrate nitrogen and total phosphorus. There is also a decreasing ammoniacal nitrogen trend national (Ballantine et al, 2010).

Waiarohia Stream at Whau Valley Road

Waiarohia Stream is a small stream originating from Pukenui Forest and the Western Hills in Whāngārei. The upper catchment is mainly indigenous forest with some exotic forestry. The stream flows through a small area of low intensity farm land (mostly lifestyle blocks), before it reaches residential housing and the central business area of Whāngārei. This site is located upstream of the majority of residential housing in the upper catchment of the Waiarohia Stream.

The results from 2008-09 for the Waiarohia Stream site at Whau Valley Road are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.1	11.4 - 21	
Dissolved oxygen (% Sat.)	98.3	85 - 101.4	25
Conductivity (mSm)	28.4	16.6 - 40.3	
Water clarity (m)	1.40	0.63 - 2.56	83
Turbidity (NTU)	4.7	2.9 - 18.3	42
<i>E. coli</i> (n/100mL)	367	110 - 1850	8
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.016	25
Total phosphorus (mg/L)	0.026	0.016 - 0.047	33
Ammoniacal nitrogen (mg/L)	0.015	0.005 - 0.04	92
Total nitrogen (mg/L)	0.612	0.332 - 1.012	58
pH	7.3	7 - 7.6	67

Results from 2008-09 highlight several areas of concern in the Waiarohia Stream. Even though all medians met their respective trigger values, single sample compliance was an issue this year with most parameters failing to meet trigger values on four or more sampling occasions. The source of nutrient and bacterial contamination is likely to be surrounding, small-scale pastoral farming and could be related to stock access to the stream. NRC needs to encourage the surrounding landowners to exclude stock from the stream before this stream deteriorates further.

There is not yet sufficient data to undertake trend analysis for this site.

Ngunguru River

The Ngunguru River originates in Waipaipai to the west of the Tutukaka Coast and flows through the Glenbervie forest out into the Ngunguru Estuary. Half of the catchment is pastoral, with the rest a mixture of *Pinus radiata* forest and indigenous forest. The site is situated in the lower reaches of the river just before the river becomes saline.

The 2008-09 results for the Ngunguru River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.6	11.3 - 22.4	
Dissolved oxygen (% Sat.)	92.2*	68.5 - 101.4	42
Conductivity (mSm)	15.2	9.3 - 296	
Water clarity (m)	1.02	0.61 - 2.55	100
Turbidity (NTU)	6.5*	2.9 - 24	42
<i>E. coli</i> (n/100mL)	285	122 - 556	92
Dissolved reactive phosphorus (mg/L)	0.005	0.005 - 0.013	64
Total phosphorus (mg/L)	0.025	0.013 - 0.077	58
Ammoniacal nitrogen (mg/L)	0.020	0.005 - 0.04	83
Total nitrogen (mg/L)	0.268	0.172 - 0.452	100
pH	6.9*	4.6 - 7.1	0

The second year of results suggests that turbidity and nutrient levels often exceed trigger values; however, single sample compliance for most parameters is much better than the previous year. *E. coli* compliance has improved significantly this year with only one sample exceeding the recreational bathing trigger value of 550 per/100ml. Last year, four samples exceeded the trigger value. Water clarity and total nitrogen were the only parameter to comply with their trigger values on all sampling occasions.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Hakaru River

The Hakaru River originates in native bush and pine forestry in the Brynderwyn hills and flows south through farmland until it reaches the Topuni River. The Topuni River feeds into an arm of the Kaipara harbour. The underlying geology in the catchment is a mixture of volcanic acidic, and hard and soft sedimentary rock. The site is located at the bottom of the catchment, above the saline influence.

