

Geothermal features annual monitoring report, June 2010

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Acknowledgement

I would like to acknowledge the co-operation and assistance of the Tourism concessionaires and business owners, farmers, and Department of Conservation, in allowing access, and sharing their time and knowledge of the geothermal features. Thank you.

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1. Outline

Project

Monitoring reported here is undertaken for the Waikato Regional Council for the purpose of monitoring the natural geothermal features of the Waikato Region that are associated with high temperature geothermal systems. The brief is to report on the geothermal surface manifestations in the geothermal areas listed below, and specifically to be alert to any changes, whether human-induced or natural, and to advise of any potential threat to these features.

Sites

Atiamuri

Golden Springs

Horohoro

Ngatamariki

Orakeikorako

Reporoa

Tauhara

Te Kopia

Tokaanu

Waikite

Waiotapu

Method

This is the first and second round of sampling carried out by this team. As such a surprising amount of time was spent looking for springs and some were not visited. However, the majority from the preceding monitoring report (86 %) were visited, and some which have no data since 2005 were visited, for instance two of the three tomos on Murphy's Farm (Te Kopia) and the Scalding Spring at Waikite.

Most of the map locations were already given from previous work; where necessary for this report a Garmin GPSmap 60Cx was used to record or check locations. Sketch maps of the multi-pool features at Paerata Rd, Mokai, are included in order to assist future monitoring.

Direct temperature measurements were made with a thermocouple on a 4 m long wire, or a 100 mm long rigid probe, connected to a Fluke multimeter. If the surface to be measured was not accessible, a Fluke IR thermometer was used, however this is subject to limitations, particularly if there is steam present.

If the spring is easily accessible, the pH is measured with a Hanna Instruments pH meter with a maximum operating temperature of 50°C; if the spring temperature is > 50°C the water is cooled to less than 50°C before the pH measurement was taken. In future we will carry a sampler that can allow us to take a sample from a 1 m distance and therefore enable more pH measurements.

The liquid flow rate or discharge is estimated if we believe the estimate is realistic, i.e. that the entire flow can be seen and seepage or flow diversion is not occurring on a large scale. The water level was recorded

for some features; subject to choosing an easily identified and physically long-lived benchmark in the vicinity. 'Ebullience' and gas discharge are recorded, also water clarity and colour, and the general condition of the sinter is noted.

Discussion

It is noted that a requirement of this contract is to advise on the relevance of features to the monitoring programme. For this reporting period the approach has been to acquaint ourselves with the current monitoring programme and observe the features first-hand, while also recognising that there should be a justification for the resources invested in monitoring each feature. We are aware that this evaluation of the monitoring effort is part of the ongoing work programme, and will be a component of future reports.

It also appears that the names of the features have 'evolved' over the years, and that there needs to be an effort to ensure that historical names and data are related to current names and data. This should also be part of the ongoing work programme.

Records of Observations

In addition to this report, a MS Excel spreadsheet contains historical observations of geothermal features (Doc No. 1723079). Due to size constraints, this spreadsheet is not available in printed form but can be obtained on request from Environment Waikato.

2. Atiamuri

152 Matapan Rd

E2779201 N6302030

There are two springs; one discharging around 3 m above the pool, with a temperature of 64 °C, and a cooler spring with a smaller flow discharging from the right of the rock face around 1 m above the pool. There was no smell of H₂S, the rocks below the springs and in the pool below are covered with black algae.

Table 2.1: Atiamuri: Observations of Matapan Rd Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
12 April 2010	64	7.8	~5	-	-	Clear
12 April 2010	22		~0.5	-	-	Clear

Whangapoa Pools

Northwest Pool

E2776598 N6311134

It was difficult to approach the pool due to the fence and blackberry. The fence is in a state of disrepair but is still difficult to impossible to cross. The temperature was measured in the pool, near the outlet.

Table 2.2: Atiamuri: Observations of Northwest Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
12 April 2010	58	-	~2	-	Upwelling.	Blue-green, slightly cloudy.



2-1. Outlet of Northwest Whangapoa Pool, April 2010. Arrow indicates measurement point.

Southeast Pool

E2776615 N6311082. The pool is fenced.

Table 2.3: Atiamuri: Observations of Southeast Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
12 April 2010	61	8.1	~1	-	Upwelling in centre of pool.	Blue-green, clear.



2-2 Southeast Whangapoa Pool, April 2010.

Two small springs off Ohakuri Rd (Bergs)

E2776422 N6311362

These springs are small, deep holes in the ground surrounded by blackberry and weed. They are enclosed by a fence.

The western feature appears to be the slightly more active of the two.

Table 2.4: Atiamuri: Observations of Bergs West Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Depth (m)	Diameter (m)	Ebullition	Colour
12 April 2010	97	nd	steam	nd	~1	~0.3	Audible continual bubbling.	Probe came up clean. Could smell H ₂ S.

Table 2.5: Atiamuri: Observations of Bergs East Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Depth (m)	Diameter (m)	Ebullition	Colour
12 April 2010	98	nd	steam	nd	~0.5	~0.3	Audible intermittent bubbling.	Probe came up clean. Could smell H ₂ S.



2-3 Atiamuri: Berg Springs, April 2010

3. Golden Springs

Pools in the stream through the Golden Springs Motel

North Pool

E2798840 N6298535

Table 3.1: Golden Springs: Observations of North Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
10 April 2010	36	6.9	~30	nd	-	Beige, cloudy.

South Pool

E2798774 N6298395

One swimmer.

Table 3.2: Golden Springs: Observations of Golden Springs North Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
10 April 2010	33	7.4	~40	nd	-	Beige, cloudy.



3-1. Golden Springs North Pool in the motel grounds.

Pools across the road from the motel

Feature 3

E2798940 N6298927

Table 3.3: Golden Springs: Observations of No 3 Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	43	6.3	nd	nd	calm	Milky yellow-brown.

Feature 4

E2798921 N6299017

Table 3.4: Golden Springs: Observations of No 4 Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	46	6.2	~30	nd	Calm, minor gas discharge.	Milky pale green.



a)



b)

3-2. Golden Springs a) Feature 3 and b) Feature 4.

4. Horohoro

2788384E 6323144N

Table 4.1: Horohoro: Observations of Waipupumahana Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	49	8.2	5 to10	nd	Calm, gentle effervescence.	Dark green, slightly cloudy.



4-1. Waipupumahana pool at Horohoro April 2010.

5. Mokai

Tirohanga Rd

I have put a 'T' prefix on these feature numbers to distinguish them from Paerata Rd features.

This group of features are surrounded by an electric fence. There is an area of mudpools immediately by the cowshed (Features T1 & T2), and another group of features over a slight rise from these.

Feature T1 & T2

E2763460 N6295714. This site has two merged pools.

Table 5.1: Mokai: Observations of Tirohanga Rd T1 and T2 pools

Date	Feature	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	T1	57	7.0	0 visible	~0.3 below rim	Calm.	Milky khaki.
14 June 2010	T2	19	7.1	0 visible	~0.3 below rim	Calm.	Milky pale brown.



a)



b)

5-1. Tirohanga Rd Features 1&2, June 2010. a) Feature 2; b) Feature 1.

Feature T3

E2763455 N6295751

Table 5.2: Mokai: Observations of Tirohanga Rd T3 pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	36	7.1	No visible	-0.3 rel to stump.	Calm.	Murky pale brown.



a)

5-2. Tirohanga Rd Feature T3, June 2010.

Feature T4a and T4b

E2763460 N6295777

Site T4a has three features, T4a_i, T4a_ii, and T4a_iii. These have cooled considerably since February 2009.

Table 5.3: Mokai: Observations of Tirohanga Rd T4a pools

Date	Feature	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	T4a_i	29	nd	0 visible	-1.5 below rim	Calm.	Clear, slightly milky.
14 June 2010	T4a_ii	19	nd	0 visible	-1.5 below rim	Calm.	Milky pale brown.
14 June 2010	T4a_iii	16	nd	0 visible	-1.5 below rim	Calm.	Milky pale brown.



a)



b)

5-3. Tirohanga Rd Features T4a_i, T4a_ii, and T4a_iii, June 2010. a) all of feature 4a; b) Feature 4a_i.

