Environment Bay of Plenty
REGIONAL COUNCIL

NERMN Estuarine Water Quality

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Working with our communities for a better environment

Acknowledgement

John Gibbons-Davies for managing the monitoring programme. Dave Bassett, Amanda Austrin and laboratory staff for invaluable assistance.

Cover photo: Ohiwa Harbour and Ohope Spit

Executive Summary

As part of Environment Bay of Plenty's Natural Environment Regional Monitoring Network (NERMN), the water quality of estuarine sites around the Bay of Plenty are monitored. This data combines with estuarine ecological monitoring to build up a picture of the state of the estuaries and the trends in environmental changes.

This report collates the water quality data since 1990. In the period of monitoring some changes have taken place in the sampling strategy with some new sites being added and some sites changed to another adjacent location.

The objective of the monitoring programme is to determine the quality of estuarine waters of the Bay of Plenty and trends in their quality, compliance of the water with appropriate objectives in the regional coastal Environment Plan.

Generally the estuaries of the Bay of Plenty are of high to good quality. However, this is most likely assisted by dilution with coastal waters. The sites with minor excursions from the bathing guideline have greater freshwater influences. In these catchments, agricultural, industrial and urban sources contribute bacteria to the waterways.

Matata Lagoon has the poorest quality, probably due to the large waterfowl population.

Monitoring at 2 monthly intervals will continue at the 21 estuarine sites.

Contents

Chapter 1: Introduction

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This report collates the water quality data since 1990. In the period of monitoring some changes have taken place in the sampling strategy with some new sites being added and some sites changed to another adjacent location.

In 1996 a re-assessment of the regional monitoring network was made and sites were included at the mouths of major rivers where a saline or brackish environment existed for part of the tidal cycle. A second site was also added to the Opotiki Estuary at the Opotiki Wharf. Sites were also established at the mouths of the Whakatane River, the Rangitaiki River, the Tarawera River and at the diversion structure for the re-established flow of the Kaituna River to Maketu Estuary.

In 1998 the jetty near the Tauranga Yacht and Boat Club was de-commissioned so this site in the main stream of the Otumoetai Channel became unavailable for shore-based monitoring. A new site was therefore established at the Toll Bridge Marina.

Also the monitoring of the north-western end of the Tauranga Harbour was transferred to shore-based monitoring to avoid the use of a boat. The Kauri Point jetty, the Tanner's Point jetty and the Bowentown jetty gave good access to main channels, which reflect the quality of the harbour at high tide adequately.

All these changes can be noted in the graphed results.

1.1 Objective

The objective of the monitoring programme is to determine:

(a) The quality of estuarine waters of the Bay of Plenty and trends in their quality.

(b) Compliance of the water with appropriate objectives in the regional coastal Environment Plan.

Chapter 2: Methods

The sites are sampled every two months over the high tide period. The sites reported here are listed in Table 1. LABSTAR is the laboratory database which contains all the analytical data. The site number refers to the locational details on the following figures in this report.

Table 1 Location details for the estuarine monitoring sites.

LABSTAR	Site	Current	Location	NZMS 260 Map ref	Site number
BOP150001	**Kukumoa**	**Y**	Opotiki Estuary	W15:8500-4750	1
BOP150017	**Opotiki Wharf**	**Y**	Opotiki Estuary	W15:8600-4670	2
BOP150002	**Ruatuna Road**	**Y**	Ohiwa Harbour	W15:7340-4550	3
BOP150003	**Port Ohope Wharf**	**Y**	Ohiwa Harbour	W15:7090-4940	4
BOP150004	**Boat Ramp**	**Y**	Whakatane Harbour	W15:6240-5420	5
BOP150018	**Jetty at Boat Ramp**	**Y**	Rangitaiki River	W15:5100-5840	6
BOP150019	**50m d/s of Matata/Thornton Rd**	**Y**	Tarawera River	V15:4320-6060	7
BOP150029	**Control Structure**	**Y**	Matata Lagoon	V15:4085-6150	8
BOP150010	**Bridge to Domain**	**Y**	Matata Lagoon	V15:4080-6150	9
BOP150006	**50m offshore from Domain**	**Y**	Little Waihi Estuary	V14:1680-7650	10
BOP150005	**Boat Ramp**	**Y**	Maketu Estuary	V14:1460-7700	11
BOP150020	**River Diversion Structure**	**Y**	Kaituna River Estuary	V14:1100-7730	12
BOP150011	**Maungatapu Bridge**	**Y**	Tauranga Harbour	U14:9140-8340	13
BOP150021	**Toll Bridge Marina**	**Y**	Tauranga Harbour	U14:9050-8750	14
BOP150016	**Tauranga Yacht and Boat Club**	**N**	Tauranga Harbour	U14:8970-8880	15
BOP150012	**Otumoetai, Beach Rd.**	**Y**	Tauranga Harbour	U14:8732-8854	16
BOP150013	**Te Puna Beach, Pitua Rd.**	**Y**	Tauranga Harbour	U14:8230-8920	17
BOP150014	**Omokoroa, Wharf.**	**Y**	Tauranga Harbour	U14:7980-9210	18
BOP150026	**Pahoia Beach Rd**	**Y**	Tauranga Harbour	U14:7515-9236	19
BOP710107	**Mid Harbour**	**N**	Tauranga Harbour	U14:7500-0000	20
BOP710105	**Matakana**	**N**	Tauranga Harbour	U13:7400-0700	21
BOP150023	**Kauri Point Jetty**	**Y**	Tauranga Harbour	U13:7328-0509	22
BOP150027	**Tanners Point Jetty**	**Y**	Tauranga Harbour	U13:7087-0930	23
BOP150015	**Bowentown, Entrance to Pio's**	**N**	Tauranga Harbour	U13:7330-1050	24
BOP150022	**Bowentown Boat Ramp**	**Y**	Tauranga Harbour	U13:7320-1186	25

Laboratory methods are listed in Appendix I.

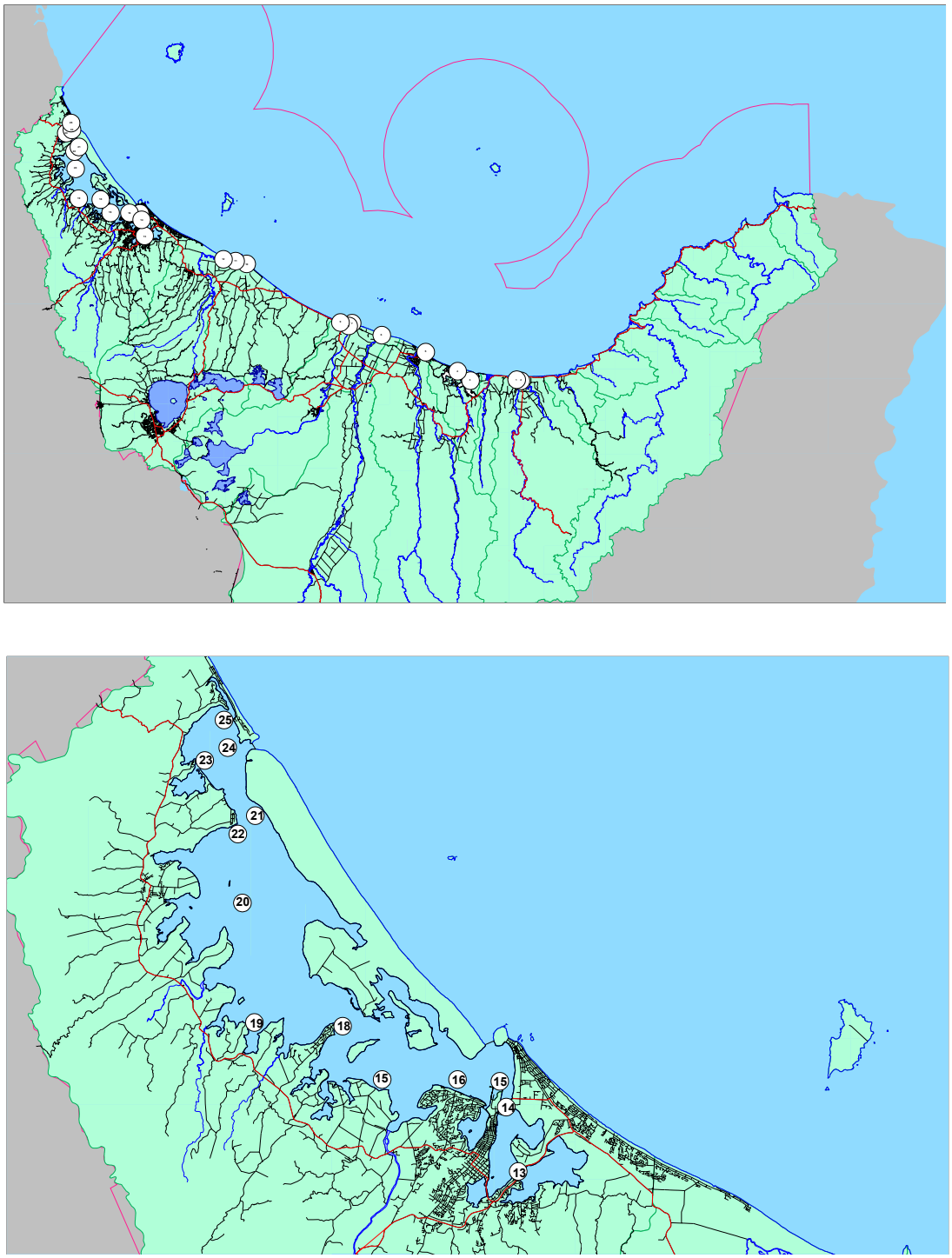


Figure 1 *General location map (Upper) and Tauranga Harbour locational map (Lower).*

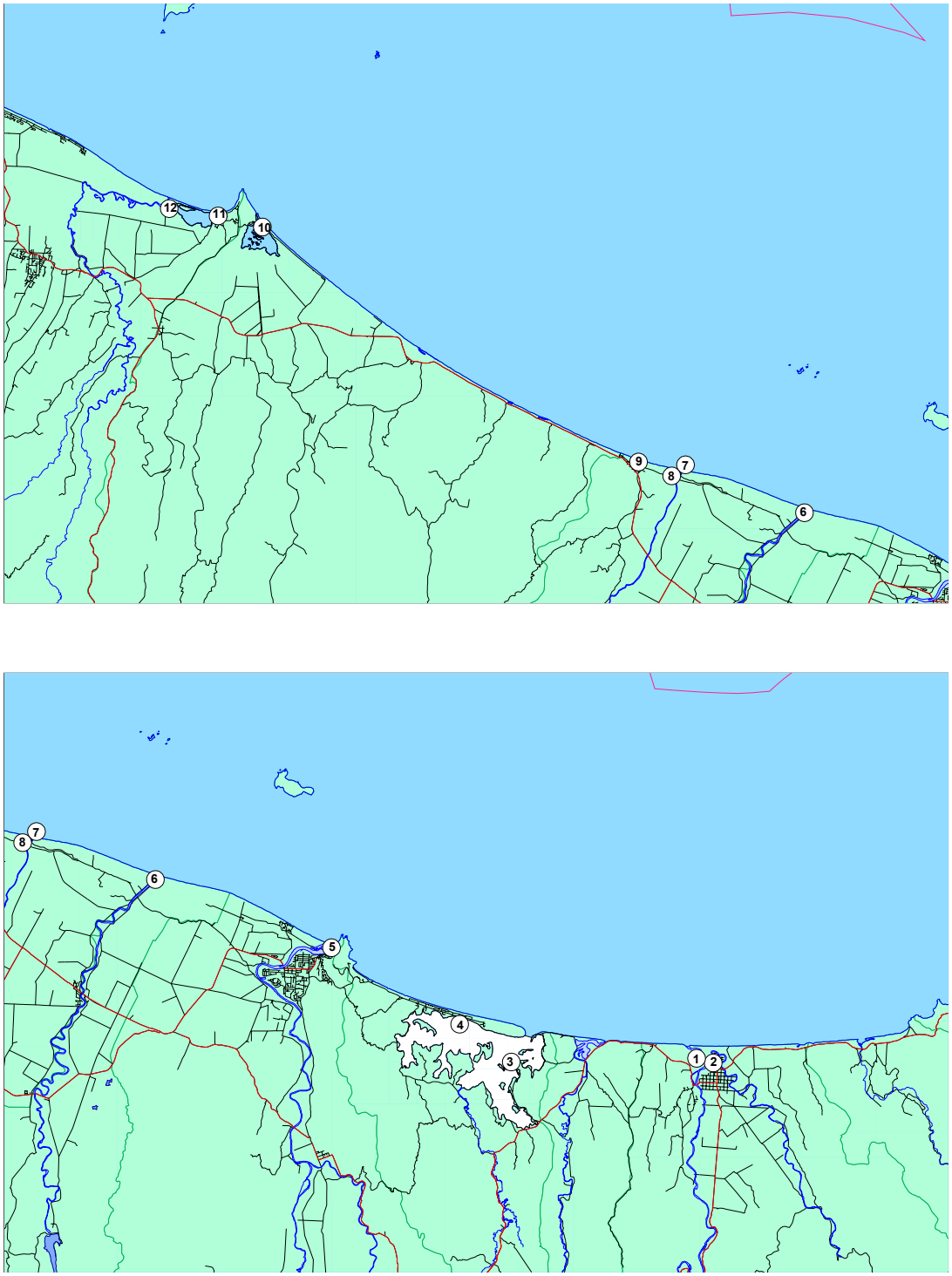


Figure 2 *Location map from the Kaituna River to the Rangitaiki River (Upper) and from Whakatane to Opotiki (Lower).*

Chapter 3: Results

The major results have been graphed in the figures on the following pages and the complete data set of analytical results is in Appendix II.