The results for 2008-09 for Hakaru River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	14.6	11.1 - 20.4	
Dissolved oxygen (% Sat.)	106.1*	87.6 - 112.9	25
Conductivity (mSm)	17.9	16.3 - 18.9	
Water clarity (m)	0.87	0.5 - 1.2	92
Turbidity (NTU)	11*	7.6 - 35	0
<i>E. coli</i> (n/100mL)	224	52 - 480	100
Dissolved reactive phosphorus (mg/L)	0.051*	0.03 - 0.077	0
Total phosphorus (mg/L)	0.096*	0.059 - 0.129	0
Ammoniacal nitrogen (mg/L)	0.015	0.005 - 0.03	75
Total nitrogen (mg/L)	0.683*	0.411 - 1.306	30
pH	7.75	7.4 - 8	58

The results for 2008-09 indicate that water quality in the Hakaru River is moderately impacted, with high turbidity and nutrient levels. The 2009 macroinvertebrate community scores also indicate that the water in the Hakaru River is moderately polluted (Pohe, 2009).

Results are similar to the previous year with the medians for more than half of the parameters exceeded their respect guideline values. Turbidity, dissolved reactive and total phosphorus all exceeded their trigger values on all sampling occasions. This relatively poor water quality can be linked to runoff from surrounding agricultural land use. Excluding stock access and reducing fertiliser use will reduce nutrient levels in the Hakaru River

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Wairua River at Purua

The Wairua River above Whāngārei flows west into the Kaipara Harbour. It is one of the major tributaries of the greater Wairoa River. The catchment upstream of the sampling site is predominantly pastoral. The river cuts through hard sediments along a low gradient. The Wairua River site at Purua is one of four sites in Northland that are part of the National River Water Quality Network administered by NIWA.

The results for 2008-09 for the Wairua River at Purua are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. Note: Dissolved reactive phosphorus and ammoniacal nitrogen results are only available for July 2008 to December 2008. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.7	11.7 - 22.6	
Dissolved oxygen (% Sat.)	94.5*	76.6 - 118	8
Conductivity (mSm)	12.9	10.8 - 14.1	
Water clarity (m)	0.8	0.16 - 2.34	83
Turbidity (NTU)	8*	3 - 39.5	17
<i>E. coli</i> (n/100mL)	68.6	29.5 - 2419.2	83
Dissolved reactive phosphorus (mg/L)	0.019*	0.017 - 0.029	0
Total phosphorus (mg/L)	0.06*	0.033 - 0.14	10
Ammoniacal nitrogen (mg/L)	0.026*	0.004 - 0.146	50
Total nitrogen (mg/L)	0.528	0.226 - 1.29	60
pH	7.0*	6.6 - 7.7	42

Elevated turbidity, phosphorus and nitrogen results for this year indicate that the Wairua River is polluted. Medians for six of the nine parameters did not meet their respective trigger values. Dissolved oxygen compliance was poor again this year with only one sample falling within the trigger value range for lowland rivers. The extreme range in oxygen levels found in this river is a likely result of large macrophyte beds in the river which is a result of high nutrient concentrations.

Trend analysis on data from October 1996 to December 2008 indicates several positive trends, including decreasing ammoniacal nitrogen, nitrate nitrogen and total nitrogen. However nitrogen levels are still high and compliance with trigger values is poor. Excluding stock from waterways and reducing fertiliser use in the catchment will further reduce nutrient levels in the river.

There is also a trend suggesting that pH is increasing. This is likely to be a beneficial trend for this site as pH is often below the optimum range for the protection of aquatic ecosystems.

Waiharakeke River at Stringer Road

The Waiharakeke River is a major tributary of the Kawakawa River, which flows into the Waikare Inlet in the Bay of Islands. The Waiharakeke River originates in the Motatau Forest and flows North through a mixture of pine forestry, pastoral land and indigenous forest, before reaching Moerewa. The underlying geology is hard sedimentary.