Site T4b has two pools, the smaller (T4b_ii) of which was draining into the larger (T4b_i). There is white sinter surrounding both the pools, and covering the outflow from the larger pool.

Table 5.4: Mokai: Observations of Tirohanga Rd T4b pools

Date	Feature	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	T4b_i	71	7.5	0 visible	g.l.	Calm.	Slightly milky blue green.
14 June 2010	T4b_ii	70	7.2	0 visible	g.l.	Calm.	Slightly milky brownish-blue.



a)



b)

5-4. Tirohanga Rd Features T4b_i, and T4b_ii, June 2010; a) Feature T4b pools; b) T4b_i outflow,

Feature T5

E2763448 N6295832

Site T5 has two pools, with the larger (T5_i) draining into the smaller (T5_ii).

Table 5.5: Mokai: Observations of Tirohanga Rd T5 pools

Date	Feature	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	T5_i	41	6.1	~2	-1.5 below rim	Calm.	Murky brown.
14 June 2010	T5_ii	66	7.0	~2	-1.5 below rim	Calm.	Murky brown.



5-5. Tirohanga Rd Features T5_i, T5_ii, June 2010.

Paerata Rd

The Paerata Rd features are prefixed with a 'P' here to distinguish it from the Tirohanga Rd sites.

Feature P1a, b, c, d, e, f, g

E2765402 N6294657

This is referred to as Feature 1 in the 2009 Annual Report. Site P1 is a muddy area with seven pools, and small hot seeps on the margins near the cliff. The maximum temperature recorded from the hot seeps was 77°C, with a pH of 3.4. A small gas discharge with no visible liquid had a temperature of 93°C.

Table 5.6: Mokai: Observations of Paerata Rd P1 pools

Date	Feature	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	P1aN	38	3.8	0		Gas discharge.	Light grey- brown.
14 June 2010	P1aS	41	3.5	0		Gas discharge.	Light grey- brown.
14 June 2010	P1b	39	2.7	0		Calm.	Light grey- brown.
14 June 2010	P1c_i	21		0		Calm.	Light grey- brown.
14 June 2010	P1c_ii	17		0		Calm.	Light grey- brown.
14 June 2010	P1d	Uncertain of the location of P1d					
14 June 2010	P1e	20	2.7	0		Gas discharge.	Light grey- brown.
14 June 2010	P1f	17	2.5	0		Gas discharge.	Light grey- brown.
14 June 2010	P1g	16	2.5	0		Gas discharge.	Light grey- brown.



5-6. Paerata Rd Features P1 June 2010.



a)



b)

5-7. Paerata Rd June 2010; a) Feature P1a, and b) Feature P1b.



a)



b)

5-8. Paerata Rd June 2010; a) Feature P1c, and b) Feature P1e, f and g.

Feature P4a, b, c, d, e, f, g, and x

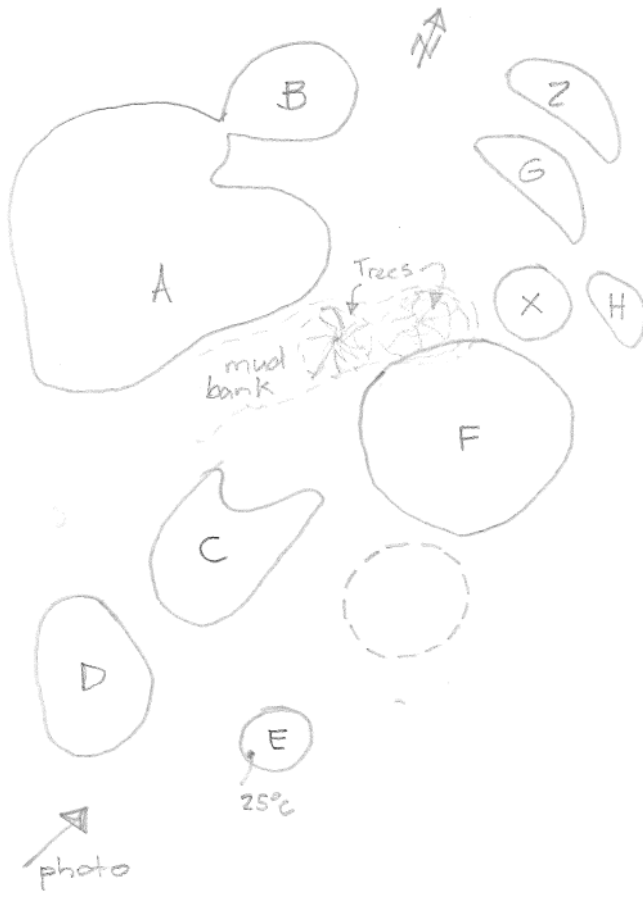
This is referred to as Feature 4 in the 2009 Annual Report. P4 is a muddy depression approximately 30 m diameter.

Table 5.7: Mokai: Observations of Paerata Rd P4 pools

Date	Feature	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 June 2010	P4a	18	2.3	0		Calm.	Murky grey- brown.
14 June 2010	P4b	18	2.4	0		Calm.	Murky grey- brown.
14 June 2010	P4c	18	2.3	0		Calm.	Murky grey- brown.
14 June 2010	P4d	17	2.5	0		Calm.	Murky grey- brown.
14 June 2010	P4e	24		0			
14 June 2010	P4f	10	2.4	0		Calm.	Murky grey- brown.
14 June 2010	P4g	12	4.6	0		Calm.	Green-brown.
14 June 2010	P4x	14	2.3	0		Calm.	Murky grey- brown.



5-11. Paerata Rd Features P4 June 2010.



5-12. Sketch map of Paerata Rd Feature P4 June 2010. Note that D and C are joined in June 2010.

The dotted outline is a small mud volcano which did not appear to be currently active.

6. Ngatamariki

Hydrothermal Eruption Crater

Large Pool occupying the crater

E2786600 N6291801

This site has a large pool (~30 m x 10 m) occupying the hydrothermal eruption crater, with a rim of debris to the between the pool and the stream. There is also a small mud pool in what appears to be a collapse crater. This is 3 m away from the main pool, and the water level is approximately 1 m above that of the main pool. Between the two pools, and on the margin of the large pool there is an area of intense gas discharge, which extends into the pool. In the pool there is a shallow feature consisting of gel-like grey clay which has small (< 0.4 m diameter) craters with gas discharging from each. Between the craters green algae covers the clay. The same features appear to exist on the far side of the pool around an area of intense thermal activity.

In April we measured ground temperature (at 0.10 m depth) in the area between the small and large pools and on the large pool margins. Although there was a lot of gas and minor water discharge in the area, there was only one small area where ground temperatures were >70 °C, which is where the small pool would overflow into the larger pool. The maximum ground temperature was 93 °C at 0.10 m depth.

It appears as though the maximum activity occurs in a line from the small mud pool, across the main pool to the base of the cliff. This is shown in Figure 6-2b) and c). There is other minor gas discharge all over the large pool.

Table 6.1: Ngatamariki: Observations of Crater Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	50	6.2	~10	nd	Calm, moderate gas discharge.	Dark green.
14 June 2010	46	7.0	~10	nd	Calm, moderate gas discharge.	Dark green.



a)



b)



c)



d)

6-1. Ngatamariki: The large pool occupying the hydrothermal eruption crater.

- a) Overview of the pool;
- b) Area of gas discharge at the pool margin, and steam activity on the far side of the pool.
- c) Steam activity at the base of the cliff.
- d) Outflow channel



a)



b)



c)



d)

6-2. Ngatamariki: The large pool occupying the hydrothermal eruption crater.

