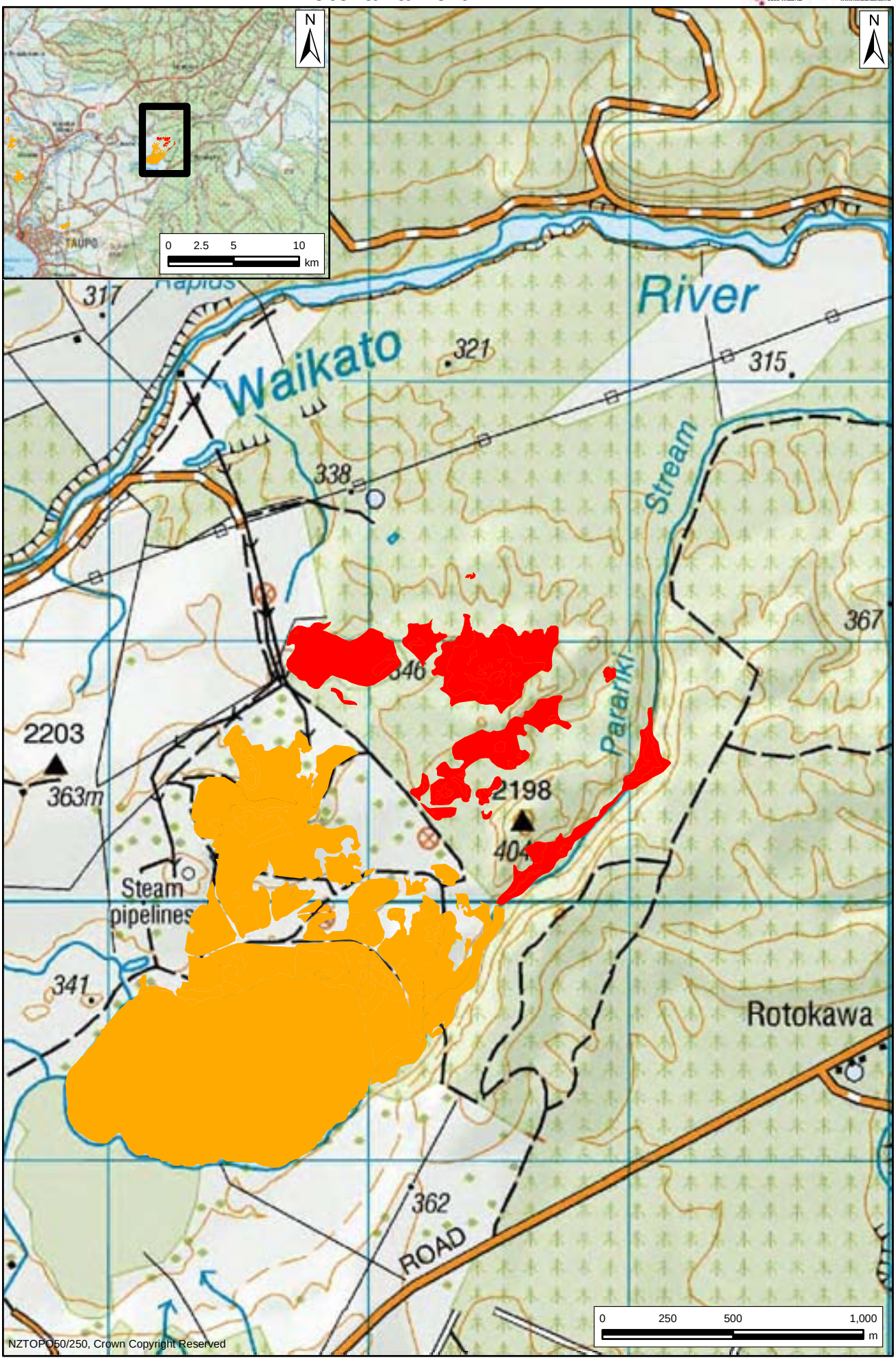
1.13 ROTOKAWA GEOTHERMAL FIELD

List of Geothermal Sites

RKV01	Rotokawa North
RKV02	Lake Rotokawa

RKV01

Rotokawa North



RKV01

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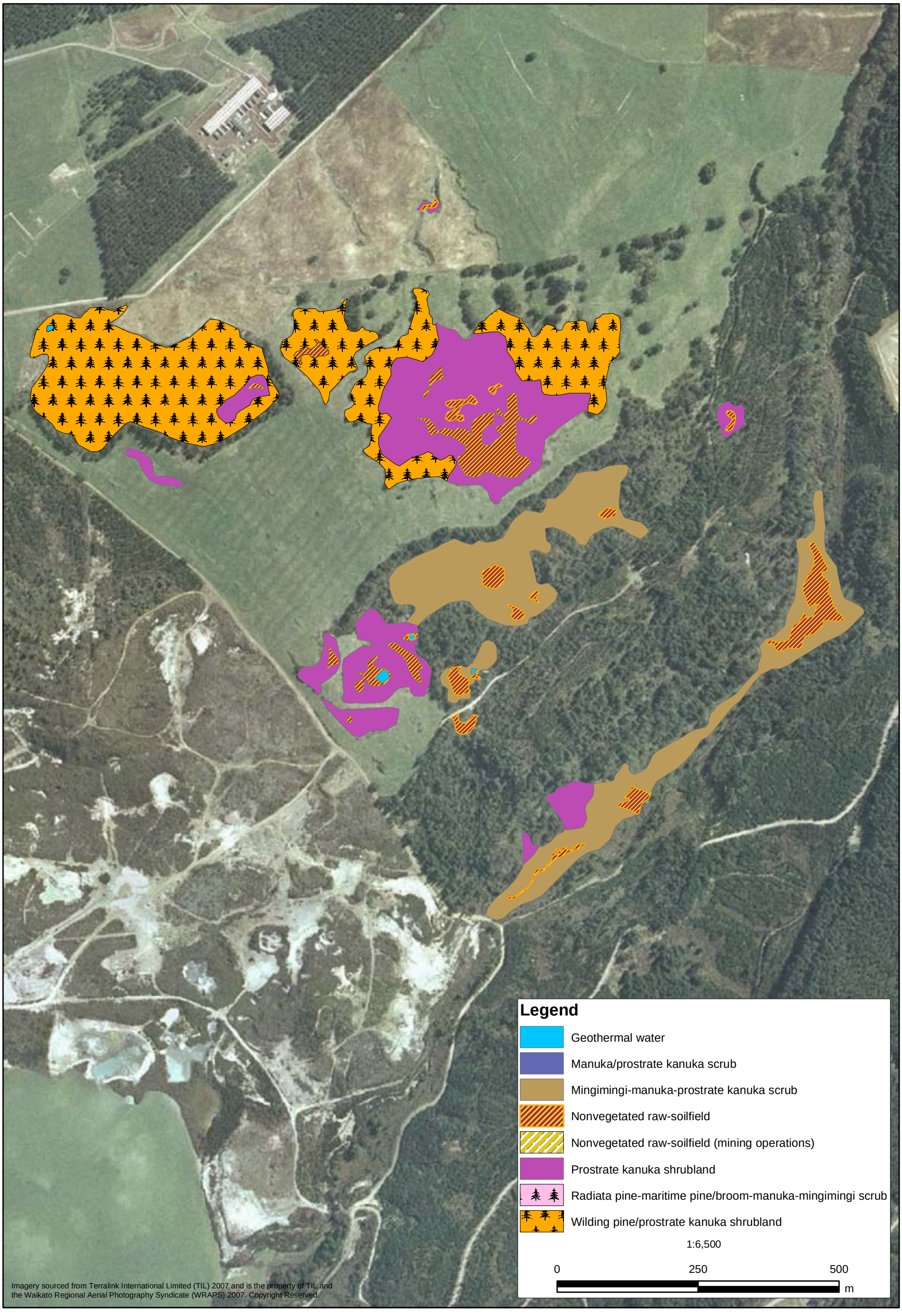


ROTOKAWA NORTH

Site Number: RKV01[1]
Grid Reference: NZTopo50 BG37 784 209
GPS Reference: NZTM E1878482 N5720902
Local Authority: Taupō
Ecological District: Atiamuri
Geothermal Field: Rotokawa
Bioclimatic Zone: Submontane
Tenure: Protected (Lake Rotokawa Conservation Area) and unprotected private land
Altitude: *c.*320-400 m
Extent of Geothermal Habitat: *c.*34.4 ha
Extent of Geothermal Vegetation: *c.*34.3 ha
Date of Field Survey: 4 May 2004