The results from 2008-09 for the Waiharakeke River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.3	10.7 - 21.8	
Dissolved oxygen (% Sat.)	93*	70.4 - 101.1	18
Conductivity (mSm)	15.7	10.2 - 18.6	
Water clarity (m)	0.67	0.4 - 1.21	55
Turbidity (NTU)	10.3*	4.1 - 25	8
<i>E. coli</i> (n/100mL)	273.5	121 - 1565	83
Dissolved reactive phosphorus (mg/L)	0.016*	0.005 - 0.052	27
Total phosphorus (mg/L)	0.042*	0.025 - 0.078	25
Ammoniacal nitrogen (mg/L)	0.020	0.005 - 0.07	67
Total nitrogen (mg/L)	0.522	0.212 - 0.822	67
pH	7.4	6.2 - 7.5	75

This year's results for the Waiharakeke Stream indicate nutrient and turbidity levels often exceed trigger values. Dissolved reactive and total phosphorus compliance was particularly poor with only three samples complying with their trigger values of 0.01 and 0.033 mg/l, respectively. Turbidity compliance is the same as last year's results with only one sample meeting the trigger value. Bacterial levels are lower than the previous year's with 83% of samples complying this year compared with 50% last year.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Waioitu River at SH1

The Waioitu River is a hard sediment bottomed river derived from a predominantly agricultural catchment. The river originates from the hills to the northeast of State Highway one, between Kawakawa and Whāngārei, and runs into the Whakapara River to form the greater Wairua River.

The results from 2008-09 for the Waioitu River site are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.2	10.6 - 21.2	
Dissolved oxygen (% Sat.)	92*	67.1 - 105.9	8
Conductivity (mSm)	9.6	8.9 - 10.9	
Water clarity (m)	0.71	0.39 - 1.6	82
Turbidity (NTU)	9.7*	4.6 - 34	25
<i>E. coli</i> (n/100mL)	283.5	134 - 1850	75
Dissolved reactive phosphorus (mg/L)	0.022*	0.01 - 0.031	18
Total phosphorus (mg/L)	0.067*	0.024 - 0.212	8
Ammoniacal nitrogen (mg/L)	0.03*	0.005 - 0.1	42
Total nitrogen (mg/L)	0.665*	0.172 - 1.207	50
pH	7.1*	6.6 - 7.3	42

This year's water quality results for the Waiotu River are similar to previous years with the medians for the majority of parameters not meeting their respective trigger values. Total phosphorus and dissolved oxygen compliance was significantly poor with only one sample out of 12 meeting their respective trigger values.

Trend analysis on data collected for this site suggests that there is a positive decreasing trend in nitrate nitrogen. This suggests that there has been a reduction in fertiliser use in the catchment. There is however, a negative increasing trend in turbidity. This increasing trend in turbidity indicates increased erosion in the catchment. Excluding stock from waterways and planting riparian margins will improve stream bank stability which will reduce sediment loading into waterways.



Photo: Waiotu River

Oruru River

The Oruru River originates from the Otangaroa forest and flows north through indigenous forest and scrub. In the lower catchment, the river meanders through pastoral dominated land eventually flowing out into the Taipa River. Underlying geology is dominated by volcanic acidic rock, with some areas of soft sediments.

The results for 2008-09 for the Oruru River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.8	11.9 - 22.1	
Dissolved oxygen (% Sat.)	75.4*	58.6 - 87.3	0
Conductivity (mSm)	16.8	13.1 - 18.4	
Water clarity (m)	0.6	0.5 - 0.8	67
Turbidity (NTU)	9.7*	4 - 26	25
<i>E. coli</i> (n/100mL)	258	109 - 776	92
Dissolved reactive phosphorus (mg/L)	0.021*	0.01 - 0.025	9
Total phosphorus (mg/L)	0.041*	0.025 - 0.074	25
Ammoniacal nitrogen (mg/L)	0.010	0.005 - 0.03	92
Total nitrogen (mg/L)	0.193	0.052 - 0.313	100
pH	7.5	7 - 7.6	83

