SURFACE WATER QUALITY

Highlights 2001-2002

- Water quality in the Northland region varies greatly from pristine in upper native forest catchments through to highly impacted in modified lowland catchments. Aquatic ecosystem guidelines are regularly not met in developed areas, including the Wairua, Whakapara, Mangakahia, Awanui and Waitangi Rivers.

- Results for 2001-02 show that many lower reaches of rivers and streams in developed areas are unsuitable for swimming. Pressures on surface water quality include both point source discharges (such as those from dairy shed oxidation ponds and other wastewater discharges), septic tank seepage and faecal material from runoff or stock wading in streams.

- Nutrient levels vary between catchments, however many have high enough concentrations to promote excessive algal growths. Levels are regularly high in developed catchments, including the Wairua, Whakapara, Mangakahia, Awanui and Waitangi Rivers. In some rivers, such as the Mangere, levels are extremely high. It is likely that a significant proportion of nitrogen is derived from point and non-point agricultural sources in these catchments.

Annual Plan Performance Targets

To continue to develop and implement a prioritised State of the Environment monitoring programme based on the Regional Policy Statement and Regional Plans by:

- **Operating a region-wide hydrometric network for the measurement, recording and reporting of river, lake and groundwater quality trends.**

Regional Water Quality Network

The Regional River Water Quality Monitoring Network (RWQMN) was established in 1996. Its purpose is to provide information about river water quality in the Northland region so that baseline levels and water quality trends can be monitored. The use of this information assists NRC's decision making in its role as water quality manager.

During 2001-02, three sites were added to the RWQMN. Twelve sites now form the RWQMN as shown in Map 2.1. Four additional sites are sampled by NIWA as part of the National Water Quality Network. Sites are sampled monthly for a range of physical/chemical and microbiological parameters. Only four of the parameters are described here; these give a general indication of the water quality of rivers in the region.

Suitability for Contact Recreation

The Regional Council monitors levels of the bacteria '*E. coli*' in surface water that are associated with disease-causing organisms. *E. coli* is an indicator of contamination from human and animal waste. By monitoring *E. coli* levels in freshwater, an assessment can be made on whether the water is suitable for contact recreation (swimming).

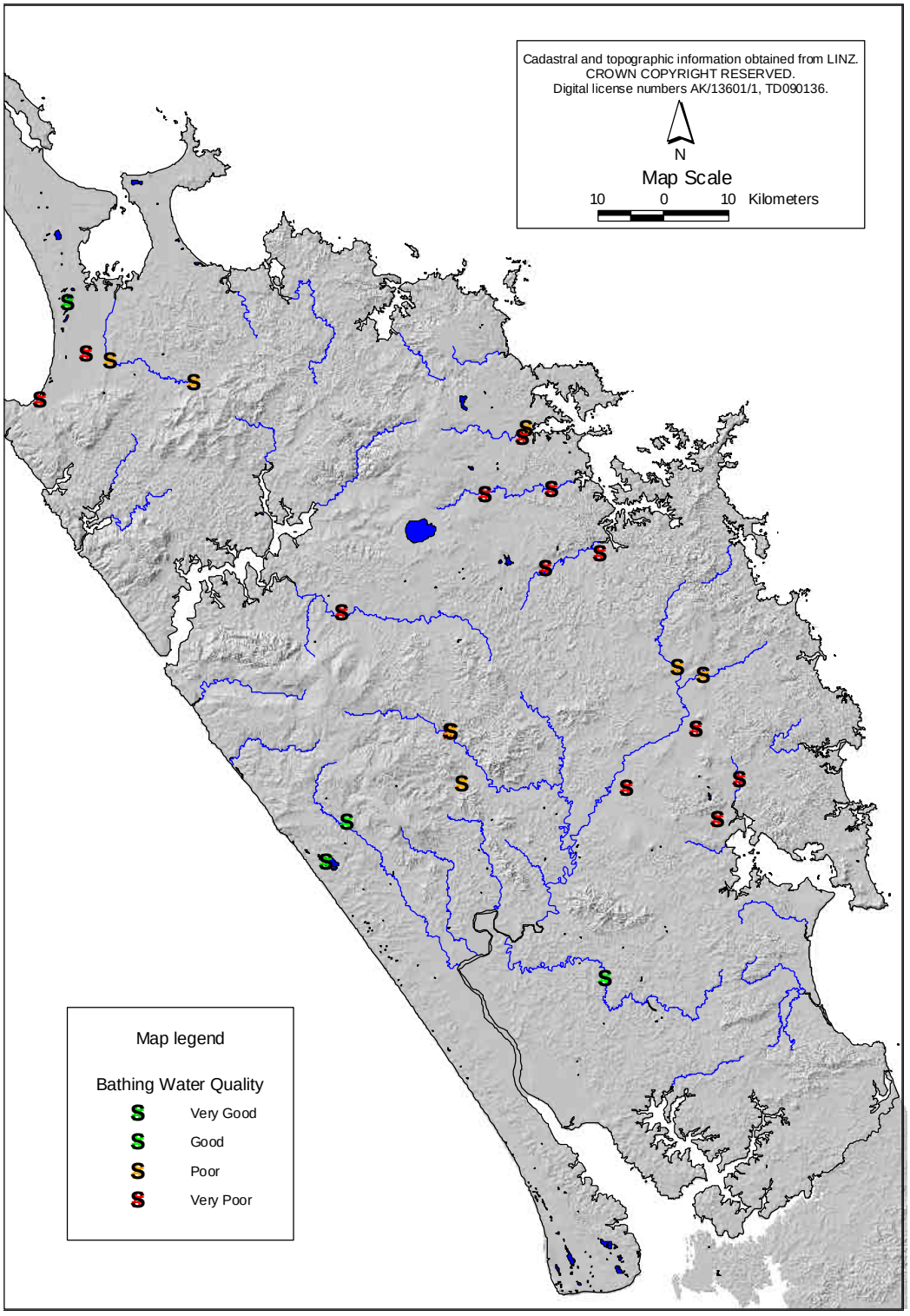
In addition to measuring *E. coli* levels at RWQMN sites the Regional Council operates a freshwater bathing survey at 14 sites over the summer period. Results of both surveys are presented here.

