
WATER QUALITY DATA REPORT RAROTONGA

January – December 2008



May 2009

**Dorothy Solomona
Ngereteina George
Teina Tuatai
Tuaine Turua**

Annual Report 2008

INSHORE AND AQUACULTURE DIVISION



**MINISTRY OF MARINE RESOURCES
Government of the Cook Islands-**

**PO Box 85, Avarua, Rarotonga, Cook Islands.
Tel: +682 28722 Fax: +682 29721 E-mail: rar@mmr.gov.ck**

Ref no: IADS-1/0509

Water Quality Data Report Rarotonga 2008

May 2009

Water Quality Data Report Rarotonga 2008

Dorothy Solomona
Ngereteina George
Teina Tuatai
Tuaine Turua

May 2009

Contents

1.	Introduction	5
2.	Methods	7
2.1	Sampling	7
2.2	Rarotonga Marine and Stream Sampling Site Map.	8
2.3	Physical Parameters	9
2.4	Nutrients	10
2.5	Chlorophyll <i>a</i> and Suspended Solids	10
2.6	Bacteria	10
2.7	Missing Data	10
3.	Acknowledgments	11
4.	References	12
5.	Appendix	13
5.1	Appendix 1. Water Quality data lagoon sites.	13
5.2	Appendix 2. Water Quality data stream sites.	22
5.3	Water Quality Report Card Rarotonga 2009	

1. Introduction

Rarotonga the capital of the Cook Islands is rapidly developing with tourism as one of the major income earners for the country. The health of the lagoon and reef is important for the welfare of the people. It is vital that the health of the lagoon is monitored and action is taken to protect the health of the lagoon, coral reef and the people that use it. Human activities contribute to the decreased water quality; for example farming of pigs, deforestation and farming crops close to streams. The water quality monitoring programme gives an evaluation of the state of the streams and the lagoons, and can be used to identify issues that need to be addressed.

In 2003, the Ministry of Marine Resources started to monitor the Rarotonga lagoon. Measurements included temperature, dissolved oxygen, pH and salinity, nutrients, chlorophyll *a*, suspended solids and bacterial contamination to measure long term changes in water quality of the lagoons and streams.

Temperature varies seasonally and influences the occurrence and growth of aquatic plants, and animals. The solubility of dissolved oxygen (DO) is regulated by temperature however other factors also affect DO including water flow. In the water, DO is either absorbed directly from the atmosphere or is produced by algae via photosynthesis and is removed by respiration and decomposition of organic matter. The recommended minimum for DO saturation is not less than 75% saturation for oceanic waters, embayments, open coastal waters and estuaries and not less than 80% for streams (Department of Health, Clean Water Branch Hawaii 1994). Salinity varies little in most marine environments and saltwater is normally between 34ppt and 36ppt in areas away from freshwater influences (Smith 2004). Mosely et al. (2004) in water quality guidelines developed for Pacific Countries suggest that pH should be between 8.0 and 8.4 in lagoon type environments. The Department of Health, Clean Water Branch Hawaii (1994) pH standard for open coastal waters is between 7.6 and 8.6 and can be as low as 7.0 in areas influenced by freshwater input.

Nutrients such as nitrate and phosphate which are naturally present in seawater are essential for the growth of phytoplankton and other algae which form the base of the food web. Elevated nutrients concentration can lead to an increase in algae and aquatic plants biomass which can have detrimental impacts on the coral reef health. The guidelines for nutrient concentrations for

the protection of coral reef health are 14µg/L for dissolved inorganic nitrogen (DIN), which is made up of nitrate and ammonia (NO₃-N + NH₄-N), and 2.6µg/L for dissolved reactive phosphorus (DRP) (Bell 1992). The ANZECC guideline values for streams or lowland rivers that are a cause for concern in Australia tropical areas based on measured values are 10µg/L for nitrate (NO₃-N) and ammonia (NH₄-N), and 4µg/L for DRP (ANZECC 2000).

Chlorophyll *a* and total suspended solids measure phytoplankton biomass, inorganic and organic particulate material in the water respectively. Elevated concentrations of both have been shown to impact negatively on coral reef health above concentration of 0.5µg/L and 4-5mg/L Bell (1992) respectively.

Increased inorganic and organic materials entering lagoons are often associated with increases in bacteria numbers which can be disease causing organisms. Enterococci bacteria are used to indicate the potential presence of human pathogens in marine and freshwater environment. Guidelines have been developed by the World Health Organisation (WHO) for contact recreation using Enterococci numbers (Table 1). This guideline is also used for freshwater samples to evaluate the bacterial water quality of the streams as they flow directly into the lagoon and are likely to impact the bacterial water quality of the lagoon.

Table 1: WHO Standards for Bathing Water Quality (WHO 2001).

Category	Indicator Counts	Microbiological Assessment
A.	≤ 40 Enterococci / 100ml	Suitable for swimming
B.	≥ 41 to ≤ 200 Enterococci / 100ml	Suitable for swimming but requires surveillance
C.	≥ 201 to ≤ 500 Enterococci /100ml	Not suitable for swimming, requires assessment
D.	> 500 Enterococci / 100ml	Not suitable for swimming, public warnings

This report is a Data Report in support of the Water Quality Report Card findings of the water quality sampling program in 2008. The Water Quality Report Card 2008 is attached at the back of this report.

2. Methods

2.1 Sampling

All the water quality parameters were measured monthly for both lagoon and streams. In total there are 14 marine sites and 8 stream sites for Rarotonga (Figure 1 and Table 2 & 3). Water samples for Rarotonga were stored in the dark on ice and the samples were processed soon after sample collection.