Water quality results for the Oruru River indicate that there are high turbidity and phosphorus levels. Dissolved oxygen concentrations are also poor as levels fell outside the trigger value range of 98 to 105% on all sampling occasions. The median of 0.021 mg/l for dissolved reactive phosphorus is well above the national river network median of 0.004 mg/l. Overall compliance is up slightly on last years results for *E. coli*, ammoniacal nitrogen and total nitrogen. This is probably due to a drier season.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Awanui River at FNDC water take

The Awanui River originates from Raetea Forest (Mangamuka's) and meanders north for a significant distance through pasture and the Kaitāia Township, eventually flowing into the Ranganu Harbour. There are 3 sites in the network on the Awanui River system; one in the upper reaches on Victoria River, one in the mid reaches at the FNDC water take and one in the lower reaches directly above Waihue channel.

The FNDC water take from the Awanui River is adjacent to State Highway 1, just south of Kaitāia. Land use in the upstream catchment is predominantly pastoral, with some semi-forested tributaries, for example, the Victoria River. The river's geology is soft sediments.

The results from 2008-09 for the Awanui River at the FNDC water take are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.2	11.4 - 21.7	
Dissolved oxygen (% Sat.)	83.4*	70.8 - 91.6	0
Conductivity (mSm)	19.2	15 - 21.9	
Water clarity (m)	0.7	0.5 - 1	75
Turbidity (NTU)	8.8*	3.4 - 29	25
<i>E. coli</i> (n/100mL)	283.5	84 - 2382	83
Dissolved reactive phosphorus (mg/L)	0.018*	0.01 - 0.02	9
Total phosphorus (mg/L)	0.04*	0.022 - 0.068	33
Ammoniacal nitrogen (mg/L)	0.02	0.01 - 0.03	88
Total nitrogen (mg/L)	0.291	0.072 - 0.462	100
pH	7.6	7.1 - 7.8	92

As for the previous two years, results from 2007-08 indicate that nitrogen concentrations at this site are satisfactory on most occasions, however dissolved oxygen, phosphorus and turbidity failed to meet their trigger values on eight or more sampling occasions. Some of these elevated results coincided with high flows and therefore are most likely the result of surface run-off from surrounding land during rainfall events.

Improved riparian management, for example, restricting stock access to waterways in this catchment will assist in improving water quality. Better maintenance of septic tanks in the catchment may also reduce contamination.

Trend analysis for 12 years of water quality data shows that there is a decreasing trend in dissolved reactive and total phosphorus at this site. These are all beneficial trends and may be the result of improved land management practices in the catchment.

Utakura River

The Utakura River is fed by Lake Omapere, to the north of Kaikohe, and flows west into the Waihou River arm of the Hokianga Harbour. The catchment is dominated by farmland with areas of native forest, pine forest and manuka scrub.

The results from 2008-09 for the Utakura River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.6	10.9 - 21.9	
Dissolved oxygen (% Sat.)	88.2*	76.5 - 95.1	0
Conductivity (mSm)	10.9	9.4 - 12.2	
Water clarity (m)	0.66	0.45 - 0.08	55
Turbidity (NTU)	27.2*	1 - 34	8
<i>E. coli</i> (n/100mL)	309	146 - 1106	92
Dissolved reactive phosphorus (mg/L)	0.011*	0.005 - 0.026	45
Total phosphorus (mg/L)	0.058*	0.045 - 0.092	0
Ammoniacal nitrogen (mg/L)	0.02	0.005 - 0.03	92
Total nitrogen (mg/L)	0.587	0.261 - 0.912	58
pH	7.1*	6.8 - 7.3	17

The second year of results indicates that there are low oxygen and high turbidity and nutrient levels. Dissolved oxygen and total phosphorus results are similar to the previous year with all values failing to meet their trigger values on all sampling occasions. *E. coli* compliance is better than the previous year with only one sample exceeding the trigger value of 550 per/100ml, compared to four samples last year. This is consistent with bacterial results from other river network sites this year and is due to less rainfall this year.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Mangahuru Stream at Apotu Road

The Mangahuru Stream, which begins in *Pinus radiata* forestry southeast of Hikurangi, is a small tributary of the Wairua River. Other than the exotic forestry in the headwaters, the catchment is predominantly agricultural land use, with an increasing number of lifestyle blocks. The underlying geology is hard sedimentary.