Monitoring has shown that there are excessive *E. coli* levels present in many Northland rivers and streams. High *E. coli* levels are indicative of a potential health risk. Illness risk to people swimming varies between sites as shown in map 2.1.

Results for 2001-02 show that many lower reaches of rivers and streams in Northland are unsuitable for swimming. Pressures on surface water quality include both point source discharges (such as those from dairy shed oxidation ponds and other wastewater discharges), septic tank seepage and faecal material from runoff or stock wading in streams.

Results from the summer freshwater bathing survey generally show that a range from poor to very poor bacteriological water quality was measured at nine of the 14 sites, with the best bacteriological water quality found at the lake sites. Five sites met the provisional *E. coli* guideline considered to be safe for contact recreation. Four of these were lake sites, located at Lake Taharoa of the Kai Iwi group and Lake Ngatu on the Aupouri Peninsula.

Nine sites exceeded the seasonal median guideline for contact recreation and were considered potentially unsafe for contact recreation.



Map 2.1: Bathing water quality at selected Northland sites

Suitability for Aquatic Ecosystems

Dissolved Oxygen

An adequate supply of dissolved oxygen is essential for the survival of aquatic life. A deficiency in this area is a sign of an unhealthy river. The atmosphere is the main source of dissolved oxygen in river water. Oxygen diffuses naturally into river water, and waves and tumbling water also mix atmospheric oxygen with river water. Oxygen is also produced by rooted aquatic plants and algae as a product of photosynthesis.

There are a variety of factors affecting levels of dissolved oxygen. Organic matter, such as sewage effluent or dead plant material that is readily available to microorganisms, has the greatest impact on dissolved oxygen concentrations. These microorganisms utilise dissolved oxygen as they decompose organic matter. Deficiencies in dissolved oxygen are a sign of higher organic loadings to the river, which can potentially be detrimental to aquatic ecosystems.

Dissolved oxygen levels in upper catchments (such as the upper Mangakahia) are generally high as the result of turbulent, well-aerated waterways and low organic loading. The Opouteke and Victoria Rivers show similar high levels of dissolved oxygen. Some lowland river sites show lower dissolved oxygen levels. Sites in the Wairua catchment (including the Whakapara, Waiotu and Mangere Rivers) record lower values. This catchment includes the Hikurangi drainage scheme.

Within the larger Awanui River catchment dissolved oxygen levels decrease downstream with the lowest values observed at the lower Awanui River site.

As expected, dissolved oxygen levels vary seasonally at all sites, with a general trend towards higher levels in winter and lower levels in summer. More importantly, dissolved oxygen levels vary over a daily cycle as the result of aquatic plant photosynthesis/respiration and stream temperature. A similar sampling time is maintained for sites on subsequent sampling runs to minimise the effect of diurnal variation on water quality variables.

Turbidity

Turbidity is a measure of the 'cloudiness' of water, which is generally an indication of the amount of sediment in water. High turbidity reduces the amount of light penetrating into water that would be available for aquatic life. It makes it difficult for fish to see prey, and reduces the ability of plants to photosynthesise. High turbidity also makes water less attractive to swim in.