2.1 Rarotonga Marine and Stream Sampling Site Map.

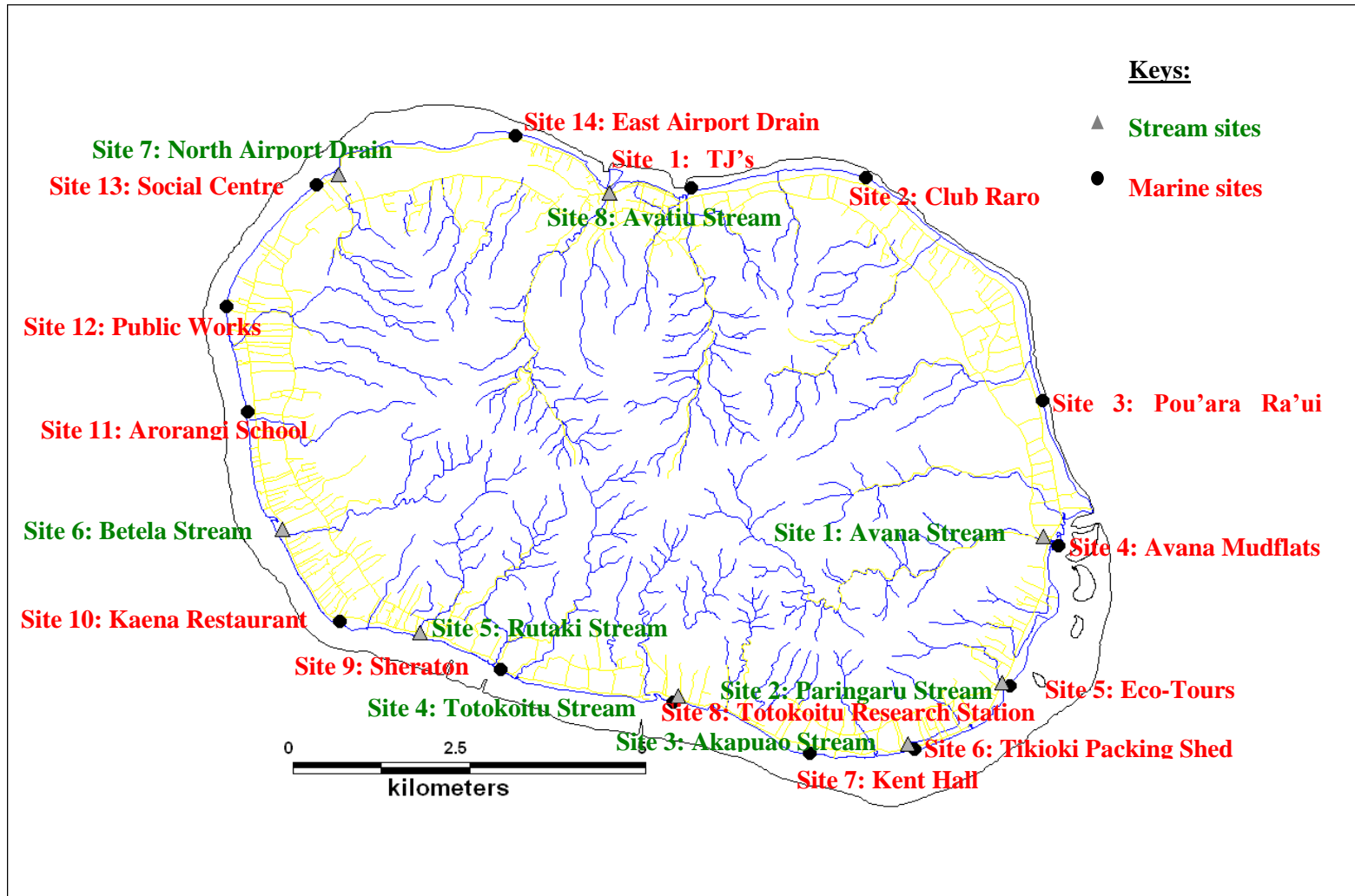


Figure 1. Lagoon and stream sites for Rarotonga.

Table 2: Rarotonga Lagoon sampling locations.

SITE NUMBER	LOCATION	LATITUDE	LONGITUDE
1	TJ's	S21 12.308	W159 46.441
2	Club Raro	S21 04.417	W159 45.304
3	Pou'ara Ra'ui	S21 13.821	W159 43.842
4	Avana Mudflat	S21 14.864	W159 43.730
5	Eco-Tours	S21 15.856	W159 44.089
6	Tikioki Packing Shed	S21 16.314	W159 44.788
7	Kent Hall	S21 16.195	W159 45.335
8	Totokoitu Research Station	S21 15.976	W159 46.570
9	Sheraton	S21 15.744	W159 47.851
10	Kaena Restaurant	S21 15.401	W159 49.036
11	Arorangi School	S21 13.903	W159 49.723
12	Public Works	S21 13.149	W159 49.873
13	Social Centre	S21 12.285	W159 49.205
14	East Airport Drain	S21 11.932	W159 47.737

Table 3: Rarotonga Stream sampling locations.

SITE NUMBER	LOCATION	LATITUDE	LONGITUDE
1	Avana	S21 14.794	W159 43.835
2	Paringaru	S21 15.838	W159 44.135
3	Akapuao	S21 16.274	W159 44.836
4	Totokoitu	S21 15.938	W159 46.535
5	Rutaki	S21 15.481	W159 48.442
6	Betela	S21 14.739	W159 49.462
7	North Airport Drain	S21 12.214	W159 49.043
8	Avatiu	S21 12.342	W159 47.047

2.2 Physical Parameters

At each site temperature (°C), dissolved oxygen (DO), % saturation and concentration, pH, and salinity (‰) were measured using a YSI 556 Probe. The individual probes were calibrated before use in the field and measurements were made at each site at the time of sampling (Hall et al., 2007).

2.3 Nutrients

All water samples for nutrient analysis were filtered through a Whatman GF/F glass fibre filter into a 250ml acid washed plastic bottle. These samples were stored frozen until they were shipped on ice in chilly bins to NIWA for analysis. All nutrient analysis were conducted using an Astoria Pacific autoanalyser 300 series with methods from the Astoria Pacific International Methods Manual (A 6/00). Nitrate were analysed by the cadmium column reduction method (Astoria 305-A177), DRP by the molybdenum blue method (Astoria 305-A204) and NH₄-N by the indophenol blue method (Astoria 305-A026).

2.4 Chlorophyll *a* and Suspended Solids

Samples for chlorophyll *a* and total suspended solids analysis of known volumes were filtered on to GF/F filters; chlorophyll *a* filters were frozen immediately and the suspended solid filters were dried in the oven after processing. The frozen filters for chlorophyll *a* were then analyzed later by acetone extraction and fluorometry (APHA 1998) in the MMR laboratory (Hall et al., 2007). Total suspended solids analysis followed Hall et al., (2007).

2.5 Bacteria

Water samples collected for Enterococci were analysed in duplicate using membrane filtration method and placed on Enterococci agar. The volumes filtered differed depending on how clean the water was and on previous results. Enterococci plates were incubated at 37⁰C for 24 hours (Hall et al., 2007).

2.6 Missing Data

Lagoon:

All lagoon pH data for June and from August to December for all sites were deleted because of instrument calibration were not within specification. Chlorophyll *a* data is missing for TJ's in January. The suspended solids results for Kaena Restaurant in July were a processing error and in December the VSS data for Totokoitu Research Station was not used because it was much higher than the TSS.

Stream:

There was no water in Rutaki and Akapua Stream in August. All stream pH data in May to July and September to November were deleted because instrument calibrations were out of specifications and all August and Avana data in May were not entered because of sampling error. There were no Enterococci data in December at Paringaru Stream.

3. Acknowledgments

We thank Drs Julie Hall and Els Maas for both technical advice and editorial comments, Mike Crump and his team at NIWA for their technical support, and the staffs of the Ministry of Marine Resources for editorial and for sample collecting. We are grateful to the National Environment Services for providing man power and transport during the sampling. Thanks also to the Cook Islands Meteorological Services for providing the weather and rainfall information. The Ministry of Marine Resources would also like to thank NZAid for all the funding support.

4. References

ANZECC (2000). Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No.4, Australian and New Zealand Environment and Conservation Council.

Astoria Pacific International Methods Manual (A 6/00).

Bell, P.R.F. (1992). Eutrophication and coral reefs – some examples in the Great Barrier Reef lagoon. *Water Res.* Vol. 26, No.5 pp. 553-568

Clean Water Branch, Department of Health, Hawaii (1994). Clean water Act Objective and Water Quality Standards. Department of Health, Hawaii.

Hall, J.A., Crump, M., Maas, E. (2007). Water Quality Monitoring Network For Cook Islands. Version 4.3. Ministry of Marine Resources.