3.1 Dissolved Oxygen, Temperature, Salinity

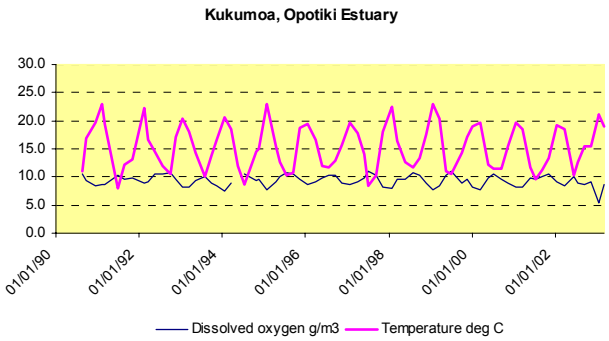
The scale has been kept uniform where possible.

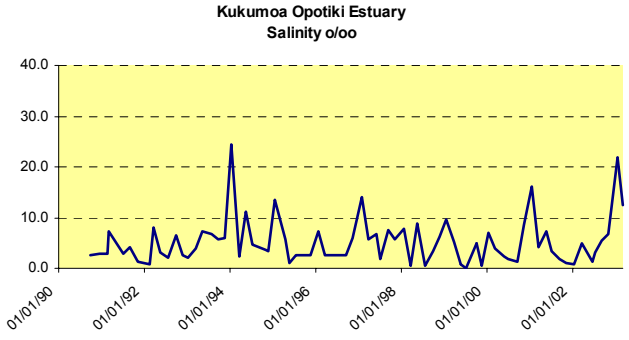
Dissolved oxygen and temperature data is plotted in the following figures, with the salinity in parts per thousand (‰) plotted alongside.

Seawater has a salinity of approximately 35 ‰. The river entrances tend to have lower salinity than the major harbours. Salinity affects the quantity of dissolved oxygen that water can contain at saturation with seawater containing approximately 8.5 g/m^3 dissolved oxygen at saturation. The relationship between temperature and dissolved oxygen concentration at saturation can be clearly seen in the plots *e.g.* the Kukumoa site at Opotiki.

In the Opotiki Estuary, a small amount of salinity was recorded at the Wharf site, compared to the Kukumoa site further downstream. The Ohiwa Harbour sites, like the Tauranga Harbour sites are predominantly coastal water but dilution with fresh water inflows can be noted. The Whakatane River shows the effects of salinity spikes at high tide but this effect is largely absent from the Rangitaiki and Tarawera Rivers. The salt wedge in the Whakatane River has been found to extend several kilometres inland to the Whakatane District Council water intake on Valley Rd at extreme low river flows. However, very little salt penetrated the Rangitaiki and Tarawera River in comparison. The saline spikes can also be seen in the Kaituna/Maketu data but Maketu Estuary like Little Waihi Estuary is predominantly saline at high tide. Matata Lagoon also appears to receive a small saline seepage through the sand dunes.

The Tauranga Harbour sites are predominantly saline. At Maungatapu Bridge the data shows the influence of dilution with fresh water. This dilution would include the Waimapu Stream pushed up the Maungatapu channel by the incoming tide as well as the freshwater inputs from the Welcome Bay inflows. The Pahoia site also demonstrates the freshwater influence of the Wainui River.


Kukumoa, Opotiki Estuary
30.0
25.0
20.0
15.0
10.0
5.0
0.0
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Dissolved oxygen g/m3
Temperature deg C


Kukumoa Opotiki Estuary
Salinity o/oo
40.0
30.0
20.0
10.0
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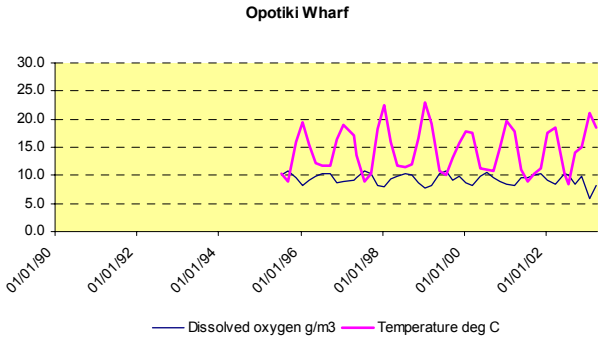
Opotiki Wharf
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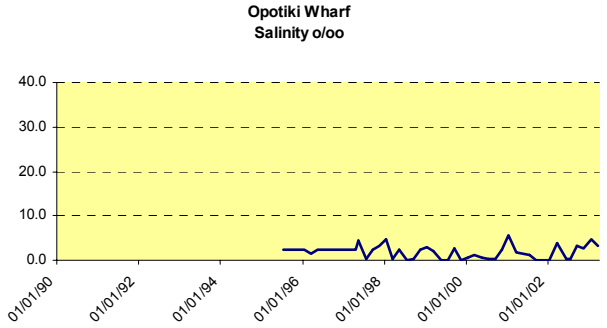
Dissolved oxygen g/m3
Temperature deg C


Opotiki Wharf
Salinity o/oo
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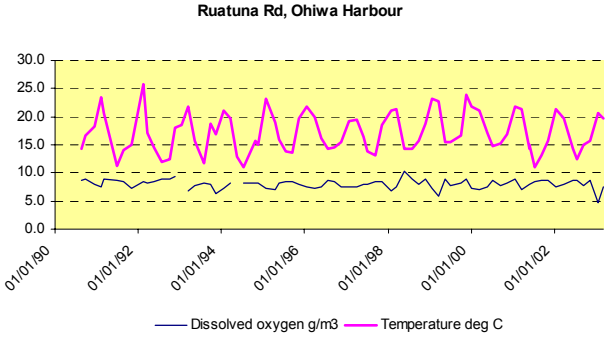
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25.0
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15.0
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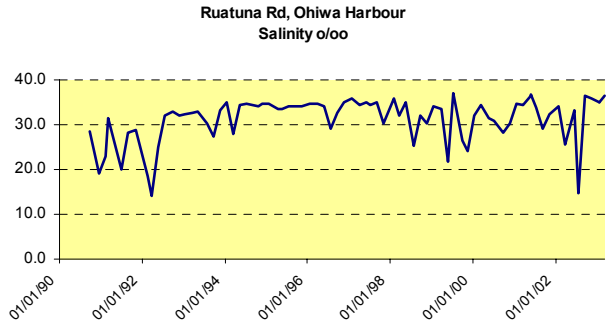
01/01/02
Dissolved oxygen g/m3
Temperature deg C


Ruatuna Rd, Ohiwa Harbour
Salinity o/oo
40.0
30.0
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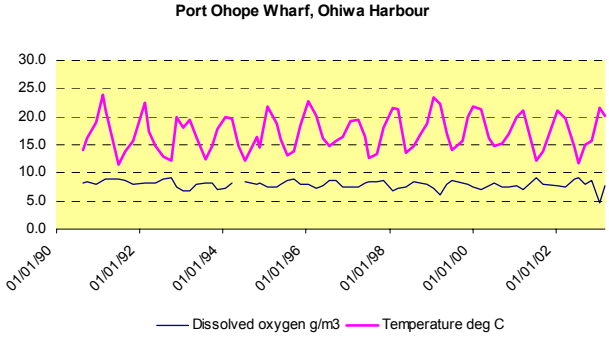
Port Ohope Wharf, Ohiwa Harbour
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01/01/90
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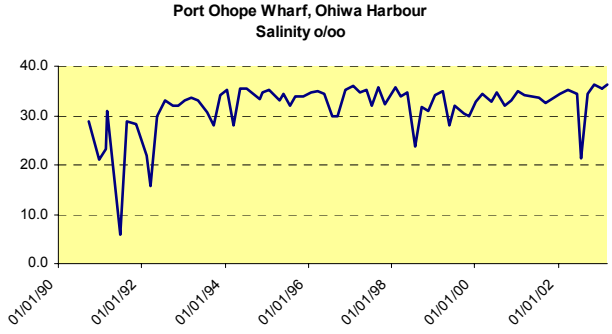
01/01/02
Dissolved oxygen g/m3
Temperature deg C


Port Ohope Wharf, Ohiwa Harbour
Salinity o/oo
40.0
30.0
20.0
10.0
0.0
01/01/90
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01/01/96
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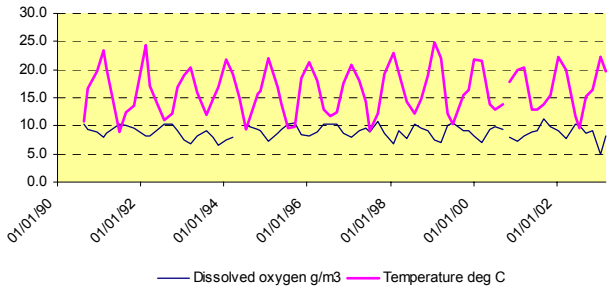
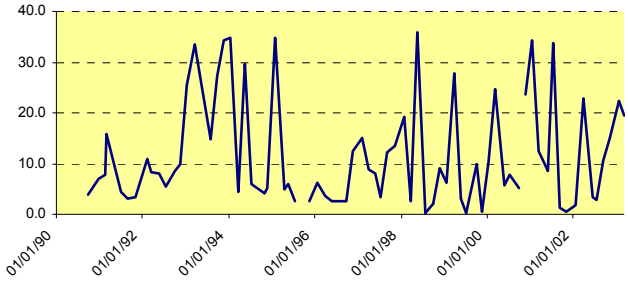
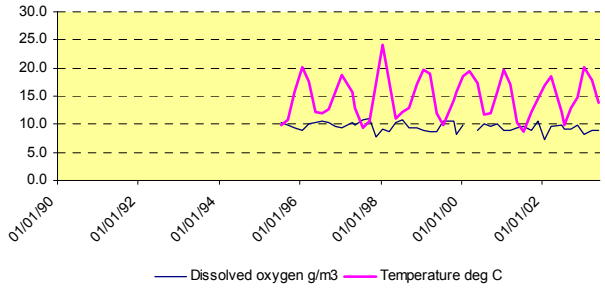
Whakatane River, boat ramp



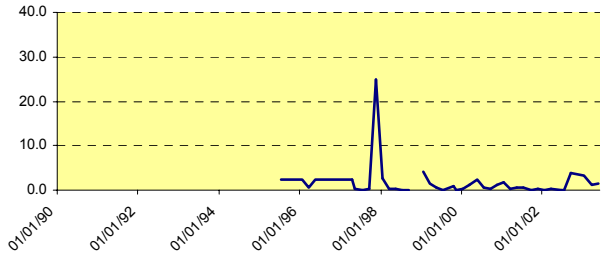
Whakatane River, boat ramp
Salinity o/oo



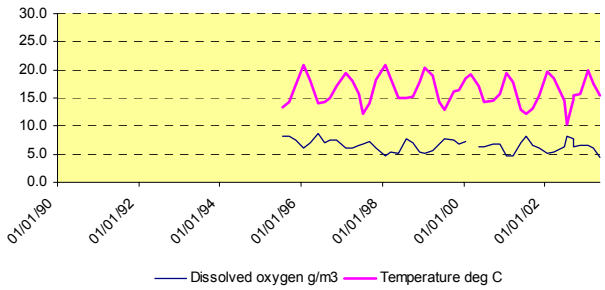
Rangitaiki River, Jetty



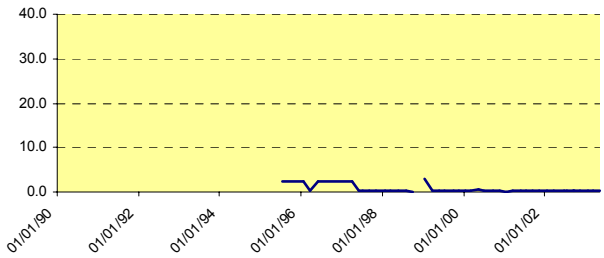
Rangitaiki River Estuary
Salinity o/oo



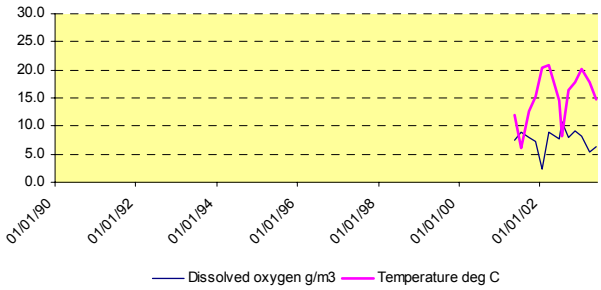
Tarawera River Estuary



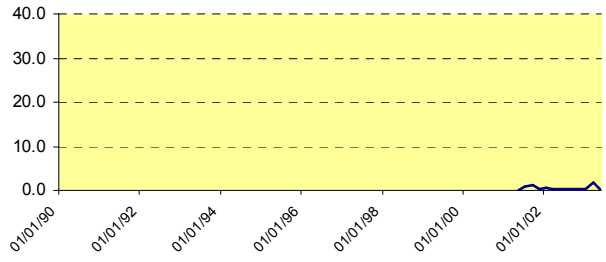
Tarawera River Estuary
Salinity o/oo



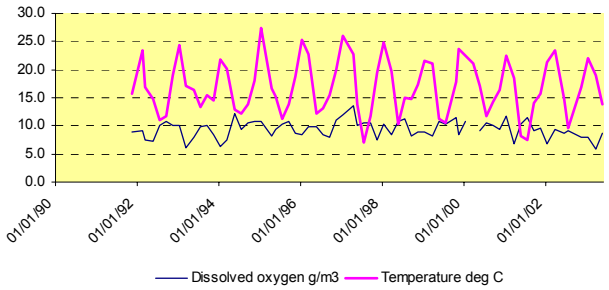
Matata Lagoon, control structure



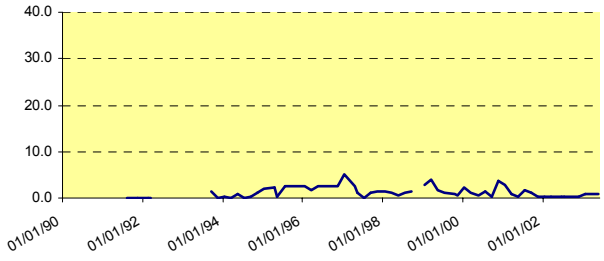
Matata Lagoon, control structure
Salinity o/oo



