WAITANGI CATCHMENT

WATER QUALITY UPDATE

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Contents

1 Current monitoring in the catchment 1
2 River ecosystem and water quality 3
2.1 Long term water quality results and trends 3
2.2 National water quality standards and guidelines 6
2.3 Water quality results 7
2.3.1 Nutrient levels 8
2.3.2 Periphyton community 11
2.3.3 Water clarity 12
2.3.4 Faecal pathogens – Escherichia coli *(E. coli)* 13
2.3.5 Swimming water quality monitoring 14
2.3.6 Dissolved oxygen 15
2.3.7 Invertebrate community health 16
2.3.8 Stream habitat quality 18
2.3.9 NOF results 2012 to 2014 19
3 Water quality summary 20
4 References 23
5 Abbreviations 23
6 Appendix 24

Figures

Figure 1: Waitangi catchment RWQMN and WNW water quality monitoring sites. 2
Figure 2: Current water quality state at the Waitangi at Waimate North Road RWQMN site.. 4
Figure 3: Current water quality state at the Waitangi at Wakelins NIWA site 5
Figure 4: Box and whisker plot description. 7
Figure 6: Ammoniacal nitrogen toxicity (July 2014 to June 2015) 8
Figure 7: Nitrate nitrogen toxicity (July 2014 to June 2015) 9
Figure 8: Dissolved reactive phosphorus (July 2014 to June 2015) 10
Figure 9: Chlorophyll a (July 2014 to June 2015) 11
Figure 10: Turbidity (July 2014 to June 2015) 12
Figure 11: Annual *E. coli* levels (logarithmic scale) (July 2014 to June 2015) 13
Figure 12: Swimming water quality sites 15
Figure 5: Dissolved oxygen (July 2014 to June 2015) 16
Figure 13: Macroinvertebrate Community Index (MCI) results, summer 2014/15. 17
Figure 14: Rapid habitat assessment results as a percentage of reference condition 18
Figure 15: Bank and channel erosion at the Waitangi at Wakelins site 19
Figure 16: Erosion occurring at Waitangi River sites 21
Figure 17: Waiaruhe D/S Mangamutu confluence 24
Figure 18: Pekapeka at Ohaeawai 24
Figure 19: Watercress at SH1 25
Figure 20: Mania at SH10 25
Figure 21: Waiaruhe at Puketona. 26

Figure 22: Waipapa at Waimate North Road 26
Figure 23: Waitangi at Waimate North Road 27
Figure 24: Waitangi at SH10 27
Figure 25: Waitangi at Wakelins 28

Tables

Table 1: Waitangi catchment water quality monitoring sites 2
Table 2: National Objectives Framework attributes and grades 6
Table 3: National guideline values for the protection of aquatic ecosystems. 7
Table 4: Microbial source tracking results for four sites in the Waitangi catchment. 14
Table 5: Macroinvertebrate Community Index (MCI) scoring system 17
Table 6: NOF grades from 2012 to 2014 at the two RWQMN sites 19
Table 7: Water quality summary (July 2014 to June 2015) 20

1 Current monitoring in the catchment

The following environmental monitoring is currently conducted by Northland Regional Council in the Waitangi catchment:

- **River Water Quality Monitoring Network (RWQMN)** established in 1996. Thirty six river sites throughout Northland encompassing 22 river catchments are monitored monthly for a range of parameters, including temperature, dissolved oxygen, pH, water clarity, nutrients and bacterial levels. This monitoring includes two sites on the Waitangi River located at Waimate North Road, and downstream at Wakelins above Haruru Falls. The Wakelins site has been sampled since 1989, and the Waimate site since 2002. Annual and five yearly reports are available here:

  http://www.nrc.govt.nz/Resource-Library-Summary/Environmental-Monitoring/State-of-the-Environment-Monitoring/

- **Waiora Northland Water (WNW)** water quality sites established in July 2014 consisting of 29 sites distributed between the Whangarei Harbour, Mangere, Waitangi and Doubtless Bay priority catchments and bringing the total number of sites monitored in Northland to 66. In total nine sites are currently monitored in the Waitangi catchment spread between the five main sub-catchments; Upper Waitangi, Lower Waitangi, Waiaruhe, Puketōtara (Watercress) and Mania and including the two RWQMN sites (Figure 1).

- **Stream invertebrate (macroinvertebrate) monitoring** at RWQMN sites since 1997. Every site in the network is monitored once a year in summer. Monitoring at both RWQMN sites in the Waitangi catchment was initiated in 2008 and WNW sites were monitored for the first time in 2015. Annual reports are available here:

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

- **Stream habitat assessments** at RWQMN sites since 2004. Historically assessments were carried out every second year. The Waitangi River sites have been assessed in 2008, 2010 and 2012. Since 2014 habitat assessments are undertaken annually alongside the macroinvertebrate monitoring programme. Reports are available here:

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

- **Hydrological monitoring.** There are automatic telemetered water level recorders in the Waitangi River at both the Waimate North Road and the Wakelins site. As well as specific monitoring programmes some ad-hoc monitoring has also been carried out to check compliance with resource consent conditions and investigate environmental incidents.

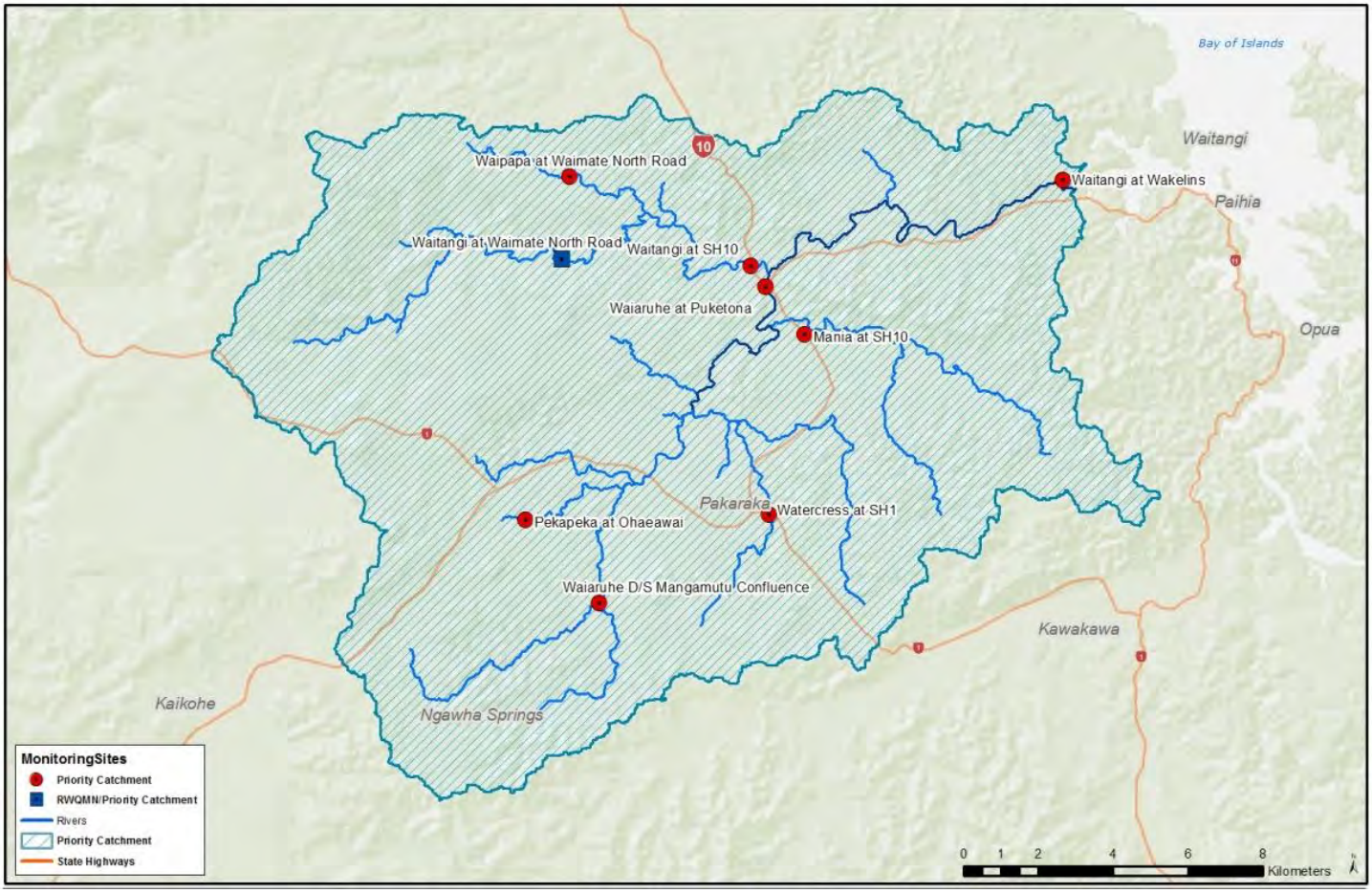

Figure 1: Waitangi catchment RWQMN and WNW water quality monitoring sites.