Mosely, L.; Singh, S. & Aalbersberg, B. (2004). Water Quality Monitoring in Pacific Island Countries. SOPAC – Technical Report 381, Suva.

WHO. 2001. *Bathing Water Quality and Human Health: Protection of the human environment water, sanitation and health.* Report WHO/SDE/WSH/01.2. World Health Organisation, Geneva.

Water Quality Database-Ministry of Marine Resources.

YSI 556 MPS Multi Probe System Operations Manual. YSI Incorporated

5. Appendix

Appendix 1. Water Quality data lagoon sites.

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
TJ's	1	15-Jan-08	26.9	35.6	159.0	10.4	8.3	5	4	2	6			1.1	0.3	16
TJ's	1	12-Feb-08	27.4	35.7	111.9	7.3	8.1	4	7	1	8		0.20	0.7	0.2	0
TJ's	1	05-Mar-08	27.1	35.5	116.4	7.6	7.5	3	2	3	5		0.25	0.8	0.4	3
TJ's	1	02-Apr-08	27.4	35.4	113.6	7.4	7.9	2	0.5	4	4.5		0.2	0.9	0.2	15
TJ's	1	06-May-08	26.7	35.9	111.2	7.3	8.3	0.5	24	5	29	0.28	0.1	0.4	0.2	0
TJ's	1	06-May-08						2	5	1	6	0.16	0.2	0.3	0.1	0
TJ's	1	10-Jun-08	25.3	35.4	129.9	8.7		1	3	4	7		0.1	0.9	0.3	11
TJ's	1	01-Jul-08	24.7	35.6	129.2	8.8	8.2	4	3	3	6	0.17		0.4	0.2	0
TJ's	1	19-Aug-08	22.4	33.0	79.0	5.7		0.5	10	3	13	0.17	0.1	0.3	0.3	0
TJ's	1	19-Aug-08						1	11	2	13	0.17	0.1	0.8	0.1	0
TJ's	1	02-Sep-08	21.2	35.7	109.3	7.9		3	9	3	12		0.3	1.7	0.3	215
TJ's	1	07-Oct-08	23.9	35.1	124.8	8.6		2	2	2	4	0.17	0.4	1.9	0.8	8
TJ's	1	04-Nov-08	27.2	35.9	136.6	8.9		0.5	2	2	4	0.12	0.0	2.1	0.9	0
TJ's	1	04-Nov-08						2	4	2	6	0.18	0.0	2.3	0.4	1
TJ's	1	09-Dec-08	26.2	35.8	106.1	7.0		4	2	3	5	0.20		5.8	1.8	8
TJ's	1	09-Dec-08						2	0.5	2	2.5	0.18		4.8	1.0	6
Club Raro	2	15-Jan-08	27.0	35.6	152.2	9.9	8.3	2	2	2	4	0.39	0.2	9.8	3.7	3
Club Raro	2	15-Jan-08						1	3	6	9	0.28	0.2	5.9	1.2	6
Club Raro	2	12-Feb-08	28.3	35.7	116.7	7.5	8.1	3	5	3	8		0.16	8.6	1.3	0
Club Raro	2	05-Mar-08	27.2	35.6	117.9	7.7	7.8	1	4	5	9		0.14	2.0	2.0	39
Club Raro	2	02-Apr-08	27.3	35.5	111.4	7.3	8.0	5	3	4	7		0.1	0.5	0.4	0
Club Raro	2	06-May-08	26.8	35.9	99.4	6.5	8.3	3	7	1	8		0.1	4.1	1.3	0
Club Raro	2	10-Jun-08	25.3	35.7	111.2	7.5		3	12	3	15		0.2	1.2	0.8	8
Club Raro	2	10-Jun-08						3	4	2	6					
Club Raro	2	01-Jul-08	25.0	35.5	104.8	7.1	8.2	4	6	8	14	0.23		1.8	0.0	0
Club Raro	2	19-Aug-08	22.9	33.2	101.1	7.2		2	9	2	11		0.2	0.6	0.2	0
Club Raro	2	02-Sep-08	21.7	35.3	102.8	7.4		6	6	8	14		0.7	6.3	1.1	21
Club Raro	2	07-Oct-08	23.9	35.7	121.2	8.3		6	1	2	3	0.25	0.3	19.5	2.4	9400
Club Raro	2	04-Nov-08	27.5	36.0	128.2	8.3		0.5	2	2	4	0.25	0.4	4.3	0.9	240
Club Raro	2	09-Dec-08	26.3	35.9	108.3	7.1		0.5	2	2	4	0.32		12.6	1.6	0

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Pou'ara Ra'ui	3	15-Jan-08	27.0	35.6	170.2	11.1	8.4	2	7	1	8		0.6	1.9	0.3	2
Pou'ara Ra'ui	3	12-Feb-08	27.8	35.7	118.0	7.6	8.0	3	4	2	6		0.28	3.3	0.8	0
Pou'ara Ra'ui	3	05-Mar-08	27.9	35.6	113.5	7.3	8.1	4	3	2	5		0.23	0.3	0.3	1
Pou'ara Ra'ui	3	02-Apr-08	28.1	35.4	144.2	9.3	8.0	0.5	9	1	10	0.31	0.7	1.0	1.0	2
Pou'ara Ra'ui	3	02-Apr-08						3	10	5	15	0.29	0.5	1.1	0.9	0
Pou'ara Ra'ui	3	06-May-08	27.0	35.9	109.5	7.1	8.3	0.5	0.5	0.5	1		0.2	0.9	0.5	0
Pou'ara Ra'ui	3	10-Jun-08	25.7	35.7	136.8	9.1		2	7	4	11	0.46	0.3	1.6	0.7	15
Pou'ara Ra'ui	3	10-Jun-08						3	7	4	11	0.37	0.9	2.8	1.8	58
Pou'ara Ra'ui	3	01-Jul-08	25.3	35.6	150.7	10.1	8.3	0.5	6	3	9	0.31		1.1	0.4	6
Pou'ara Ra'ui	3	19-Aug-08	23.2	34.8	101.5	7.1		2	15	14	29		0.1	1.4	0.9	0
Pou'ara Ra'ui	3	02-Sep-08	22.1	34.1	103.0	7.4		2	7	7	14		0.6	7.5	1.4	10
Pou'ara Ra'ui	3	07-Oct-08	24.0	34.0	121.8	8.4		2	5	4	9	0.48	0.3	2.6	1.1	255
Pou'ara Ra'ui	3	04-Nov-08	30.6	36.2	197.8	12.2		3	18	8	26	0.87	0.8	3.4	0.3	2150
Pou'ara Ra'ui	3	09-Dec-08	27.5	35.7	167.9	10.9		0.5	2	3	5	0.46		4.4	1.1	8
Avana Mudflat	4	15-Jan-08	26.7	33.3	102.1	6.8	8.1	8	5	11	16	0.35	0.4	1.4	0.2	74
Avana Mudflat	4	15-Jan-08						8	11	11	22	0.38	0.4	1.6	0.2	83
Avana Mudflat	4	12-Feb-08	29.3	35.3	107.2	6.8	8.0	0.5	2	4	6		1.62	1.3	0.3	4
Avana Mudflat	4	05-Mar-08	28.1	33.9	107.0	6.9	8.1	8	11	14	25		1.34	3.7	1.2	6
Avana Mudflat	4	02-Apr-08	27.7	33.6	108.4	7.1	8.1	9	14	16	30		1.1	3.1	0.8	11
Avana Mudflat	4	06-May-08	25.9	35.8	84.4	5.6	8.2	3	5	5	10		0.2	1.3	0.9	0
Avana Mudflat	4	10-Jun-08	25.9	31.0	108.1	7.4		9	11	48	59		0.3	1.7	0.5	23