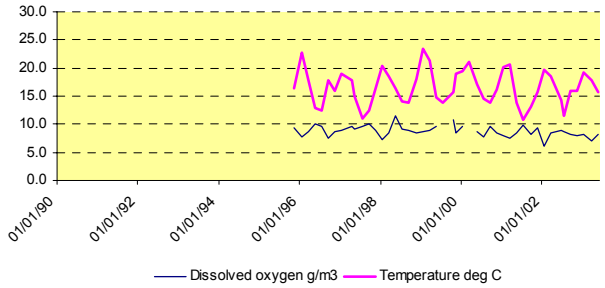
Matata Lagoon, bridge to Domain



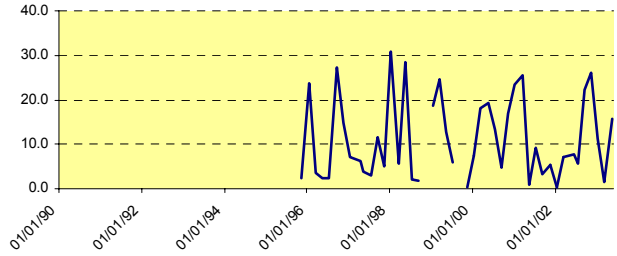
Matata Lagoon, bridge to Domain
Salinity o/oo



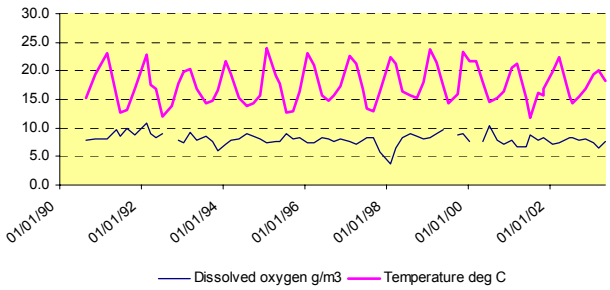
Kaituna/Maketu Estuary diversion structure



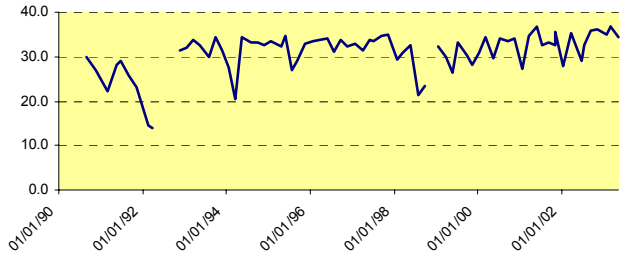
Kaituna/Maketu diversion structure
Salinity o/oo



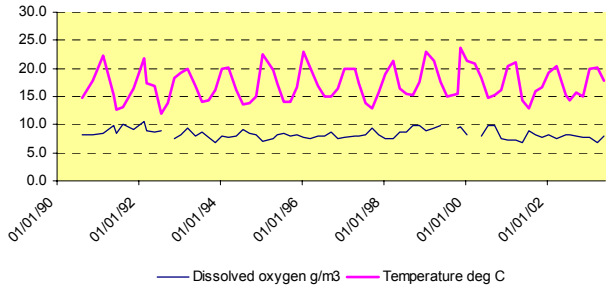
Maketu Estuary, boat ramp



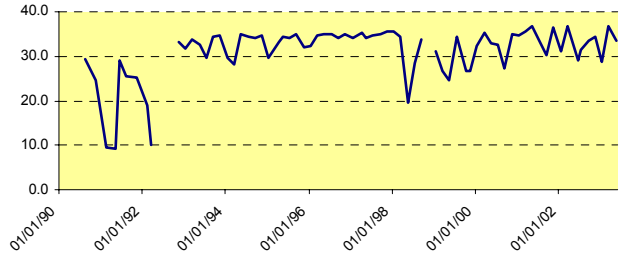
Maketu Estuary, boat ramp
Salinity o/oo



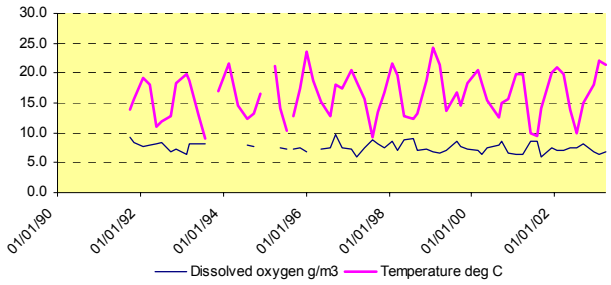
Little Waihi Estuary



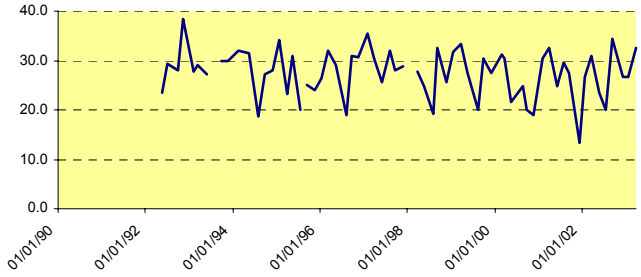
Little Waihi Estuary
Salinity o/oo



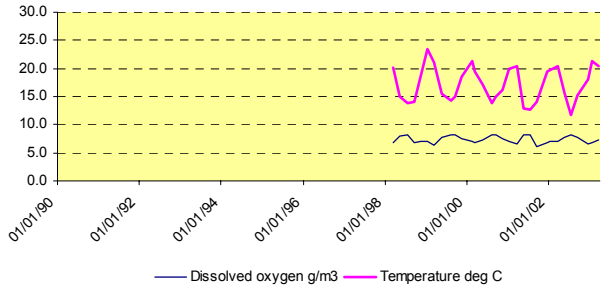
Maungatapu Bridge, Tauranga Harbour



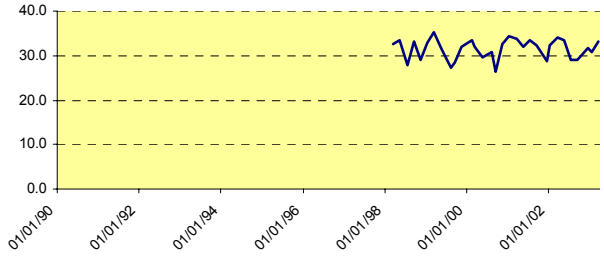
Maungatapu Bridge, Tauranga Harbour
Salinity o/oo



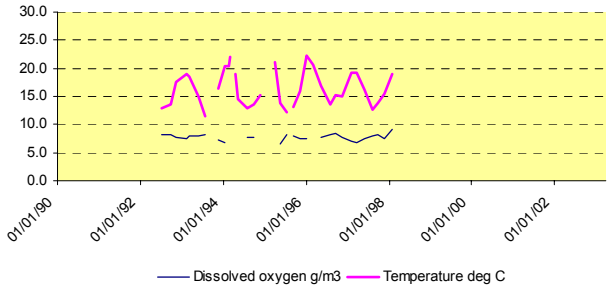
Toll Bridge Marina, Tauranga Harbour



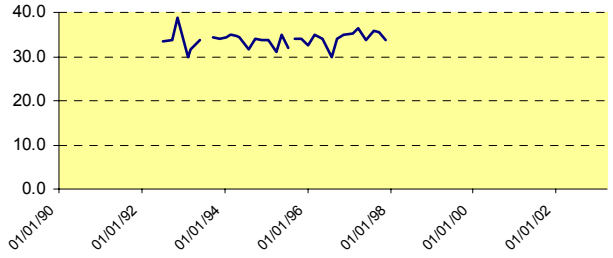
Toll Bridge Marina, Tauranga Harbour
Salinity o/oo



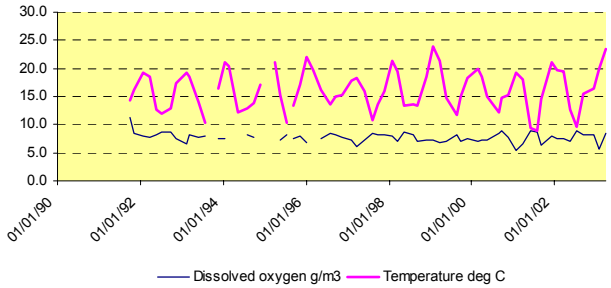
Tauranga Yacht & Boat Club



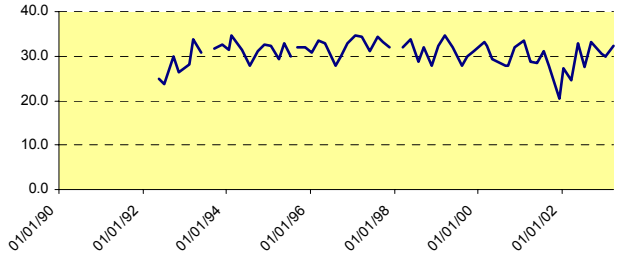
Tauranga Yacht & Boat Club, Tauranga Harbour
Salinity o/oo



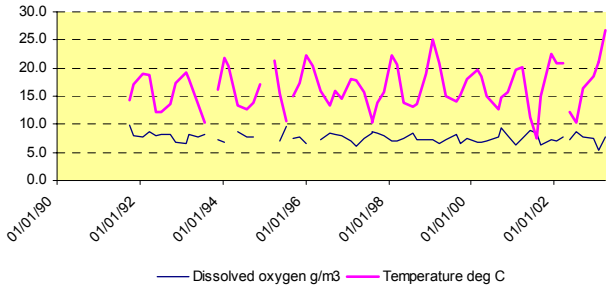
Otumoetai, Tauranga Harbour



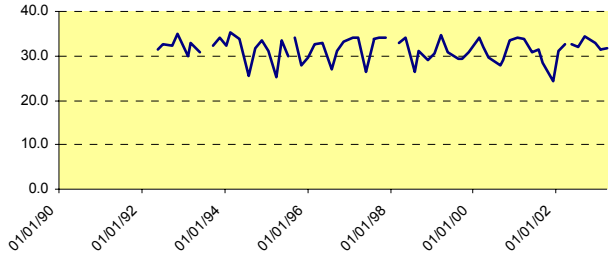
Otumoetai, Tauranga Harbour
Salinity o/oo



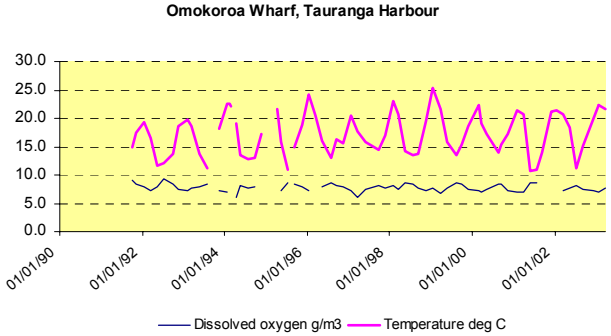
Pitua Rd, Te Puna, Tauranga Harbour



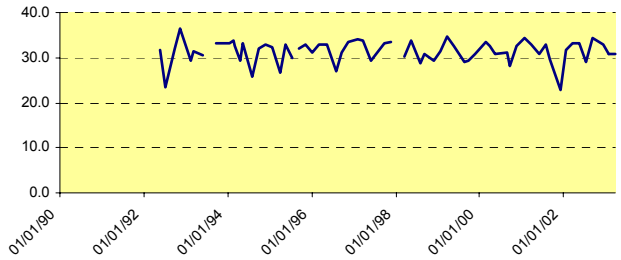
Pitua Rd, Te Puna, Tauranga Harbour
Salinity o/oo



