4 Current Pressures - Water, Air and Soil Quality

Beach water quality

Beach water quality is now monitored weekly by Auckland City Council. Port FitzRoy, Tryphena and Medlands were initially chosen and were monitored from the 99/00 season until 04/05. Since 05/06 however samples have been taken at Pah Beach, Mulberry Grove and Okupu. Sampling and analysis follows Ministry for the Environment (MfE)[i] guidelines (Applicable Water Quality Standards 2003[ii]) set out as "health risk" levels for disease-causing organisms in Table 4.1:

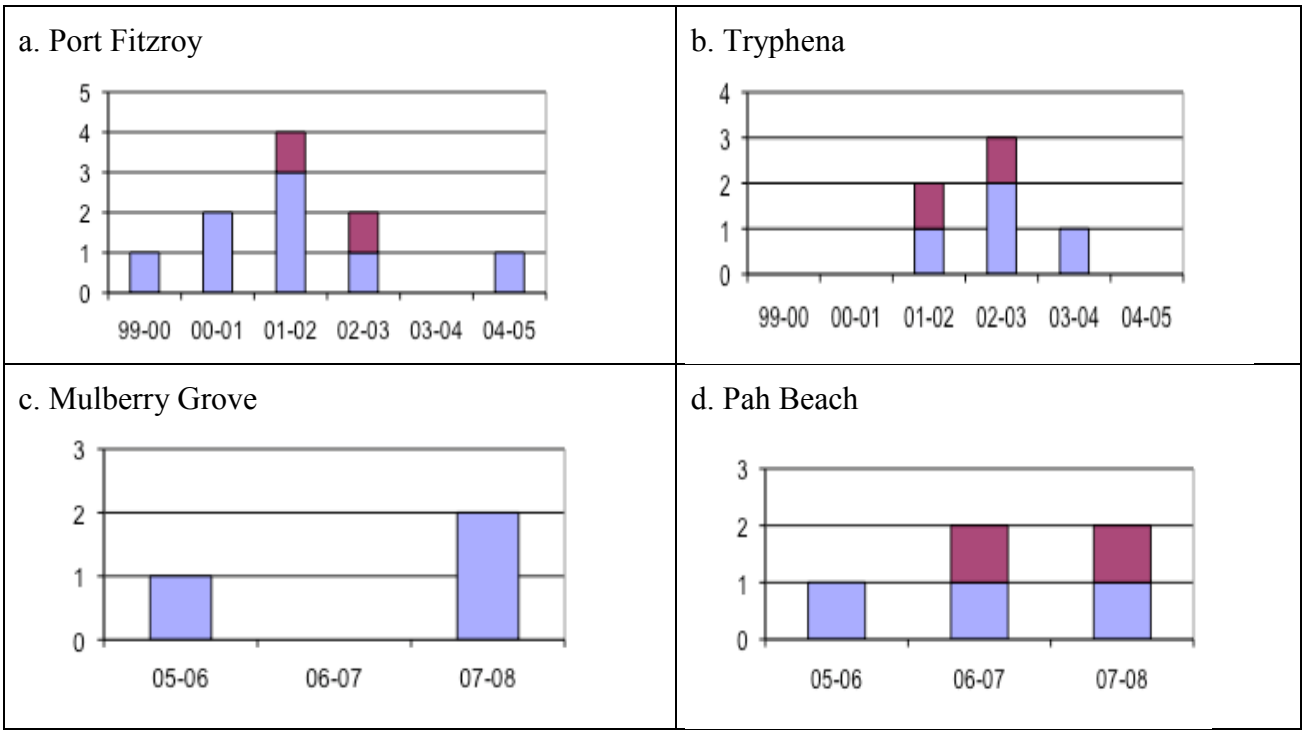
Table 4.1 Applicable Water Quality Standards MfE

Type	Measure	Alert level	Action level
Freshwater	No of *E. Coli*/100ml	260*	550*
Marine water	No *Enterococci*/100ml	140*	280**

* Single sample exceeding this value
** Two consecutive single samples exceeding this value

The following graphs (Fig 4.1) show the number of times the MfE 140 'Alert' level was exceeded for each beach over the monitoring seasons. Okupu has had no 'Alerts' and hence no graph applies. The blue 'Alert' part of the column shows how many times the sea water sample exceeded the guideline and resulted in a second test being carried out; the red 'Action' part of the column shows how many times the second re-test sample also exceeded the guideline and thus action, such as the erection of a sign on the beach, followed.