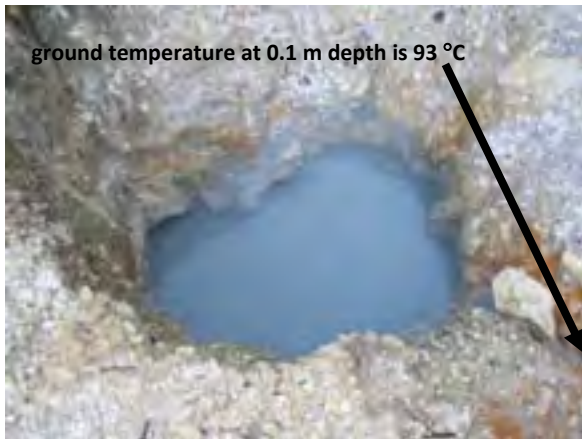
- a) Overview of the pool;
- b) Area of gas discharge at the pool margin, and steam activity on the far side of the pool.
- c) Linear zone of gas discharge (dotted line) from the small mud pool to the area of activity below the cliff..
- d) Outflow channel with green algae.

Mud pool beside large pool

There is a small pool in what appears to be a collapse hole of approximately 1.5 m diameter in the eruption deposits near the large pool.

Table 6.2: Ngatamariki: Observations of Mud Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	49	nd	0 visible	nd	Gas discharge.	Murky black.
14 June 2010	33	3.5	0 visible	0.3 below outflow.	Calm.	Murky mid-grey.



6-3. Ngatamariki: Small mud pool, June 2010.

7. Orakeikorako

Waihunuhunu Inlet

In April and June there were no swimmers. In April we passed one vehicle on the track as we were leaving. In June there was one fisherman.

Inlet 1

E2785533 N6300770

Table 7.1: Orakeikorako: Observations of Inlet Spring 1, Waihunuhunu

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
12 April 2010	55	nd	~20	-	-	Clear.
14 June 2010	55	7.0	~20	-	-	Clear.

Inlet 2

E2785509 N6307774

The flow is difficult to estimate as the pipe is below water level. The temperature measurement was made in the top of the pipe.

Table 7.2: Orakeikorako: Observations of Inlet Spring 2, Waihunuhunu

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
12 April 2010	42	nd	nd	-	-	Clear.
14 June 2010	45	6.8	nd	-	-	Clear.



a)



b)

7-1. a) Waihunuhunu Inlet 1; a) April 2010, and b) June 2010.



a)



b)

7-2. a) Waihunuhunu Inlet 2; a) April 2010, and b) June 2010.

Sinter Terraces

Diamond Geyser

E2784619 N6298509. The geyser did not erupt while we observed it either in April or June.

Table 7.3: Orakeikorako: Observations of Diamond Geyser

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
12 April 2010	88	nd	0	-	Upwelling and gas discharge	Clear.
15 June 2010	86	6.4	0	-	Upwelling.	Clear.



7-3. Orakeikorako: Diamond Geyser in April 2010.

Bush Geyser

Did not approach the geyser.

Cascade Geyser

Table 7.4: Orakeikorako: Observations of Cascade Geyser

Date	T(°C)	pH	Flow (l/s)	Eruption duration (s)	Eruption height (m)	Eruption Interval (s)	Number of eruptions
12 April 2010	nd	nd	nd	30	0.4	nd	1
15 June 2010	nd	nd	nd	120	1.0	300	3



a)



b)

7-4. Orakeikorako: Cascade Geyser; a) in April 2010, and b) in June 2010.

Sapphire Geyser

Did not approach the geyser. This was not observed erupting in June 2010.

Table 7.4: Orakeikorako: Observations of Sapphire Geyser

Date	T(°C)	pH	Flow (l/s)	Eruption duration (s)	Eruption height (m)	Number of eruptions
12 April 2010	nd	nd	nd	60	0.2	1

Map of Africa

E2784682 N6298522. Orange algal mats surround the pool. More of these were covered in June. The water appears dark, due to the rocks being covered with algae.

Table 7.5: Orakeikorako: Observations of Map of Africa

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	53	nd	nd	nd	Calm.	Clear.
15 June 2010	46	nd	nd	nd	Calm.	Clear.



a)



b)

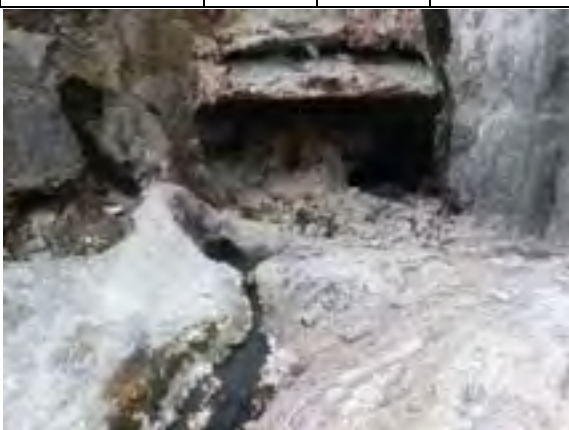
7-5. Orakeikorako: Map of Africa; a) April 2010, and b) June 2010.

Devil's Throat

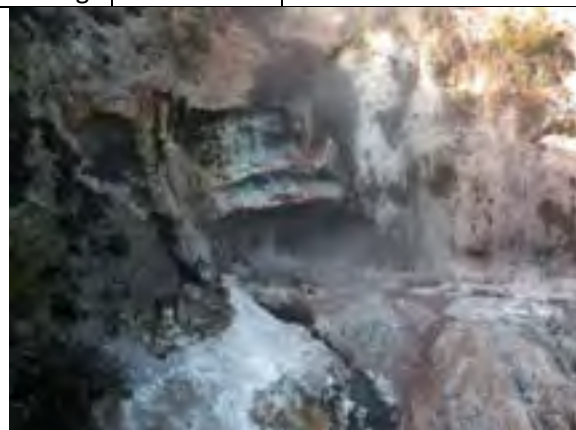
E2784703 N6298564.

Table 7.6: Orakeikorako: Observations of Devil's Throat

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	100	nd	1	Overflowing.	Ebullient.	Clear.
15 June 2010	99	6.9	1	Overflowing.	Ebullient.	Clear.



a)



b)

7-6. Orakeikorako: The Devil's Throat; a) April 2010, and b) June 2010.

Fred and Maggies Pool

E2784752 N6298549

Table 7.7: Orakeikorako: Observations of Fred and Maggy Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	100	nd	1	Overflowing.	Ebullient, boiling.	Clear blue-green.
15 June 2010	99	7.0	0.5	Overflowing.	Ebullient, boiling.	Clear blue-green.



a)



b)

7-7. Orakeikorako: Fred and Maggie's Pool; a) April 2010, and b) June 2010.

Wairiri Geyser

E2784747 N6298519

Table 7.8: Orakeikorako: Observations of Wairiri Geyser

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	83	nd	0	0.2 m below rim.	Occasional gas discharge.	Clear blue-green.
15 June 2010	81	7.3	0	0.35 m below rim.	Calm.	Clear blue-green.



a)



b)

7-8. Orakeikorako: Wairiri; a) April 2010, and b) June 2010.

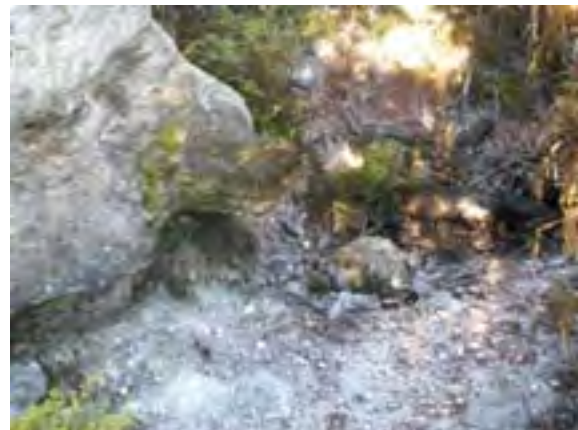
Elephant Rock

E2784752 N6298494

Measured the ground temperature in the pit approximately 1.5 m in front of the trunk. Depth of probe 0.075 m.

Table 7.9: Orakeikorako: Observations of Elephant Rock

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	93	-	Wisps of steam.	-	-	-
15 June 2010	92	-	Wisps of steam.	-	-	-



a)

b)

7-9. Orakeikorako: Ground in front of Elephant Rock; a) April 2010, and b) June 2010.

Steaming Ground on western edge of Artists Palette

E2784765 N6298478.