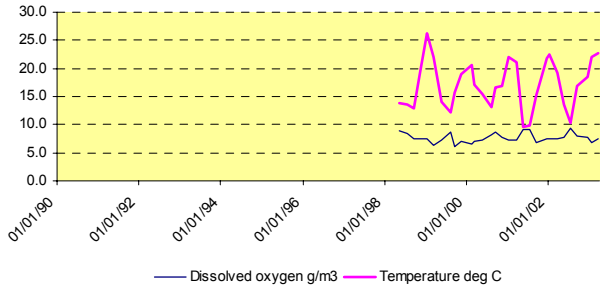
Omokoroa Wharf, Tauranga Harbour



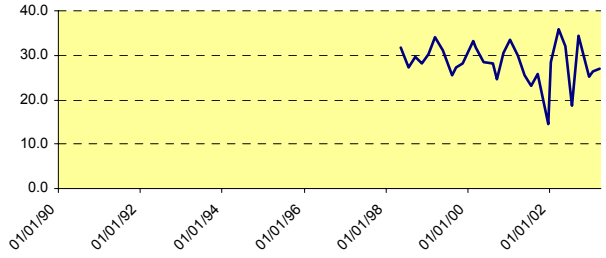
Omokoroa Wharf, Tauranga Harbour
Salinity o/oo



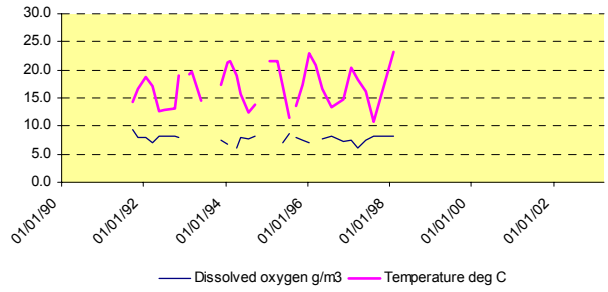
Pahoia Beach Rd, Tauranga Harbour



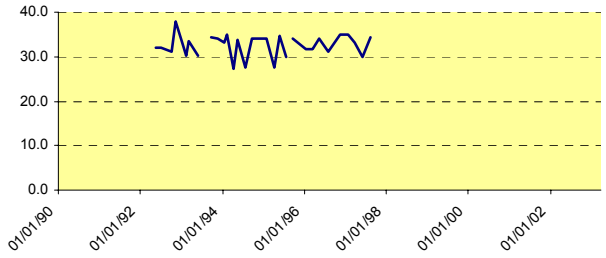
Pahoia Beach Rd, Tauranga Harbour
Salinity o/oo



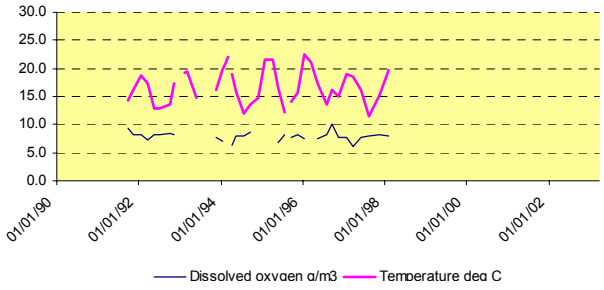
Mid Harbour, Tauranga Harbour



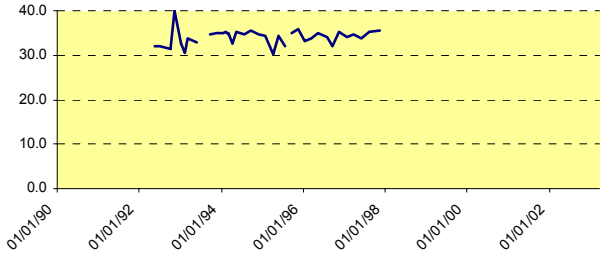
Mid Harbour, Tauranga Harbour
Salinity o/oo



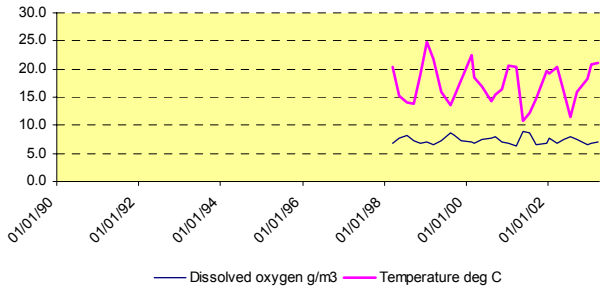
Matakana, Tauranga Harbour



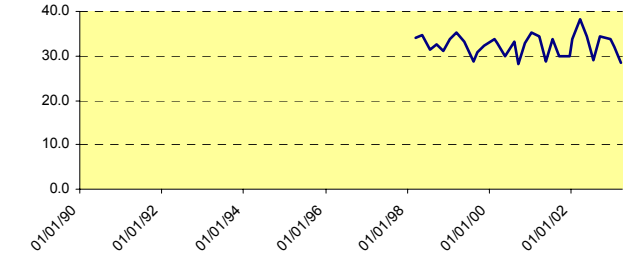
Matakana, Tauranga Harbour
Salinity o/oo



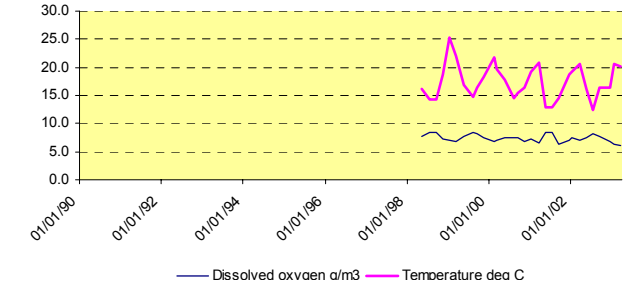
Kauri Point Jetty, Tauranga Harbour



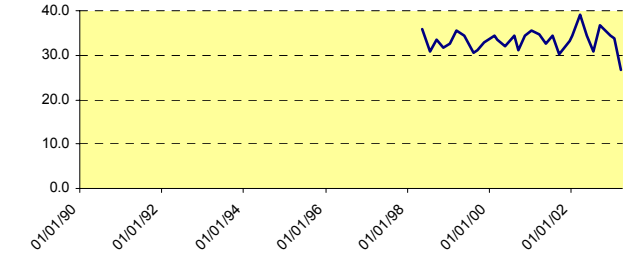
Kauri Point Jetty, Tauranga Harbour
Salinity o/oo



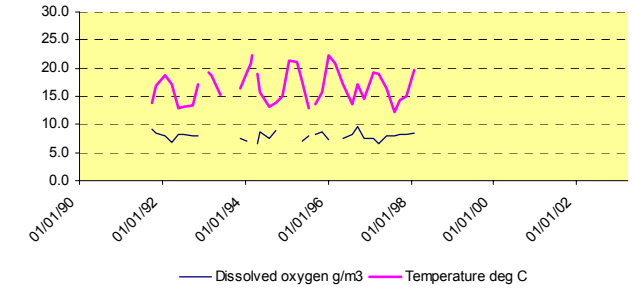
Tanners Point Jetty, Tauranga Harbour



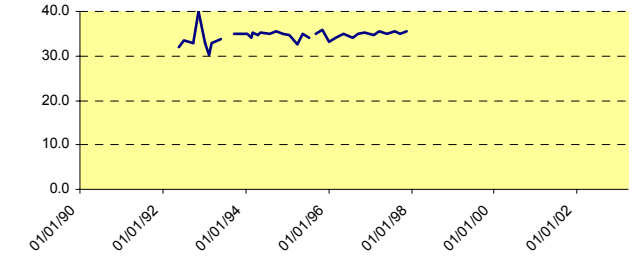
Tanners Point Jetty, Tauranga Harbour
Salinity o/oo



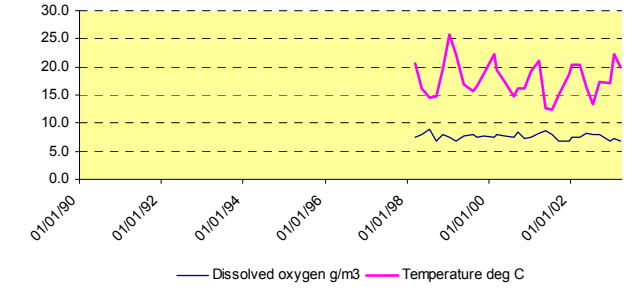
Bowentown, Tauranga Harbour



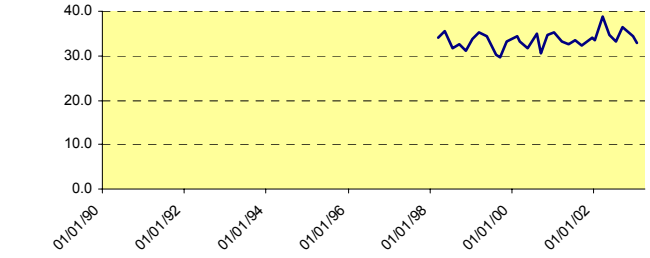
Bowentown, Tauranga Harbour
Salinity o/oo



Bowentown Boat Ramp, Tauranga Harbour



Bowentown boat ramp, Tauranga Harbour
Salinity o/oo



3.2 Phosphorus and Nitrogen

Note different scales on the 'Y' axis when comparing data.

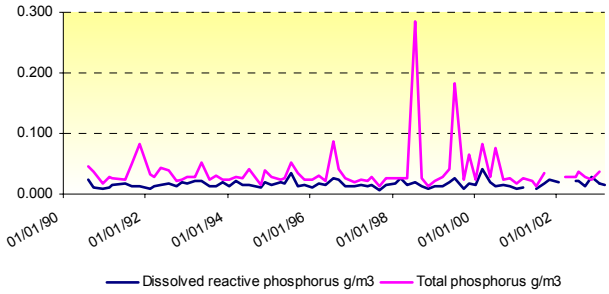
Estuarine water is influenced by freshwater flows from the land and the inflowing coastal waters. Harbours like Ohiwa and Tauranga have large inputs of coastal water. Although the nutrient levels in these waters are low the quantity of nitrogen and phosphorus are greater than that entering from the land because of the volume difference. For example, the sea lettuce blooms in Tauranga Harbour are known to be correlated with El Nino conditions, when persistent westerly winds tend to drive coastal water off-shore. In these conditions the deeper oceanic water up-wells to replace the coastal water bringing with it slightly more nutrient rich water which then enters the estuaries. It is considered that this nutrient source in combination with the prevailing climate conditions triggers the sea lettuce blooms (Park, 1996 & 2000)

Matata Lagoon has the highest nutrient levels reflecting its freshwater status and the low flushing rate.

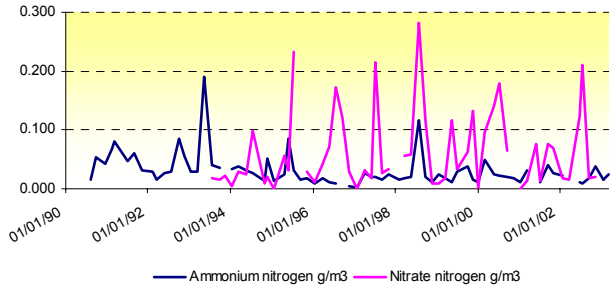
Nitrate nitrogen levels in freshwater generally have a seasonal pattern, with high levels in the winter when the soluble nitrate tends to be less utilised by growing plants and is flushed from the soil by increased drainage rates. This pattern can be detected in the data at some sites. Other influences are apparent at sites like the Kaituna/Maketu diversion structure, where discharges from urban and industrial sources occur.

No apparent trends show in the data, as the length of time that the series represents is still short for trend analysis. Levels of nutrients in the waters are not considered to be of concern.