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Avana Mudflat	4	10-Jun-08						5	4	35	39					
Avana Mudflat	4	01-Jul-08	23.9	35.0	82.2	5.7	8.0	4	4	13	17	0.23		1.2	0.4	57
Avana Mudflat	4	01-Jul-08						6	14	13	27	0.27		0.9	0.9	39
Avana Mudflat	4	19-Aug-08	23.8	31.2	100.0	7.1		8	14	24	38		0.4	1.1	0.3	8
Avana Mudflat	4	02-Sep-08	21.1	34.8	97.1	7.1		5	13	9	22	0.36	0.8	7.7	1.6	180
Avana Mudflat	4	02-Sep-08						5	14	11	25	0.41	0.4	6.5	1.4	270
Avana Mudflat	4	07-Oct-08	23.5	31.8	122.9	8.7		6	5	18	23	0.38	0.7	2.3	0.5	7
Avana Mudflat	4	04-Nov-08	29.0	33.6	136.4	8.7		0.5	2	3	5	0.40	0.7	1.0	1.0	0
Avana Mudflat	4	09-Dec-08	27.7	31.0	126.2	8.4		3	3	20	23	1.24		1.4	0.6	49
Eco-Tours	5	15-Jan-08	26.7	32.09	104.4	6.99	8.0	9	6	8	14	1.65	2.8	5.5	1.5	460
Eco-Tours	5	15-Jan-08						10	6	9	15	1.75	2.4	5.8	1.5	280
Eco-Tours	5	12-Feb-08	29.9	34.8	104.1	6.5	8.0	0.5	5	3	8		2.48	1.9	0.7	2
Eco-Tours	5	05-Mar-08	27.8	33.5	108.4	7.1	8.0	4	5	12	17		1.14	8.2	1.9	7
Eco-Tours	5	02-Apr-08	28.0	33.3	106.7	6.9	8.0	5	19	26	45	0.77	1.0	4.4	1.8	0
Eco-Tours	5	02-Apr-08						0.5	16	22	38	0.51	1.1	2.7	0.6	0
Eco-Tours	5	06-May-08	25.6	35.1	68.1	4.6	8.1	0.5	8	11	19		0.4	3.6	0.4	19
Eco-Tours	5	10-Jun-08	25.4	32.7	97.9	6.7		4	13	15	28		0.7	3.3	0.9	13
Eco-Tours	5	01-Jul-08	23.7	34.7	81.4	5.7	8.0	5	12	5	17	0.82		10.7	1.2	0
Eco-Tours	5	19-Aug-08	24.1	34.9	65.8	4.5		7	12	3	15		0.1	2.8	0.9	3
Eco-Tours	5	02-Sep-08	20.5	33.3	100.2	7.4		4	9	14	23		0.9	8.3	1.4	11800
Eco-Tours	5	07-Oct-08	23.3	34.3	108.0	7.6		9	5	37	42	0.75	1.0	5.2	0.9	236
Eco-Tours	5	04-Nov-08	29.2	34.7	137.5	8.7		2	10	11	21	0.36	0.6	2.7	0.7	0
Eco-Tours	5	09-Dec-08	28.9	33.2	144.2	9.2		2	8	19	27	0.49		2.6	1.2	10
Eco-Tours	5	09-Dec-08						0.5	7	15	22	0.43		3.3	1.7	18
Tikioki Packing Shed	6	15-Jan-08	26.5	33.8	106.1	7.1	8.0	7	7	19	26		0.9	2.5	0.8	6
Tikioki Packing Shed	6	12-Feb-08	28.8	35.1	113.9	7.2	8.0	1	5	14	19		0.94	2.9	1.0	2

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Tikioki Packing Shed	6	05-Mar-08	27.9	34.5	102.9	6.7	8.0	2	7	14	21		0.85	1.0	0.6	2
Tikioki Packing Shed	6	02-Apr-08	27.6	34.5	109.5	7.1	8.0	3	13	24	37	0.49	1.5	1.6	0.3	0
Tikioki Packing Shed	6	02-Apr-08						8	14	20	34	0.37	1.3	3.8	1.0	0
Tikioki Packing Shed	6	06-May-08	26.0	35.6	95.6	6.3	8.2	0.5	0.5	4	4.5		0.4	2.4	0.3	5
Tikioki Packing Shed	6	10-Jun-08	25.2	33.2	107.6	7.3		7	9	38	47		0.6	2.8	0.9	1800
Tikioki Packing Shed	6	01-Jul-08	23.6	34.8	87.4	6.1	8.0	7	4	10	14	1.34		4.2	0.2	6
Tikioki Packing Shed	6	20-Aug-08	24.2	34.8	73.8	5.1		8	10	7	17		0.2	0.8	0.6	0
Tikioki Packing Shed	6	02-Sep-08	20.6	34.5	101.7	7.5		14	8	11	19	0.67	0.8	11.5	1.4	255
Tikioki Packing Shed	6	02-Sep-08						14	9	14	23	0.47	0.6	8.3	1.1	235
Tikioki Packing Shed	6	07-Oct-08	22.9	34.7	109.3	7.7		6	6	21	27	0.39	0.5	7.9	0.7	10
Tikioki Packing Shed	6	04-Nov-08	28.0	34.5	115.2	7.4		12	4	25	29	0.38	0.5	1.2	1.2	10
Tikioki Packing Shed	6	09-Dec-08	27.9	34.5	108.8	7.0		2	11	26	37	0.47		1.1	0.3	8
Kent Hall	7	15-Jan-08	26.3	34.1	100.8	6.7	8.1	9	7	18	25		0.4	1.4	0.4	8
Kent Hall	7	12-Feb-08	28.5	35.5	102.6	6.5	7.9	1	20	11	31		1.22	1.3	0.6	1
Kent Hall	7	05-Mar-08	27.9	33.9	108.3	7.0	8.0	6	9	25	34		1.24	1.9	0.9	3
Kent Hall	7	02-Apr-08	27.5	34.5	97.2	6.3	8.0	5	4	19	23		0.4	1.1	1.1	4
Kent Hall	7	06-May-08	25.6	35.6	84.5	5.6	8.2	3	15	10	25		0.2	2.5	0.7	36
Kent Hall	7	10-Jun-08	25.4	34.8	96.4	6.5		7	5	25	30		0.2	1.6	0.4	7