The Waiotu River has consistently high levels of turbidity

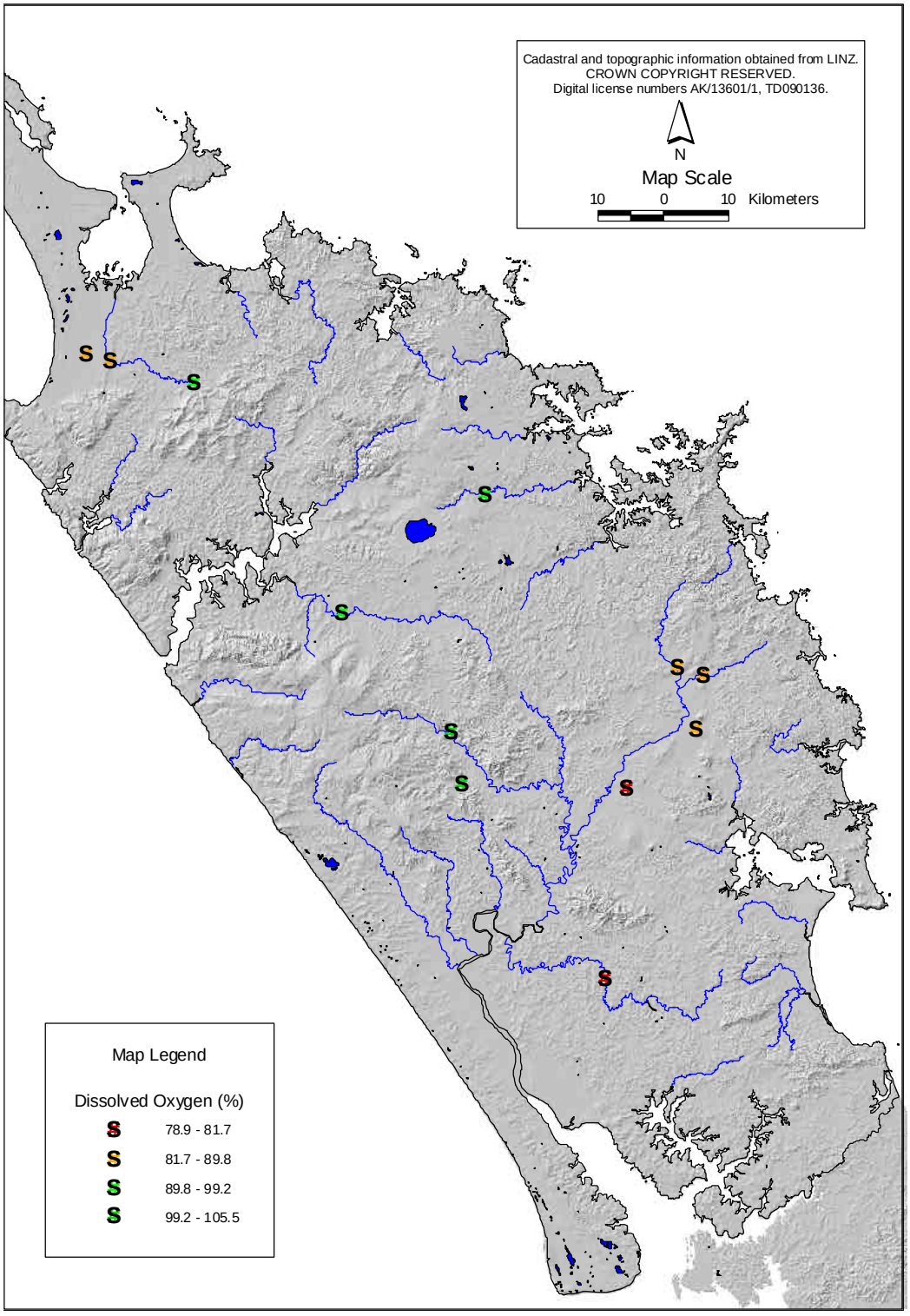
Many Northland rivers have sand or silt bottoms and this accounts for the relative high turbidity when flow and turbulence are sufficient to suspend bottom sediment. As shown in map 2.3, sites with high levels of turbidity include those in the Wairua River catchment, the Mangakahia River, and the mid and lower Awanui River. Only the two relatively 'unimpacted' sites, on the Victoria and Opouteke Rivers, have low levels of turbidity.

Nutrients (Dissolved Reactive Phosphorous and Dissolved Inorganic Nitrogen)

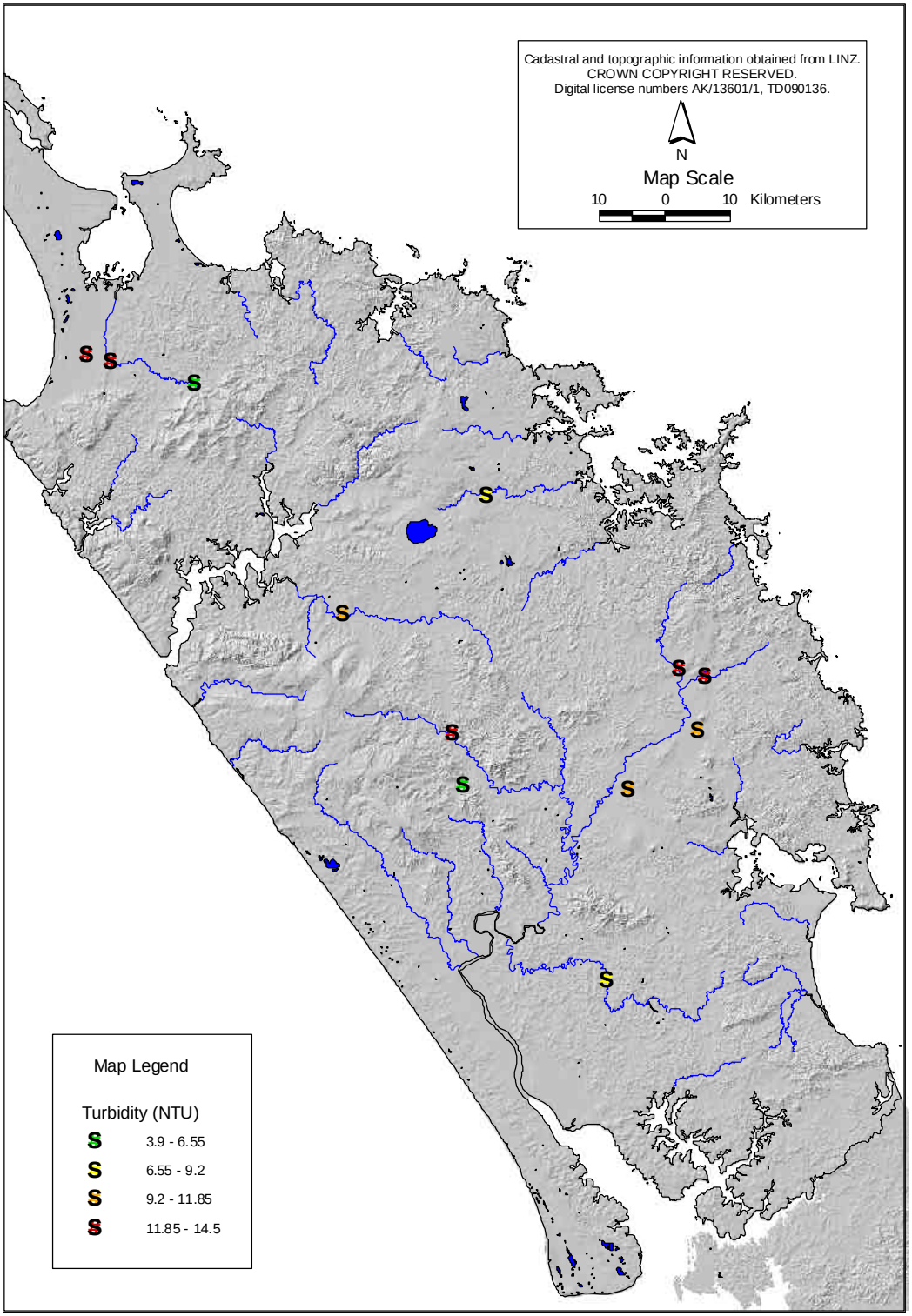
Phosphorus and nitrogen are important nutrients for plant growth. High levels of nutrients contribute to algal growths and eutrophication processes, and excessive algal growths degrade recreational and aesthetic values, as well as impacting on aquatic life habitat. The Regional Council measures dissolved reactive phosphorous (DRP) and dissolved inorganic nitrogen (DIN) as measure of the amount of nutrients available for plant growth.