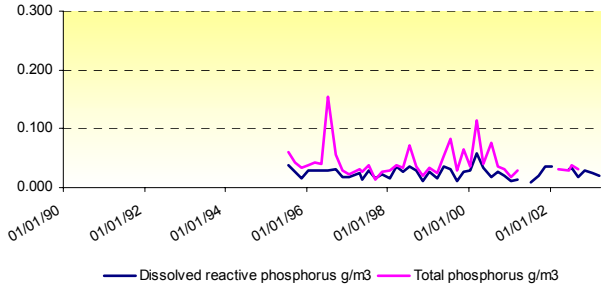
Kukumoa, Opotiki Estuary



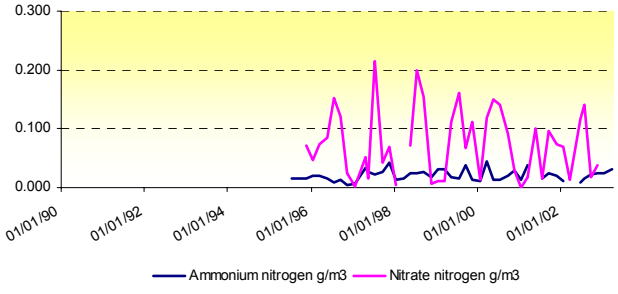
Kukumoa, Opotiki Estuary



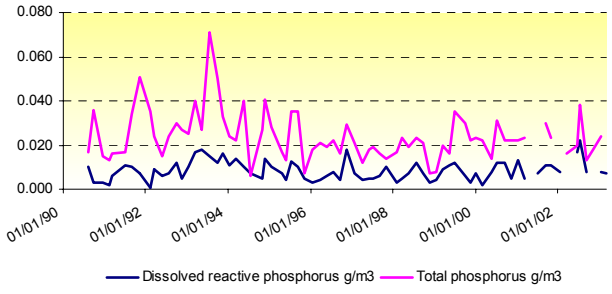
Opotiki Wharf, Opotiki Estuary



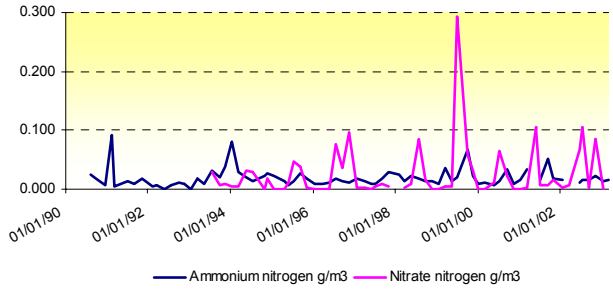
Opotiki Wharf, Opotiki Estuary



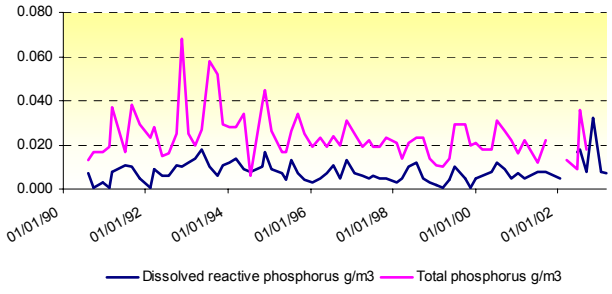
Ruatuna Rd, Ohiwa Harbour



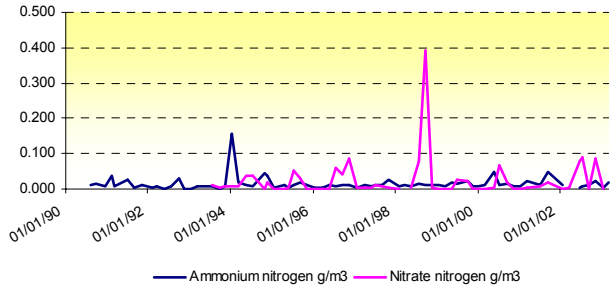
Ruatuna Rd, Ohiwa Harbour

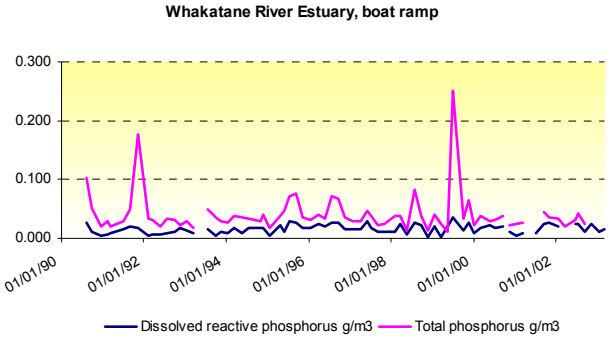


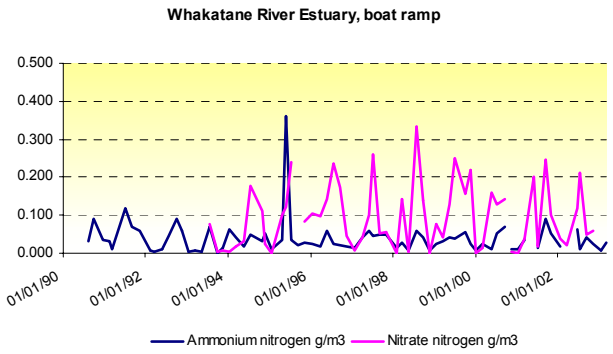
Port Ohope Wharf, Ohiwa Harbour

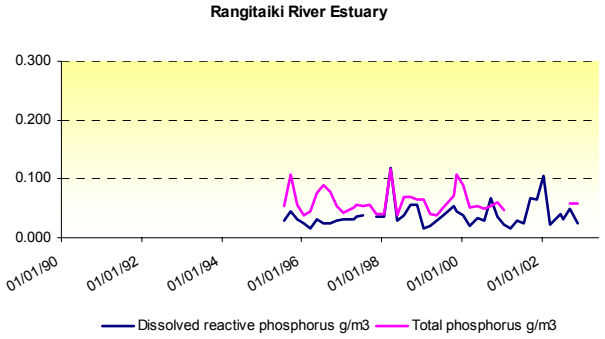


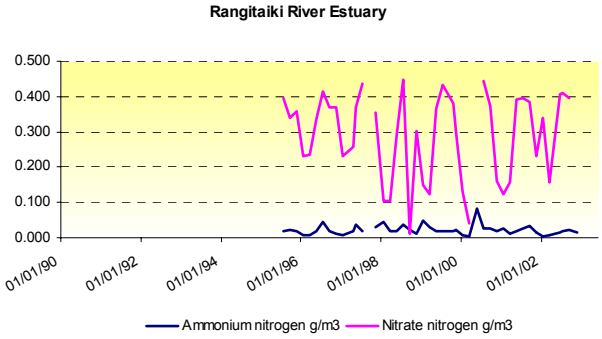
Port Ohope Wharf, Ohiwa Harbour

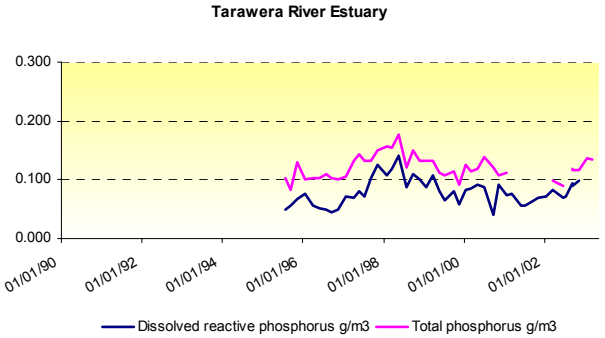


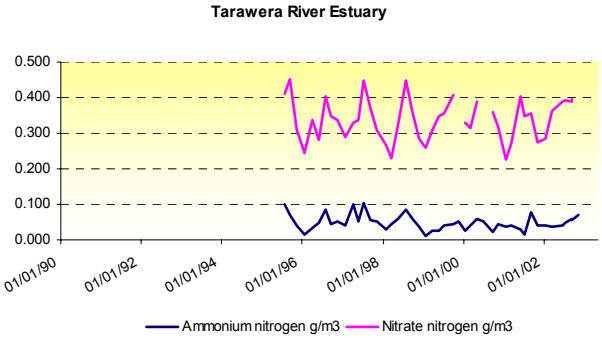

Whakatane River Estuary, boat ramp
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Dissolved reactive phosphorus g/m3
Total phosphorus g/m3

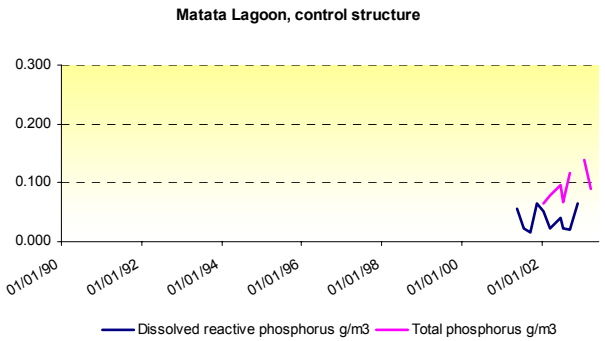

Whakatane River Estuary, boat ramp
0.500
0.400
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Ammonium nitrogen g/m3
Nitrate nitrogen g/m3

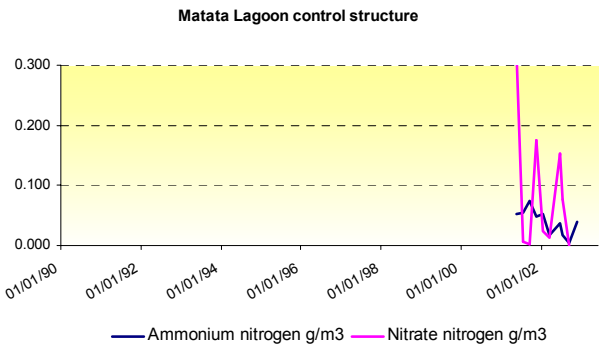

Rangitaiki River Estuary
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Dissolved reactive phosphorus g/m3
Total phosphorus g/m3


Rangitaiki River Estuary
0.500
0.400
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Ammonium nitrogen g/m3
Nitrate nitrogen g/m3

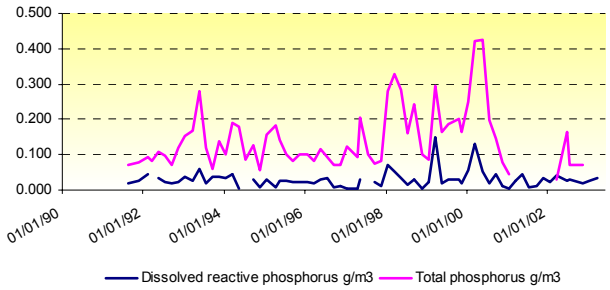

Tarawera River Estuary
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Dissolved reactive phosphorus g/m3
Total phosphorus g/m3


Tarawera River Estuary
0.500
0.400
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Ammonium nitrogen g/m3
Nitrate nitrogen g/m3

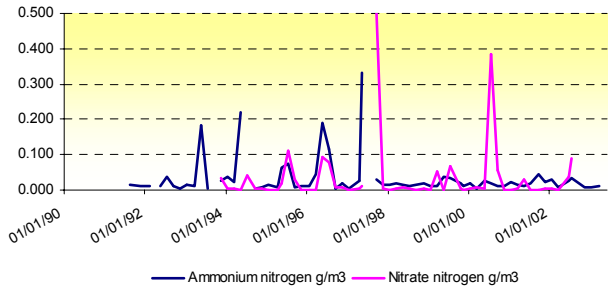

Matata Lagoon, control structure
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Dissolved reactive phosphorus g/m3
Total phosphorus g/m3


Matata Lagoon control structure
0.300
0.200
0.100
0.000
01/01/90
01/01/92
01/01/94
01/01/96
01/01/98
01/01/00
01/01/02
Ammonium nitrogen g/m3
Nitrate nitrogen g/m3