Measured the ground temperature in several places. Depth of probe 0.03 m.

Table 7.10: Orakeikorako: Observations of Palette Steaming Ground

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	60-94	-	-	-	-	-
15 June 2010	36-100	-	-	-	-	-



a)

7-10. Orakeikorako: Steaming ground on western edge of Artists Palette; a) April 2010, and b) June 2010.

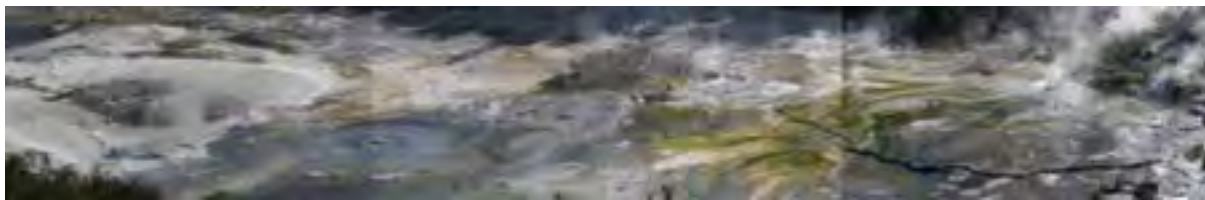
Artists Palette and Pyramid of Geysers.



7-11. Orakeikorako: Artists Palette, with the Pyramid of Geysers in the background, April 2010.



7-12. Orakeikorako: Composite photo of Artists Palette and Pyramid of Geysers, April 2010.



7-13. Orakeikorako: Composite photo of Artists Palette and Pyramid of Geysers, June 2010.

Fumarole to left of the boardwalk

E2784766 N6298446.

Measured the ground temperature at 0.1 m depth.

Table 7.11: Orakeikorako: Observations of Boardwalk Fumarole

Date	T(°C)	pH	Flow (l/s)	Water level	Depth (m)	Diameter (m)	Ebullition	Colour
14 April 2010	42	nd	steam	-	~0.5	~1.0 x 0.7	Weak steam.	
15 June 2010	89 at 0.1 m	nd	steam	-	~0.5	~1.0 x 0.7	Weak steam.	



7-14. Orakeikorako: Fumarole beside boardwalk; a) April 2010, and b) June 2010.

Two pools by boardwalk

E2784774 N6298443.

South Pool

Table 7.12: Orakeikorako: Observations of South Pool

Date	T(°C)	pH	Flow (l/s)	Water level (m)	Ebullition	Colour
14 April 2010	78	-	0 observed.		Moderate gas discharge.	Slightly cloudy.
15 June 2010	73		0 observed.	-1.6	Moderate gas discharge.	Slightly cloudy grey.

North Pool

Table 7.13: Orakeikorako: Observations of North Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	80	-	0 observed.		Weak gas discharge.	Slightly cloudy.
15 June 2010	74	-	0 observed.	~-1.6	Calm.	Slightly cloudy.



a)

7-15. Orakeikorako: Pools beside boardwalk June 2010; a) South Pool.

Ruatapu Cave

E2784856 N6298338

Main Pool at the base of the cave

Table 7.14: Orakeikorako: Observations of Ruatapu Base Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	37	2.5	0 observed.	nd	Calm.	Clear blue-green.
15 June 2010	35	2.5	0 observed.	nd	Calm. Very small gas discharge on LHS of pool.	Clear blue-green.



a)



b)

7-16. Orakeikorako: Main Pool in the Ruatapu Cave; a) April 2010, and b) June 2010.

Small Pool at the base of the cave

This pool is to the right of the large pool.

Table 7.15: Orakeikorako: Observations of Ruatapu Right Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	28	2.5	0 observed.	nd	Calm.	Clear blue-green.
15 June 2010	32	2.4	0 observed.	nd	Calm.	Clear blue-green.



a)



b)

7-17. Orakeikorako: Small Pool in the Ruatapu Cave; a) April 2010, and b) June 2010.

Small cave to the left

This cave has a pool in it. In April we could only measure the air temperature at the mouth of the small cave. In June we could reach the water with a weighted thermocouple.

Table 7.16: Orakeikorako: Observations of Ruatapu Sub-Cave Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	25 (air T)	nd	0 observed.	~2 m (vertically) below cave mouth.	Calm, possible intermittent bubbling.	Clear blue-green (from photo).
15 June 2010	28	nd	0 observed.	~2 m (vertically) below cave mouth.	nd	



a)



b)

7-18. Orakeikorako: The small cave on left side of Ruatapu Cave; a) April 2010, and b) June 2010.

Soda Fountain

E2784659 N6298492. In April and June there was a small amount of water in the base of the pool.

Table 7.17: Orakeikorako: Observations of Soda Fountain Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	97	nd	0 observed.	~1.5 m below rim.	Calm, gas discharge.	Clear blue-green.
15 June 2010	94	nd	0 observed.	1.7 m below rim (at the back).	Upwelling, no gas discharge.	Clear blue-green.



7-19. Orakeikorako: The Soda Fountain, April 2010.

Map of Australia

E2784264 N6298545

On carpark side of lake, through a large gate on the far side of the carpark from the tourist shop.

Table 7.18: Orakeikorako: Observations of Map of Australia Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
14 April 2010	83	nd	~5	-20 cm below top of the ruler.	Upwelling from deepest point.	Clear blue-green.
15 June 2010	79	7.7	~5	-195 cm below top of the ruler.	Upwelling from deepest point. Minor gas discharge.	Clear blue-green.



a)



b)

7-20. Orakeikorako: The Map of Australia; a) April 2010, and b) June 2010.

8. Reporoa

Fumaroles

E2800900 N6304314

Audible gurgling from all vents.

Table 8.1: Reporoa: Observations of Fumaroles

Date	Pool	T(°C)	Flow (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	1	45	steam	~1	~0.5	Audible gas discharge.	Black mud.
11 April 2010	2	45	steam	~1	~0.5	Audible gas discharge.	Black mud.
11 April 2010	3	60	steam	~1	~0.4	Audible gas discharge.	Black mud.
11 April 2010	4	41	steam	>1	~0.8	Audible gas discharge.	Black mud.
11 April 2010	5	39	steam	nd	nd	Audible gas discharge.	Black mud.
11 April 2010	6	92	steam	>0.2	~0.1	Audible gas discharge.	nd



8-1. Orakeikorako: Fumaroles at Reporoa, April 2010.

Figure 8 shaped hot pools

E2800884 N6304388

The pools have merged, however the larger pool seems to be more active.

Table 8.2: Reporoa: Observations of Figure 8 Pools

Date	Pool	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	Large	94	nd	0 visible	-20 cm below ground level.	Upwelling, gas discharge.	Clear, dark brown mud base.
11 April 2010	Small	93	nd	0 visible	-20 cm below ground level.	Calm	Clear, dark brown mud base.



8-2. Orakeikorako: The Figure 8 Pool, April 2010.

Hot Pool 3

E2800959 N6304325. This was difficult to see due to steam.

Table 8.3: Reporoa: Observations of Hot Pool 3

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	95	nd	~5		Upwelling.	Clear blue-green.



8-3. Orakeikorako: Hot Pool 3, April 2010.

Hot Pool 4

E2801252 N6304570

Unable to get close. The water level appears to be ~ 0.8 m below rim, higher than previous records.

Table 8.4: Reporoa: Observations of Hot Pool 4

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	nd	nd	None visible	-0.8	nd	



8-4. Orakeikorako: Hot Pool 4, April 2010.