Table 1: Waitangi catchment water quality monitoring sites.

Site name	Easting	Northing
Waiaruhe D/S Mangamutu confluence	1682883	6084542
Pekapeka at Ohaeawai	1680862	6086779
Watercress at SH1	1687416	6086899
Mania at SH10	1688382	6091733
Waiaruhe at Puketona	1687317	6093001
Waipapa at Waimate North Road	1682092	6095939
Waitangi at Waimate North Road	1681894	6093741
Waitangi at SH10	1686946	6093563
Waitangi at Wakelins	1695269	6095708

Photos of sampling sites are presented in the Appendix.

2 River ecosystem and water quality

The ecological health, or integrity, of river ecosystems are related to a number of environmental factors including, but not limited to, the availability of suitable habitat types (e.g. diverse range of substrate sizes, aquatic plants, large woody debris and varied flow types), food and light availability, disturbance and water quality. It is important to note that the relationship between ecosystem health and environmental factors is often very complex and unpredictable.

Ecological health in rivers and streams is dependent on water quality parameters such as, in no particular order, temperature and dissolved oxygen, clarity, nutrients, suspended solids and faecal pathogens. Faecal pathogens are not known to affect aquatic ecosystems, but affect the suitability of a water body for swimming and stock drinking water. Biological monitoring information such as invertebrates, periphyton, habitat assessments and fish, can be used to help determine influences of water quality on river ecosystems, however as mentioned above causal effects are not always clear. Current national standards and guidelines outlined below are used to facilitate inter-site comparisons of the state of water quality in the region's rivers and streams.

2.1 Long term water quality results and trends

Currently the only sites with long term water quality data in the Waitangi catchment are the Waitangi at Waimate North Road, and the Waitangi at Wakelins which is a site monitored by the National Institute of Water and Atmospheric research (NIWA). These sites have been monitored since 2002 and 1989 respectively. Land Air Water Aotearoa (LAWA)[1], a website which brings together water quality data from regional councils throughout New Zealand, currently provides results for *E. coli*, turbidity, and nutrients, i.e. nitrogen and phosphorus, rank amongst the worst 50 percent of similar sites in New Zealand (Figure 2 and Figure 3). *E. coli* levels in the Waitangi at Waimate North site are amongst the worst 25 percent.

Trend analyses for the past ten years indicate meaningful degradation in turbidity levels at both sites but meaningful improvement in total nitrogen at the Wakelins site. However, when the time period for analysis is reduced to the last five years (not shown) results indicate a levelling off with no meaningful trends at either site apart from a meaningful improvement in *E. coli* levels at the Wakelins site.

The addition of seven monitoring sites within the catchment will help identify problematic areas/sub-catchments for targeted water quality improvement management in the Waitangi. Although there is only just over a year of data this report outlines preliminary results and compares them to appropriate national bench marks/standards for this purpose.

[1] For more information visit: http://www.lawa.org.nz/explore-data/northland-region/

Figure 2: Current water quality state at the Waitangi at Waimate North Road RWQMN site compared to similar sites in New Zealand with 10 year trends for nine water quality parameters (excerpt from Land Air Water Aotearoa (LAWA) website).

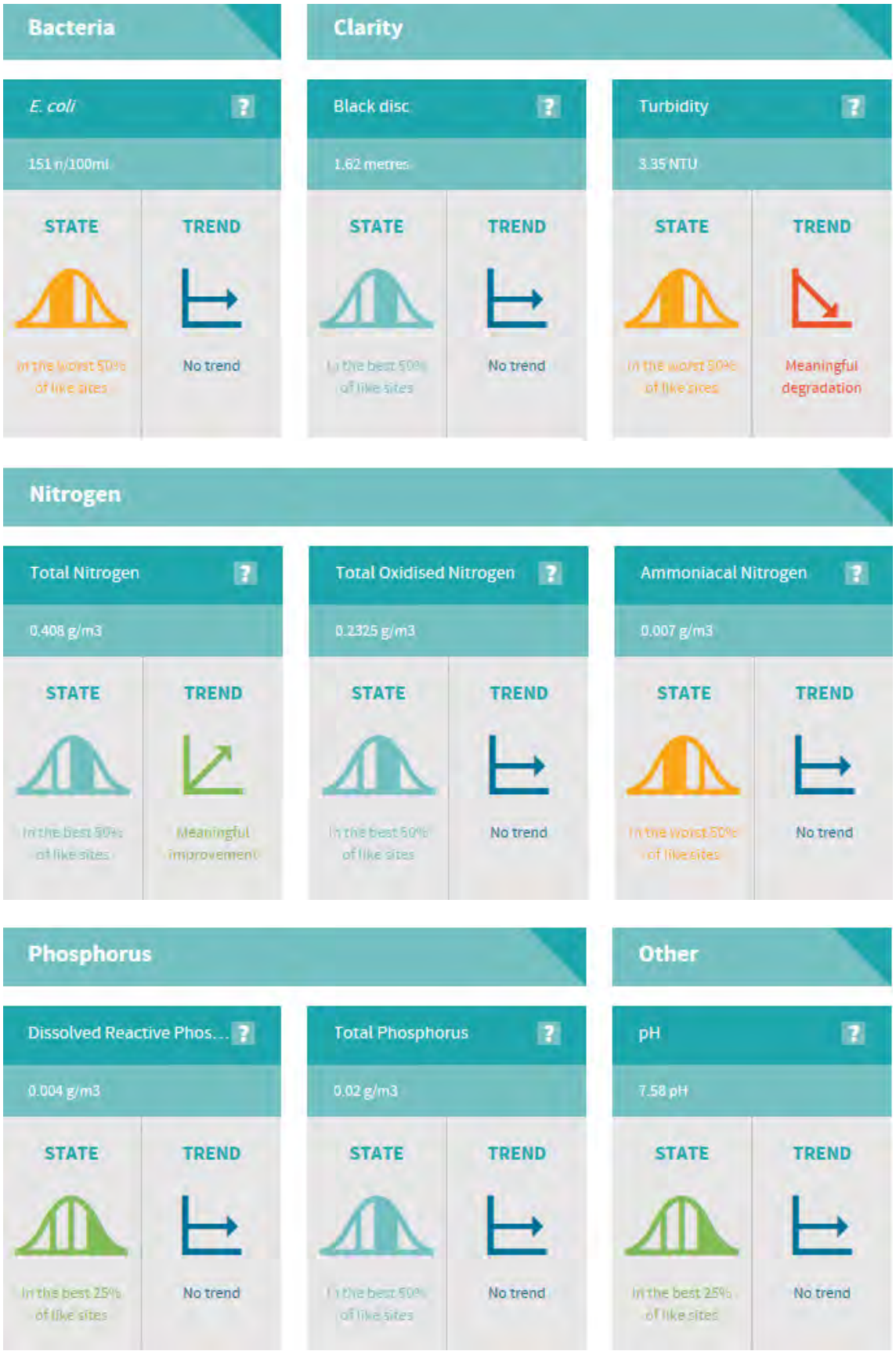

Figure 3: Current water quality state at the Waitangi at Wakelins NIWA site compared to similar sites in New Zealand with 10 year trends for nine water quality parameters (excerpt from Land Air Water Aotearoa (LAWA) website).

2.2 National water quality standards and guidelines

The National Policy Statement for Freshwater Management (NPS-FM) was introduced by the Government in 2011 as part of the first phase of freshwater reforms. It was updated in 2014 with a National Objectives Framework (NOF) and includes targets to provide direction to Regional Councils around maintaining and improving water quality. It includes a number of grades as well as 'national bottom lines' (Table 2) – thresholds of water quality attributes that good management should prevent our waterways from reaching in a consistent way across the country. Councils are obliged to maintain or improve water quality within their regions. They cannot simply let conditions degrade down to the bottom line. The NOF water quality grades provide a reporting framework to assess water quality. The bottom line is the point separating a C from a failing D grade.

Table 2: National Objectives Framework attributes and grades.