Fig 4.1 Beach water quality: MfE 'Alert' (blue) and 'Action' (red) levels of *Enterococci* on Great Barrier Island beaches. Vertical axes are number of times the levels were exceeded (additive). Horizontal axes are monitoring periods. All sites were not monitored in all years. *Data from S. Tang Auckland City Council. Available also from 'Safeswim' website.*



The 140 guideline used here is the strictest of the Ministry's guidelines: beach water should not exceed 140 *Enterococci* per 100mls of seawater in a single sample. A single sample above the

guideline limits does not prove that health is at risk as many factors, such as heavy rain, dogs, birds or even seaweed can affect a single sample. However MfE guidelines recommend that when levels of *Enterococci* exceed limits in the water, recreational activities should not occur.

In February 2009 *Enterococci* levels exceeded the alert (140) guideline on two of the four monitoring days at Mulberry Grove. Although retesting gave lower values, taken with data from the streams (below), and extensive algal blooms in the bay,[iii] these readings are cause for concern (see Fig 1.3a in the Introduction).

Fresh water quality

The standard MfE guidelines for the health quality of freshwater are counts of *Escherichi coli* (*E. coli*) per 100ml water sample. Counts exceeding 260 are cause for concern ('Alert' level), while consecutive counts > 550 are cause for 'Action'.

The Auckland Regional Council has no freshwater monitoring sites on Great Barrier Island,[iv] nor are there any WaiCare community groups operating. Auckland City Council currently carries out fresh water monitoring (in conjunction with its beach water checks) at four streams in the populated areas around Tryphena harbour (two streams at Mulberry Grove, and one at each of Gooseberry Flat and Pah Beach). In the past other streams have also been monitored. The results are summarised in Tables 4.2 and 4.3. Medians are the levels exceeded by 50% of the test values.

Table 4.2 Median *E. Coli* counts in Great Barrier Island streams 2003 – 09. Red indicates median values exceeding the 'Action' level (550 *E. coli*/100ml), yellow indicates medians exceeding the 'Alert' (260) level. Figures in brackets are minima and maxima during the sampling period. Periods dictated by available data, but covering the summer holidays.
Raw data from S. Tang, Auckland City Council.

Site	Sep 03 - April 04	Oct 04 - Jun 05	Jun 06 - Jan 07	Nov 07 - Apr 08	Jun 08 - Apr 09
Medlands Oruawharo		**44** (2-3500)			
Medlands Causeway		**970** (2 -4100)	**710** (70-23000)		
Tryphena Pah Beach		**690** (58-4500)	**750** (280-29000)	**1230** (10-23000)	**650** (10-30,000)
Tryphena Gooseberry Flat		**415** (52 -4130)	**270** (45 -27000)	**520** (82-7300)	**206** (10-4500)
Tryphena Mulberry Grove Nth	**520** (5-3100)	**505** 40-2110)	**570** (50-6800)	**600** (120-8100)	**270** (10-6400)
Tryphena Mulberry Grove Sth	**1020** (66 -23200)	**470** (68 -4300)	480 (180-57000)	**465** (136-7000)	**127** (10-6100)
Tryphena Shoal Bay	**133** (13 -1120)				
Port FitzRoy Old Lady Track		**15** (2-1280)			
Port FitzRoy Warren Track		**10** (2-2100)			