As shown in map 2.5, most catchments have DIN concentrations high enough to promote excessive algal growths. Levels are regularly high in developed catchments, including the Wairua, Whakapara, Mangakahia, Awanui and Waitangi Rivers. In some rivers, such as the Mangere, levels are extremely high. It is likely that a significant proportion of nitrogen is derived from point and non-point agricultural sources in these catchments.

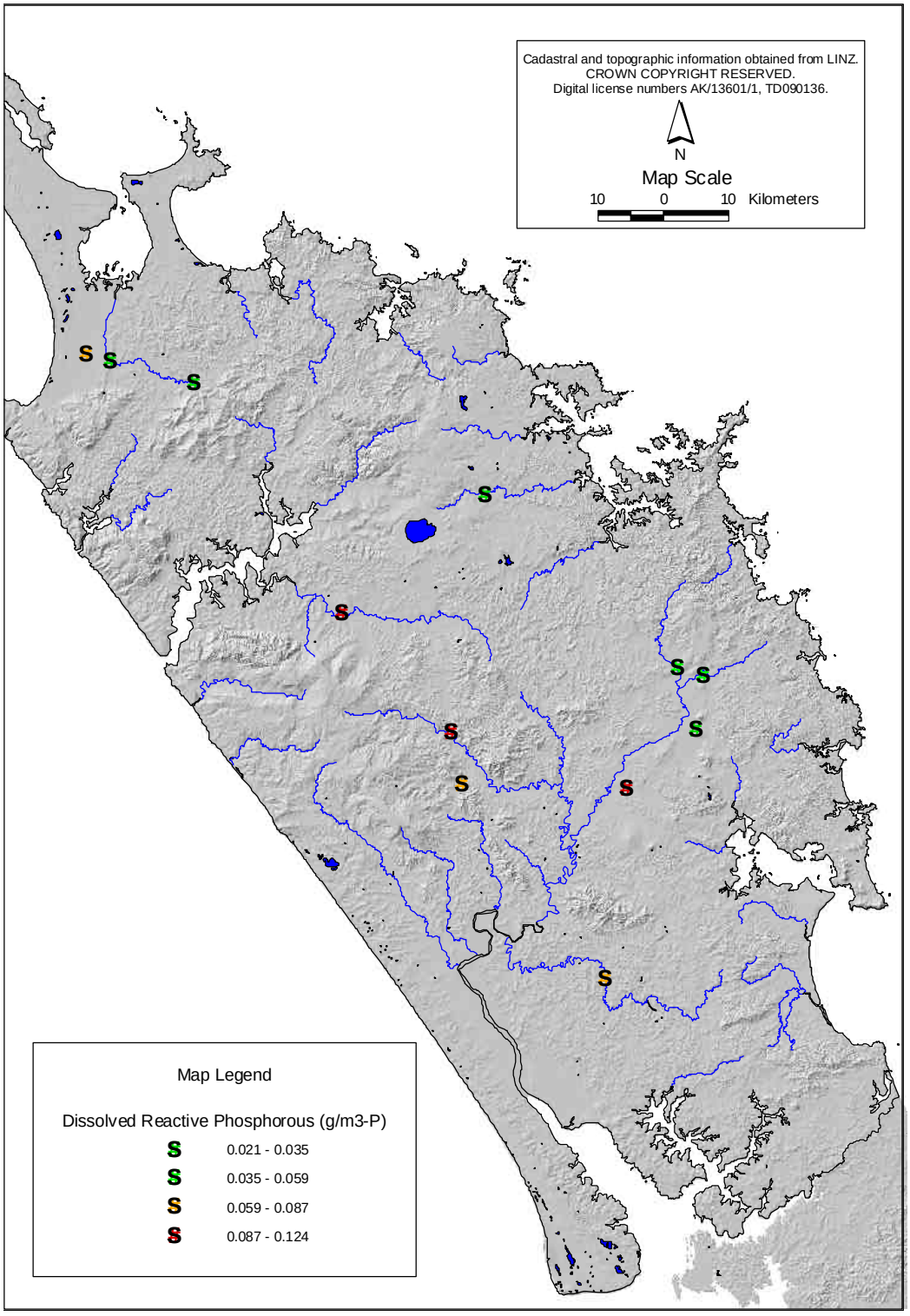
DRP levels vary both between catchments and within lengths of rivers (map 2.4). This is largely the result of assimilation of phosphorus further down the river and the impact of point source discharges (such as dairyshed oxidation ponds). Sites with elevated DRP levels are sited both within intensively farmed catchments and below major point source discharges. Generally speaking, phosphorous is the limiting nutrient for excess algal growth in Northland. Despite this, concentrations are high enough in most developed catchments for excess algal growth to occur under the right conditions.