Attributes		National Objectives Framework grades			
		A	B	C	D
Ammoniacal nitrogen toxicity (mg/L)	annual median	≤0.03	>0.03 and ≤0.24	>0.24 and ≤1.30	>1.30
	annual maximum	≤0.05	>0.05 and ≤0.40	>0.40 and ≤2.20	>2.20
Nitrate nitrogen toxicity (mg/L)	annual median	≤1	>1and ≤2.4	>2.4 and ≤6.9	>6.9
	annual 95th percentile	≤1.5	>1.5 and ≤3.5	>3.5 and ≤9.8	>9.8
E. coli/100mL	annual median (2nd contact recreation)	≤260	>260 and ≤540	>540 and ≤1000	>1000
Periphyton chlorophyll-a (mg/m^2)	exceeds no more than 8% samples over 3 years	≤50	>50 and ≤120	>120 and ≤200	>200

Key

A	Similar to reference conditions
B	Slightly impacted
C	Moderately impacted (lower/upper limit national bottom line)
National bottom line	
D	Degraded/unacceptable (must be managed to C or better)

The NOF is still under development with a number of additional attributes to be added in the near future. In the interim other water quality parameters not currently covered by the NOF are assessed against relevant trigger/guideline values (Table 3). These values differ from the NOF in that they are not national standards and therefore do not entail statutory obligations, but instead provide conservative numbers for physical and chemical measurements in rivers above or below which aquatic ecosystems may be exposed to stress. In this report annual medians are compared to the trigger/guideline values (Table 3).

There are two major rivers within the Waitangi catchment: the Waitangi and the Waiaruhe (which is a major tributary of the Waitangi River). Historically only two sites on the Waitangi River have been monitored monthly as part of the region wide River Water Quality Monitoring Network:

- the Waitangi at Waimate North Road located upstream of the Waiaruhe confluence,
- and the Waitangi at Wakelins located downstream of the confluence.

Since July 2014 seven additional sites have been monitored (Figure 1).

Table 3: National guideline values for the protection of aquatic ecosystems.

Identifier	Abbreviation	Reference	Trigger/guideline value
Dissolved Oxygen	DO	RMA 1991 Third Schedule	≥80% saturation
Dissolved Reactive Phosphorus	DRP	ANZECC (2000)	≤0.010mg/L
Turbidity	TURB	ANZECC (2000)	≤5.6NTU

2.3 Water quality results

The following section describes water quality in the Waitangi catchment using box and whisker plots to graphically display the distribution of water quality data based on a five value summary: the minimum value, first quartile, median, third quartile, and maximum. The central rectangle spans the first quartile to the third quartile (the *interquartile range* or *IQR*) covering the middle 50% of data. A segment inside the rectangle shows the median and "whiskers" above and below the box show the minimum and maximum values or the 95th percentile values depending on the parameter being measured.

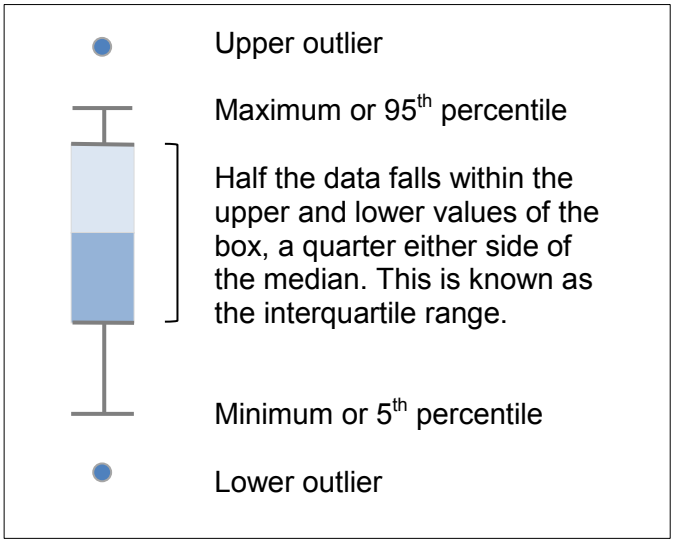

Figure 4: Box and whisker plot description.

Just over a year of water quality data has now been collected at seven new sites in the Waitangi priority catchment since sampling began in July 2014. This adds to data already collected at the two long-term RWQMN sampling sites. It is very difficult to accurately interpret water quality data without several years of data to smooth out the impacts of weather patterns, climatic conditions, seasonal variation, etc. However, current results from July 2014 to June 2015 indicate that the main water quality issues in the Waitangi catchment may include elevated phosphate levels and high sediment/turbidity loads. Note: results for the Waitangi at Waimate North Road and Waitangi at Wakelins sites only include data for the same time period to provide consistency.

2.3.1 Nutrient levels

Nitrogen and phosphorus are the two main nutrients required by algae, plants and animals for metabolism and growth. Nitrogen and phosphorus naturally occur in water as a result of natural processes, such as the erosion of soil, atmospheric deposition, and the breakdown of organic matter. Nitrogen is highly soluble and can leach through soil, whereas phosphorus usually enters water in direct discharges or associated with sediment. Whilst nutrients are necessary for sustaining life, high levels of nitrogen and phosphorus can cause excessive growth of aquatic plants and algae, and reduce overall water quality.

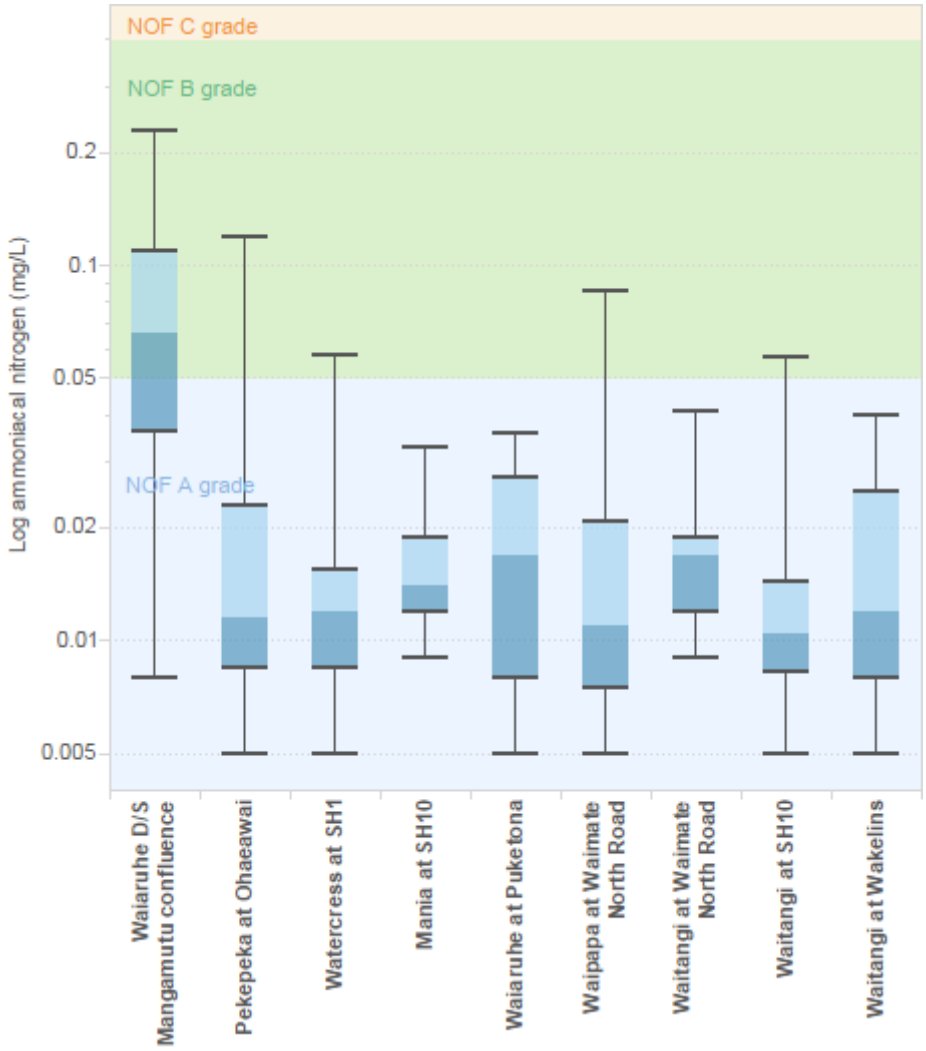

Figure 5: Ammoniacal nitrogen toxicity (July 2014 to June 2015) with annual maximum NOF grades.

