

Bacteriological water quality of the Waimoku catchment

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Executive summary

Poor bacteriological water quality in the small Waimoku Stream which flows across the popular Oakura beach, together with proposed subdivisional development in the township which does not have a reticulated sewerage system, have prompted further investigations into the source of the bacterial contamination within the catchment.

Three surveys were undertaken under relatively low flow, summer-autumn conditions between late 2003 and early 2005. The latter two surveys focused on individual subcatchments and indicated that the principal sources of elevated counts were consistent with extensive ponded, swampier reaches of tributaries inhabited by large numbers of wildfowl. Minor stock access to tributaries was noted. There were no indications of any dairy shed wastes disposal impacts on surface waters in the catchment, nor septic tank ground soakage effects on the Waimoku Stream through the township.

The Council's state of the environment monitoring indicates that the Waimoku Stream consistently fails to meet the MfE guidelines for contact recreation at the publicly accessible mouth on the Oakura beach. However, the poor bacteriological water quality of the small Waimoku and nearby Wairau Streams, does not compromise the bacteriological quality of the popular bathing beach at Oakura which consistently remains well within recommended contact recreation guidelines.

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1. Introduction

Over a period of nearly 15 years concerns have been expressed from time to time about bacteriological contamination of surface and groundwater in the Oakura beach township, particularly with regard to the small Waimoku and Wairau Streams catchments. The popularity of the bathing beach and probable expansion in population numbers (ie subdivision development) at Oakura, coupled with the absence of a reticulated sewerage treatment system, have focussed attention on surface water quality in these streams and the recreational waters of the Tasman Sea. Since 1989 several freshwater surface and groundwater bacteriological surveys have been performed (see References to the report) and additional contact recreational monitoring of the beach and Waimoku Stream has been a component of Taranaki Regional Council state of the environment programmes which have been performed since 1996 (see References).

Monitoring of some individual consented domestic wastewater systems in Oakura during the 2003-04 period was performed by the Taranaki Regional Council to ensure that nearby surface water bacteriological quality was not compromised by their usage. In conjunction with this monitoring, and in recognition of proposed subdivisional development (requiring the installation of individual domestic wastewater package treatment systems), the Council agreed to undertake a further, detailed investigation of the bacteriological water quality of the Waimoku Stream catchment. This investigation involved sampling within the catchment at established sites (for comparative purposes), and additional sites in relation to observed land and water usage.

2. Methods

Standard, documented sampling methods were used to collect water quality samples from various sites in the Waimoku Stream catchment on three survey occasions. The sites sampled were located as shown in Figure 1 and presented in Table 1 (together with appropriate survey dates). Samples were analysed for conductivity, turbidity, faecal coliforms and E.coli bacteria in the Council's IANZ-registered laboratory.

Table 1 Sites' locations and dates of sampling surveys

Site code	Site	Location	Map reference (P19:)	Survey dates		
				19.12.03	15.04.04	19.01.05
WMK000100	Waimoku Stream	Lucy's Gully	914-280	✓	✓	-
WMK000102	Waimoku Stream	adjacent to upper Ahuahua Road	909-284	✓	✓	-
WMK000140	Waimoku Stream	1.15 km d/s of SH45	910-293	-	✓	-
WMK000150	Unnamed tributary ¹	5 m u/s of Waimoku S. confluence	910-293	-	✓	-
WMK000170	Waimoku Stream	1.5 km d/s of SH45	913-299	✓	✓	-
WMK000173	Waimoku Stream	5 m u/s of culvert crossing	913-304	✓	✓	-
WMK000180	Unnamed tributary ²	adjacent to Kaitake Golf Club	914-303	✓	✓	-
WMK000240	Unnamed tributary ³	30 m u/s of Waimoku S. confluence	913-305	✓	✓	-
WMK000242	Waimoku Stream	80 m d/s of tributary confluence	913-305	✓	✓	-
WMK000255	Waimoku Stream	u/s of Kaitake Place	915-309	✓	✓	✓
WMK000261	Unnamed tributary ⁴	15 m u/s of SH45	920-299	-	-	✓
WMK000264	Unnamed tributary ⁴	50 m d/s of Golf Club	919-301	-	-	✓
WMK000266	Unnamed tributary ⁴	300 m d/s of Golf Club	919-303	-	-	✓
WMK000270	Unnamed tributary ⁴	300 m u/s of Waimoku S. confluence	918-310	-	✓	✓
WMK000271	Unnamed tributary ⁵	SH45	920-300	-	-	✓
WMK000272	Unnamed tributary ⁵	300 m d/s of SH45	920-302	-	-	✓
WMK000273	Unnamed tributary ⁵	600 m d/s of SH45	920-307	-	-	✓
WMK000274	Unnamed tributary ⁵	900 m d/s of SH45	920-308	-	-	✓
WMK000275	Unnamed tributary ⁵	280 m u/s of Waimoku S. confluence	919-309	-	✓	✓
WMK000280	Unnamed tributary ⁴	80 m u/s of Waimoku S. confluence	916-311	✓	✓	✓
WMK000295	Waimoku Stream	Oakura camping ground	918-315	✓	✓	✓
WMK000298	Waimoku Stream	near mouth at beach	918-316	✓	✓	✓