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Kent Hall	7	01-Jul-08	24.0	35.0	90.0	6.2	8.0	5	5	13	18	0.45		2.8	0.5	0
Kent Hall	7	19-Aug-08	23.0	34.5	87.2	6.1		7	4	13	17	0.43	0.2	1.4	0.3	2
Kent Hall	7	19-Aug-08						1	6	15	21	0.46	0.0	1.0	0.1	3
Kent Hall	7	02-Sep-08	20.5	32.3	99.4	7.4		17	3	25	28		0.4	9.3	1.9	129
Kent Hall	7	07-Oct-08	22.8	34.3	106.2	7.5		9	6	20	26	0.27	0.5	1.5	0.2	135
Kent Hall	7	09-Dec-08	27.6	33.5	104.4	6.8		11	8	28	36	0.38		1.5	2.0	53
Totokoitu Station	8	15-Jan-08	27.0	33.5	108.1	7.1	8.1	8	4	6	10		0.5	2.1	0.8	84
Totokoitu Station	8	12-Feb-08	28.7	35.0	90.9	5.8	7.9	2	2	2	4		0.83	0.7	0.2	3
Totokoitu Station	8	05-Mar-08	28.0	31.9	99.3	6.5	8.0	9	14	5	19	0.52	1.59	1.4	0.6	61
Totokoitu Station	8	05-Mar-08						9	5	9	14		1.03	0.9	0.8	62
Totokoitu Station	8	02-Apr-08	27.8	33.4	102.4	6.7	8.0	8	11	5	16		1.6	2.4	2.4	24
Totokoitu Station	8	06-May-08	25.8	35.2	86.9	5.8	8.2	4	8	7	15		0.4	1.4	0.6	8
Totokoitu Station	8	10-Jun-08	25.4	28.9	111.1	7.7		10	5	11	16		0.2	2.2	0.0	125
Totokoitu Station	8	01-Jul-08	23.6	35.0	86.7	6.0	7.9	5	4	12	16	0.25		2.3	0.6	11
Totokoitu Station	8	01-Jul-08						4	3	7	10	0.28		2.7	0.4	3
Totokoitu Station	8	19-Aug-08	23.8	32.4	107.9	7.6		5	8	4	12		0.1	3.0	0.6	30
Totokoitu Station	8	02-Sep-08	20.7	34.7	100.6	7.4		7	5	22	27		0.1	10.5	1.7	126
Totokoitu Station	8	07-Oct-08	24.4	27.8	120.2	8.6		8	5	10	15	0.37	1.2	1.3	0.1	36
Totokoitu Station	8	07-Oct-08						7	7	11	18	0.36	0.9	1.5	0.1	14
Totokoitu Station	8	04-Nov-08	28.2	30.2	149.0	9.8		8	0.5	4	4.5	0.23	0.5	1.1	0.2	130
Totokoitu Station	8	09-Dec-08	29.1	32.0	102.4	6.6		19	11	10	21	0.22		2.8	11.0	83
Sheraton	9	12-Feb-08	28.0	34.8	118.8	7.7	8.0	4	8	13	21		0.28	0.4	0.4	2
Sheraton	9	05-Mar-08	27.5	33.7	115.2	7.5	8.0	4	0.5	11	11.5	0.24	0.34	0.7	0.4	14
Sheraton	9	05-Mar-08						7	2	8	10	0.29	0.37	0.3	0.0	18
Sheraton	9	02-Apr-08	27.8	33.6	121.3	7.9	8.0	15	13	14	27		0.2	0.6	0.6	15

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Sheraton	9	06-May-08	26.2	35.9	93.7	6.2	8.2	4	12	5	17	0.28	0.2	1.5	0.9	7
Sheraton	9	06-May-08						0.5	0.5	2	2.5	0.29	0.1	1.5	1.5	4
Sheraton	9	10-Jun-08	25.5	33.8	110.8	7.5		8	3	20	23		0.1	0.8	0.2	32
Sheraton	9	01-Jul-08	24.0	34.6	93.3	6.4	7.8	5	7	7	14	0.17		1.4	0.0	0
Sheraton	9	19-Aug-08	23.3	35.1	102.4	7.1		0.5	7	4	11		0.0	0.9	0.1	5
Sheraton	9	02-Sep-08	21.6	35.5	101.3	7.3		3	6	9	15		0.4	8.4	1.2	96
Sheraton	9	07-Oct-08	23.6	31.7	114.3	8.1		3	4	13	17	0.20	0.2	2.2	0.2	20
Sheraton	9	07-Oct-08						3	3	18	21	0.23	0.3	1.0	0.2	1270
Sheraton	9	04-Nov-08	27.4	34.2	129.9	8.5		3	4	20	24	0.17	0.1	0.3	0.3	10
Sheraton	9	09-Dec-08	28.6	30.8	120.4	7.9		4	6	15	21	1.11		1.9	0.3	16
Kaena Restaurant	10	15-Jan-08	26.8	35.4	111.9	7.3	8.1	5	18	4	22		0.2	1.1	0.2	3
Kaena Restaurant	10	12-Feb-08	27.1	35.4	99.2	6.5	8.0	4	13	4	17		0.34	1.0	0.3	1
Kaena Restaurant	10	12-Feb-08						0.5	14	5	19	0.38	0.42	0.4	0.3	1
Kaena Restaurant	10	05-Mar-08	28.0	35.2	138.4	8.9	8.1	7	4	6	10		0.73	0.4	0.0	21
Kaena Restaurant	10	05-Mar-08						7	8	8	16	0.42	0.55	1.3	0.7	14
Kaena Restaurant	10	02-Apr-08	27.5	35.3	136.5	8.8	8.1	3	11	4	15		0.4	0.8	0.4	9
Kaena Restaurant	10	06-May-08	26.2	35.9	96.3	6.4	8.2	4	2	4	6		0.3	1.4	0.6	0
Kaena Restaurant	10	06-May-08						2	0.5	3	3.5	0.22	0.3	1.1	0.0	0
Kaena Restaurant	10	10-Jun-08	25.6	35.4	107.9	7.2		6	6	11	17	0.12	0.1	1.3	0.4	16
Kaena Restaurant	10	10-Jun-08						0.5	1	12	13	0.10	0.1	1.2	0.3	29
Kaena Restaurant	10	01-Jul-08	23.9	35.3	91.5	6.3	8.0	2	2	5	7	0.27		3.4	0.1	4
Kaena Restaurant	10	01-Jul-08						4	0.5	5	5.5	0.28				5
Kaena Restaurant	10	19-Aug-08	23.1	34.9	99.0	6.9		0.5	8	5	13		0.1	0.9	0.3	5
Kaena Restaurant	10	02-Sep-08	22.1	29.2	100.9	7.4		0.5	8	7	15		0.2	4.7	1.0	23
Kaena Restaurant	10	07-Oct-08	23.9	35.6	111.6	7.7		3	4	4	8	0.29	0.3	1.3	0.2	1270