The data in Table 4.2 indicate a serious pollution situation. All the streams monitored on Great Barrier Island, in all years, have at least some *E. coli* values above the 'Action' level. In all cases where streams have been monitored for more than one season, median values are generally above the 'Alert' level, and in most cases above the 'Action' level. There is some indication of an improvement at Mulberry Grove South, and Gooseberry Flat in the last sampling period (June 08 – April 09), but even here values above the 'Action' level were reported from some samples. Pah Beach stream remains consistently the most polluted, with median values above the health hazard 'Action' level every year since sampling commenced. The median *E. coli* values are telling, but it is probably more

informative to consider the proportion of samples reaching or exceeding the 'Action' guideline of 550 *E. coli*/100ml.

One hundred, or more, assessments of *E. coli* levels have been made for each of the four Tryphena streams since 2003. Taken over the whole span of records at all seasons (2003 – 2009) the proportion of times the 'Action' level has been exceeded ranges from 30% in Gooseberry Flat stream, to 59% in Pah Beach stream (Table 4.3). Note also that average *E. coli* levels far exceed the 'Action' level in all cases. Examination on a year by year basis indicates a worsening situation at Pah beach.

Table 4.3. Average *Escherichi Coli* levels in four Tryphena streams (2003 – 2009).

Measure	Mulberry Grove South stream	Mulberry Grove North stream	Gooseberry Flat stream	Pah Beach stream
Number of samples	122	124	123	100
>550 Action	51	53	37	59
% > 550 Action	42	43	30	59
Average E. coli/100ml	1579	920	959	2263

Serious pollution is not confined to the populated areas. For example, the water entering both ends of Medland's beach is polluted, with that at the north end (Causeway) being so about 70% of the time (Table 4.4). There is no reason to believe that this situation has improved since sampling stopped in 2007 – indeed it is more likely to have deteriorated further.

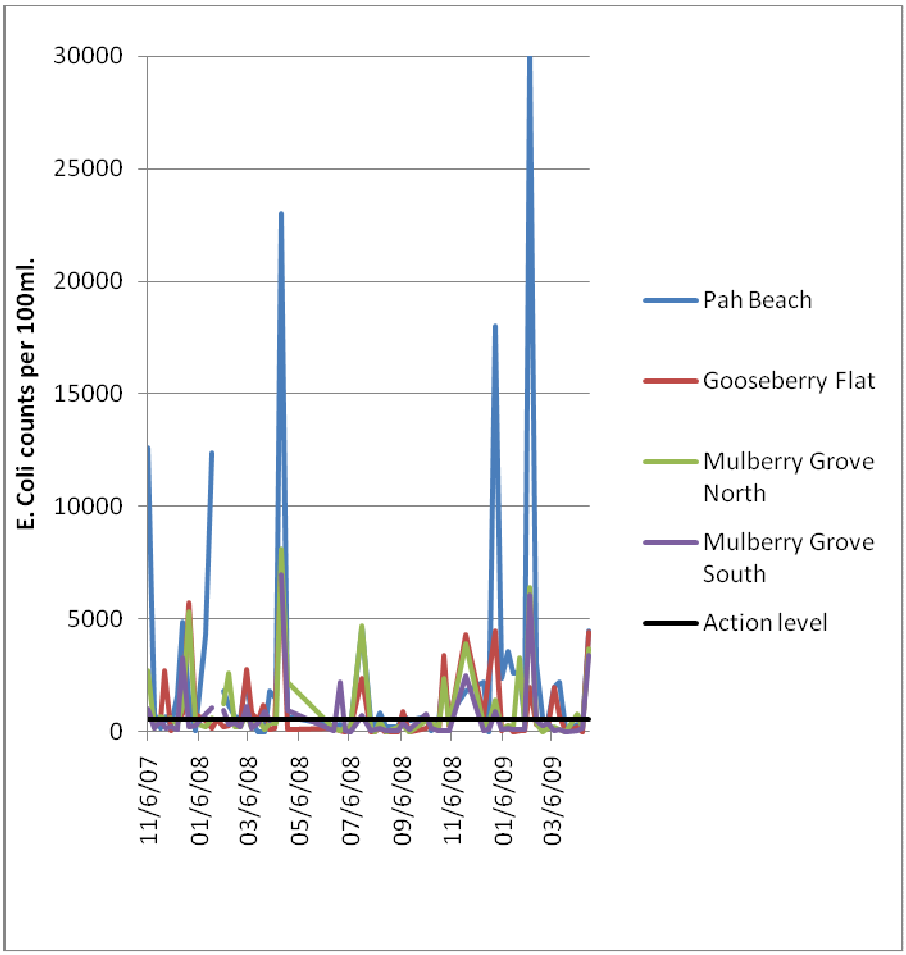
Table 4.4 Pollution of waterways entering Medlands beach 2004 – 2007; percentage of times *E. coli* levels exceeded 'Action' level (Data from S. Tang, Auckland City Council).