[Notes: ¹ upper western tributary; ² main western tributary; ³ lower western tributary; ⁴ larger eastern tributary; ⁵ smaller eastern tributary]

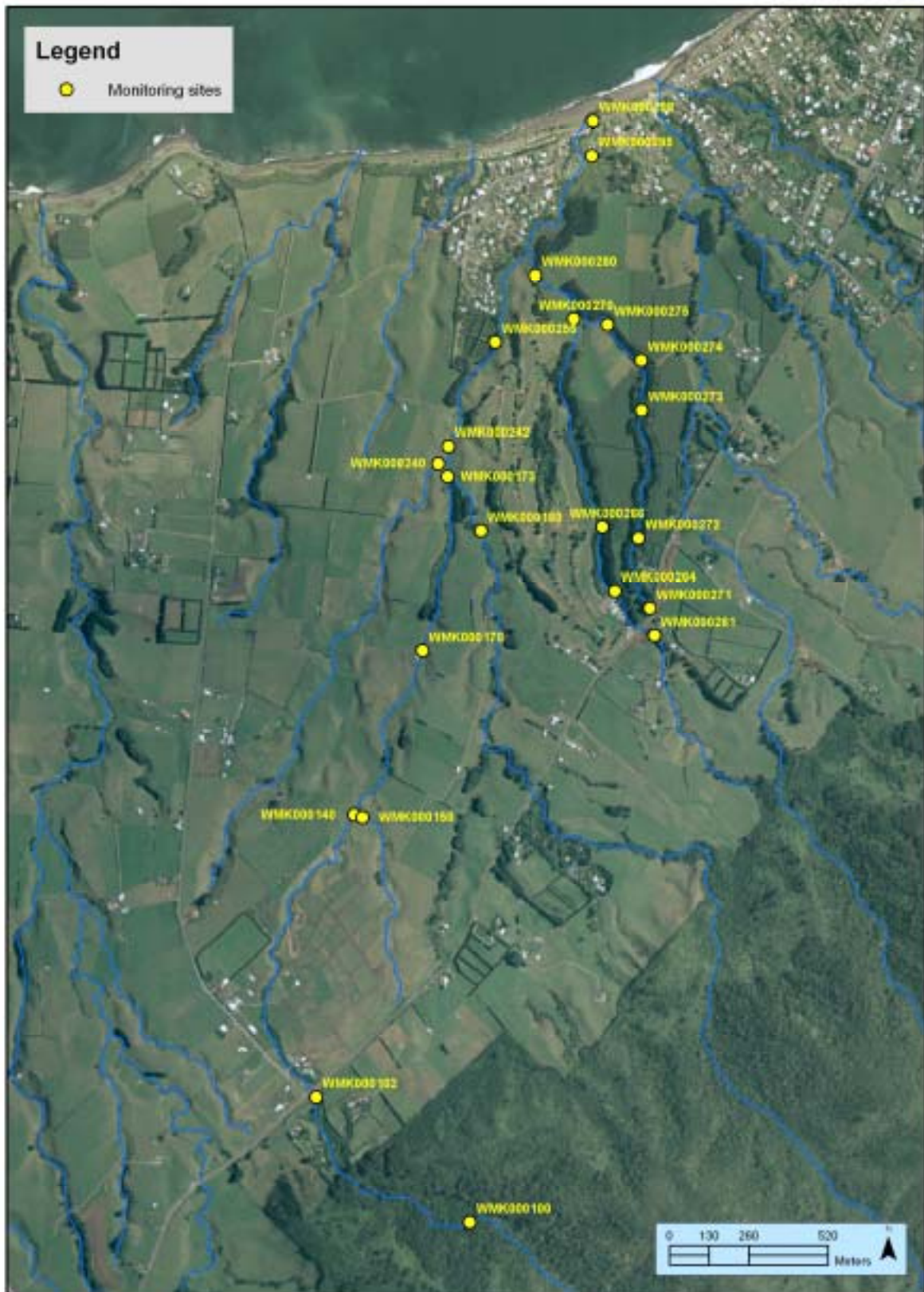


Figure 1 Location of sites sampled in the Waimoku Stream catchment

3. Results and discussion

The results of each of the surveys are presented and discussed beneath, together with a summary of historical bacteriological data for each site (where data exist) in Table 2. A summary of historical bacteriological data for two sites in the Tasman Sea in the vicinity of the Waimoku Stream mouth (SEA903030: opposite surf club, and SEA903032: opposite camp ground) is presented in Table 3.

Table 2 Summary of previous bacteriological data for the Waimoku Stream

Site	Period	Bacteria (nos/100 ml)					
		Faecal coliforms			E.coli		
		N	Range	Median	N	Range	Median
WMK000255	Sep 85 to Feb 95	44	110-2600	595	2	500-930	-
WMK000295	Jan 89 to Mar 99	30	63-2800	560	10	410-1400	800
WMK000298	Sep 85 to Dec 03	137	85-30000	670	97	85-2800	670

[Note: E.coli are the indicator bacteria for contact recreational freshwater]

Table 3 Summary of previous bacteriological data for the Tasman Sea

Site	Period	Bacteria (nos/100 ml)					
		Faecal coliforms			Enterococci		
		N	Range	Median	N	Range	Median
SEA903030	Jan 89 to Dec 03	144	<1-720	9	123	<1-880	11
SEA903032	Jan 89 to Dec 03	137	<1-220	3	116	<1-280	4

[Note: Enterococci are the indicator bacteria for contact recreational freshwater]

3.1 December 2003 survey

The initial catchment survey was performed at eleven sites (Table 1) on 19 December 2003 under moderate flow conditions, five days after significant rainfall in the catchment. These results are presented in Table 4.

Table 4 Results of the water quality survey in the Waimoku Stream catchment, 19 December 2003

Parameter Site	Time	Temperature	Conductivity @ 20°C	Turbidity	Faecal coliforms	E.coli	Appearance
Units	NZST	°C	mS/m	NTU	nos/100 ml	nos/100 ml	
WMK000100	1100	12.4	9.8	0.65	3	3	clear, uncoloured
WMK000102	1050	12.9	10.8	1.3	<8	<8	clear, uncoloured