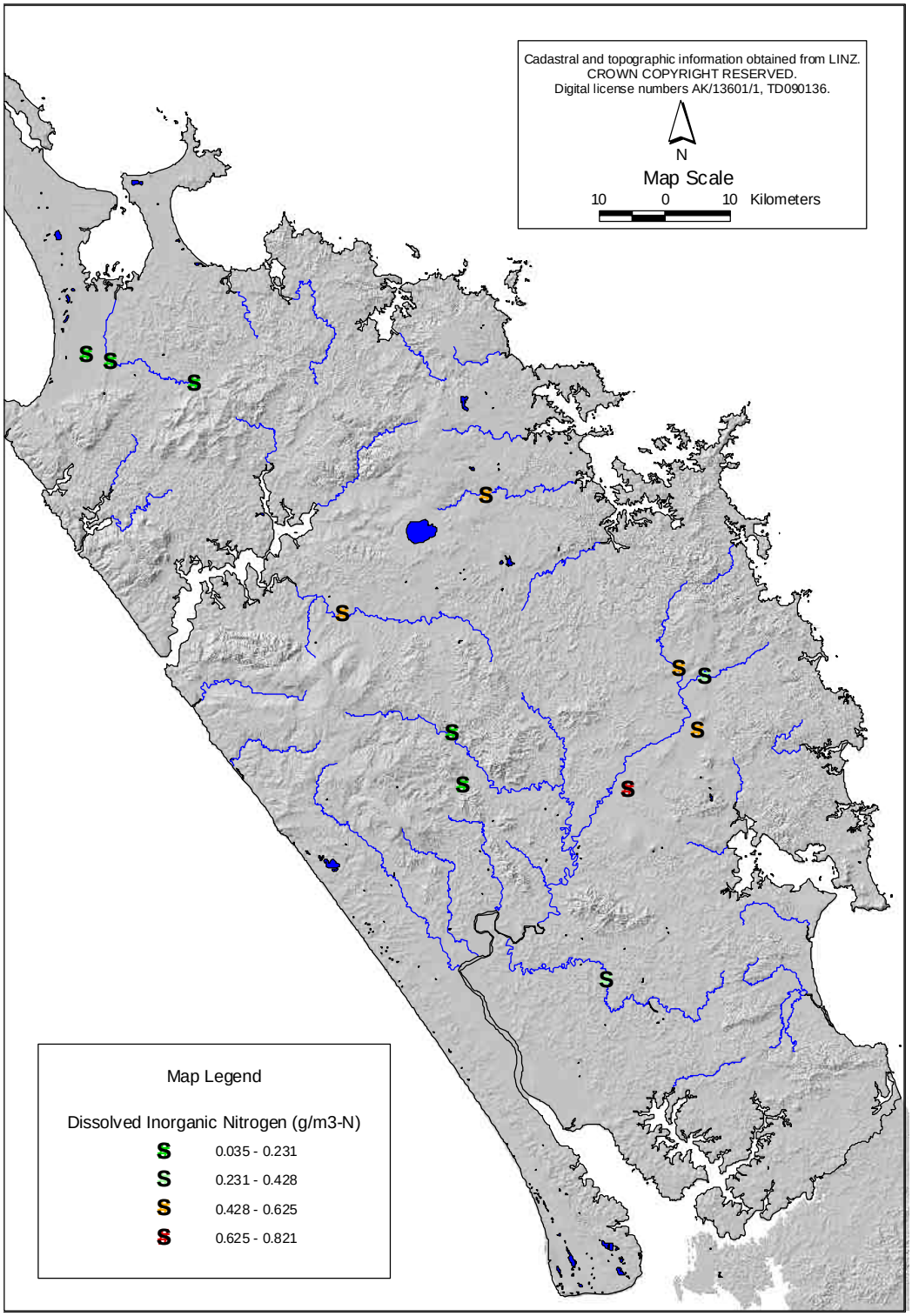
Map 2.2: Dissolved Oxygen (%) at selected Northland sites



Map 2.3: Turbidity levels at selected Northland sites



Map 2.4: Dissolved Reactive Phosphorous concentrations at selected Northland sites



Map 2.5: Dissolved Inorganic Nitrogen concentrations at selected Northland sites

Macroinvertebrate Monitoring

Highlights 2001-2002

- Generally, habitat quality is excellent in forested headwaters, but declines further downstream.
- From 1997- 2002 there has been a general trend of decreasing species richness with a 10-60% loss at all sites except school cut. While species decline is a real trend at these monitoring sites, the decline is largely a feature of the differences between 1997-1998 and the 1999 results. The most probable causes are the difference in samplers between 1997-98 and 1999.
- Macroinvertebrate Community Index (MCI) scores have been stable or increased. Significant increases in the SOE sites were noted at Awanui-School cut and Mangahahuru Stream at Apotu Rd bridge. The only decline in MCI of note was at Mangakahia-Gorge and this decline was not a significant linear trend.
- QMCIs' show a general increasing trend providing evidence that more sensitive species are occurring at sites.

Macroinvertebrates include the insects, snails, crustaceans, and worms that live in rivers and streams. They are abundant in shallow, stony areas but they also live on plants and debris in rivers and streams.

Macroinvertebrates show varying degrees of sensitivity to water quality and the condition of habitat. Because of this sensitivity, they are good indicators of the state of fresh water ecosystems.