The results for 2008-09 for the Mangahuru Stream at Apotu Road are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.9	10.9 - 22.1	
Dissolved oxygen (% Sat.)	96.5*	70.2 - 117	8
Conductivity (mSm)	12.8	11.5 - 18.1	
Water clarity (m)	0.8	0.38 - 2.18	82
Turbidity (NTU)	7.4*	4 - 17.7	25
<i>E. coli</i> (n/100mL)	619.5*	175 - 1789	50
Dissolved reactive phosphorus (mg/L)	0.021*	0.01 - 0.088	9
Total phosphorus (mg/L)	0.069*	0.04 - 0.22	0
Ammoniacal nitrogen (mg/L)	0.025*	0.005 - 0.07	50
Total nitrogen (mg/L)	0.692*	0.107 - 0.934	33
pH	7.0*	5.9 - 7.2	25

The medians for all parameters except one (water clarity) exceeded their trigger values this year which suggests water quality is poor in the Mangahuru Stream. Single sample compliance was significantly poor for total phosphorus with all samples exceeding the trigger value of 0.033 mg/l. Dissolved oxygen levels are of particular concern, as there are large variations with the lowest observed reading being 70.2 mg/l and the highest being 117 mg/l. It is likely these variations are due to the dense oxygen weed beds.

The most likely source of contamination at this site is surface run-off from surrounding land, as spikes in contamination are associated with high river flows after rainfall events. Poorly maintained septic tanks, stock access to the stream and point source consented discharges, such as the Hikurangi Oxidation Pond, may also contribute. Further sampling is required to investigate this.

Trend analysis on data for the site indicates positive (improving) trends for dissolved reactive and total phosphorus in the Mangahuru Stream. As phosphorus is associated with sediment particles, this indicates there is less erosion occurring in the catchment. However, there is a negative (increasing) trend in nitrate nitrogen but not in ammoniacal or total nitrogen which suggests fertiliser use is increasing.

Paparoa Stream

The Paparoa Stream is a soft sediment-bottomed stream, which is set in a catchment dominated by high production farmland, with pockets of pine forestry and native bush. The stream flows west into an arm of the Kaipara harbour. The site is located in the park in Paparoa Township.

The results from 2008-09 for Paparoa Stream are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.3	11.1 - 21.3	
Dissolved oxygen (% Sat.)	91.6*	65.1 - 108.9	25
Conductivity (mSm)	30.6	20.9 - 1114.7	
Water clarity (m)	0.72	0.58 - 1.38	75
Turbidity (NTU)	9.0*	5.1 - 28	8
<i>E. coli</i> (n/100mL)	422.5	132 - 663	58
Dissolved reactive phosphorus (mg/L)	0.02*	0.005 - 0.04	18
Total phosphorus (mg/L)	0.062*	0.024 - 0.098	8
Ammoniacal nitrogen (mg/L)	0.02	0.005 - 0.04	67
Total nitrogen (mg/L)	0.647*	0.193 - 1.095	42
pH	7.3	6.9 - 7.6	75

The results from 2008-09 indicate that the Paparoa Stream is affected by high turbidity, nutrient and *E. coli* concentrations. Dissolved oxygen is also an issue with levels exceeding the trigger value on nine sampling occasions. High algal biomass in the stream during the summer months is the most likely cause of low oxygen levels.

Total phosphorus and dissolved reactive phosphorus only complied one and two times, respectively, through the year. High phosphorus and turbidity levels indicate erosion is occurring in the catchment. Erosion control measures, such as fencing and planting riparian margins, need to be implemented to reduce sediment from entering the waterways.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Mangere River at Knights Road

The Mangere River is a low-lying, sluggish tributary to the Wairua River, which flows through a mostly intensive agricultural catchment. The river begins as the Mangere Stream, which flows east out of the Pukenui forest near Whāngārei. It becomes a river on the flats before joining the Wairoa River just west of Kokopu. For the most part, soft sedimentary rocks make up the underlying geology.