WMK000170	1030	15.1	11.8	1.3	1300	1300	clear, uncoloured
WMK000173	1005	14.2	11.9	1.3	1200	1200	clear, uncoloured
WMK000180 ²	1015	14.7	13.4	1.3	610	610	clear, uncoloured
WMK000240 ³	1000	15.4	14.5	0.70	490	490	clear, uncoloured
WMK000242	0950	14.4	13.2	0.95	930	930	clear, uncoloured
WMK000255	0900	14.2	13.1	1.0	800	800	clear, uncoloured
WMK000280 ⁴	0930	16.1	16.9	2.8	1600	1600	clear, uncoloured
WMK000295	0845	14.5	13.6	1.0	1000	1000	clear, uncoloured
WMK000298	0840	14.2	13.7	0.80	1000	1000	clear, uncoloured

[Notes: ² main western tributary; ³ lower western tributary; ⁴ larger eastern tributary]

Results from this initial survey in December 2003 indicated high bacteriological water quality in the upper reaches of the main Waimoku Stream, as would be anticipated given the National Park source of the stream. However, very elevated

bacterial counts were found in the main stream reaches some 1.5 km downstream of SH45 continuing through to near Oakura township. The faecal coliform bacteriological count at site WMK000255 was above the historical median (595 per 100 ml) for this site (Table 2). The two tributaries surveyed below site WMK000173 had moderately high counts, but were not the principal sources of the high counts in the main stream. The reach of the main stream between the main highway and site WMK000140, 1.15 km downstream, was characterised by swampy sections with waterfowl access and habitat.

Bacterial counts remained elevated in the main Waimoku Stream through Oakura township and onto the beach, increasing slightly below the large western tributary which had a high bacterial count in its lower reaches at site WMK000280. Counts in the lower reaches of the Waimoku Stream were well above long term median numbers (Table 2).

Contact recreational bacteriological monitoring of the two Oakura beach sites (SEA903030 and SEA903032) on 17 December 2003 found very low faecal coliform counts of 3 and 1 (per 100 ml) respectively, indicative of no impact of the nearby Waimoku and Wairau Streams' mouths, and typical of historical records (Table 3).