Habitats are uniquely characterised by their own macroinvertebrate community. High quality, gravel bottomed streams sheltered by native forest are typically dominated by the larvae of mayflies, stoneflies, and caddisflies. Snails, typical fly larvae, and worms dominate polluted streams and rivers, particularly those in lowland catchments influenced by urban or agricultural land use.

Northland Regional Council uses three indices that express water quality and habitat opportunities. These are species richness, the macro-invertebrate community index (MCI) and the quantitative macroinvertebrate community index (QMCI). The Council has assessed macroinvertebrate communities at 21 sites throughout the region since 1996. The Ngatiwai Trust Board Resource Management Unit also conducts regular macroinvertebrate surveys.

Generally, habitat quality is excellent in forested headwaters, but declines further downstream.

From the regional water quality state of the environment monitoring programme three sites appear better than others in terms of habitat quality. The upper Victoria River and the Waitangi River sites show moderate ecosystem health – both are upstream 'unimpacted' sites. The Waipapa River at Puketi Forest shows excellent ecosystem health, reflecting its 100% native forest catchment.

At all other sites habitat quality is moderately poor to poor. Lowland streams, especially in agricultural and urban areas, have poor habitat quality.

Studies of Northland waterways have confirmed the importance of native riparian vegetation in providing suitable habitat for sensitive macroinvertebrates. Riparian vegetation provides habitat for breeding adults, shade to keep stream temperatures low, and filters contaminants from runoff before it enters the stream or river. The same study found poor habitats related to the extent of pastoral development in the catchment.

Lowland streams in agricultural catchments generally provide poor to very poor habitats because of the large loads of silt, excessive algal growths and high levels of organic pollution.

The macroinvertebrates at state of the environment sites are monitored in November and March to give an indication of the health of aquatic organisms throughout Northland. Results from the 2001/02 year are detailed below:

Species Richness

Species richness describes the variety in the types of macroinvertebrates observed at a site. Since 1996, there has been a general trend of decreasing species richness, with a fall from 16-20 species on average to around 6-9 species. All sites except for Awanui at School cut have declined in species richness since 1996.

A decline in species is not always an indication of habitat or water quality deterioration. Where water quality and habitat is improving, poor habitat tolerant species may lose their dominance and even be replaced by better habitat species. For example a reduction in surface algae may limit the habitats holding capacity for potamopyrgus snails, or enrichment reduction may reduce chironomid midge populations and mosquitoes in favour of mayfly.

Table 2.1: Species richness and macroinvertebrate community index (MCI) scores

Site	Species richness	MCI
Awanui River @ School Cut	↑	↑
Victoria River @ Thompsons Bridge	↑	--
Waipapa River @ Forest Ranger	↑	--
Waitangi River @ Waimate	↑	↑
Waitangi River @ Wakelins	↑	↑
Whakapara River @ Cableway	↑	--
Mangahahuru River @ Apotu Rd Bridge	↑	↑
Wairua River @ Purua Bridge	↑	↑
Mangere River @ Knights Rd bridge	↑	↑
Mangakahia River @ Titoki	↑	--
Oputeke River @ Suspension bridge	↑	--
Mangakahia River @ Twin Bridges	↑	↑

Key: ↑ Improvement in parameter ↓ Decline in parameter - No change in parameter

Macroinvertebrate Community Index (MCI)

There has been a general increase in the MCI index values since 1997. This indicates that the quality of habitat and / or water has been improving (or at least stable).

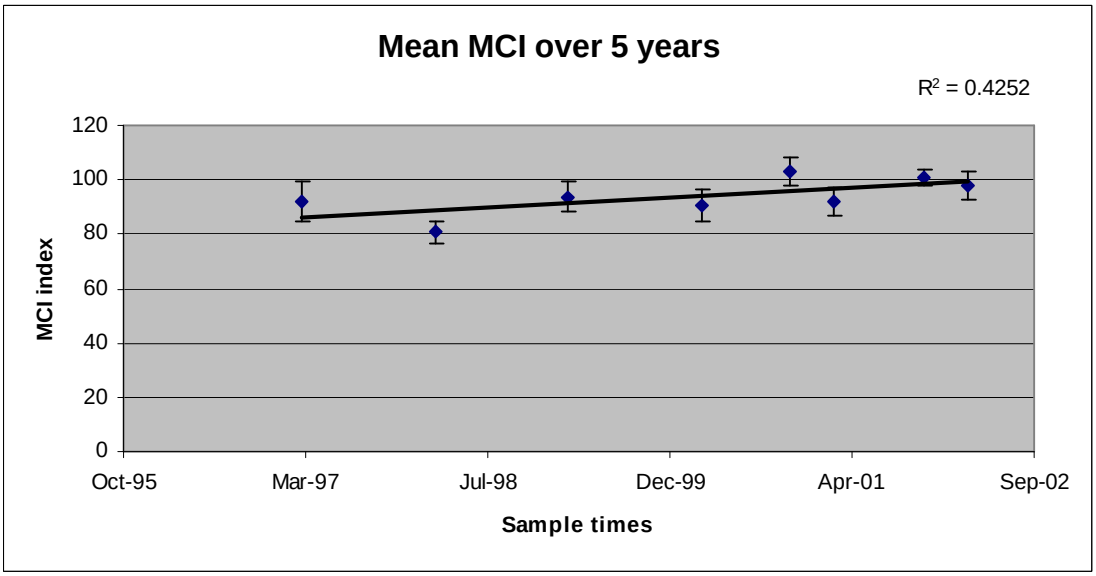


Figure 2.1: MCI Scores for the State of the Environment sites

Quantitative Macroinvertebrate Community Index (QMCI)

The QMCI scores show a slight increase. This is further evidence that low scoring species have been lost or, more likely, reduced in abundance across most of the sites. The error bars (standard error of the mean) however, indicates that the differences in the QMCI's are not statistically significant, and it is most appropriate to consider the QMCI scores as being stable over the last three years of measurement.