The results from 2008-09 for the Mangere River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	14.3	11 - 20	
Dissolved oxygen (% Sat.)	87.3*	72.6 - 97.1	0
Conductivity (mSm)	16.6	15.7 - 17.5	
Water clarity (m)	1.1	0.56 - 1.78	92
Turbidity (NTU)	7*	4.5 - 18	25
<i>E. coli</i> (n/100mL)	452	185 - 1046	67
Dissolved reactive phosphorus (mg/L)	0.058*	0.005 - 0.143	9
Total phosphorus (mg/L)	0.104*	0.044 - 0.219	0
Ammoniacal nitrogen (mg/L)	0.045*	0.005 - 0.18	33
Total nitrogen (mg/L)	0.927*	0.617 - 2.042	0
pH	7.2*	6.6 - 7.4	50

Results from 2008-09 indicate that nutrient, turbidity and bacterial levels are often elevated in the Mangere River. Both total phosphorus and total nitrogen failed to meet their trigger values on all sampling occasions. Turbidity compliance is similar to the previous year with only three samples meeting the lowland river trigger value of <5.6 NTU. Like many RWQMN sites, dissolved oxygen levels are consistently below the trigger range.

On a positive note, *E. coli* levels are significantly lower than previous years with 67% of the samples complying with the trigger value, compared to only 17% last year. This is probably due to work been done in the catchment to reduce point source discharges from dairy farms.

Long term trend analysis for this site indicates some positive trends. These include decreasing ammoniacal nitrogen, nitrate/nitrite nitrogen, total nitrogen and total phosphorus and increasing water clarity. Again, reducing point source discharges and stream fencing has contributed to these trends.

Manganui River at Mitaitai Road

The Manganui is a major tributary into the Wairoa River, flowing from the western fringes of the Marertu forest to join the Wairoa just east of Dargaville. The river runs through extremely low gradient, predominantly pastoral land, with some exotic forestry blocks scattered through the catchment. The underlying geology at the site is soft sediments.

The results from 2008-09 for the Manganui River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	16.2	11.6 - 23.9	
Dissolved oxygen (% Sat.)	81.7*	57.8 - 118.1	8
Conductivity (mSm)	20.2	17.2 - 22.8	
Water clarity (m)	0.81	0.54 - 1.58	92
Turbidity (NTU)	13.1*	6.2 - 21	0
<i>E. coli</i> (n/100mL)	74	20 - 669	92
Dissolved reactive phosphorus (mg/L)	0.039*	0.005 - 0.073	9
Total phosphorus (mg/L)	0.083*	0.036 - 0.144	0
Ammoniacal nitrogen (mg/L)	0.02	0.005 - 0.05	58
Total nitrogen (mg/L)	0.708*	0.348 - 1.197	42
pH	7.4	6.9 - 8.5	67

This year's results indicate that the water quality in the Manganui River has been heavily impacted by surrounding land use. High levels of all nutrients, in particular dissolved reactive and total phosphorus, indicate that agricultural run-off is the source of contamination in the Manganui catchment.

Elevated levels of phosphorus are usually a sign that fertiliser, which has been applied to land, is not being absorbed by the soil but is being washing off the land during rainfall events and entering waterways. Another possible source of phosphorus is soil erosion in the riparian management zone. Better riparian management and more efficient fertiliser application would reduce the amount of phosphorus in waterways.

The median for *E. coli* was significantly lower this year compared with the previous year, 74 and 833, respectively.

Trend analysis on eight years of data for this site shows that there are no significant trends in any of the parameters.