9. Tauhara

Lake Taupo Shore

Taharepa Spring

E2793082 N6294721

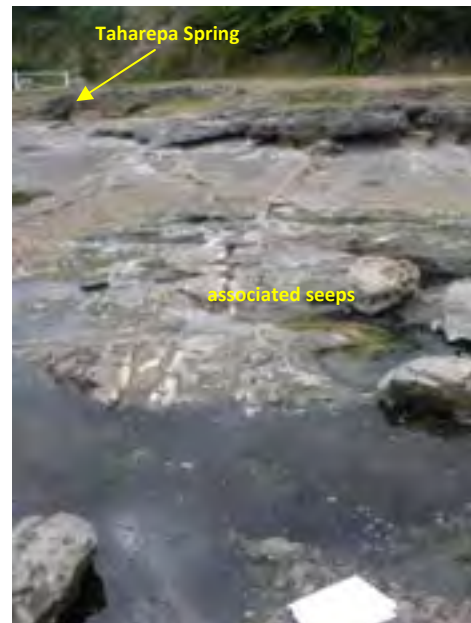
The Taharepa and Lake Taupo Spring and nearby hot water discharges from thin (< 0.025 m), vertical sandstone dikes in the outcropping mudstone.

Table 9.1: Tauhara: Observations of Taharepa Spring

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	64 (Fig 7-1 a). 63 (another seep on shore as shown in Fig 7-1 b).	nd	0.05 (seep)	nd	No gas.	Clear, oily slick on pools.
13 June 2010	63	6.4	0.05 (seep)	nd	No gas.	Clear



a)



b)

9-1. Tauhara: Taharepa Spring, April 2010. a) Main spring b) Associated seep 25 m south.



9-2. Tauhara: Taharepa Spring, June 2010.

Rocky Point Spring

E2778368 N6273387

Table 9.2: Tauhara: Observations of Rocky Point Spring

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	66	nd	>2	nd	No gas.	Clear, Fe oxide staining the rocks.
13 June 2010	66	6.4	>2	nd	No gas.	Clear, Fe oxide staining the rocks.



a)



b)

9-3. Tauhara: Lake Taupo Spring; a) April 2010 and b) June 2010.

Otumuheke

E2779160 N6276670

The original feature was difficult to locate. Eventually we measured the stream temperature at the end of the ponga fence (at the end of Spa Rd).

Table 9.3: Tauhara: Observations of Otumuheke Spring

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	53	6.4	50	nd	No gas.	Clear.
13 June 2010	50	6.3	50	nd	No gas.	Clear.



a)



b)

9-4. Tauhara: Stream at the end of ponga fence, Spa Rd; a) April 2010 and b) June 2010.

Wapahihi Source

E2779885 N6273260

Table 9.4: Tauhara: Observations of Waipahihi Source Spring

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
13 April 2010	66	nd	seep	White deposits on margin above water level.	No gas.	Clear, surrounded by brackish water.
13 June 2010	69	6.8	seep		No gas.	Clear.



a)



b)

9-5. Tauhara: Waipahihi Source; a) April 2010 and b) June 2010.

10. Te Kopia

Mud Geyser and associated pools

Large Pool and Mud Geyser

E2790866 N6306251

This feature is a large (50 m diameter collapse pool), with a mud geyser in the western wall of the pool. The sides of the pool are cracked and slumped and the water level is ~ 5 m below the surrounding ground level.

The ground in the entire area is light grey hydrothermally altered clay.

The mud geyser is inaccessible, and in April the surrounding vegetation was coated with mud. In June the lip over the geyser had collapsed, and there was no evidence of recent eruptive activity, i.e. no mud coating on vegetation.

Table 10.1: Te Kopia: Observations of Mud Geyser

Date	Pool	T(°C)	Flow (l/s)	Depth to water (m)	Diameter (m)	Ebullition	Colour
12 April 2010	Large pool	47-52 (IR)	steam	~5	~50	Gas discharge.	Light grey mud.
12 April 2010	Mud geyser	nd	Steam /mud	nd	~1	Mud observed to erupt over the lip.	Light grey mud.
13 June 2010	Large pool	48-57 (IR)	steam	~5	~50	Gas discharge.	Light grey mud.
13 June 2010	Mud geyser	nd	Steam /mud	nd	~1	No activity observed.	Light grey mud.



10-1. Te Kopia: Large mud pool, April 2010.



10-2. Te Kopia: Mud Geyser, April 2010.



a) b)

10-3. Te Kopia: June 2010; a) Large mud pool, b) Mud Geyser.

Small Mud Pool on the Geyser Ridge

E2790858 N6306249

Table 10.2: Te Kopia: Observations of Geyser Mud Pool

Date	T(°C)	Flow (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
12 April 2010	100	Weak steam	0.5	~1.5 x 2	-	Light grey dry cracked mud.
13 June 2010	96 (0.2 m into vent)	None visible	0.5 to cracked floor	~1.5 x 2	Audible gurgling.	Light grey dry cracked mud.



10-4. Te Kopia: Small Mud Pool on Geyser ridge; a) April 2010, and b) June 2010.

Mud Pools (Tomos) on west of Te Kopia Rd

The area is accessed from the road at a gate with GPS co-ordinates E2791149 N6306610. Walk straight across a paddock towards a Eucalypt forest, cross the fence into the forest and continue to the top of the hill then turn north-west down hill.

The three vents are on the north facing slope in the Eucalypt forest. Walk around the top of the vents and approach from the downhill side. The GPS co-ordinates of the middle vent are E2791030 N6306688. The western vent is inaccessible due to blackberry and a steep approach.

Eastern Vent (Doom) and central vent (TK8)

E2791030 N6306688

In April Doom has an insanely violent gas discharge and an apron of freshly ejected mud extending approximately 3 m from the lower lip. In June the activity had reduced somewhat, and it was possible to see into the vent, which extends > 7 m into the hill from the downhill lip. The base of the vent has grey muddy liquid which is bubbling furiously at the back of the vent, but is calm below the downhill lip. Depth to liquid from the downhill lip is ~ 2 m.

There is still a mud apron around this lip, but the mud does not look as fresh as it did in April.

TK8 is ~ 5 m west of Doom, and also has insane bubbling gas but no apron of mud. It was not possible to get the thermocouple into TK8, and the IR gun probably measured the steam temperature at some intermediate depth.

Table 10.3: Te Kopia: Observations of Eastern and Central Vents

Date	Feature	T(°C)	Flow (l/s)	Depth to water (m)	Width (m)	Ebullition	Colour
12 April 2010	Doom	83	steam	~3 (very rough est)	~3	Insanely violent gas discharge.	Brown-grey mud.
13 June 2010	Doom	42	0 visible	~2 (more accurate)	~3	Violent gas discharge.	Brown-grey mud.
12 April 2010	TK8	53	steam	>4	~4	Violent gas discharge.	Brown-grey mud.
13 June 2010	TK8	86	steam	~4	~4	Vigorous gas discharge. H ₂ S smell	Brown-grey mud.



a)



b)

10-5. Te Kopia: Doom; a) April 2010, and b) June 2010.



a)

10-6. Te Kopia: TK8; a) June 2010.

11. Tokaanu

Tourist Walk

Hydrothermal Eruption Pool beside Te Waihoto Pool

E2749577 N6244826

Table 11.1: Tokaanu: Observations of Te Waihoto Hydrothermal Eruption Pool

Date	T(°C)	pH	Flow (l/s)	Depth to water (m)	Diameter (m)	Ebullition	Colour
11 April 2010	55		0	0.6	~1.5	Calm, no gas.	Brown-grey, cloudy.
13 June 2010	42	6.2	0	0.4	~1.5	Calm, no gas.	Clear slightly brown.



a)



b)

11-1. Tokaanu: Hydrothermal Eruption Crater beside Te Waihoto; a) April 2010, and b) June 2010.

Matewai Pool

E2749593 N6244781

There is an inflow from Hoani A Pool.

In April the water level in Matewai Pool is ~0.9 m from ground level, and the pool is divided in two by an exposed ridge. In June the central ridge was covered by water.

Table 11.2: Tokaanu: Observations of Matewai Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	82	nd	~5 (inflow)	-0.6 m below ground level. (~0.05 m below central ridge)	Calm.	Clear blue-green.
13 June 2010	71	nd	~2 (inflow)	~0.5 m below g.l. Covering central ridge.	Calm, slight effervescence in pool furthest from inflow	Clear blue-green.



a) b)
11-2. Tokaanu: The Matewai Pool; a) April 2010 and b) June 2010.

Hoani A Pool

E2749583 N6244773

There is an outflow to Matewai Pool.