Toxicity levels for ammoniacal nitrogen and nitrate nitrogen are reasonably low in the Waitangi catchment. Maximum levels for ammoniacal nitrogen toxicity fall into the NOF A or B grades for all sites (Figure 5). Nitrate nitrogen toxicity levels all fall within the A NOF grade (Figure 6).

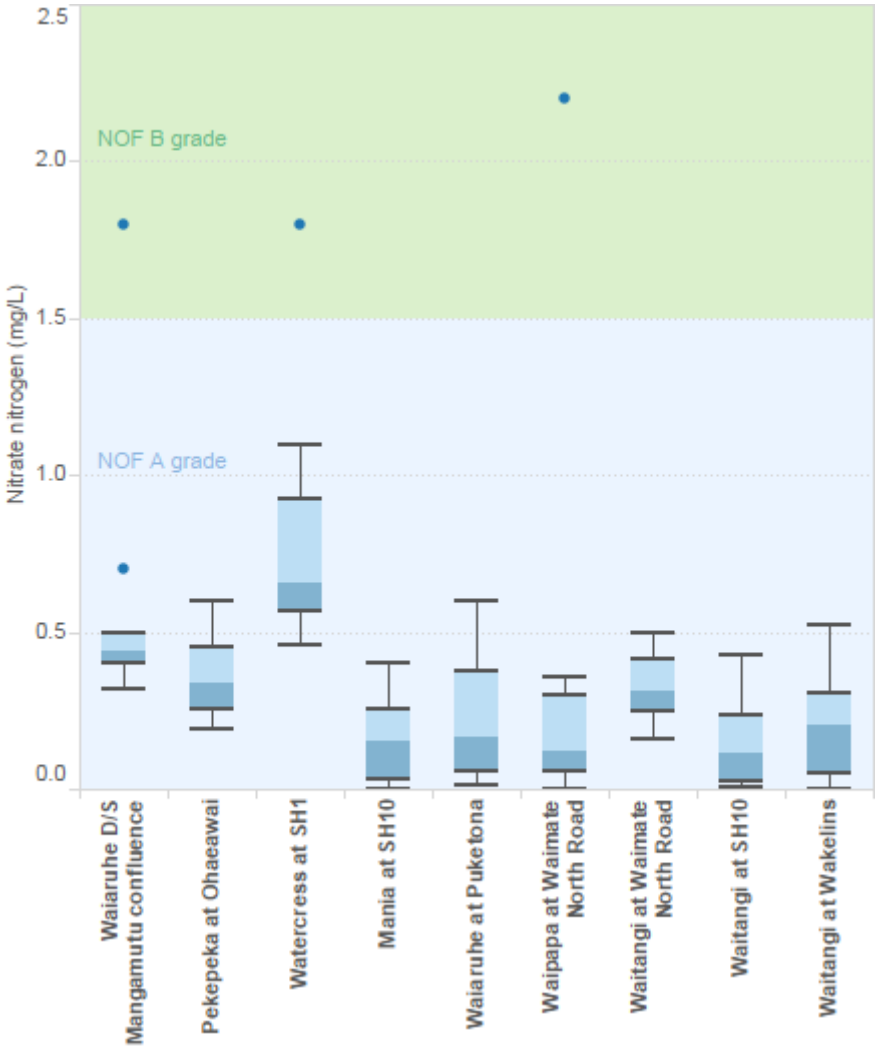

Figure 6: Nitrate nitrogen toxicity (July 2014 to June 2015) with 95th percentile NOF grades.

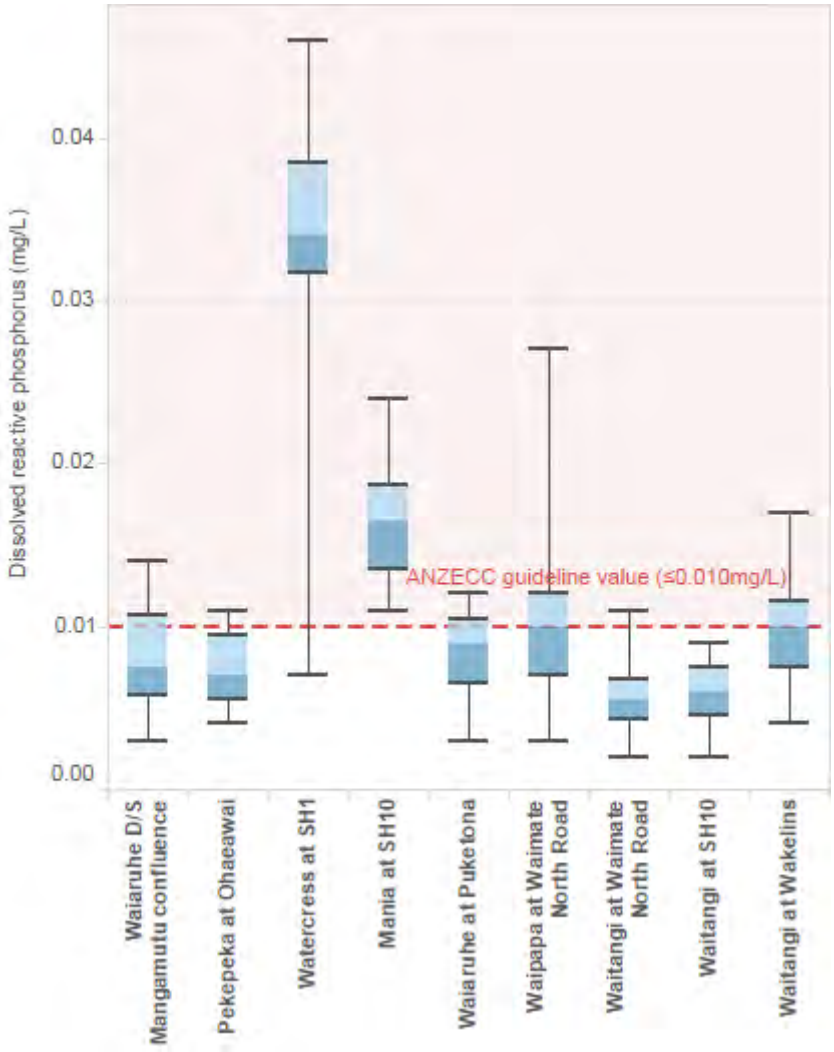

Figure 7: Dissolved reactive phosphorus (July 2014 to June 2015) with ANZECC guideline value.

There is currently no guideline for dissolved reactive phosphorous in the NOF. However, at two sites: Mania at SH10 and Watercress at SH1 median levels are elevated and well above ANZECC guideline value for lowland rivers (0.01mg/L) (Figure 7).

2.3.2 Periphyton community

Periphyton is the slime and algae community growing on river and stream beds. As the primary producer in stream ecosystems, it is an important indicator of ecosystem health. It has the ability to respond quickly to changes in water quality and form excessive growths under ideal conditions, affecting instream values, such as biodiversity and recreational use.

Chlorophyll a (Chl a) level is used as a measure of periphyton biomass in the NOF. The main drivers for periphyton growth include light and nutrient levels. However, periphyton growth normally requires a stable substrate such as rocks and cobbles to become established, and many streams in Northland have a substrate of mainly fine sediment which is easily disturbed making it difficult for periphyton to become established. Seven of the nine Waitangi sites have a stony substrate suitable for sampling and are monitored monthly for periphyton cover and Chl a levels. Sites without a stony substrate are the Waitangi at Wakelins and the Mania at SH10 and are therefore not sampled.

The NOF guidelines recommend at least three years of data to complete and interpret periphyton results. One year of data currently available suggest that three sites may be prone to periphyton blooms and fail the national bottom line of a maximum value of 200mg Ch a/m^2: Pekapeka at Oheawai, Waiaruhe D/S Mangamutu confluence and Watercress at SH1 (Figure 8).