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Kaena Restaurant	10	07-Oct-08						4	2	8	10	0.16	0.2	1.2	1.2	1425
Kaena Restaurant	10	04-Nov-08	26.7	35.7	134.9	8.8		1	6	2	8	0.17	0.1	0.3	0.2	0
Kaena Restaurant	10	09-Dec-08	27.7	33.5	150.4	9.8		2	2	4	6	0.97		0.8	1.3	9
Arorangi School	11	15-Jan-08	27.1	34.7	134.6	8.8	8.2	4	5	19	24		0.4	3.1	0.7	6
Arorangi School	11	12-Feb-08	26.8	34.7	119.6	7.9	8.0	8	7	18	25	0.36	0.07	0.6	0.3	1
Arorangi School	11	12-Feb-08						3	15	18	33	0.37	0.40	0.8	0.3	0
Arorangi School	11	05-Mar-08	28.6	33.9	162.7	10.5	8.2	9	3	16	19		0.29	0.3	0.1	2
Arorangi School	11	02-Apr-08	28.7	33.7	136.5	8.8	8.1	10	8	18	26		0.2	0.8	0.2	13
Arorangi School	11	06-May-08	25.9	35.6	95.4	6.3	8.1	4	34	4	38		0.5	3.2	0.4	26
Arorangi School	11	10-Jun-08	25.8	33.7	124.3	8.4		6	1	34	35		0.2	1.8	0.5	22
Arorangi School	11	01-Jul-08	24.0	34.3	98.3	6.8	7.9	12	12	17	29	0.60		8.9	0.8	0
Arorangi School	11	19-Aug-08	23.9	32.2	104.6	7.3		16	6	7	13		0.1	6.5	1.1	40
Arorangi School	11	02-Sep-08	22.5	34.3	104.3	7.4		6	5	7	12		0.3	5.0	0.7	120
Arorangi School	11	07-Oct-08	25.4	33.8	156.2	10.6		11	4	44	48	0.27	0.2	3.5	0.8	0
Arorangi School	11	04-Nov-08	26.5	34.2	140.4	9.3		5	6	17	23	0.39	0.1	1.0	0.2	305
Arorangi School	11	04-Nov-08						12	6	22	28			4.9	1.5	470
Arorangi School	11	09-Dec-08	27.6	32.8	137.2	9.0		8	11	67	78	0.28		2.0	0.8	490
Arorangi School	11	09-Dec-08						9	8	92	100	0.23		0.8	0.4	150
Public Works	12	15-Jan-08	26.6	32.3	121.3	8.1	8.1	12	5	82	87		0.5	4.8	0.3	2
Public Works	12	12-Feb-08	26.6	33.7	118.3	7.9	8.0	6	6	57	63		0.96	1.1	0.3	3
Public Works	12	05-Mar-08	28.8	33.6	141.4	9.1	8.2	12	4	111	115		0.34	1.1	0.4	0

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Public Works	12	02-Apr-08	28.2	34.0	133.1	8.6	8.1	9	6	19	25		0.4	1.8	0.4	0
Public Works	12	05-Mar-08	28.8	33.6	141.4	9.1	8.2	12	4	111	115		0.34	1.1	0.4	0
Public Works	12	02-Apr-08	28.2	34.0	133.1	8.6	8.1	9	6	19	25		0.4	1.8	0.4	0
Public Works	12	06-May-08	26.1	35.8	97.6	6.5	8.1	0.5	0.5	2	2.5		0.3	1.5	0.8	23
Public Works	12	10-Jun-08	25.6	32.1	115.9	7.9		7	0.5	81	81.5	0.21	0.1	5.9	2.2	100
Public Works	12	10-Jun-08						8	0.5	60	60.5	0.29	0.2	5.7	1.3	100
Public Works	12	01-Jul-08	24.0	33.7	99.8	6.9	7.9	7	0.5	36	36.5	0.29		10.9	1.3	169
Public Works	12	19-Aug-08	23.9	35.4	107.6	7.4		8	8	5	13	0.48	0.3	6.3	1.0	6
Public Works	12	19-Aug-08						4	5	6	11	0.46	0.4	9.4	1.8	8
Public Works	12	02-Sep-08	23.3	32.2	103.0	7.3		6	4	24	28		0.2	4.3	0.6	945
Public Works	12	07-Oct-08	25.3	31.5	127.8	8.8		8	2	67	69	0.21	0.2	2.3	2.3	645
Public Works	12	04-Nov-08	26.1	31.2	116.6	7.9		12	7	60	67	0.25	0.1	2.5	0.3	21
Public Works	12	04-Nov-08						11	4	88	92	0.28	0.1	2.9	0.6	16
Public Works	12	09-Dec-08	27.2	35.5	113.8	7.4		0.5	5	17	22	0.20		4.9	1.6	54
Social Centre	13	15-Jan-08	27.5	35.5	106.5	6.9	8.2	4	6	5	11		0.1	5.6	0.9	3
Social Centre	13	12-Feb-08	26.7	35.8	99.9	6.6	7.8	2	7	3	10		0.29	1.1	0.4	9
Social Centre	13	05-Mar-08	28.3	35.6	125.8	8.0	8.1	6	2	5	7		0.14	0.7	0.6	0
Social Centre	13	02-Apr-08	28.1	35.4	116.0	7.5	8.1	6	7	4	11		0.1	0.7	0.3	1
Social Centre	13	06-May-08	25.8	35.9	90.2	6.0	8.0	1	28	5	33		0.2	1.4	0.7	1
Social Centre	13	10-Jun-08	25.9	35.6	115.9	7.7		0.5	1	3	4		0.1	2.5	0.7	21
Social Centre	13	01-Jul-08	23.9	35.5	98.6	6.8	7.8	2	0.5	5	5.5	0.40		12.3	12.3	37

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	DIN (µg/L)	Extraction (Chl a µg/L)	Invivo (Chl a µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Social Centre	13	19-Aug-08	24.2	34.9	106.2	7.3		1	6	5	11		0.2	4.0	0.7	235
Social Centre	13	02-Sep-08	22.7	36.0	102.4	7.2		10	11	4	15	0.19	0.2	4.7	0.5	48
Social Centre	13	02-Sep-08						2	4	3	7	0.21	0.2	4.4	0.6	57
Social Centre	13	07-Oct-08	25.3	35.4	119.9	8.1		1	1	1	2	0.25	0.2	5.7	0.9	920
Social Centre	13	04-Nov-08	27.6	36.1	114.4	7.4		0.5	2	2	4	0.17	0.2	1.3	1.3	2
Social Centre	13	09-Dec-08	27.4	36.0	107.5	7.0		2	5	1	6	0.23		7.9	2.7	2
East Airport Drain	14	15-Jan-08	27.0	35.1	121.7	8.0	8.2	7	5	4	9		0.2	3.2	0.9	45
East Airport Drain	14	12-Feb-08	27.2	34.3	130.1	8.5	7.5	5	2	2	4	0.33	0.25	0.9	0.3	2
East Airport Drain	14	12-Feb-08						5	6	4	10	0.27	0.34	1.1	0.2	4
East Airport Drain	14	05-Mar-08	29.3	33.2	174.6	11.1	8.3	6	10	9	19		0.38	18.1	17.4	7
East Airport Drain	14	02-Apr-08	28.7	33.1	140.3	9.0	8.1	5	9	4	13		0.3	1.2	0.4	8
East Airport Drain	14	06-May-08	25.8	34.7	98.5	6.6	7.9	6	10	5	15		1.0	3.6	1.5	9
East Airport Drain	14	10-Jun-08	26.3	34.7	131.1	8.7		5	8	5	13		0.2	3.0	0.7	4
East Airport Drain	14	01-Jul-08	23.9	35.5	94.4	6.5	7.4	3	0.5	1	1.5	0.41		2.2	0.3	65
East Airport Drain	14	19-Aug-08	24.0	35.4	123.6	8.5		3	9	2	11		0.3	1.5	0.5	0
East Airport Drain	14	02-Sep-08	21.4	36.8	142.7	10.2		3	8	1	9		0.3	6.5	1.6	18
East Airport Drain	14	07-Oct-08	26.8	35.8	147.6	9.7		0.5	4	0.5	4.5	0.60	0.2	10.0	0.7	78
East Airport Drain	14	04-Nov-08	28.6	36.0	143.6	9.1		1	2	2	4	0.22	0.1	2.3	2.3	0
East Airport Drain	14	09-Dec-08	27.9	25.3	127.0	8.7		14	15	54	69	0.91		10.5	2.1	385