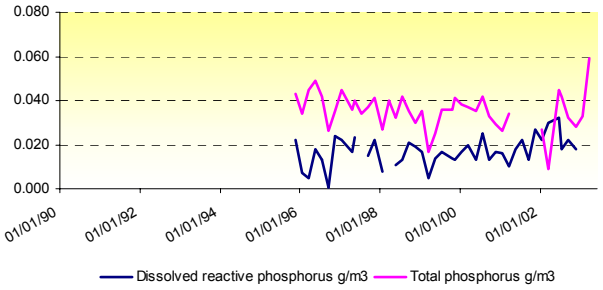
Matata Lagoon, bridge to Domain



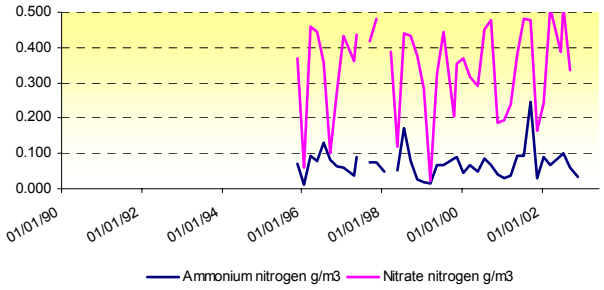
Matata Lagoon, bridge to Domain



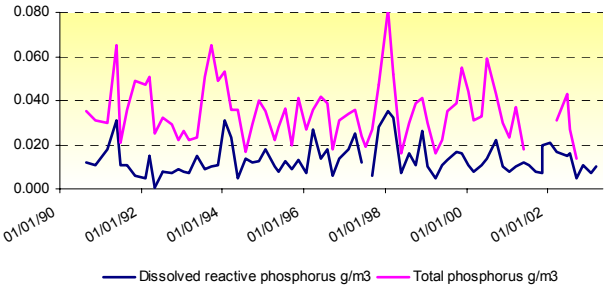
Kaituna/Maketu diversion structure



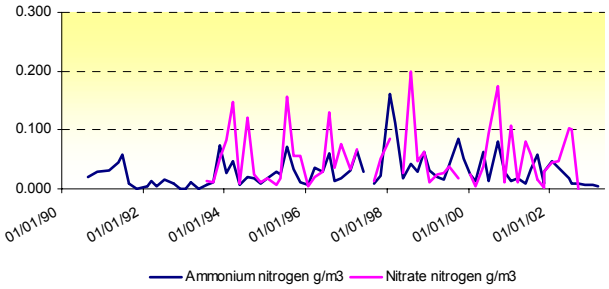
Kaituna/Maketu diversion structure



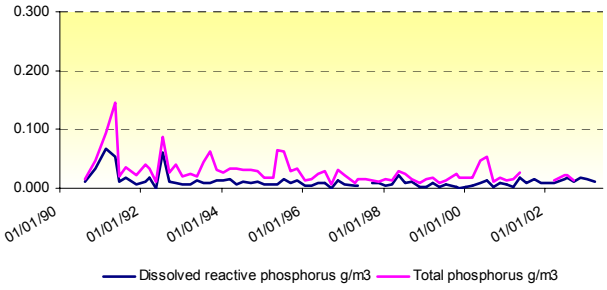
Maketu Estuary, boat ramp



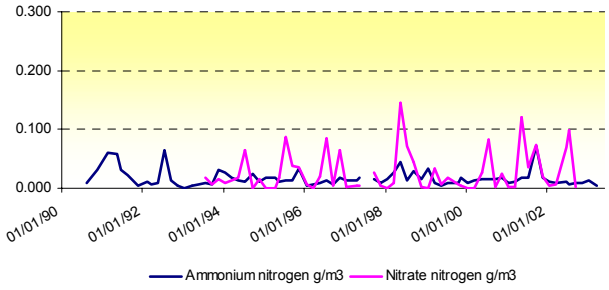
Maketu Estuary, boat ramp



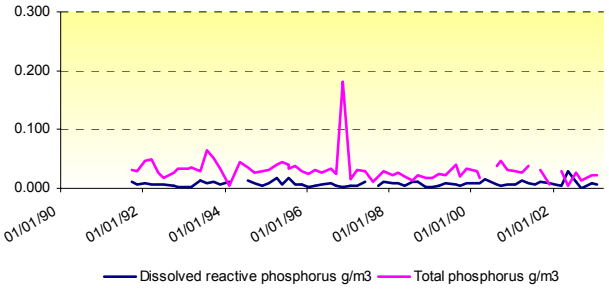
Little Waihi Estuary



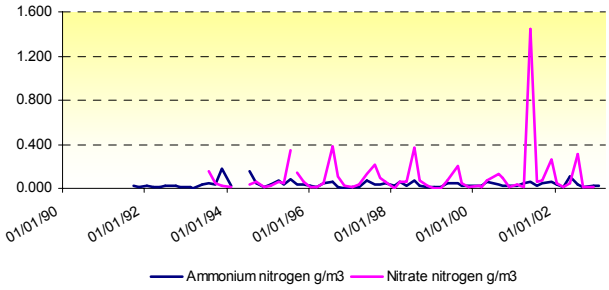
Little Waihi Estuary



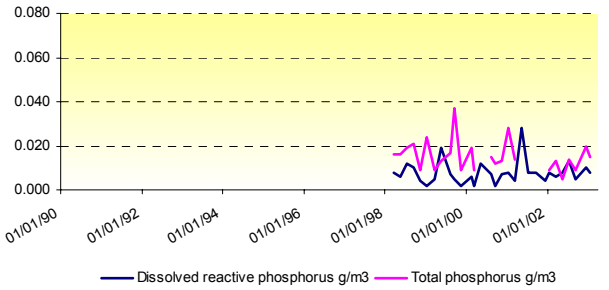
Maungatapu Bridge, Tauranga Harbour



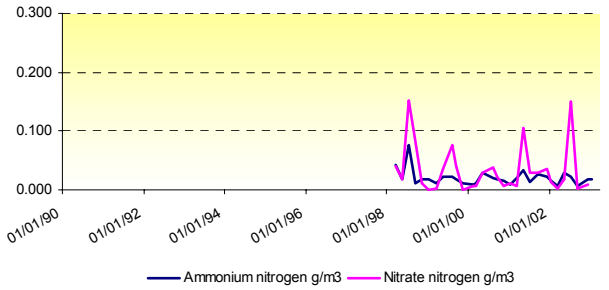
Maungatapu Bridge, Tauranga Harbour



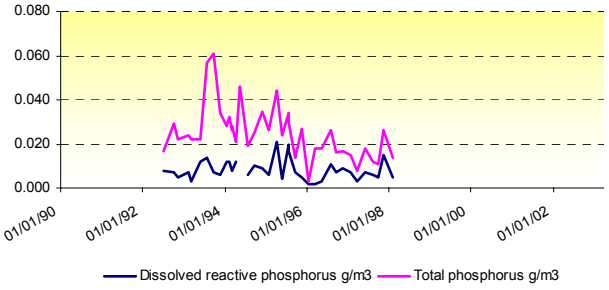
Toll Bridge Marina, Tauranga Harbour



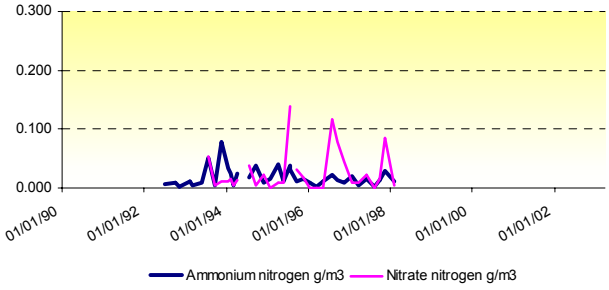
Toll Bridge Marina, Tauranga Harbour



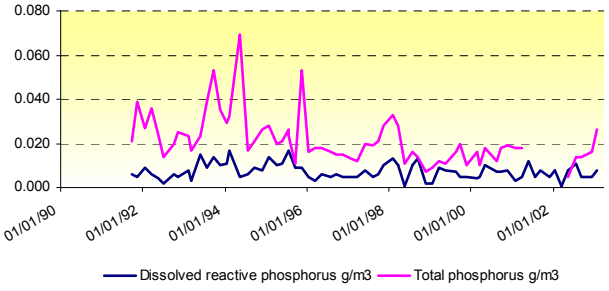
Tauranga Yacht & Boat club, Tauranga Harbour



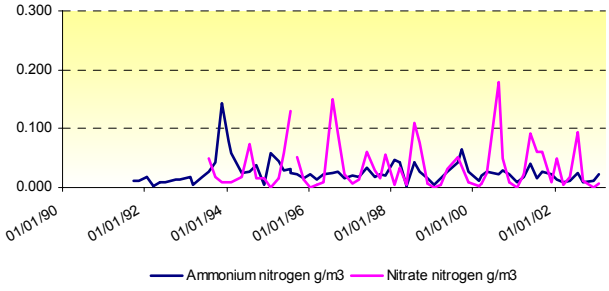
Tauranga Yacht & Boat Club, Tauranga Harbour



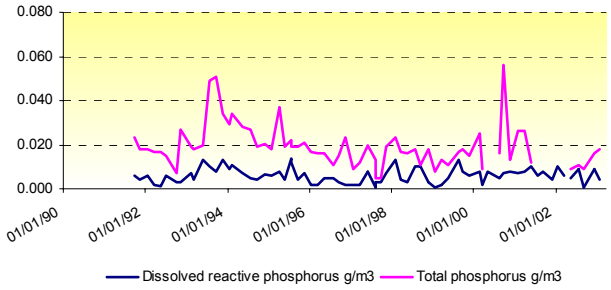
Oumoetai, Beach Rd, Tauranga Harbour



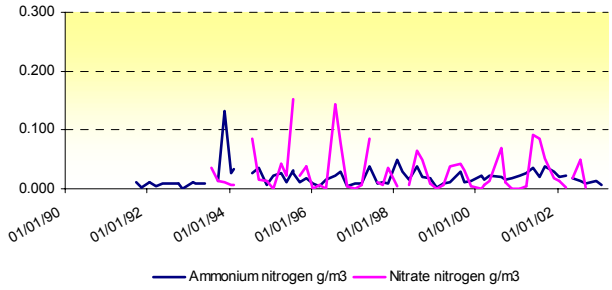
Otumoetai, Beach Rd, Tauranga Harbour



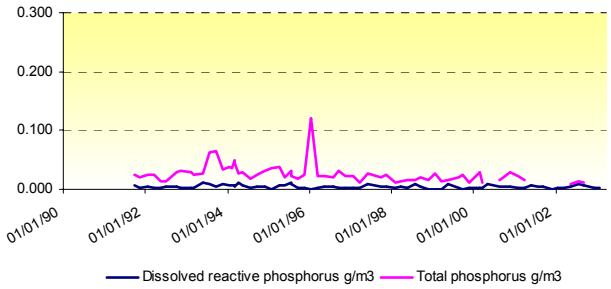
Te Puna, Pitua Rd, Taurnaga Harbour



Te Puna, Pitua Rd, Tauranga Harbour



Omokoroa Wharf, Tauranga Harbour



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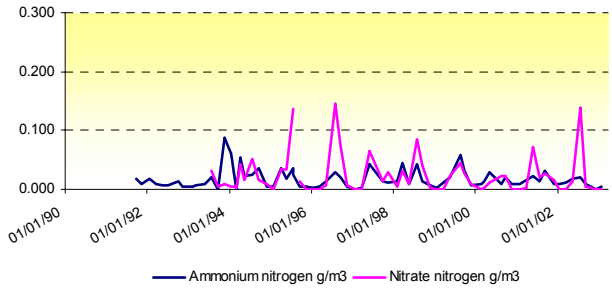

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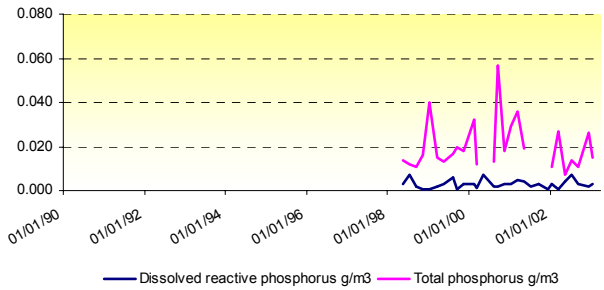
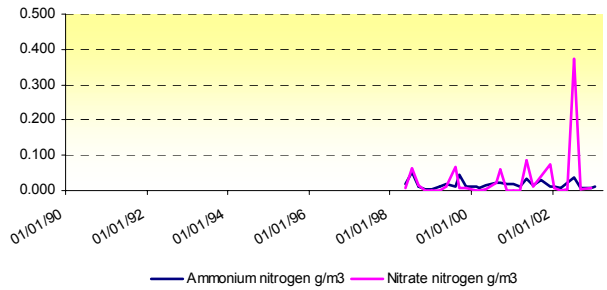
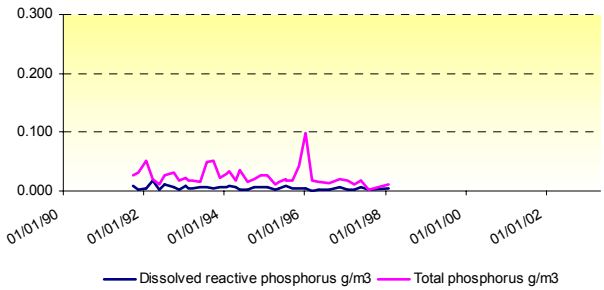