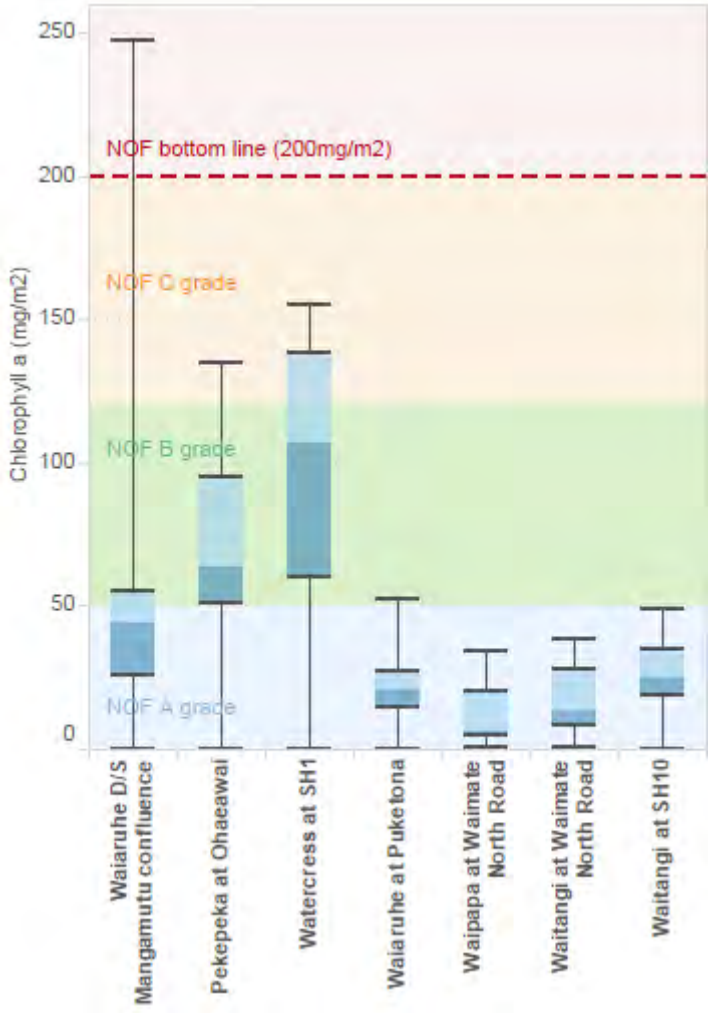

Figure 8: Chlorophyll a (July 2014 to June 2015) with corresponding NOF grades.

2.3.3 Water clarity

Good water clarity is important for light availability for periphyton growth. Clear water is also important for visual feeding by fish and invertebrates. Water clarity is influenced by a number of factors including suspended sediment and algal biomass. Suspended sediments are typically elevated following large rainfall events, causing low water clarity and high turbidity. Turbidity is one measure of water clarity.

Currently there is no measure for turbidity in the NOF. However, median turbidity levels from July 2014 to June 2015 met ANZECC guideline value for lowland rivers (5.6NTU) at all sites (Figure 9).

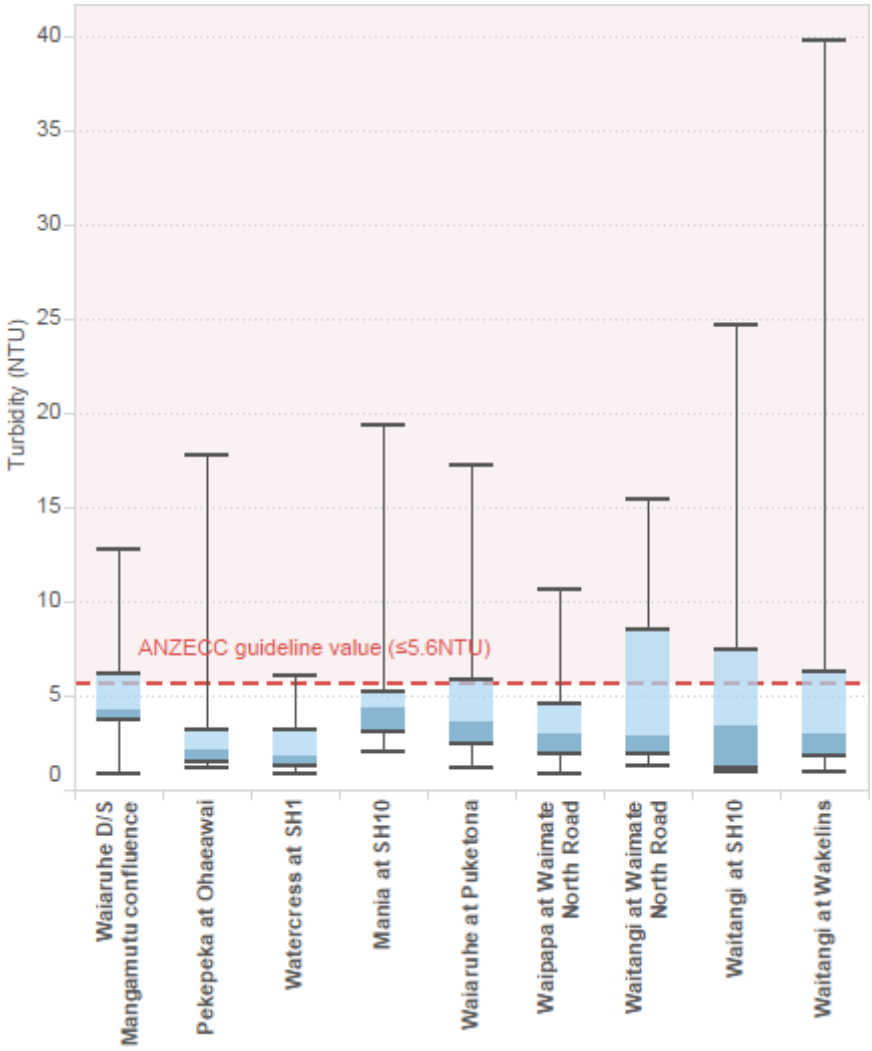

Figure 9: Turbidity (July 2014 to June 2015) with ANZECC guideline value.

However some samples were high, well above the guideline value, particularly in the Waitangi catchment. The Waitangi at Waimate North Road recorded the most extreme levels which could be associated with serious erosion issues in its tributary, as well as bank erosion at the site (Figure 15).

2.3.4 Faecal pathogens – Escherichia coli *(E. coli)*

Although faecal pathogens are not known to affect aquatic ecosystems they are of concern for both human and animal health. The faecal indicator bacteria *E. coli* indicates contamination from faecal matter which can potentially contain harmful pathogens. *E. coli* levels recorded in the Waitangi catchment predominantly fall into the NOF A grade for secondary contact recreation with median *E. coli* levels below 1000 *E. coli*/100mL (Figure 10). However, at times *E. coli* levels can be highly elevated often associated with land run-offs during high rainfall events. It should be noted that natural background *E. coli* levels tend to be slightly higher in warm wet lowland areas such as Northland compared to other river environments in New Zealand (McDowell et. Al., 2013).

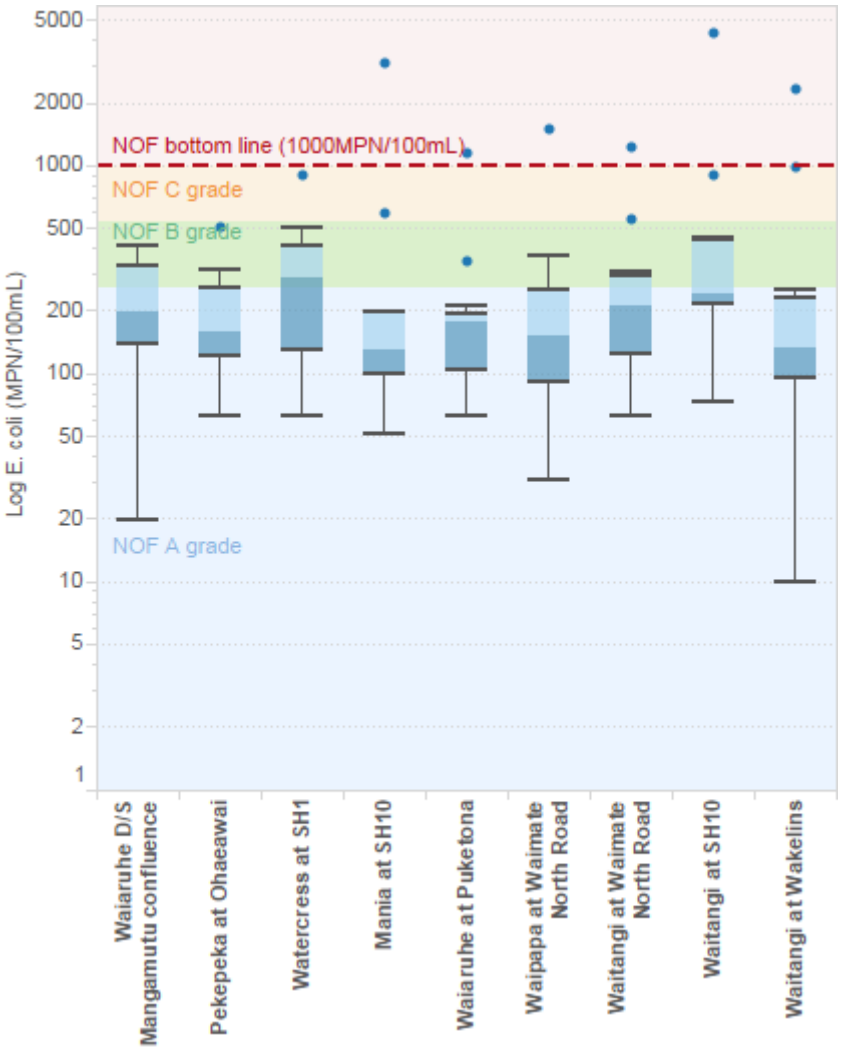

Figure 10: Annual *E. coli* levels (logarithmic scale) (July 2014 to June 2015) with corresponding NOF grades for secondary contact recreation.