Awanui River at Waihue Channel

This site is the lowest of three sites on the Awanui River system and is located directly downstream of the discharge from the Kaitāia oxidation ponds and upstream of the Waihue Channel. At this point, the Awanui River has flowed through more than 30km of agricultural land and the Kaitāia Township. The '*River Environment Classification*' identifies this site as a low elevation river with soft sediment geology and pastoral land use.

The results from 2008-09 for the Awanui River site at Waihue Channel are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	15.8	11.6 - 22.8	
Dissolved oxygen (% Sat.)	77.1	55.3 - 88.3	0
Conductivity (mSm)	20.3	15.5 - 23.1	
Water clarity (m)	0.6	0.4 - 0.8	58
Turbidity (NTU)	12.9	5. - 50	8
<i>E. coli</i> (n/100mL)	271	122 - 1317	75
Dissolved reactive phosphorus (mg/L)	0.037	0.02 - 0.059	0
Total phosphorus (mg/L)	0.083	0.045 - 0.156	0
Ammoniacal nitrogen (mg/L)	0.04	0.005 - 0.37	42
Total nitrogen (mg/L)	0.46	0.173 - 1.172	67
pH	7.6	7.1 - 8	67

The results from 2008-09 indicate that water quality at this site on the Awanui River is severely impacted. The medians for dissolved oxygen (% saturation), water clarity, turbidity, total nitrogen, and dissolved reactive and total phosphorus did not meet their respective guidelines.

Consistently high phosphorus levels at this site are of particular concern. The source of this phosphorus is likely to be run-off from pastoral land use within the catchment but the Kaitāia oxidation pond discharge directly upstream could also be a source.

Long term trend analysis at this site indicates that turbidity, dissolved reactive phosphorus, total phosphorus and ammoniacal nitrogen are all declining. However, there is a significant increasing trend in conductivity.

Ruakaka River at Flyger Road

The Ruakaka River catchment is relatively small and runs east from Ruakaka forest to Bream Bay. The catchment is dominated by pastoral land with areas of the upper catchment native bush. The underlying geology at the site is mainly soft sediments.

The results from 2008-09 for the Ruakaka River are summarised in the table below. These include the median, range and percentage of sampling occasions that complied with the relevant guidelines. An asterisk in the table below denotes a median value outside the recommended guideline.

Parameter	Median	Range	% comply with guideline
Temperature (deg. cel.)	13.9	11 - 19.1	
Dissolved oxygen (% Sat.)	83.8*	71.2 - 88.7	0
Conductivity (mSm)	21.8	19.5 - 23.5	
Water clarity (m)	0.5	0.37 - 0.78	17
Turbidity (NTU)	24*	14 - 29	0
<i>E. coli</i> (n/100mL)	341	148 - 1539	83
Dissolved reactive phosphorus (mg/L)	0.09*	0.056 - 0.123	0
Total phosphorus (mg/L)	0.162*	0.116 - 0.216	0
Ammoniacal nitrogen (mg/L)	0.04*	0.02 - 0.2	25
Total nitrogen (mg/L)	0.912*	0.622 - 1.828	0
pH	7.3	6.9 - 7.5	75

This year the Ruakaka River has been ranked as the worse river in the network as it is a highly impacted river, with poor water clarity and high nutrient levels. Results from 2008-09 indicate that dissolved oxygen (%), turbidity, water clarity, nitrogen and phosphorus levels are above their recommended guideline values on most sampling occasions.

Trend analysis cannot yet be undertaken for this site as there is insufficient data.

Trends in Water Quality

Long-term trend analysis was carried out using a Seasonal Kendall test, which eliminates any seasonal influence on the results. The table below shows water quality trends for 18 of the RWQMN sites that have five or more year's data. The start of the dataset for trend analysis for each site is shown in brackets under the site name. The end date for the four NIWA sites is December 2008.

Only significant trends are shown. Significant trends are those with at least a 95% confidence level i.e. 95% likelihood that the trend is "real". It must be highlighted that 5 years data is a minimum for carrying out long term trend analysis and that these trends are likely to change as more data becomes available.