5.2 Appendix 2. Water Quality data stream sites.

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Avana	1	15-Jan-08	24.8	0.1	75.1	6.2	7.2	38	3	29	4.0	1.9	2750
Avana	1	12-Feb-08	25.2	1.0	87.5	7.2	6.4	35	10	31	0.3	0.5	2500
Avana	1	05-Mar-08	25.0	0.1	94.5	7.8	6.7	25	5	13	0.3	0.3	3300
Avana	1	02-Apr-08	23.8	0.1	90.5	7.7	7.4	65	24	12	1.1	0.6	2570
Avana	1	06-May-08						35	22	17	6.1	2.5	1680
Avana	1	10-Jun-08	23.8	0.5	97.1	8.2		42	8	28	5.0	1.3	3900
Avana	1	01-Jul-08	24.2	22.4	98.9	7.3		42	9	40	0.9	0.5	4500
Avana	1	19-Aug-08						56	2	25	0.5	0.4	8950
Avana	1	19-Aug-08						53	5	18	1.0	0.4	11850
Avana	1	02-Sep-08	20.3	9.0	130.8	11.2		34	8	14	2.5	0.6	720
Avana	1	07-Oct-08	25.4	0.3	195.7	16.0		37	8	29	0.6	0.6	525
Avana	1	04-Nov-08	29.5	12.13	106.7	7.6		28	5	10	0.8	0.4	770
Avana	1	09-Dec-08	23.5	0.1	100.1	8.5		45	6	67	1.8	1.2	965
Avana	1	09-Dec-08						43	2	67	1.3	1.3	830
Paringaru	2	15-Jan-08	28.8	0.2	124.6	9.6	7.6	26	7	31	2.4	0.8	10550
Paringaru	2	15-Jan-08						22	9	32	2.9	1.3	9700
Paringaru	2	12-Feb-08	25.1	0.2	44.1	3.6	7.0	3	47	34	4.0	0.8	1400
Paringaru	2	12-Feb-08						1	48	35	4.3	1.6	1100
Paringaru	2	05-Mar-08	25.7	0.2	44.2	3.6	6.9	6	19	30	5.4	1.4	918
Paringaru	2	02-Apr-08	25.3	0.2	54.5	4.5	7.1	6	28	47	2.1	0.0	460
Paringaru	2	06-May-08	24.7	10.6	74.6	5.8		3	30	162	0.8	0.8	165
Paringaru	2	10-Jun-08	25.8	0.2	76.6	6.2		5	13	181	1.2	0.1	455
Paringaru	2	01-Jul-08	24.3	0.2	119.8	10.0		4	14	141	3.0	1.1	3250
Paringaru	2	19-Aug-08						14	20	41	3.4	1.9	1540
Paringaru	2	02-Sep-08	20.1	3.6	91.6	8.1		12	173	236	1.1	0.2	7050
Paringaru	2	02-Sep-08						9	166	211	1.8	0.2	8100
Paringaru	2	07-Oct-08	23.9	0.1	127.9	10.8		11	24	164	1.7	1.7	350
Paringaru	2	04-Nov-08	27.8	0.24	74.4	5.8		9	43	31	1.6	2.3	6500
Paringaru	2	09-Dec-08	24.9	0.1	96.7	8.0		42	7	353	2.1	0.9	

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Akapuao	3	15-Jan-08	24.5	0.1	81.8	6.8	7.7	6	135	99	14.8	4.9	10000
Akapuao	3	12-Feb-08	26.1	0.3	33.4	2.7	7.2	12	105	48	13.1	4.4	16200
Akapuao	3	05-Mar-08	27.4	0.2	41.3	3.3	7.2	5	73	90	3.4	1.2	6000
Akapuao	3	05-Mar-08						5	75	92	109.2	21.9	6800
Akapuao	3	02-Apr-08	26.0	0.2	34.6	2.8	7.3	4	230	107	4.0	2.2	4800
Akapuao	3	02-Apr-08						3	228	105	4.7	2.0	4100
Akapuao	3	06-May-08	24.9	0.2	15.4	1.3		6	136	31	11.8	4.7	3700
Akapuao	3	10-Jun-08	25.4	0.2	33.7	2.8		0.5	77	166	8.8	1.5	6700
Akapuao	3	10-Jun-08						0.5	77	167	4.6	0.7	5650
Akapuao	3	01-Jul-08	22.8	0.3	41.9	3.6		9	189	27	4.9	2.1	5650
Akapuao	3	19-Aug-08											
Akapuao	3	02-Sep-08	21.0	34.3	75.0	5.5		79	290	39	9.4	3.9	17850
Akapuao	3	07-Oct-08	22.4	0.7	111.7	9.7		5	218	22	6.7	1.0	6400
Akapuao	3	07-Oct-08						6	203	23	8.5	1.1	4400
Akapuao	3	04-Nov-08	25.7	0.32	9.8	0.8		13	124	8	5.8	4.4	4900
Akapuao	3	04-Nov-08						11	119	8	5.3	3.6	4900
Akapuao	3	09-Dec-08	26.0	0.2	52.5	4.3		73	47	321	7.6	7.6	15700
Totokoitu	4	15-Jan-08	25.3	0.1	116.3	9.6	7.7	52	19	15	4.5	2.2	4550
Totokoitu	4	12-Feb-08	24.3	0.1	89.2	7.5	7.6	23	16	22	2.0	0.7	2650
Totokoitu	4	05-Mar-08	24.5	0.1	92.7	7.7	7.6	27	16	16	1.8	0.3	2200
Totokoitu	4	02-Apr-08	23.6	0.1	86.8	7.4	7.5	40	15	17	2.9	1.2	1600
Totokoitu	4	06-May-08	22.9	0.1	92.9	8.0		26	25	27	4.4	1.1	4300
Totokoitu	4	06-May-08						25	11	28			
Totokoitu	4	10-Jun-08	23.5	0.2	88.0	7.5		10	5	11	0.6	0.1	1450
Totokoitu	4	01-Jul-08	22.5	0.1	122.3	10.6		30	19	44	1.8	0.7	6250
Totokoitu	4	01-Jul-08						29	17	45	1.9	0.9	3350
Totokoitu	4	19-Aug-08						24	14	26	0.6	0.4	865
Totokoitu	4	02-Sep-08	20.2	0.6	95.3	8.6		23	19	13	0.8	0.8	5550
Totokoitu	4	07-Oct-08	26.2	0.2	114.4	9.2		30	20	17	0.4	0.0	1540
Totokoitu	4	04-Nov-08	23.9	0.08	91.2	7.7		75	14	31	5.0	5.4	6750
Totokoitu	4	09-Dec-08	23.3	0.1	97.4	8.3		55	5	22	3.4	1.8	1200