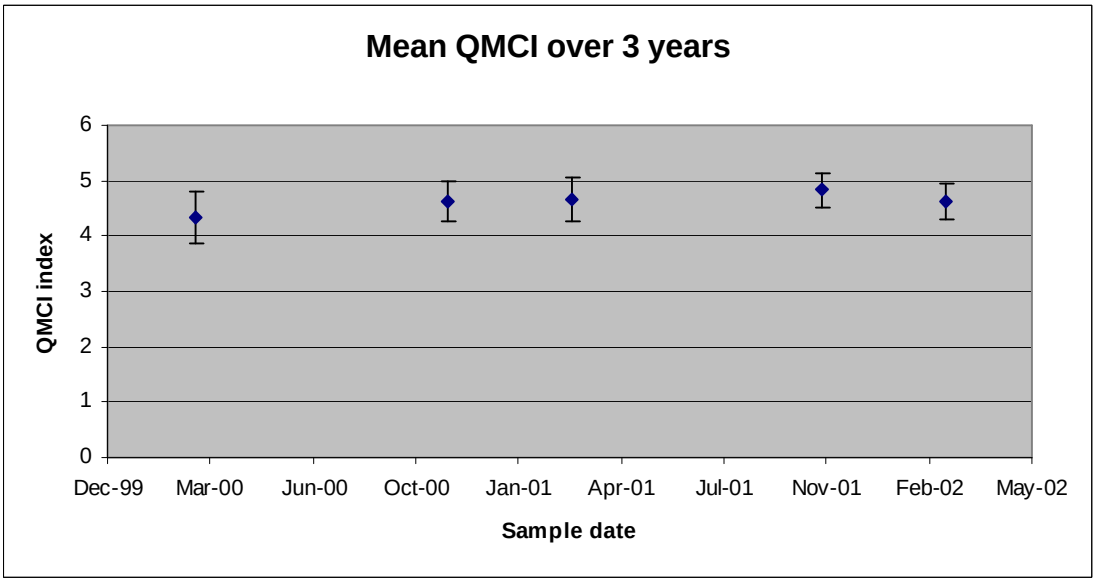


Figure 2.2: QMCI scores at state of the environment sites

Macroinvertebrate Monitoring in the Waiarohia Stream Catchment

Highlights 2001-2002

- Data across sites and between years is highly variable and few of the trends observed are statistically significant. More sampling is therefore required to confirm these results.
- Biological health along the length of the Waiarohia River seems to be moderately good and appears to be stabilising with improved although more uniform conditions.
- Species richness has either declined or remained the same. While loss of species is intially alarming, the quality indicators of macroinvertebrate stream health at all sites monitored show stable or improving trends. It therefore appears to be species that prefer poor water that are being lost.

The Waiarohia Stream aquatic habitat is monitored in November and March to assess the health of its aquatic organisms.

Summary of condition trends at Waiarohia Stream sites from 1997 - 2002

Site	Species Richness	MCI	Overall Trend
Rust Ave Bridge	↑	↑	↑
Russell Rd Bridge South	↑	↑	↑
Russell Rd Bridge North	↑	-	-
96 West Hills Drive	-	↑	↑
27A Huia Street	↑	↑	↑
Kamo Tributary Culvert	↑	-	-
Whau Valley Rd Bridge	↑	-	-
Proven Bridge	↑	↑	↑

Key: ↑ Improvement in parameter ↓ Decline in parameter - No change in parameter

Species Richness

The species richness throughout the Waiarohia catchment has declined (but not significantly) over the last five years of monitoring. Dropping from an average of around 18-20 species to 10 species in 2002.

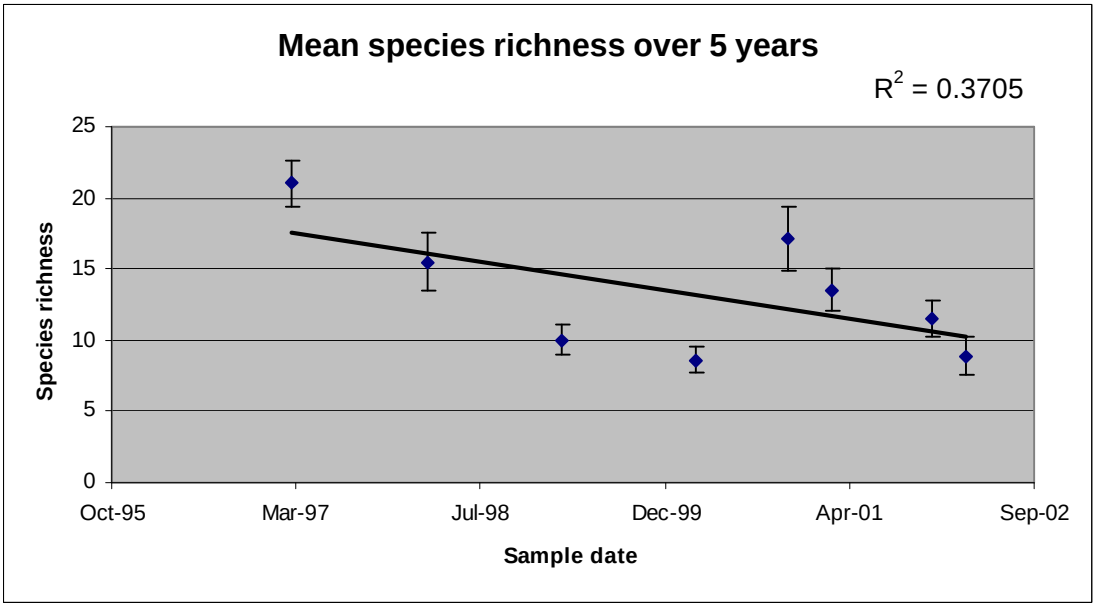


Figure 2.3: Species Richness at the Waiarohia Stream Sites over the last 5 years

Macroinvertebrate Community Index (MCI)

The average MCI score in 2001/2002 is 89 (8 less than last year). However, despite this there is a slight general increase in the MCI index since 1997.