Table 11.3: Tokaanu: Observations of Hoani A Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	87	nd	~5 (outflow)	Close (within 0.02 m) to ground level.	Two zones of gas discharge.	Clear blue-green.
13 June 2010	84	6.8	~ 2 (outflow)	At ground level.	One zone of gas discharge. Visible upwelling.	Clear blue-green.



a) b)
11-3. Tokaanu: The Hoani A Pool. a) April 2010 and b) June 2010.

Hoani B and C Pools

E2749572 N6244769. There is the Hoani B Pool, and another cooler pool (Hoani C) behind the Hoani A Pool. Next to Hoani B an area of sinter has cracked and collapsed. The ground in the vicinity of Hoani C is eroded into a humpy texture.

Table 11.4: Tokaanu: Observations of Hoani B and C Pools

	Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
Hoani B	13 June 2010	84	6.8	~ 2 (outflow)	g.l.	One zone of gas discharge. Visible upwelling.	Clear blue-green.
Hoani C	13 June 2010	22	5.5	No visible	~-0.2 m from g.l.	Calm with minor effervescence.	Murky brown.



a)



b)

11-4. Tokaanu: The Hoani B Pool June 2010; a) the Hoani B Pool, and b) cracked sinter.



11-5. Tokaanu: The Hoani C Pool, June 2010.

Takarea 6 Pool

E2749449 N6244723. Takarea 6 has orange microbial mats at southern end, and minor sinter on the pool margins.

Table 11.5: Tokaanu: Observations of Takarea 6 Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	56	nd	0 visible	Close to ground level.	Occasional slight gas discharge.	Clear blue-green.
13 June 2010	59	6.6	0 visible.	All algal mats covered.	Calm/minor gas discharge.	Clear blue-green.



a)



b)

11-6. Tokaanu: The Takarea 6 Pool; a) April 2010 and b) June 2010.

Takarea 5 Pools

Table 11.6: Tokaanu: Observations of Takarea 5 Pool

Date	Pool	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
11 April 2010	East	58	nd	0 visible	-0.05 m below lip between pools	Occasional slight gas discharge.	Clear blue-green.
	West	44	nd	0 visible		Occasional slight gas discharge.	Clear blue-green.
13 June 2010	East	56	6.0	0 visible	The water was over the lip between pools.	2 strong bubble plumes.	Clear blue-green.
	West	38		0 visible		1 strong bubble plume.	Clear blue-green.



a)

11-7. Tokaanu: The East Takarea 5 Pool; a) June 2010.

Mud Pools close to Paurini

E2749405 N6244701

Mud Pool 1

The dimensions of the pool have not changed.

Table 11.7: Tokaanu: Observations of Paurini Mud Pool 1

Date	T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	98	0	0.3	0.8	Two areas of bubbling mud at base. Moderate steam.	Black-brown mud.
13 June 2010	99	0			One area of bubbling mud at base.	Dark brown mud.



11-8. Tokaanu: Mud Pool 1; a) April 2010 and b) June 2010.

Mud Pool 2

Table 11.8: Tokaanu: Observations of Paurini Mud Pool 2

Date	T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	50	0	0.25	0.2 w x 0.4	Bubbling mud at edge of hole, mostly dry and cracked.	Black-brown mud.
13 June 2010	97	0	0.3	0.2 w x 0.4	Bubbling mud in hole.	Black-brown mud.



11-9. Tokaanu: Mud Pool 2, April 2010.

Mud Pool 3

Table 11.9: Tokaanu: Observations of Paurini Mud Pool 3

Date	T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	49	0	0.5	0.3	Bubbling mud at base. Weak steam.	Black-brown mud.
13 June 2010	90	0	0.5	0.3	Bubbling mud at base.	Black-brown mud.



11-10. Tokaanu: Mud Pool 3, April 2010.

Mud Pool 4

In April the mudpools had cracked rims, but not in June, and the pool diameter had increased.

Table 11.10: Tokaanu: Observations of Paurini Mud Pool 4

Date		T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	4N	92	0	~0.5	~0.8	Bubbling mud at base. Weak steam.	Black-brown mud.
11 April 2010	4S	80	0	~0.75	~0.6	Gas discharge through water.	Cloudy grey water.
13 June 2010	4N	92	0	~0.5	~1.0	Gas discharge through mud.	Brown mud.
13 June 2010	4S	97	0	~0.75	~0.8	Gas discharge through mud.	Brown mud.



11-11. Tokaanu: Mud Pools 4; a) April 2010 and b) June 2010.



a)



b)

11-12. Tokaanu: a) Mud Pool 4N; a) April 2010 and b) June 2010.



a)



b)

11-13. Tokaanu: a) Mud Pool 4S; a) April 2010 and b) June 2010.

Paurini Pool

E2749403 N6244684

Paurini had vigorous gas discharge in the centre and other less vigorous discharges around the margins.

Table 11.11: Tokaanu: Observations of Paurini Pool

Date	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
11 April 2010	59	nd	0 visible	-1.3 m rel to lookout floor.	Gas discharge.	Murky green.
13 June 2010	61	6.5	0 visible		Difficult to see for rain.	



11-14. Tokaanu: Paurini Pool June 2010.

Toretiti Pool

E2749426 N6244714

The Toretiti Pool is linked to Te Ngutu.

Table 11.12: Tokaanu: Observations of Toretiti Pool 1

Date	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
13 June 2010	49	5.7	0 visible	g.l.	Calm	Clear.



a)

11-15. Tokaanu: The Toretiti Pool, June 2010.

Te Ngutu Pool

E2749426 N6244714

Table 11.13: Tokaanu: Observations of Te Ngutu Pool 1

Date	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
11 April 2010	50	nd	0 visible	0.35 m below boardwalk.	Calm.	Clear with green algae.
13 June 2010	37	5.7	0 visible	0.2 m below boardwalk. (g.l.)	Calm	Slightly murky.



a) b)
11-16. Tokaanu: The Te Ngutu Pool; a) April 2010 and b) June 2010.

Teretere Pool

E2749431 N6244757

Table 11.14: Tokaanu: Observations of Teretere Pool

Date	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
11 April 2010	35	5.7	0 visible.	nd	Calm.	Murky brown.
13 June 2010	18	6.2	0 visible.	0.1 m below track.	Calm	Murky brown.



a) b)
11-17. Tokaanu: The Teretere Pool; a) April 2010 and b) June 2010.

Hydrothermal Eruption Crater Pool

E2749391 N6244754

Table 11.15: Tokaanu: Observations of Hydrothermal Eruption Crater Pool

Date	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
11 April 2010	25	6.5	0 visible	nd	Calm.	Black.

Vent by gravel walkway

E2749529 N6244815

Surrounding vegetation is dead.

Table 11.16: Tokaanu: Observations of Walkway Vent

Date	T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	94	0	~0.3	0.5	Audible bubbling.	Dry gravel in vent.
13 June 2010	15	0	Completely flooded.		No activity	Bottom of pool is orange-brown (Fe) coloured.



11-18. Tokaanu: Hot vent near gravel walkway, April 2010.



11-19. Tokaanu: Hot vent near gravel walkway, June 2010.

Area across the road from the swimming pools

Tauwhare

I believe this measurement is from the Tauwhare Pool, whereas previous measurements are from an adjacent small, much cooler, pool. Tauwhare is dangerous as it is not possible to assess the stability of the banks, and at the time we were there it was difficult to see through the steam, partly because the plants completely shelter the pool and the steam does not clear.

In June the area could not be approached due to flooding. In the flooded area the water temperature was 25 °C.

Table 11.17: Tokaanu: Observations of Tauwhare Pool

Date	T(°C)	pH	Flow (l/s)	Water level	Ebullition	Colour
11 April 2010	91	nd	nd	See photo below.	Calm.	Clear blue-green.



11-20. Tokaanu: Tauwhare, April 2010.



11-21. Tokaanu: Approach to Tauwhare, June 2010. The arrow points to the approach to Tuwhare.

Cooking area

Taumatapuhpuhi

E2749633 N6244801

In April Taumatapuhpuhi erupted twice while we were observing it - at 1336 for 30 seconds, and at 1344 for 15 seconds.