Stream	Year	No of samples	No of samples > 550 'Action' level	Percentage > 'Action' level
Oruawharo	2004	11	2	18
Oruawharo	2005	19	2	11
Oruawharo	2006	2 tests only	1	
Oruawharo	2007	no tests		
Causeway	2004	11	8	73
Causeway	2005	19	12	63
Causeway	2006	6	5	83
Causeway	2007	3	2	67

The Medlands data (Table 4.4) and some of the few measurements in other 'rural' streams suggest that pollution by stock is a probable cause of high *E. coli* levels. Currently, in the eastern bays stock have free access to parts of the Oruawharo stream, Causeway stream, Blackwell's stream, the Claris drain, Awana creek and at least some of the creeks entering Whangapoua Harbour. They are kept away from the creek margin at Harataonga by a single electric wire. Stock do not currently access the Kaitoke creek, which mostly flows through public conservation estate; however there are no fences stopping them from doing so where private land abuts the creek. Stock defecate in the creeks. Rotting dead stock animals have been seen in the Awana creek and one of the Whangapoua drains. The Oruawharo, Blackwells, Awana, and Harataonga creeks all have campsites on their banks and children play in them every summer, when pollution levels are likely to be greatest.

The results in Figure 4.2 show the typical pattern of spikes in the Pah Beach stream in recent years, but with background levels generally above the 'Action' line. Taken with the growth in deposits of coarse green algae (*Microdictyon mutabile*) in the bay, this is cause for concern and warrants further investigation.

Fig 4.2. *E. coli* in Tryphena streams; Nov. 2007 – April 2009. All values above the black line (550 *E. coli*/100ml) indicate a potentially serious human health risk.



1986 Water Resources Report

A survey of Great Barrier Island's water resources was carried out by the Ministry of Works & Development in 1986[v] in order to gather data for a water allocation policy for the island. Water resources (stream characteristics and flow data), water quality, macro invertebrates, and biological data were collected from more than 20 streams. All sites were carefully recorded on a map and with grid references.

The report notes that most stream catchments are small, and summer stream flows are limited. This limits the use of streams for domestic water supplies which must be supplemented by catching water from the roof. In 1986 current usage of some streams approached 100% of the summer low-flows. The report notes that there is no reticulated water supply on the island and residents must rely on rain water catch or draw from natural water ways or springs - often potable water must be delivered in long small diameter pipelines. Groundwater bores are present in some coastal areas. These have a high risk of contamination.

Most streams running through pasture had faecal coliform (*E. coli)* counts indicating pollution in 1986. Drinking without treatment was not recommended and the Tryphena and Mulberry Grove streams were of dubious quality even for swimming. A 'boil before use' policy was recommended. Unrestricted access by stock to stream margins was regarded as the primary cause of faecal bacterial contamination.

Stream pollution extended to the marine zone in some cases. In the summer of 1986 faecal coliform counts were too high for shellfish collection in Karaka Bay.