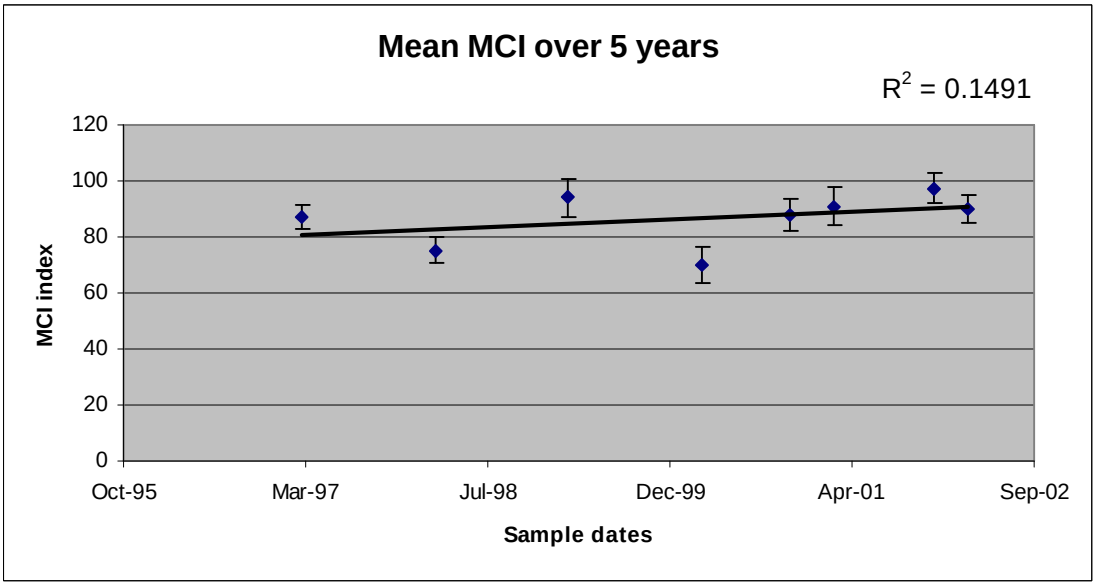


Figure 2.4: MCI Scores at the Waiarohia stream sites

Quantitative Macroinvertebrate Community Index (QMCI).

The QMCI scores further support the MCI scores, indicating that it is not simply the presence of one or two individuals which are "throwing" the MCI index off, but that abundances of more sensitive species are increasing.

There is a linear trend indicating an increase in the QMCI scores. This means that mayfly, caddisfly, stonefly and the more sensitive species such as diptera are numerically better represented (or that the chironomid, snails and tolerant fly species are becoming fewer).

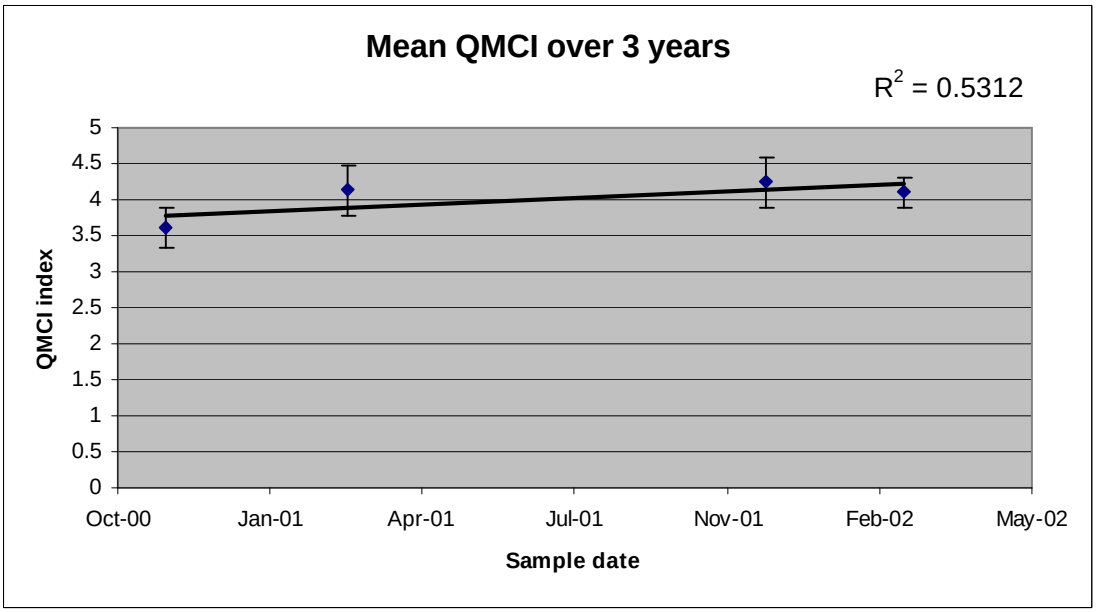


Figure 2.5: QMCI Scores at the Waiarohia stream sites