In June we observed one eruption cycle. The temperature measurement was taken at the quiescent stage.

Table 11.18: Tokaanu: Observations of Taumatapuhpuhi Pool

Date	T(°C)	pH	Height (m)	Eruption interval	Eruption duration	Colour
11 April 2010	98-100	nd	~0.3	8 min	30 s and 15 s	Clear.
13 June 2010	98	7.3	~0.5	5 min	30 s	Clear



11-22. Tokaanu: Taumatapuhipuhi; a) April 2010 and b) June 2010.

Hot vents at entry to cooking area

E2749630 N6244775

In June these vents were flooded with 0.05 m deep water. The measurements recorded here at site 1 and 2 were taken at 0.15 m depth (ie, slightly into the soil)

Table 11.18: Tokaanu: Observations of Cooking Pots 1 and 2

Date	Vent	T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	1	97	0	0.1	0.2	Water with a vigorous gas discharge.	Black-brown mud.
13 June 2010	1	76	0	nd	nd	Vigorous gas discharge.	Cloudy grey. water.
11 April 2010	2	90	0 observed.	0.1	0.4	Vigorous gas discharge from small mudpots. Weak gas discharge through pool of water.	Cloudy grey water and black-brown mud.
13 June 2010	2	59	0 observed.	nd	nd	Weak gas discharge.	Cloudy grey. water.
11 April 2010	3	80	0			Damp steaming ground.	nd
11 April 2010	4	46 at 1 m	0 observed.	> 1m	~0.2 m high.	Audible vigorous bubbling.	nd
13 June 2010	4	66 at 1 m	0 observed.	>1m	~0.2 m high.	Audible vigorous bubbling.	nd



a) 11-23. Tokaanu: a) Vents 1, 2, 3 at entry to cooking area, April 2010. b) Vent 4

Main cooking area

E2749660 N6244788. One cooking hole was measured (Feature 5), other measurements were from a fumarole (Vent 6) and mudpots (7 and 8). The other cooking holes were not accessible.

Table 11.19: Tokaanu: Observations of Main Cooking Pots

Date		T(°C)	Liq discharge (l/s)	Depth (m)	Diameter (m)	Ebullition	Colour
11 April 2010	5	74	0	~1	1.2 x 1	Audible bubbling.	nd
11 April 2010	6	99	0	nd	1	Steam discharge.	Black-brown mud.
13 June 2010	6	73	0				
11 April 2010	7	76	0	nd	0.5	Vigorous steam discharge.	Black-brown mud.
11 April 2010	8	74	0	nd	0.3	Weak steam discharge.	Black-brown mud.
13 June 2010	8	69	0	Water level 0.07 m from g.l.	0.3	Calm.	Cloudy grey water.



11-24. Tokaanu: The main cooking area, April 2010.



11-25. Tokaanu: June 2010; a) Feature 6 and b) Feature 8.

12. Waikite

Waikite Swimming Pool area

Manuroa

E2799016 N6314261

In April this pool surged approximately every 5 minutes. The surge could not be seen due to steam.

In June more of the pool could be seen. There were 3 areas of upwelling, with the major upwelling toward the far side of the pool from the platform, and minor zones in the centre and centre left. The upwelling water was full of bubbles, and appeared to be effervescing as much as boiling. The activity was extremely vigorous and the upwelling water reached heights of ~0.6 m. The water was covering some of the sinter near the platform that was showing in April, or the sinter had broken.

Table 12.1: Waikite: Observations of Manuroa Pool

Date	T(°C)	pH	Liq discharge (l/s)	Water level	Ebullition	Colour
10 April 2010	99	nd	~30	nd	Could not see.	Clear blue-green.
15 June 2010	97	nd	~30	nd	Vigorous, boiling/effervescing.	Clear blue-green.



a)



b)

12-1. Waikite: The Manuroa Pool; a) April 2010 and b) June 2010.

Top Inlet Spring

E2798917 N6314272

Table 12.2: Waikite: Observations of Top Inlet Spring

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	94	nd	~20		0	Clear.
15 June 2010	84	8.2	~20		0	Clear



b)

a)

12-2. Waikite: The Top Inlet Spring, June 2010.

Entrance to Waikite

E2798866 N6314254

Brown-green algae growth on bed of channel. No change between April and June.

Table 12.3: Waikite: Observations of Entrance Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	63	nd	Same as top inlet	-	flowing	Clear.
15 June 2010	57	8.5	Same as top inlet	-	flowing	Clear



a)



b)

12-3. Waikite: Channel at the lower end of the entrance path to Waikite Pools; a) April 2010 and b) June 2010.

Stream from Manuroa

Sampling site is by sign about scale in stream.

Table 12.4: Waikite: Observations of Manuroa Outlet

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	88	nd	~30	-	-	Clear.
15 June 2010	86	nd	~30	-	-	Clear



12-4. Waikite: Stream from Manaroa; a) April 2010 and b) June 2010.

Hot pools supply spring

E2798978 N6314244

Table 12.5: Waikite: Observations of Inlet Supply Spring

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
15 June 2010	97	7.9	pipied	No overflow.	2 vigorous discharge points at water level. See arrows.	Clear.



12-5. Waikite: Hot Pools Supply Spring, June 2010. Arrows show the spring inflow location.

Pool adjacent to Supply Spring

Table 12.6: Waikite: Observations of Spring beside Inlet Spring

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	83	nd	~2	-	Calm.	Clear.
15 June 2010	80	nd	~2	-	Calm	Clear



12-6. Waikite: Pool by Supply Spring; a) April 2010 and b) June 2010.

Baths Outlet

E2798856 N6314283

Photo/measurements from end of private pool building.

Table 12.7: Waikite: Observations of Baths Outlet

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	56	nd	~15	-		Clear.
15 June 2010	52	8.6	~15	-		Clear



12-7. Waikite: Discharge at end of private pool building; June 2010.

Bridge at Corbett Rd

E2798396 N6314187

Table 12.8: Waikite: Observations of Otamakokore Stream at Corbett Rd

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	53	nd	~150	-		Clear.
15 June 2010	45	8.4	~200	-		Clear



12-8. Waikite: Sampling point under the bridge at Corbett Rd, April 2010.

Spring on Landcorp Farm (Scalding Spring)

This spring has extensive white sinter below water level up to the rim of the spring. The deep centre of the spring is approximately 3 m x 4 m, but with the shallow shelf included the spring is around 5 m diameter. It discharges to the south over an extensive sinter terrace covered with black green and red algae. The discharge flows to the Otamakokore Stream ~10 m from the spring. A new fence has been built to restrict access to the spring, the sinter terrace, the Otamakokore Stream, and the outflow from the HT Geyser area.

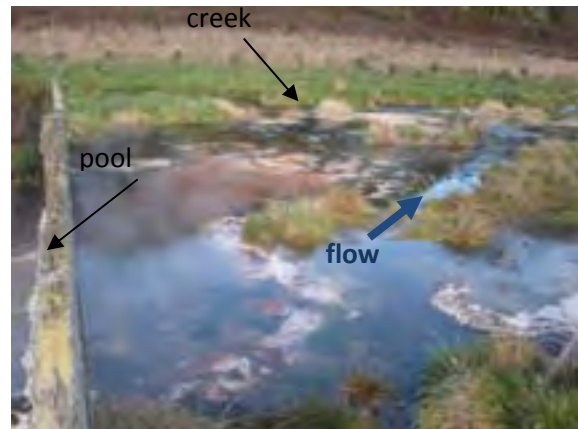
GPS reference will be recorded on the next visit, due to temporary misplacement of GPS unit.

Table 12.9: Waikite: Observations of Scalding Spring

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
15 June 2010	86	8.1	~0.5	Ground level.	Gas upwelling	Clear blue-green.



a)



b)

12-9. Waikite: Spring on Landcorp Farm, 400 m north west of HT geyser outflow; a) Spring , and b) sinter discharge terrace, June 2010.