3.2 April 2004 survey

The second catchment survey was performed at the same eleven sites, plus an additional four sites (Table 1) on 15 April 2004 under moderately low flow conditions, seven to ten days after significant rainfall in the catchment. The additional sites were utilised in an attempt to identify the sources of elevated bacteriological counts found at the time of the initial survey. The results are presented in Table 5.

Table 5 Results of water quality survey in the Waimoku Stream catchment, 15 April 2004

Parameter Site	Time	Temperature	Conductivity @ 20°C	Turbidity	Faecal coliforms	E.coli	Appearance
Units	NZST	°C	mS/m	NTU	nos/100 ml	nos/100 ml	
WMK000100	1125	11.6	10.8	1.2	17	9	clear
WMK000102	1120	12.2	12.0	1.5	4	4	clear
WMK000140*	1055	12.5	12.3	1.6	210	210	clear
WMK000150* ¹	1100	15.5	14.1	0.80	290	290	clear
WMK000170	1040	13.2	12.6	1.3	160	160	clear
WMK000173	1015	12.9	13.1	1.3	210	210	clear
WMK000180 ²	1025	13.1	14.5	0.90	230	230	clear
WMK000240 ³	1010	13.7	16.7	0.95	220	220	clear
WMK000242	1005	13.4	14.5	1.1	380	360	clear
WMK000255	0900	12.9	14.5	1.0	430	420	clear
WMK000270* ⁴	0940	13.7	18.5	1.9	850	850	clear
WMK000275* ⁵	0945	13.0	18.5	3.0	1000	970	rel. clear
WMK000280 ⁴	0930	13.4	18.8	2.6	1300	1300	rel. clear
WMK000295	0850	12.8	15.3	1.4	930	920	clear
WMK000298	0840	12.8	15.2	1.4	540	540	clear

[Notes: *additional sites to those sampled, 19 December 2003; ¹ upper western tributary; ² main western tributary; ³ lower western tributary; ⁴ larger eastern tributary; ⁵ smaller eastern tributary]

These results confirmed high bacteriological water quality in the upper reaches of the main Waimoku Stream. Some elevation in bacteria numbers was found some 1.15 to 1.5 km downstream of SH45 coincidental with a moderate count in a small unnamed tributary (site WMK000150) which showed signs of heavy stock grazing upstream. Main stream counts were markedly lower than recorded at the time of the previous (summer) survey (Table 4) and the two western tributary streams (sites WMK000180 and WMK240) had only slightly elevated counts, lower than recorded by the previous survey.

A gradual increase in bacterial numbers was found in the main Waimoku Stream downstream to near Kaitake Place (site WMK000255) where the faecal coliform number was about half that recorded by the December 2003 survey and below the historical median for this site (Table 2).

Markedly higher counts were recorded in the eastern tributary stream (and both arms of this tributary, see Figure 1) which joined the main Waimoku Stream between sites WMK000255 (about 300 m downstream) and WMK000295. These levels of faecal coliform and E.coli bacteria (850 to 1300 per 100 ml) were possibly due to extensive swampy reaches in both tributaries which were inhabited by many waterfowl noted by a more recent (late May 2004) inspection of both streams. Some slower, almost ponded sections were noted and a further bacteriological water quality survey therefore was scheduled for summer 2004-2005 in order to complete investigations.

The poorer quality of this eastern tributary stream resulted in a marked rise in the bacterial counts in the lower reaches of the Waimoku Stream to levels either well above or relatively similar to historical medians at sites WMK000295 and WMK000298 (Table 2).

Contact recreational bacteriological monitoring of the Tasman Sea at the two Oakura beach sites (SEA903030 and SEA903032) nine days earlier found low faecal coliform counts of 20 and 11 (per 100 ml) respectively, typical of historical counts (Table 3) and indicative of minimal impact of the nearby Waimoku and Wairau Streams' mouths.

3.3 January 2005 survey

The third and final survey was delayed until a period of dry weather conditions in mid January 2005. It was performed at three of the main Waimoku Stream sites but was concentrated upon both arms of the 'eastern' tributary (10 sites; Table 1 and Figure 1) on 19 January 2005 under relatively low flow conditions. The results are presented in Table 6.