Microbial source tracking analyses are also performed on samples collected at four sites in the Waitangi catchment. These analyses are only performed when *E. coli* levels exceed 540 *E. coli*/100mL in a sample. Microbial results indicate that the primary source of contamination in the catchment is ruminant with the Mania, Waiaruhe, Waitangi at Waimate North Road and Waitangi at Wakelins returning positive results for ruminant and some plant markers only. The Waitangi at SH10 results were dominated by ruminant markers on all occasions but wildfowl, dog and weak human markers were also detected (Table 4).

Table 4: Microbial source tracking results for four sites in the Waitangi catchment. Results in bold indicate a strong positive marker.

Site name	Date collected	Results
Mania at SH10	13/08/2014	Ruminant
Mania at SH11	06/11/2014	Ruminant
Waitangi at SH10	06/11/2014	Ruminant
Waitangi at SH10	20/08/2014	Ruminant, Human
Waitangi at SH10	06/05/2015	Ruminant, Wildfowl, Dog
Waitangi at Waimate North Road	16/04/2014	Ruminant
Waitangi at Waimate North Road	20/08/2014	Ruminant
Waitangi at Waimate North Road	15/12/2014	Ruminant
Waitangi at Wakelins	09/12/2013	Weak Ruminant, Plant
Waitangi at Wakelins	30/12/2013	**Ruminant**
Waitangi at Wakelins	20/08/2014	Ruminant
Waitangi at Wakelins	06/11/2014	Ruminant
Waitangi at Wakelins	15/12/2014	Ruminant
Waiaruhe at Puketona	16/04/2014	Ruminant, Plant

2.3.5 Swimming water quality monitoring

Two sites are currently monitored on the Waitangi River as part of the council's Recreational Swimming Water Quality programme[2] (Figure 11). One site located between Puketona and Haruru Falls at Lily Pond was monitored from 2004 to 2011. This site was decommissioned due to safety reasons and replaced in 2012 with the site at Watea (also known as Wakelins and located further downstream). The second site currently monitored is located at the river mouth at Waitangi Bridge.

Between 2004 and 2011, 88 samples were collected during the summer months and complied with the suitability for swimming guidelines for freshwater (*E. coli* ≤550MPN/100mL) 58 percent of the time with a median *E. coli* level of 238MPN/100mL at Lily Pond. Thirty five samples were collected between 2012 and 2015 from the site at Watea. Results complied with the suitability for swimming guidelines 86 percent of the time with a median *E. coli* level of 122MPN/100mL. Between 2004 and 2015, 135 samples were collected and complied with the guideline for marine water (*Enterococci* ≤280MPN/100mL) 92 percent of the time at Waitangi Bridge.

[2] This monitoring programme focuses on health risk therefore only water temperature and bacterial contamination (*E. coli* in freshwater and *Enterococci* in marine water) is measured.

Figure 11: Swimming water quality sites at Lily Pond (top left), Watea (right) and Waitangi Bridge (below).

2.3.6 Dissolved oxygen

Dissolved oxygen is important for freshwater invertebrates and fish, with some species being more sensitive to low oxygen levels than others. Dissolved oxygen levels vary with temperature, biological activity and how quickly it transfers from the atmosphere. Biological activity includes microbial activity by bacteria and primary production by plants and algae and can be associated with the presence of certain pollutants, particularly organic matter such as sewage effluent, decaying aquatic vegetation and animal manures. Aquatic plants photosynthesise during the day (producing oxygen) and respire at night (consuming oxygen). With high macrophytes (aquatic plants) density, occurring at the Mania at SH10 site, there are likely to be large fluctuations in dissolved oxygen levels throughout a 24-hour period compared to rivers such as the Waipapa at Waimate North Road which is faster flowing with a rocky substrate and little or no aquatic plants.

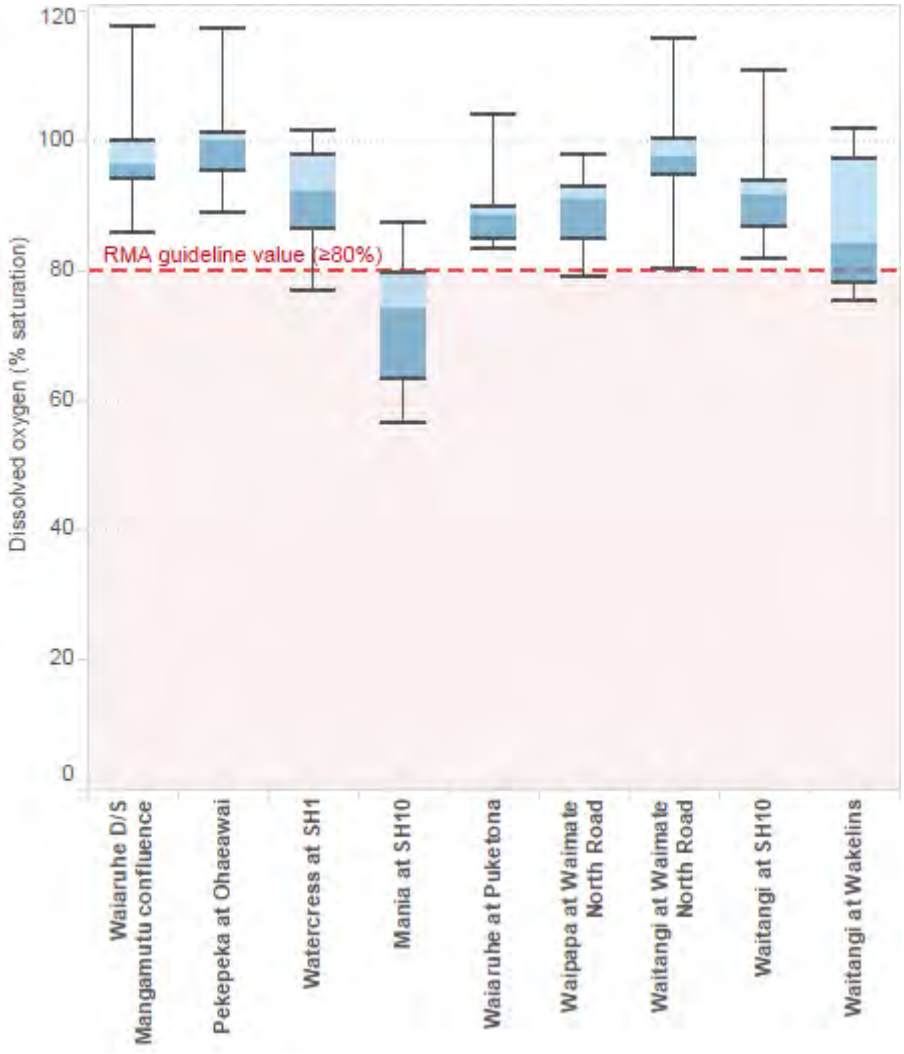

Figure 12: Dissolved oxygen (July 2014 to June 2015) with the RMA 1991 trigger value.

Between 2014 and 2015 results for dissolved oxygen levels for most sites were consistently above the recommended trigger value (Figure 12). At the Waitangi at Wakelins, Waipapa at Waimate North Road and Watercress sites, occasional low levels were recorded below the trigger value of 80 percent saturation. However levels recorded at the Mania at SH10 site were almost always below the recommended trigger value, consistently recording levels potentially harmful to aquatic life with the lowest result of just five percent saturation. These low levels are reflected by the poor macroinvertebrate scores recorded at the site (Figure 13).