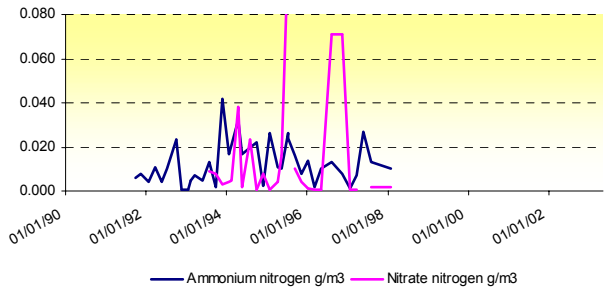
Pahoia Beach Rd, Tauranga Harbour



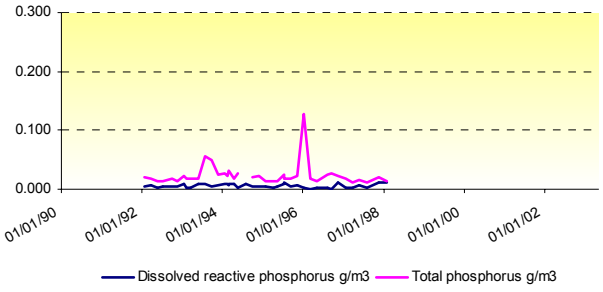
Mid Harbour, Tauranga Harbour



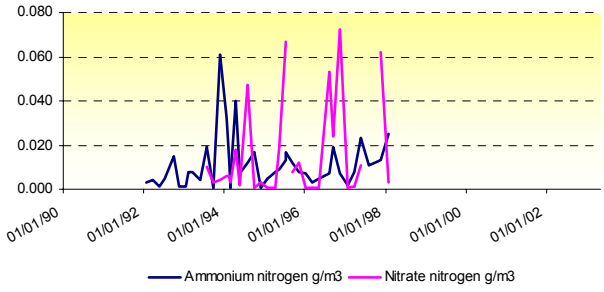
Mid Harbour, Tauranga Harbour



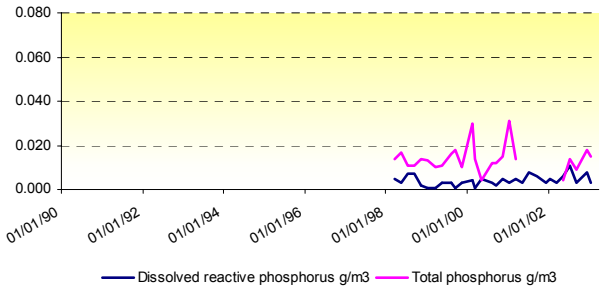
Matakana, Tauranga Harbour



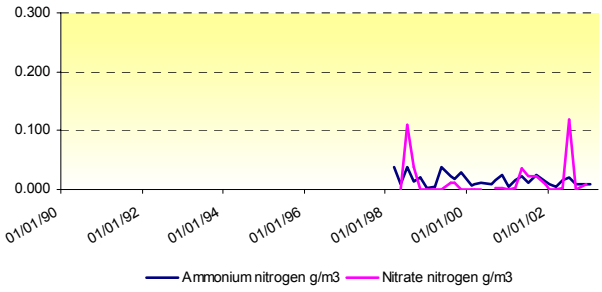
Matakana, Taurnaga Harbour



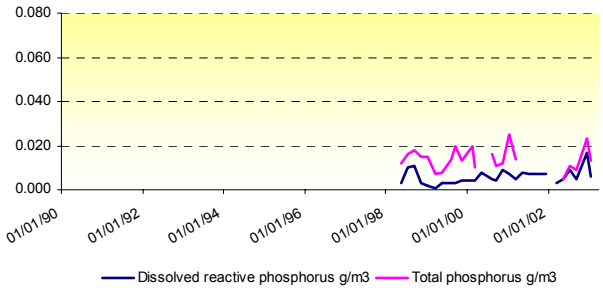
Kauri Point Jetty, Tauranga Harbour



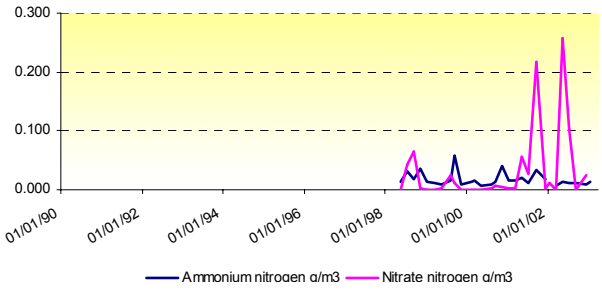
Kauri Point Jetty, Tauranga Harbour



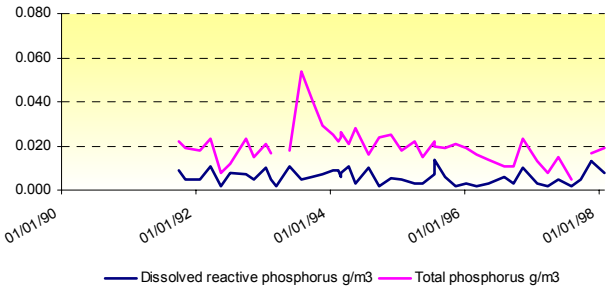
Tanner's Point Jetty, Tauranga Harbour



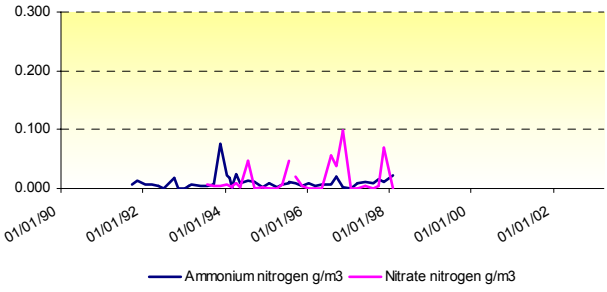
Tanner's Point Jetty, Tauranga Harbour



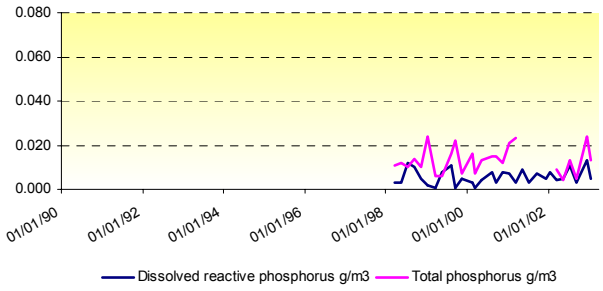
Bowentown, Tauranga Harbour



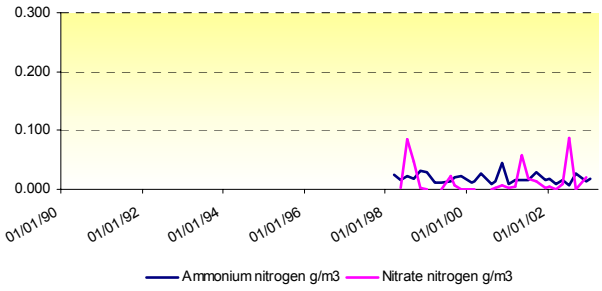
Bowentown, Tauranga Harbour



Bowentown, boat ramp, Tauranga Harbour



Bowentown boat ramp, Tauranga Harbour



3.3 Bacteria

Appendix II shows bacterial levels of faecal coliforms, enterococci and Escherichia coli (E coli). Only enterococci are plotted in the following figures, as the bathing guideline refers to enterococci. The bathing guideline of 126 enterococci/100ml has been plotted with the data.

Note a logarithmic scale is used, with each diversion on the 'Y' axis increasing by 10 times. Occasionally the scale is increased to accommodate higher values.

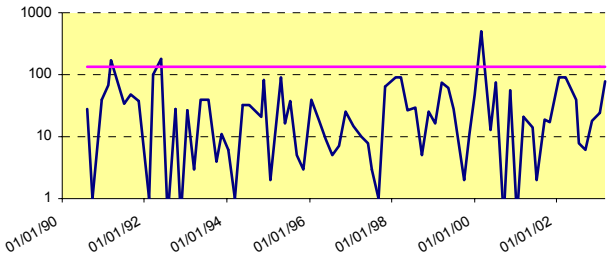
Table 2 summarises the data to demonstrate compliance with the bacterial guideline of the Regional Coastal Environment Plan.

Table 2 Comparison of enterococci data for regional monitoring estuarine quality with the bacterial guideline of the Regional Coastal Environment Plan.

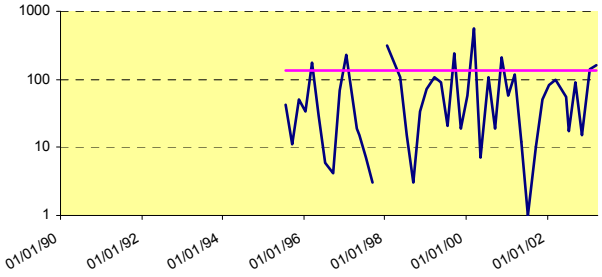
Comply	Minor excursion	Major excedence
Ohiwa Harbour	Opotiki Estuary	Matata Lagoon
Whakatane River	Rangitaiki River	
Little Waihi Estuary	Tarawera River	
Tauranga Harbour	Kaituna/Maketu Estuary	

Matata Lagoon shows high bacterial levels. Observation tends to link the high bacterial levels to the presence of waterfowl.

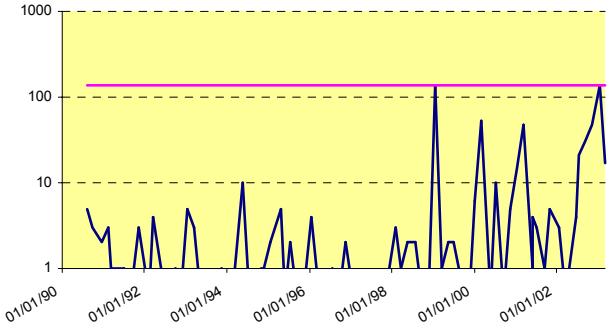
Kukumoa, Opotiki Estuary
Enterococci n/100ml



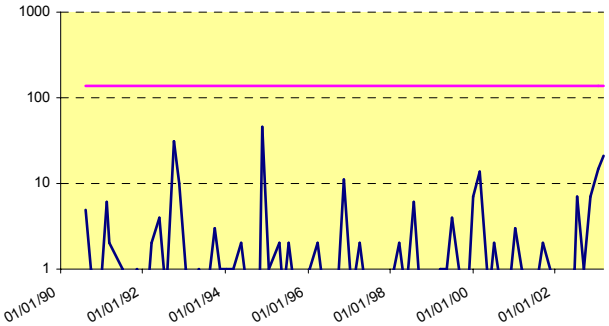
Opotiki Wharf, Opotiki
Enterococci n/100ml



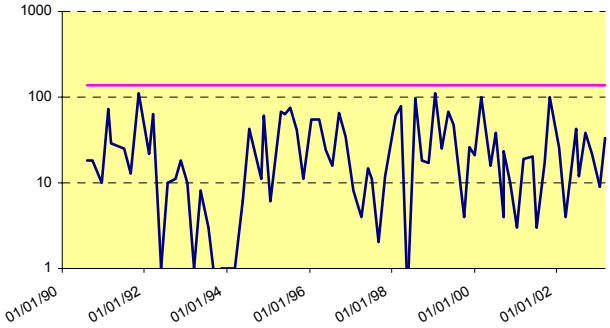
Ruatuan Rd, Ohiwa Harbour
Enterococci n/100ml



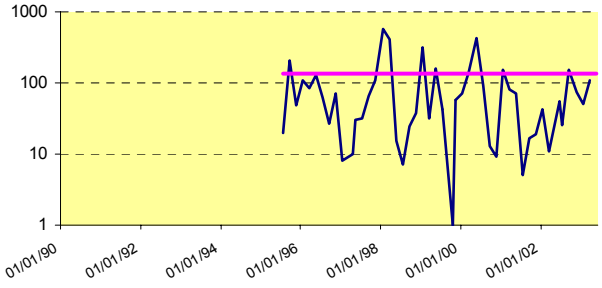
Port Ohope Wharf, Ohiwa Harbour
Enterococci n/100ml



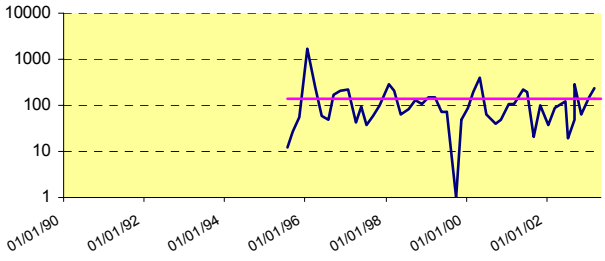
Whakatane River Estuary
Enterococci n/100ml



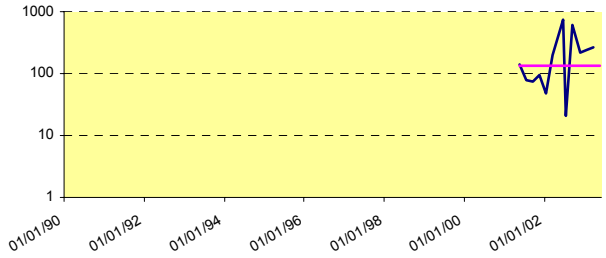
Rangitaiki River Estuary
Enterococci n/100ml



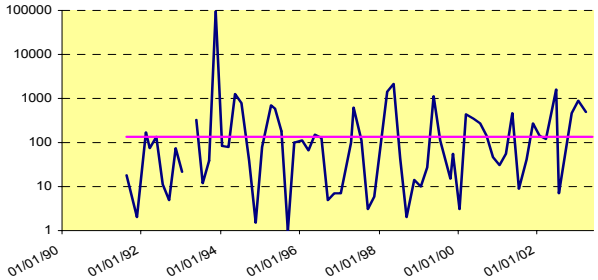
Tarawera River Estuary
Enterococci n/100ml



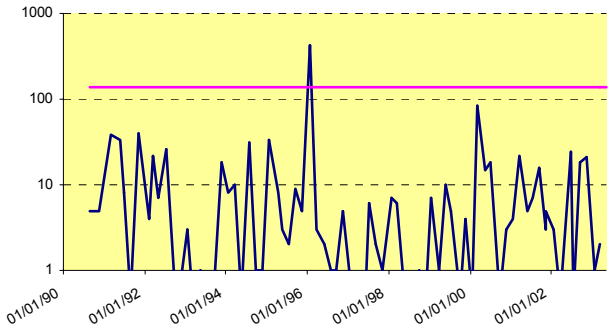
Matata Lagoon, control structure
Enterococci n/100ml



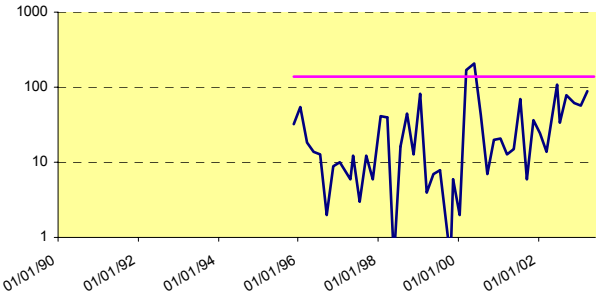
Matata Lagoon, bridge to Domain
Enterococci n/100ml



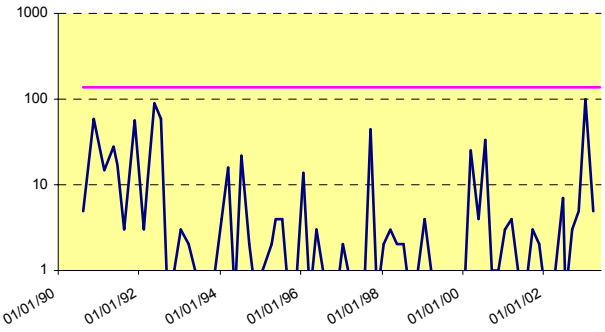
Maketu Estuary boat ramp
Enterococci n/100ml