HT Geyser outflow (Waikite Scarp Swamp)

This is an area of diffuse seepage and channel flow from an inaccessible area of thermal activity at the base of the Waikite scarp. The entire area is approximately 20 m x 50 m of predominantly algae covered sinter and warm ground. The maximum temperature was recorded at the most upstream discharge point shown in Figure 12-10. In this area there is green algae and sinter in the channel. The outflow area has extensive sinter with spongy red bubble textured algae covering a large part of the terrace. The water finally discharges to a swampy area to the north.

GPS reference will be recorded on the next visit.

Table 12.10: Waikite: Observations of HT Geyser Outflow

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
15 June 2010	66	9.0	~2	Dispersed flow over terrace.		Clear.



a)

b)



c)

d)

12-10. Waikite: HT geyser outflow; a) Terraces; b) Close-up of terrace with spongy orange algal coating; and c) the most upstream discharge with dark green algal growth; d) pale pink sinter precipitating in the channel and white sinter on the margins, June 2010.

13. Waiotapu

Tourist Walk

Weather Pool

E2804421 N6310781

Table 13.1: Waiotapu: Observations of Weather Pool

Date	T(°C) (IR)	Water level	Ebullition	Colour
10 April 2010	47-49	nd	Calm.	Pale turquoise.
15 June 2010	51		Calm.	Murky turquoise.



13-1. Waiotapu: Weather Pool; a) April 2010 and b) June 2010.

Pool north of Jean Batten Geysier

Table 13.2: Waiotapu: Observations of pool north of Jean Batten Geysier

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	19	nd	0 visible.	nd	calm	Pale turquoise.
15 June 2010	17 (IR)	nd	0 visible.	-0.4 m	calm	Clear.



a)

b)

13-2. Waiotapu: Pool north of Jean Batten Geysier; a) April 2010 and b) June 2010.

Jean Batten Geysier

E2804548 N6310482

Table 13.3: Waiotapu: Observations of Jean Batten Geysler

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	nd	nd	0 visible.	nd	Weak steam.	-
15 June 2010	nd	nd	0 visible.	ndm	Weak steam.	-



a)



b)

13-3. Waiotapu: Jean Batten Geysler; a) April 2010 and b) June 2010.

Sinter Terraces

Table 13.3: Waiotapu: Observations of sinter terraces



a)



b)

13-4. Waiotapu: Overview of the Sinter Terraces; a) April 2010, and b) June 2010.

Sinter Terraces-Yellow coloured vent

The Sinter Terraces were submerged north of the boardwalk in both April and June.

Table 13.4: Waiotapu: Observations of Yellow Vent

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	nd	nd	0 visible.	Submerged.	Calm.	Cloudy green-yellow.
15 June 2010	nd	nd	0 visible.	Submerged.	Calm.	Cloudy green-yellow.



a)

b)

13-5. Waiotapu: Yellow Pool, Sinter Terraces; a) April 2010 and b) June 2010.

Sinter Terraces-Foreground Pool

Table 13.5: Waiotapu: Observations of Foreground Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	nd	nd	0 visible.	Submerged.	Upwelling close to south edge.	Clear greenish brown.
15 June 2010	62 (IR)	nd	0 visible.	Submerged.	Upwelling and gas discharge close to south edge.	Pale green-yellow.



a)

b)

13-6. Waiotapu: Foreground Pool, Sinter Terraces; a) April 2010 and b) June 2010.

Waiotapu geyser

E2804491 N6310256

A temperature datalogger was installed in June.

Table 13.6: Waiotapu: Observations of Waiotapu Geyser

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	87	nd	0 visible.	0.08 m below rim	Calm	Clear blue.
15 June 2010	83	6.5	0 visible.	0.1 m below rim	Calm	Clear blue.



a) b)
13-7. Waiotapu: Waiotapu Geyser; a) April 2010 and b) June 2010.

Oyster Pool

E2804516 N6310204

Table 13.7: Waiotapu: Observations of Oyster Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	66	nd	~0.5	-	Moderately vigorous gas discharge in centre	Cloudy pale green.
15 June 2010	64	5.1	0 visible.	0.01 m below rim	Minor gas discharge.	Cloudy pale green.



a) b)
13-8. Waiotapu: Oyster Pool; a) April 2010 and b) June 2010.

Lake Ngakoro

Steam on eastern and southern shores in both April and June. In June the temperature of the inflow was 22°C.

Table 13.8: Waiotapu: Observations of Lake Ngakoro

Date	T(°C) (IR)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	18.6	nd	nd	nd	Calm	Mid green.
15 June 2010	19	nd	nd	nd	Calm	Mid green.



a) b)
13-9. Waiotapu: Lake Ngakoro; a) April 2010 and b) June 2010.

Champagne Pool

E2804517 N6310486

Orange floccs near surface.

Table 13.9: Waiotapu: Observations of Champagne Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	76	nd	nd	Overflowing	Effervescing	Clear green.
15 June 2010	74	5.3	nd	Overflowing	Effervescing	Clear green.



a) b)
13-10. Waiotapu: The Champagne Pool in June 2010; a) Western margin and b) overview.

Devil's Bath

Table 13.10: Waiotapu: Observations of Devil's Bath

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	17.9-20 (IR)	nd	nd	~2 m below lowest point in rim on north side	Calm	Bright green.
15 June 2010	14 (IR)	nd	nd	~2 m below lowest point in rim on north side	Calm	Bright green.



13-11. Waiotapu: Devil's Bath; a) April 2010 and b) June 2010. Despite the photographic evidence, I believe the water colour is unchanged.

Knox Geyser area

Venus Pool in creek on lady Knox Rd

E2804580 N6311425

This is a warm stream on Lady Knox Rd. Measured temperature at the upstream end of the site.

Table 13.11: Waiotapu: Observations of Venus Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	45	nd	nd			Slightly cloudy



13-12. Waiotapu: Venus Pool, April 2010.

Lady Knox Geyser

The Lady Knox Geyser was erupting while we were there

Table 13.12: Waiotapu: Observations of Lady Knox Geyser

Date	T(°C)	pH	Height (m)	Eruption interval	Eruption duration	Colour
10 April 2010	nd	nd	1-4	60 s	<60 s	Clear.



13-13. Waiotapu: Lady Knox Geyser, April 2010.

Knox Hole Spring and channel

E2805226 N6311403

There are still sulphur crystals on the roof of the spring. The vent was dry but could hear water bubbling. There was a liquid discharge ~3.5 m downstream of the Knox Hole Spring in the discharge channel.

Table 13.13: Waiotapu: Observations of Knox Hole Spring

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	83	nd	0	-	Audible bubbling, steam discharge.	-
10 April 2010	-		< 0.5			clear



13-14. Waiotapu: Knox Hole Spring, April 2010.

Hidden Pool

E2804937 N6311515

The water level in this pool appears to be lower than June 2009 (photographic evidence). There is more mud bank exposed, particularly the left bank. This is covered in a yellow-white soft deposit.

Table 13.14: Waiotapu: Observations of Hidden Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	39	2.2	-	-	Gas discharge in pool.	Cloudy brown



13-15. Waiotapu: Hidden Pool, April 2010.

Kerosene Creek area

Kerosene Creek Pool

E2806110 N6313104

There were no swimmers here, but there were ~ 20 people around the larger pool further downstream (8 cars at the park).

Table 13.15: Waiotapu: Observations of Kerosene Creek Pool

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	38	2.7	~150	-		Slightly cloudy.



13-16. Waiotapu: Kerosene Creek Pool, April 2010.

Kerosene Creek Steaming Ground

E2806118 N6312772

Small hot pools (0.1-0.3 m dia) with slightly cloudy water are ringed with black-brown material. Also some holes ringed with sinter and dry. Measured two pools, both 96 °C. The adjacent stream temperature was 39 °C.

Table 13.16: Waiotapu: Observations of Kerosene Creek Steaming Ground

Date	T(°C)	pH	Liq flow (l/s)	Water level	Ebullition	Colour
10 April 2010	96	2.7	~150	-	Vigorous gas discharge.	Slightly cloudy.



13-17. Waiotapu: Kerosene Creek steaming ground, April 2010.



13-18. Waiotapu: Kerosene Creek steaming ground features, April 2010.