2.3.7 Invertebrate community health

Stream invertebrates (macroinvertebrates) are used as biological indicators of water quality and stream health. As they live in the stream environment over an extended period of time they are commonly used as a good indicator of overall water quality and ecosystem health. The Macroinvertebrate Community Index (MCI) is an indicator of organic enrichment and pollution, where taxa are assigned predetermined scores on a scale of 1 to 10 depending on their inherent sensitivity to pollution. The MCI score at a site is based on the taxa present, with the categories in Table 5 used to determine the overall water quality level.

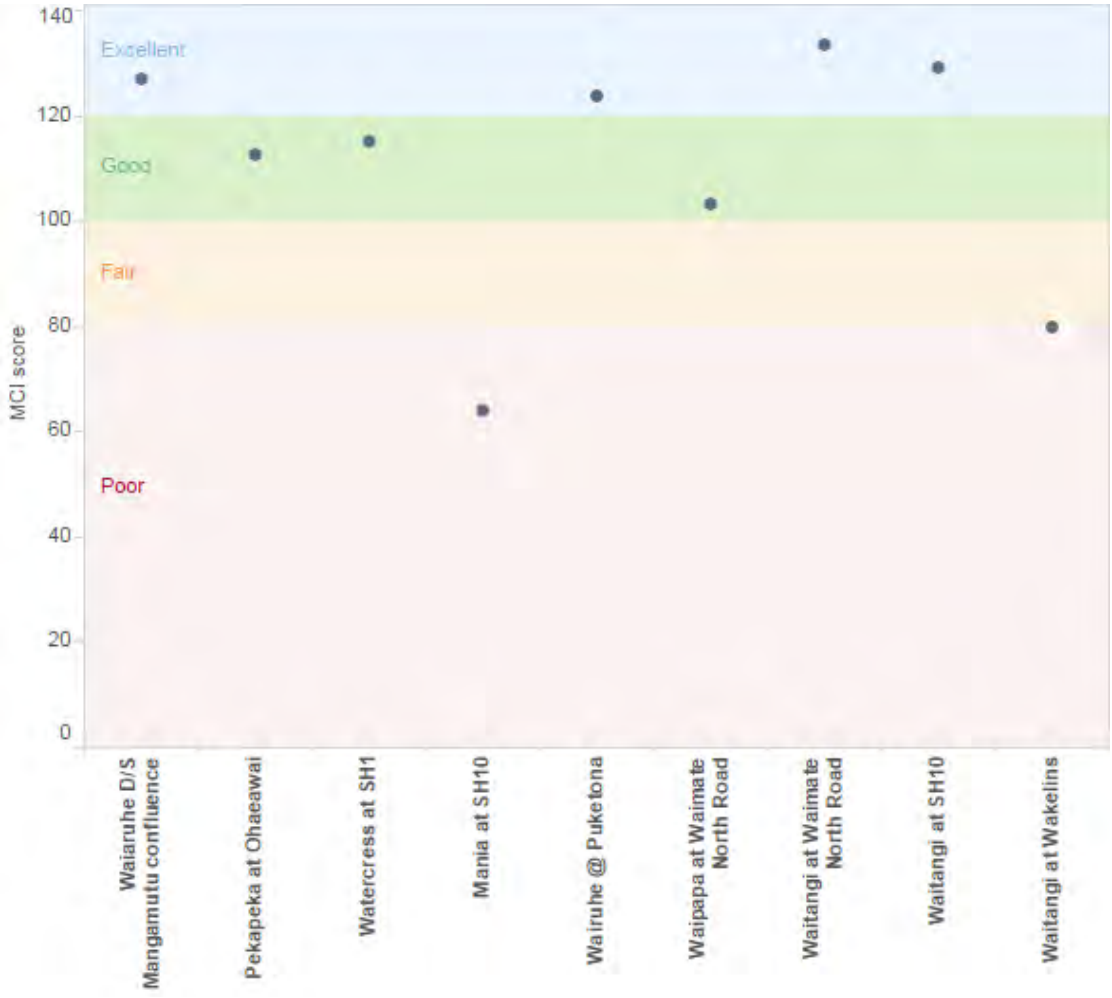

Figure 13: Macroinvertebrate Community Index (MCI) results, summer 2014/15.

Table 5: Macroinvertebrate Community Index (MCI) scoring system (Boothroyd and Stark, 2000).

Category	MCI	Stream/river state
Excellent	> 120	Clean water
Good	100 – 119.9	Possible mild pollution
Fair	80 – 99.9	Probable moderate pollution
Poor	< 80	Probable severe pollution

Results for summer 2014/15 (Figure 13) suggest that:

- most sites (seven out of nine) in the Waitangi catchment scored good or excellent,
- four sites scored excellent,
- three sites scored good, and
- two sites scored fair or poor.
- The sites with the lowest scores were the Mania at SH10 and Waitangi at Wakelins, corresponding to sites with the lowest dissolved oxygen levels (Figure 12).

2.3.8 Stream habitat quality

Where there is a diverse habitat available with a variety of flow types (runs, riffles and pools), instream debris and good quality riparian vegetation, there tends to be high ecological health. Different flow types offer a variety of different habitats, encouraging greater diversity while in stream debris such as logs, branches and leaves provide refuge. Riparian cover stabilises banks, provides a sink for nutrients, traps sediment and provides shade during hot summer months as well as a source of food in the form of falling vegetation and terrestrial invertebrates.

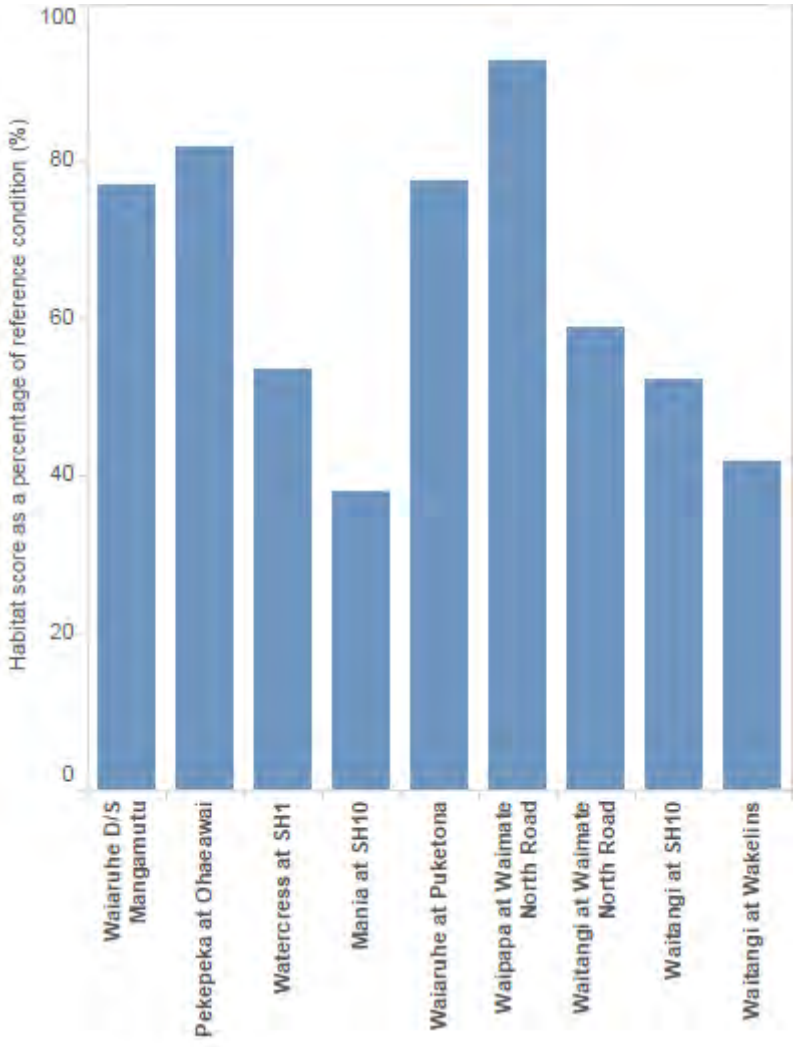

Figure 14: Rapid habitat assessment results shown as a percentage of reference condition (Waipapa at forest ranger), summer 2014/15.

Seven of the nine sites monitored in Waitangi catchment have a habitat score greater than 50 percent of reference condition (the Waipapa at forest ranger in the Puketi Forest was used as the reference site being the closest suitable reference site available). The highest scoring site was the Waipapa at Waimate North Road at 93 percent. All sites in the Waitangi catchment scored less than 60 percent. The two lowest scoring sites were Mania at SH10 and Waitangi at Wakelins with scores of 38 and 42 percent respectively (Figure 14). The surrounding land use at the Mania site is mainly pasture, stock has access to the river, there is little shading and the banks are unstable. The Wakelins site is the lowest site monitored in the Waitangi catchment, receiving water from all five Waitangi sub-catchments and subsequently influenced by a number of upstream impacts and land uses. This site was also

severely impacted by flooding in 2014 (Figure 15). Both sites have uniform flow and have substrates composed of mainly sediment/sand providing little habitat diversity (NRC 2012). These figures are correlated to lowest MCI scores recorded at both sites (Figure 13).