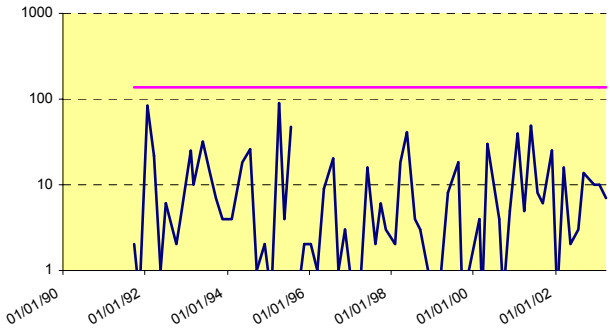
Kaituna/Maketu diversion structure
Enterococci n/100ml



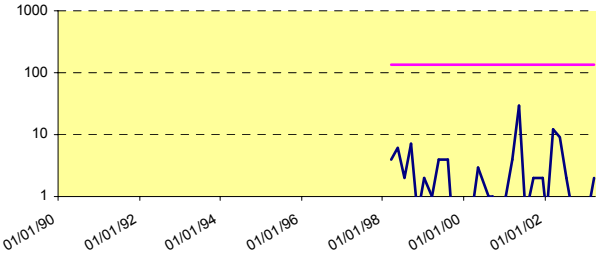
Little Waihi Estuary
Enterococci n/100ml



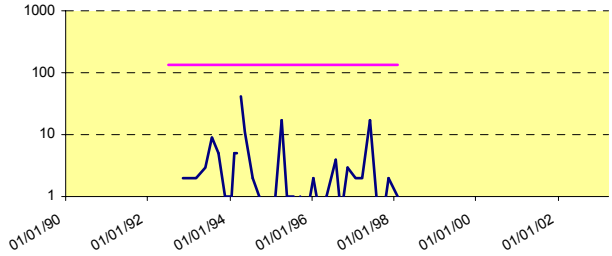
Maungatapu Bridge, Tauranga Harbour
Enterococci n/100ml



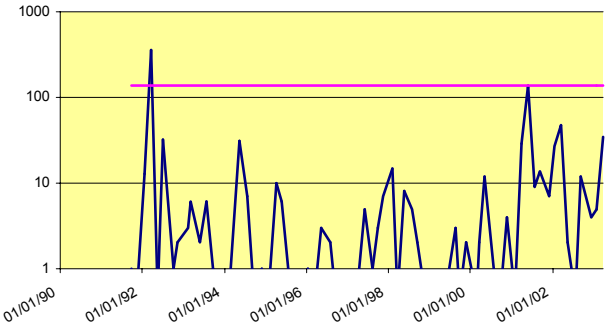
Toll Bridge Marina, Tauranga Harbour
Enterococci n/100ml



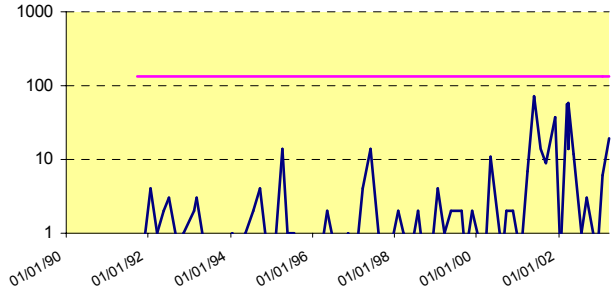
Tauranga Yacht & Boat Club, Tauranga Harbour
Enterococci n/100ml



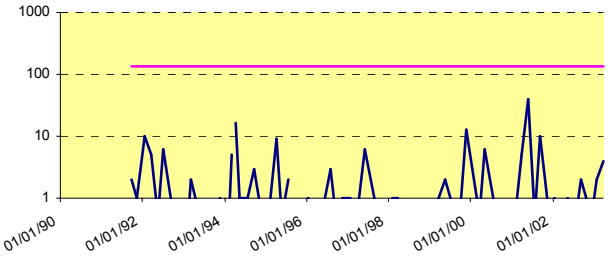
Otumoetai, Beach Rd, Tauranga Harbour
Enterococci n/100ml



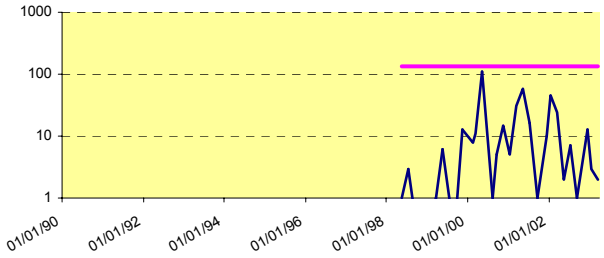
Te Puna, Pitua Rd, Tauranga Harbour
Enterococci n/100ml



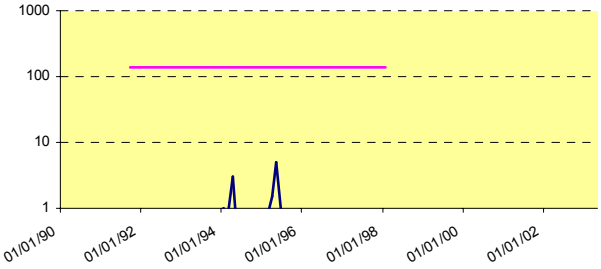
Omokoroa Wharf, Tauranga Harbour
Enterococci n/100ml



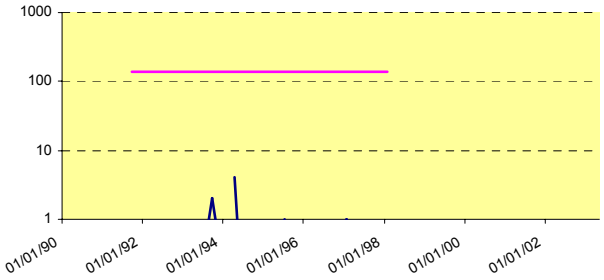
Pahoia Beach Rd, Tauranga Harbour
Enterococci n/100ml



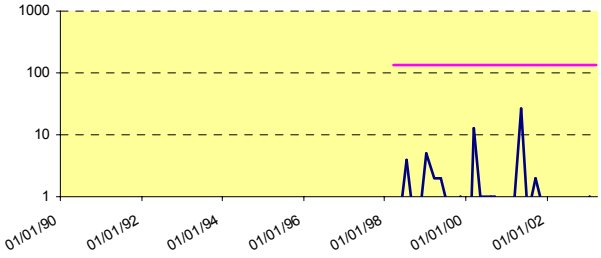
Mid Harbour, Tauranga Harbour
Enterococci n/100ml



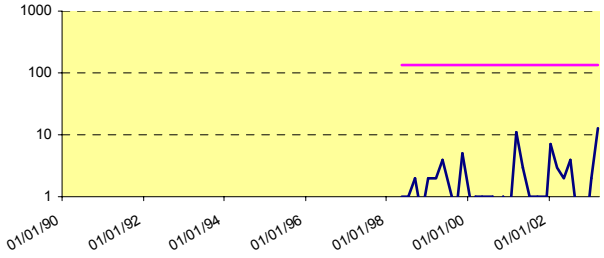
Matakana, Tauranga Harbour Enterococci n/100ml



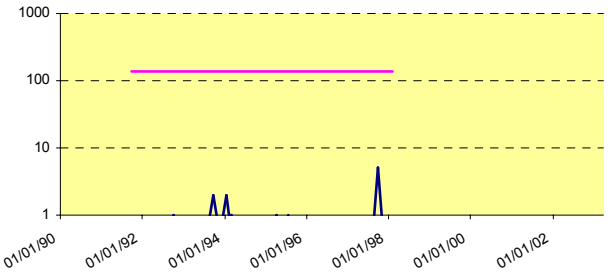
Kauri Point Jetty, Tauranga Harbour
Enterococci n/100ml



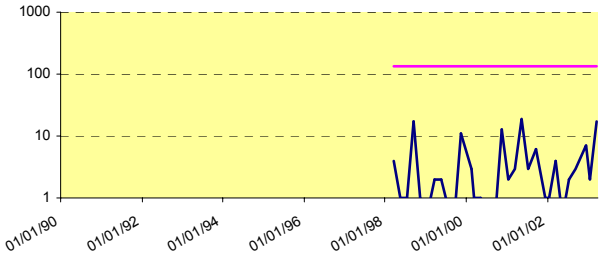
Tanner's Point Jetty, Tauranga Harbour
Enterococci n/100ml



Bowentown, Tauranga Harbour
Enterococci n/100ml

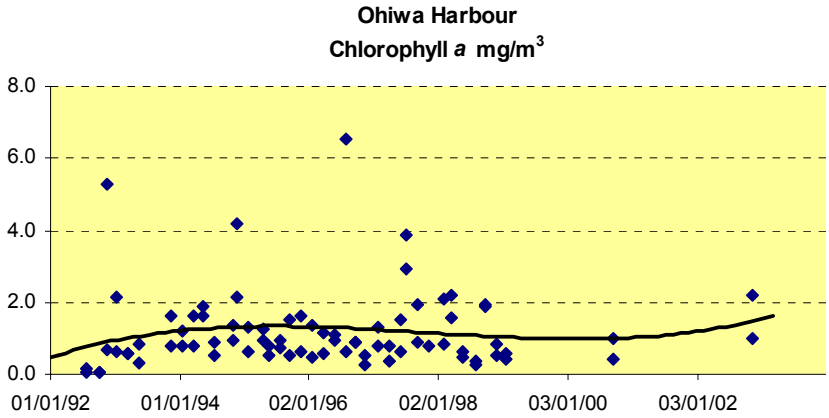


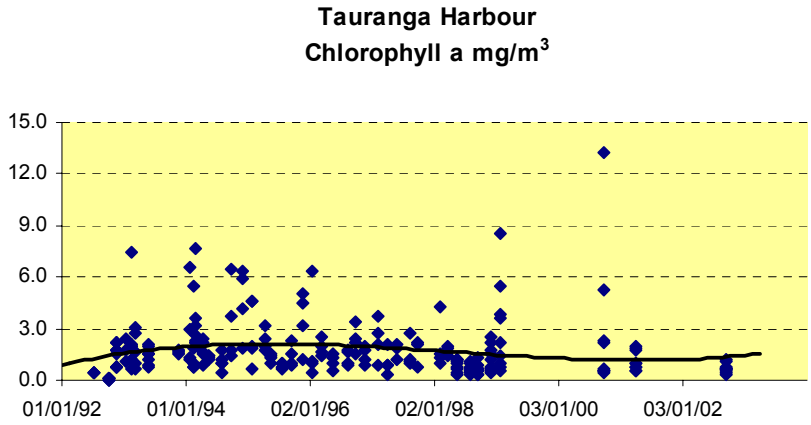
Bowentown boat ramp, Tauranga Harbour
Enterococci n/100ml



3.4 Chlorophyll *a*

Chlorophyll *a* data has been plotted for all the sites in each of Ohiwa Harbour and Tauranga Harbour, to examine for any trends in harbour productivity. No trend is apparent but Tauranga Harbour demonstrates a slightly higher chlorophyll a level and higher individual spikes at certain locations. Median chlorophyll *a* for Tauranga Harbour is 1.3 mg/m^3 and for Ohiwa Harbour 0.9 mg/m^3.





Chapter 4: **Summary**

The report highlights that bacterial contamination is the major water quality issue for Bay of Plenty estuaries. In this respect the estuaries contrast the Rotorua lakes where nutrient issues are of paramount importance.

Generally the estuaries of the Bay of Plenty are of high to good quality. However, this is most likely due to dilution by coastal waters. The sites with minor excursions from the bathing guideline have greater freshwater influences. In these catchments, agricultural, industrial and urban sources contribute bacteria to the waterways.

Matata Lagoon has the poorest quality, probably due to the large waterfowl population.

Monitoring at 2 monthly intervals will continue at the 21 estuarine sites.

References

Park S G (1996): Sea lettuce monitoring in the Bay of Plenty – changes in abundance, nutrients and environmental influences for the period July 1992 – June 1996. Environment Bay of Plenty Environmental Report 96/23.

Park S G (2000): Benthic Macrofauna Monitoring. Environment Bay of Plenty Environmental Report 2000/15.

Appendices

Appendix I – Laboratory Methods

Chlorophyll *a*	spectrofluorophotometer
Conductivity	APHA Method 2510
Dissolved oxygen	APHA Method 4500-0G YSI Temp & DO meter
Dissolved reactive phosphorus	NWASCO Misc Pub No 38 (1982) Antimony, phosphate molybdate
E coli	APHA Method 9213D
Enterococci	APHA Method 9230C
Faecal coliform	APHA 9222D
Ammonium nitrogen colorimetry	NWASCO Misc Pub No 38 (1982) Phenolhypochlorite
Nitrate nitrogen	Total oxidised nitrogen. Flow injection analyser, APHA 4500
pH	APHA Method 4500
Salinity	YSI SCT
Suspended solids	APHA Method 2540D
Temperature	YSI Temp & DO Meter
Total phosphorus digestion.	NWASCO Misc Pub No 38 (1982) Acid per sulphate
Turbidity	APHA Method 2130B – Hach 2100 N

Appendix II – Analytical Results