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Totokoitu	4	09-Dec-08						52	5	22	3.5	0.8	6150
Rutaki	5	15-Jan-08	23.8	0.1	92.8	7.8	7.7	50	4	9	1.3	0.8	2950
Rutaki	5	12-Feb-08	26.8	0.1	93.8	7.5	7.7	35	2	5	0.8	0.6	1150
Rutaki	5	12-Feb-08						29	1	5	0.8	0.6	1450
Rutaki	5	05-Mar-08	25.6	0.1	129.2	10.6	8.1	39	5	5	0.3	0.0	893
Rutaki	5	02-Apr-08	24.6	0.1	103.2	8.6	7.7	65	6	3	0.8	0.6	1350
Rutaki	5	06-May-08	23.8	0.1	96.1	8.1		37	10	8	0.6	0.6	555
Rutaki	5	06-May-08						46	10	11	1.0	0.1	545
Rutaki	5	10-Jun-08	23.7	0.1	100.6	8.5		29	6	50	0.9	0.3	8250
Rutaki	5	01-Jul-08	23.0	0.1	107.4	9.2		42	3	7	2.6	2.6	1500
Rutaki	5	19-Aug-08											
Rutaki	5	02-Sep-08	21.1	21.2	46.3	3.6		24	29	26	3.3	1.0	4650
Rutaki	5	07-Oct-08	22.4	0.4				54	0.5	31	3.2	0.0	685
Rutaki	5	04-Nov-08	23.7	0.08	95.2	8.1		167	5	42	15.3	10.2	36200
Rutaki	5	09-Dec-08	24.0	0.1	95.6	8.0		73	2	31	3.8	1.9	895
Betela	6	15-Jan-08	27.1	0.2	42.7	3.4	7.4	26	12	25	4.4	2.0	5100
Betela	6	12-Feb-08	25.6	0.1	93.7	7.7	7.7	18	5	2	2.6	1.2	5500
Betela	6	05-Mar-08	25.4	0.1	95.2	7.8	8.0	19	13	6	1.9	0.2	860
Betela	6	02-Apr-08	24.6	0.1	87.2	7.3	7.8	27	15	14	2.8	1.7	1350
Betela	6	06-May-08	23.0	0.1	72.5	6.2		20	14	28	2.2	2.2	1395
Betela	6	06-May-08						26	12	29	1.1	1.1	1285
Betela	6	10-Jun-08	23.5	0.1	88.9	7.5		18	13	74	2.6	0.6	2100
Betela	6	10-Jun-08						38	14	78	2.8	0.4	1950
Betela	6	01-Jul-08	22.7	0.1	107.3	9.3		39	11	71	0.8	0.3	2850
Betela	6	01-Jul-08						39	10	69	1.5	0.8	3350
Betela	6	19-Aug-08						38	13	14	2.0	1.0	9950
Betela	6	02-Sep-08	20.1	0.1	62.5	5.7		28	15	9	4.3	1.2	5300
Betela	6	07-Oct-08	22.1	0.1	84.3	7.4		35	9	27	1.1	0.2	575
Betela	6	04-Nov-08	24.2	0.1	57.8	4.9		43	6	13	3.3	3.5	24300
Betela	6	09-Dec-08	24.6	0.1	80.8	6.7		60	7	242	3.7	0.7	11000
North Airport Drain	7	15-Jan-08	24.4	0.1	73.3	6.1	7.6	9	15	59	16.7	5.4	4200

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
North Airport Drain	7	15-Jan-08						8	17	59	13.8	4.0	3450
North Airport Drain	7	12-Feb-08	31.8	0.4	194.5	14.2	7.6	1	4	0.5	22.0	12.7	20
North Airport Drain	7	05-Mar-08	33.3	0.2	136.2	9.7	8.4	4	16	150	3.9	1.9	24
North Airport Drain	7	05-Mar-08						6	15	140	3.8	1.6	37
North Airport Drain	7	02-Apr-08	31.2	0.2	235.8	17.4	8.3	3	13	16	2.7	2.7	65
North Airport Drain	7	02-Apr-08						3	9	24	2.1	1.2	30
North Airport Drain	7	06-May-08	26.6	0.3	138.1	11.1		0.5	3	8	3.1	1.1	37
North Airport Drain	7	10-Jun-08	26.2	0.3	168.3	13.6		10	4	195	0.8	0.4	285
North Airport Drain	7	01-Jul-08	24.6	0.2	122.0	10.2		0.5	0.5	1	0.3	0.1	880
North Airport Drain	7	19-Aug-08						3	4	2	4.8	1.7	130
North Airport Drain	7	02-Sep-08	23.4	0.3	97.7	8.3		5	4	3	6.2	1.1	142
North Airport Drain	7	07-Oct-08	22.6	0.1	110.0	9.5		4	4	19	3.0	0.6	145
North Airport Drain	7	07-Oct-08						4	3	19	2.2	0.6	46
North Airport Drain	7	04-Nov-08	31.9	0.34	135	9.9		7	81	4	19.3	8.8	178
North Airport Drain	7	04-Nov-08						8	74	3	17.8	7.4	430
North Airport Drain	7	09-Dec-08	35.3	0.2	190.9	13.2		30	33	252	9.7	3.9	453
North Airport Drain	7	09-Dec-08						41	32	273			
Avatiu	8	15-Jan-08	24.0	0.1	100.1	8.4	7.6	93	7	34	3.5	1.5	4000
Avatiu	8	12-Feb-08	26.7	0.2	151.0	12.1	7.8	21	9	2	1.5	0.9	205
Avatiu	8	05-Mar-08	28.0	0.2	142.9	11.2	8.4	28	2	5	0.6	0.0	398
Avatiu	8	02-Apr-08	26.2	0.2	156.9	12.7	8.3	33	6	7	0.5	0.3	680

Keys:**Stream sites**

Location	Site Number	Date	Temperature (°C)	Salinity (ppt)	DOSat (%)	DO (mg/L)	pH	DRP (µg/L)	NH4-N (µg/L)	NO3-N (µg/L)	TSS (mg/L)	VSS (mg/L)	Enterococci (Count/100ml)
Avatiu	8	06-May-08	24.5	0.2	70.1	5.8		29	20	49	3.8	1.1	660
Avatiu	8	10-Jun-08	24.2	0.1	87	7.3		63	7	143	0.3	0.5	580
Avatiu	8	01-Jul-08	23.6	0.2	85.4	7.2		76	16	36	0.8	0.4	65
Avatiu	8	19-Aug-08						78	75	8	4.0	2.5	640
Avatiu	8	02-Sep-08	21.2	0.4	94.1	8.3		26	5	5	3.0	0.4	10700
Avatiu	8	02-Sep-08						6	5	6	23.5	12.3	12350
Avatiu	8	07-Oct-08	23.4	0.1	109.5	9.3		50	6	74	0.6	0.2	390
Avatiu	8	04-Nov-08	29.6	12.18	70.5	5.0		49	9	3	40.0	13.6	15000
Avatiu	8	09-Dec-08	24.3	0.1	93.4	7.8		96	6	149	5.5	0.8	1035