Figure 15: Bank and channel erosion at the Waitangi at Wakelins site before (left) and after (right) the 2014 flooding event.

2.3.9 NOF results 2012 to 2014

NOF grades from 2012 to 2014 at the two RWQMN sites Waitangi at Waimate North Road and Waitangi at Wakelins are presented in Table 6.

Table 6: NOF grades from 2012 to 2014 at the two RWQMN sites in the Waitangi catchment.

Value	Ecosystem health								Human health	
Indicator (unit)	Ammoniacal nitrogen toxicity (mg/L)				Nitrate nitrogen toxicity (mg/L)				Periphyton (Chla mg/m^2)		*E. coli* (*E.coli* /100 mL)	
Site name	1 year median		1 year max		1 year median		1 year 95%ile		3 year max		1 year median (secondary Contact)	
2012												
Waitangi at Waimate North Road	0.016	A	0.029	A	0.350	A	0.494	A	ND	ND	643	C
Waitangi at Wakelins	0.011	A	0.037	A	0.369	A	0.675	A	ND	ND	192	A
2013												
Waitangi at Waimate North Road	0.015	A	0.021	A	0.325	A	0.389	A	ND	ND	371	B
Waitangi at Wakelins	0.008	A	0.035	A	0.469	A	0.981	A	ND	ND	214	A
2014												
Waitangi at Waimate North Road	0.013	A	0.063	B	0.360	A	0.515	A	70.61	B	259.0	A
Waitangi at Wakelins	0.006	A	0.047	A	0.299	A	0.833	A	ND	ND	94.6	A

ND: no data

The Waitangi at Wakelins site has consistently scored the same grades for this period, i.e. A for ammoniacal nitrogen toxicity, nitrate nitrogen toxicity and *E. coli*. The Waitangi at Waimate North Road site consistently scored an A for ammoniacal and nitrate nitrogen toxicity apart from a B result for ammoniacal nitrogen toxicity (one year maximum) in 2014. Conversely *E. coli* results have improved from a C grade in 2012 to an A grade in 2014.

3 Water quality summary

Table 7: Water quality summary (July 2014 to June 2015) for sites in the Waitangi catchment as well as a reference site in the Waipapa River (draining native vegetation) using NOF attributes and other guideline/trigger values.

Water quality monitoring site	National Objective Framework (NOF) attributes				ANZECC guideline value		RMA 1991	Ecological indicators	
	Nitrate nitrogen toxicity (mg/L)	Ammoniacal nitrogen toxicity (mg/L)	Escherichia coli (*E. coli*/100mL)	Periphyton Exceeds no more than 8% of samples (Chl a mg/m^2)	Dissolved reactive phosphorus (mg/L)	Turbidity (NTU)	Dissolved oxygen (% saturation)	Macro-invertebrates	Stream habitat
	95th percentile A ≤1.5 B >1.5 ≤3.5 C >3.5≤9.8 D >9.8	Annual maximum A ≤0.05 B>.05≤0.4 C >0.4≤2.2 D >2.2	Annual median A ≤260 B >260≤540 C >540≤1000 D >1000	Chlorophyll a A ≤50 B >50≤120 C >120≤200 D >200	Annual median <0.01	Annual median <5.6	Annual median ≥80	MCI score (Table 5)	% rating compared with reference site
Waipapa at Forest Ranger	A	A	A	A	Below	Below	Above	135	100
Waiaruhe D/S Mangamutu confluence	A	B	A	D	Below	Below	Above	127	77
Pekepeka at Ohaeawai	A	B	A	C	Below	Below	Above	113	82
Watercress at SH1	A	B	B	C	Above	Below	Above	115	54
Mania at SH10	A	A	A	No data	Above	Below	Below	64	38
Waiaruhe at Puketona	A	A	A	B	Below	Below	Above	124	78
Waipapa at Waimate North Road	A	B	A	A	Below	Below	Above	103	93
Waitangi at Waimate North Road	A	A	A	A	Below	Below	Above	133	59
Waitangi at SH10	A	B	A	A	Below	Below	Above	129	52
Waitangi at Wakelins	A	A	A	No data	Below	Below	Above	80	42

Values in Table 7 are not directly comparable; some refer to national standards while others provide conservative numbers for physical and chemical measures in rivers above or below which aquatic ecosystems may be exposed to stress.

Results for the Waipapa at Forest Ranger, the closest reference site draining almost entirely native vegetation are provided for comparison. The NOF is still under development with a number of additional attributes currently being evaluated. In its current form the NOF does not address all the water quality issues of concern in Northland. For this reason a number of other guidelines, trigger values and ecological indicators have been included to provide a more holistic overview of water quality in the catchment.

- Based on very limited data monitoring results (2014-2015) water quality generally meets most current national standards/guideline values in the Waitangi catchment. However, national comparison (LAWA website) shows results for *E. coli*, turbidity, and nitrogen, rank amongst the worst 50 percent of similar sites in New Zealand (Figure 2 and Figure 3) at the RWQMN sites. *E. coli* levels at the Waitangi at Waimate North Road site are amongst the worst 25 percent.

- All three Waitangi catchment sites, i.e. Waimate North Road, SH10 and Wakelins, exhibit occasional elevated turbidity levels (Figure 9) and spikes in *E. coli* levels (Figure 10) possibly associated with land run-offs during high rainfall events. While this in part may be linked to erosion issues occurring in its tributary, the Whangai Stream, all three sites have serious issues with slumping banks (Figure 15). Data at both RWQMN sites, i.e. Waitangi at Waimate North Road and Waitangi at Wakelins, also suggests turbidity levels have deteriorated over the past 10 years. These sites also recorded poor habitat scores of 60 percent or less of reference condition (Figure 14).

Figure 16: Erosion occurring at Waitangi River sites. From upstream to downstream order down the catchment: Waimate North Road site (top left), SH10 site (top right), Wakelins site (bottom).

- The Mania Stream is a low energy meandering stream and has a number of water quality and ecological issues including elevated dissolved reactive phosphorus levels (Figure 7), low dissolved oxygen levels (Figure 12), poor habitat quality (Figure 14) and the lowest MCI score of 61 (Figure 13) in the Waitangi catchment.

- Although within NOF guideline levels for toxicity, the three sites with the highest nitrate nitrogen levels, i.e. Watercress, Waiaruhe D/S of Mangamutu and Pekepeka at Ohaeawai show some signs of nutrient enrichment with occasional periphyton blooms (Figure 8). The Watercress site has particularly high dissolved reactive phosphorus levels (Figure 7) and the Waiaruhe D/S Mangamutu confluence has spikes in ammoniacal nitrogen toxicity (Figure 5) as well as relatively high nitrate nitrogen levels (Figure 6) compared to other sites in the catchment.

- In general, the monitored swimming spots at Lily pond and Waitangi Bridge are suitable for swimming most of the time but can occasionally exceed the suitability for swimming guideline, especially after rainfall.

4 References

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5 Abbreviations

- ANZECC: Australian and New Zealand Environment and Conservation Council
- D/S: downstream
- DO: Dissolved Oxygen
- DRP: Dissolved Reactive Phosphorus
- *E. coli*: Escherichia coli
- IQR: interquartile range
- LAWA: Land Air Water Aotearoa
- MCI: Macroinvertebrate Community Index
- MfE: Ministry for the Environment
- NIWA: National Institute of Water and Atmospheric research
- NOF: National Objective Framework
- NPS-FM: National Policy Statement for Freshwater Management
- NTU: Nephelometric Turbidity Units
- RMA 1991: Resource Management Act 1991
- RWQMN: River Water Quality Monitoring Network
- SH: State Highway
- TURB: Turbidity
- WNW: Waiora Northland Water

6 Appendix

Figure 17: Waiaruhe D/S Mangamutu confluence

Figure 18: Pekapeka at Ohaeawai

Figure 19: Watercress at SH1

Figure 20: Mania at SH10

Figure 21: Waiaruhe at Puketona.

Figure 22: Waipapa at Waimate North Road

Figure 23: Waitangi at Waimate North Road

Figure 24: Waitangi at SH10

Figure 25: Waitangi at Wakelins