In the table below, an 'up' arrow indicates an increasing trend, a 'down' arrow indicates a decreasing trend; a green arrow indicates a positive trend and a red arrow indicates a negative trend. A blue arrow has been used where it is not yet known if the trend is positive or negative.

There were no significant trends at a 95% confidence level for conductivity, *E. coli* and temperature at any of the sites. Many of the sites could not have trend analysis done for ammoniacal nitrogen, as too many results were found to be below detection limits. These are shown as NA in the table below. Some sites had insufficient data for certain parameters to carry out trend analysis. These are shown as ID in the table.

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Site	Cond	DO%	Ecoli	pH	Clarity	Turb	Temp	TKN	NH4	NNN	TN	DRP	TP
Awanui Waihue channel (Oct 1996)					↓				NA			↓	↓
Awanui FNDC take (Oct 1996)									NA			↓	↓
Kaihu (Jul 2002)					↑								
Mangahahu (Oct 1996)									NA	↑		↓	↓
Mangakahia Titoki bridge (Oct 1996)			ID						↓	↓			↓
Mangakahia Twin Bridges (Oct 1996)									NA			NA	↓
Manganui (Aug 2001)													
Mangere (Oct 1996)					↑				↓	↓	↓		↓
Opouteke (Oct 1996)									NA	↓		NA	↓
Punakitere (Aug 2001)					↑				NA		↓		↓
Victoria (Oct 1996)		↑			↓				NA			↓	↓
Waiotu (March 2000)									NA	↓			
Waipapa (Oct 1996)			ID		↑				↓	↓			↓
Waipoua (Jul 2002)												NA	NA
Wairua (Oct 1996)			ID	↑					↓	↓	↓		
Waitangi Waimate North (Aug 1999)								↑	NA	↑	↑	↓	NA
Waitangi Watea (Oct 1996)			ID					↑					
Whakapara (Oct 1996)								↑		↓		↓	↓

Conductivity

Conductivity (COND) is a measure of the amount of ions in the water column and can be used as an indicator of nutrient enrichment. There were no significant trends detected at any of the sites this year.

Dissolved Oxygen

There is an increasing trend in dissolved oxygen (%) at Victoria River. This increasing trend is likely to be a positive one as dissolved oxygen levels are often outside the recommended range for aquatic life.

Water Clarity

Trend analysis indicates that water clarity has increased (improved) at four sites; Kaihu River, Mangere River, Punakitere River and Waipapa River. The improvement in water clarity at these sites could be a result of increased riparian planting or better land management in the surrounding catchments, which would both result in decreased run-off entering rivers and streams. An improvement in the quality of point-source discharges in these catchments may also be a factor.

Water clarity at the Awanui River at Waihue channel and Victoria River has a decreasing trend which may be due to land use changes in the catchment.

Bacterial Contamination

No sites have a significant trend in bacterial levels (*E. coli*). This is an improvement as historically, the Mangere River had an increasing (negative) trend in *E. coli*.

Nutrients

In general, nutrient levels are showing decreasing trends at the majority of sites, including decreasing dissolved reactive phosphorus, ammoniacal nitrogen, nitrite/nitrate nitrogen and, in turn, total nitrogen and phosphorus. This could be as a result of improving farm management practices throughout the region, including increased stock exclusion from waterways, riparian planting and better fertiliser application. It also could be as a result of better quality point source discharges, for example, discharges of farm dairy effluent or those from oxidation ponds. However, many of the sites with decreasing trends still have very high nutrient levels and there is therefore still a long way to go before desirable levels are met.

Nutrient levels are of concern in the Waitangi River at Waimate North as nitrogen levels are increasing. This could be as a result of land movement activity in the catchment.

pH

Only one site, the Wairua River, had a significant increasing trend this year. This trend is beneficial as pH is generally below the optimum range of 7.2 to 7.8 for aquatic life. An increase in pH should therefore be of benefit to aquatic ecosystems.

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