Despite high E.coli counts, other parameters indicated good water quality and habitat conditions, although several streams had impoverished faunas. The causes of reduced biodiversity in the streams might have been pollution in some cases, but high levels of toxic minerals in some streams draining from the old mine sites on the Te Ahumata (Stamping Battery Stream, and Okupu Stream) were also implicated. A Cluster analysis of the stream faunas (>100 species) clearly separated these impoverished streams from the rest. Further research on this topic was recommended.

The 1986 report recommended government expenditure to (1) collect more stream flow data ($27,280), (2) to install a flow level recording station ($16,800) and (3) for further research into water quality ($14,300). Thus even back in 1986, considerable expenditure was seen as necessary to safeguard drinking water supplies on the island.

Other environmental measures in freshwater environments

The data outlined below may be relevant to the solubility of poisons such as brodifacoum in streams, and to natural processes such as carbon sequestration in wetlands.

Measurements of dissolved oxygen and temperature were taken in 28 streams on Great Barrier Island by Don Armitage in April 2007 (Appendix One). Dissolved oxygen ranged from 0.9 to 9.95 ppm (Mean and standard deviation: 7.1 ± 2.6) and water temperature from 14.5 to 18.3 ^{o}C (16.2 ± 1.0). As expected dissolved oxygen levels were lowest in slow-flowing ditches and highest in the larger creeks. Data on pH and conductivity, and mg/l for nitrate, ammonia, phosphorus, potassium, calcium, magnesium and sodium obtained from Kaitoke swamp by Rutherford (1998) are summarised in Table 4.5 Sodium levels and other cations were highly correlated with conductivity ($r^2 = 0.74$), but there was great variability between samples. Phosphate levels were so low they could not be measured. Acidity (pH) ranged from 4 to 7, with a mean of 5.67±0.80. Rutherford (1998) and Pegman (1999) also measured the depth of the oxygenated ground-water layer in Kaitoke swamp, and found depths ranging from 3 to 29 cm (mean and standard deviation: 15.6±9.2).

Table 4.5 Average water chemistry values in Kaitoke wetland[vi]. Conductivity measured as mS, nitrate (NO_3), ammonium (NH_4), potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) as mg/l.

	pH	Conductivity	NO_3	NH_4	K	Ca	Mg	Na
No. samples	58	58	31	31	31	31	31	31
Average value	5.67	1.96	1.2	2.3	12.8	6.0	9.4	142
Standard deviation	0.80	4.94	0.8	3.2	19.9	11.1	31.8	382

Air Quality

There is no air quality monitoring on Great Barrier Island[vii]. Diesel generators and wood burning stoves in built up areas may (or may not) affect air quality on still days.

Although there is no data on air quality specific to Great Barrier Island, it is presumed that the air quality is high because the environment is windy and there are few local sources of pollution. Measuring the quality is a project for the future.

Soil Quality

Soil type maps have been made of Great Barrier Island[viii], but these are difficult to relate to soil quality. Generally past forest clearance through fires has led to degraded soils on slopes, especially ridges, but to soil accumulation in coastal swamps and on alluvial flats. There are also soils formed from ancient coastal sands, susceptible to drought in El Nino years.

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i Ministry for the Environment

ii *Microbial Water Quality Guidelines for Marine and Freshwater Recreational Areas*. Ministry for the Environment, 2003.

iii Mostly Microdictyon mutable, *GBI Environmental News* 15 & 20.

iv Phone conversation Martin Neil, ARC, 3/07/2008

v *Preliminary Water Resources Report, Great Barrier Island*, 1986, Ministry of Works and Development, Water and Soil Division, Auckland

vi Rutherford, G.N. 1998. *The current vegetation of Kaitoke Swamp, Great Barrier Island (Aotea)*. MSc Thesis University of Auckland (Means calculated from Appendix 6

vii Phone conversation Janet Petersen, ARC, 03/07/2008

viii NZMS 290 Great Barrier Island. Provisional soils. Wellington, Department of land and Survey, 1982. 1:50,000. Coloured map 1 sheet