Table 6 Results of water quality survey in the Waimoku Stream catchment, 19 January 2005

Parameter Site	Time	Temperature	Conductivity @ 20°C	Turbidity	Faecal coliforms	E.coli	Appearance
Units	NZST	°C	mS/m	NTU	nos/100 ml	nos/100 ml	
WMK000255	1225	15.5	13.4	1.5	450	430	clear
WMK000261 ⁴	0840	16.7	17.5	3.2	120	120	rel. clear
WMK000264 ⁴	0925	16.8	17.2	1.6	320	320	clear
WMK000266 ⁴	0940	16.4	16.6	1.4	260	250	clear
WMK000270 ⁴	1000	18.9	16.6	1.8	3400	3400	clear
WMK000271 ⁵	1210	15.8	15.1	0.25	15	15	clear
WMK000272 ⁵	1120	17.9	16.3	4.4	360	350	rel. clear
WMK000273 ⁵	1100	14.9	17.0	3.9	220	210	sl. cloudy
WMK000274 ⁵	1045	16.1	18.0	15	1500	1500	sl. turbid, brown
WMK000275 ⁵	1030	16.0	19.0	16	820	800	sl. turbid, brown
WMK000280 ⁴	1020	16.1	16.9	5.0	2400	2400	cloudy
WMK000295	1250	16.9	14.2	1.6	580	550	clear
WMK000298	1320	16.5	14.3	1.4	370	370	clear

[Notes: ⁴ larger eastern tributary; ⁵ smaller eastern tributary]

Low to moderate faecal coliform counts were recorded in the upper reaches of both shaded arms of the 'eastern' unnamed tributary (sites WMK000261 and WMK000271) near SH45. Counts increased in both these small tributaries in a downstream direction coincidentally with extensive swampy, shaded, ponded reaches which had high waterfowl numbers (pukekos and ducks). Discolouration and/or increased turbidity was often associated with the presence of waterfowl. Faecal coliform bacterial numbers were relatively high above the confluence of these two arms (sites WMK000270 and WMK000275), particularly in the larger of these two tributaries where some stock access may occur giving rise to the high count below the confluence (site WMK000280). This count was higher than recorded by both earlier surveys at this site. An increase in numbers was found between sites WMK000261 and WMK000264 adjacent to the Kaitake Golf Club which has a septic tank waste disposal system (situated some 50 m from the stream) but the distance of this system from the stream and the presence of birdlife in this reach and the relatively small increase in faecal coliform number in comparison with a similar reach in the adjacent tributary (between sites WMK000271 and WMK000272) indicated no significant influence of this septic tank wastes disposal system.

Faecal coliform counts in the lower reaches of the main Waimoku Stream through Oakura township however, were lower than recorded by the two previous surveys of December 2003 and April 2004, and well below long-term median numbers (Table 2) at the lower site at the beach (WMK000298).

Contact recreational bacteriological monitoring of the Oakura beach site (SEA903030) on the same day found an elevated faecal coliform count of 160 per 100 ml, influenced by the nearby Wairau Stream. Five days later, counts at the two Oakura beach sites (SEA 903030 and SEA 903032) were low at 26 and 1 (per 100 mls) respectively, the former influenced to a lesser extent by the nearby Waimoku and Wairau Streams' inflows, more typical of historical records (Table 3).

4. Conclusions

The initial early summer 2003-04 survey found typically high faecal coliform bacteriological counts at most sites under stable flow conditions in the Waimoku Stream, particularly in the lower reaches. The late autumn, 2004 survey found a decrease in faecal coliform numbers at certain mid-reach sites but elevated counts from the eastern sub-catchment resulting in moderately high counts in the main stream through Oakura township to the coast. While there was some evidence of heavy stock grazing in one area, the principal source of the high counts was coincident with swampy, ponded reaches and extensive wildfowl populations. The mid-summer 2004-05 survey, which was concentrated on the eastern subcatchment, confirmed elevated bacteriological counts in reaches with extensive wildfowl numbers coincident with more discoloured/turbid streamflow.

The presence of extensive wildfowl populations in tributaries of the Waimoku Stream was therefore responsible for the relatively high faecal coliform counts in the lower Waimoku Stream which has consistently exceeded contact recreational guidelines at Oakura beach where its ponding, ease of access and relatively warm waters combine to provide an apparently favourable children's bathing site. There was no indication of any influences of domestic septic tank wastes ground soakage disposal on the bacteriological water quality of the lower reaches of the stream through the township.

Contact recreational bacteriological guidelines were seldom achieved in the Waimoku Stream as it flowed across Oakura beach. However, guidelines were not compromised by this stream, or the nearby Wairau Stream, at either of the Oakura coastal beach sites in the vicinity of the mouths of the streams.

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