VEGETATION		LANDFORM	EXTENT
CODE	**TYPE**		
04.02 04.02.16	**Mingimingi-dominant scrub** **Mingimingi-manuka-prostrate kanuka scrub** Mingimingi, manuka, and prostrate kanuka form a cover to *c.*2 m high, with occasional maritime pine and radiata pine emergent and small patches of monoao and nonvegetated raw-soilfield.	Flat and gentle hillslopes	*c.*9.2 ha
05.01 05.01.01	**Prostrate kanuka-dominant shrubland** **Prostrate kanuka shrubland** Prostrate kanuka is dominant with scattered mingimingi throughout. Kanuka, manuka, monoao, prickly mingimingi, and bracken are locally common on cooler soils; broom and buddleia are common, and wilding pines (mostly maritime pine) are scattered throughout. The groundcover is patchy, comprising mainly lichens (*Cladia* and *Cladonia* species). Fumaroles, thermal springs and gas vents are scattered throughout this area. Several plants of *Dicranopteris linearis* and *Nephrolepis flexuosa* were present in 2004.	Flat and gentle hillslopes	*c.*8.7 ha
05.01.14	**Exotic pine/prostrate kanuka shrubland** Maritime pine and some radiata pine appear to be establishing in large areas of prostrate kanuka shrubland. *Lycopodiella cernua*, mingimingi, Mercer grass, prickly mingimingi, bracken, *Gleichenia microphylla*, *Paesia scaberula*, and *Hypolepis distans* are scattered throughout. Mingimingi and blackberry become more common towards margins. Sheep's sorrel and wild seradella occur in disturbed sites.	Flat and gentle hillslopes	*c.*13.2 ha
22.01 22.01.01	**Geothermal water** **Geothermal water** Hot water.	Flat and gentle hillslopes	*c.*0.1 ha

[1] Previously identified as U17/34 in Wildland Consultants (2004).

VEGETATION		LANDFORM	EXTENT
CODE	TYPE		
28.01 28.01.01	**Nonvegetated raw-soilfield** **Nonvegetated raw-soilfield** Sinter deposits, fumaroles, mud pools. Patches of prostrate kanuka, and broom.	Flat	*c.*3.3 ha

Indigenous Flora: Prostrate kanuka (classed as „At Risk-Naturally Uncommon' in de Lange *et al.* 2009) and *Lycopodiella cernua* are present. Prostrate kanuka is endemic to geothermal sites, and *Lycopodiella cernua,* is a characteristic feature of geothermal areas.

Dicranopteris linearis (*c.*10 plants) and *Nephrolepis flexuosa* (*c.*2 plants), classed as „At Risk-Naturally Uncommon' and „At Risk-Declining' respectively in de Lange *et al.* (2009), were present on the sides of a hot spring at GPS reference: E1877709 N5721043 in 2004.

D. linearis is known from only *c.*24 sites in New Zealand.

Fauna: New Zealand pipit, harrier, spur-winged plover, fantail, grey warbler and tui were recorded in a 2004 survey.

Current Condition (2004 Assessment): This area and its surrounds have been modified by forestry operations and pastoral farming, resulting in a reduction in extent of the original geothermal vegetation. Invasive exotic plant species comprise a large component of the vegetation in the north of the site, in particular wilding pines (mainly radiata pine and maritime pine, with some lodgepole pine), which in some areas dominate the canopy over a lower tier of indigenous geothermal vegetation. However, geothermal vegetation remains relatively intact in several areas.

Threats/Modification/ Vulnerability:

Invasive pest plants (*2004 Assessment*)*:* Wilding pines (6-25% cover) are visually dominant, and are a serious threat to plant communities on the cooler ground. In some areas pines are dominant over a lower indigenous tier comprising prostrate kanuka and mingimingi. Other invasive pest plants present include broom, Himalayan honeysuckle, buddleia, pasture grasses (including creeping bent, browntop, sweet vernal, Yorkshire fog and ryegrass) and blackberry, each of which has approximately 1-5% cover.

Human impacts (*2004 Assessment*)*:* Forestry and pastoral farming occurs between areas of indigenous geothermal vegetation. A geothermal power station has been installed (Merrett & Burns 1997). The impacts of draw-off are unknown.

Grazing (*2004 Assessment*)*:* Livestock have access to some of the smaller units of geothermal vegetation.

Adjoining land use (*2004 Assessment*)*:* Plantation forests and farmland.

Site Change:

Recent change: Changes to the mapping (between 2004 and 2011) are based on better site information rather than real change in the total extent of geothermal

vegetation. Changes are a consequence of the 2007 aerial photographs being of better quality than those used in 2004.

Historical: An assessment was undertaken of the site based on 1941 aerial photographs (Historical photo: SN 172 Run 1173 Photos 10-13, 1941). In the 1941 photo there appears to have been more clearance for farming around geothermal features than in recent years. However by 2007, extensive areas had been planted in pine plantation. The impacts of wilding pines in geothermal vegetation are minimal in 1941. While more bare ground was present in 1941, it is difficult to determine if this is related to surface geothermal activity or other land uses such as farming.

Management Requirements: The spread of wilding pines and other exotic trees needs to be contained, with emphasis on those areas which are still predominantly indigenous. Wilding pines which occur in stands should be removed carefully, taking care not to disturb the remaining indigenous communities. The site should be monitored to identify changes that may relate to geothermal power draw-off.

Significance Level: Regional (Table 1 - Criteria 3, 5, 7, 9; Table 2 - Factors 12, 14).

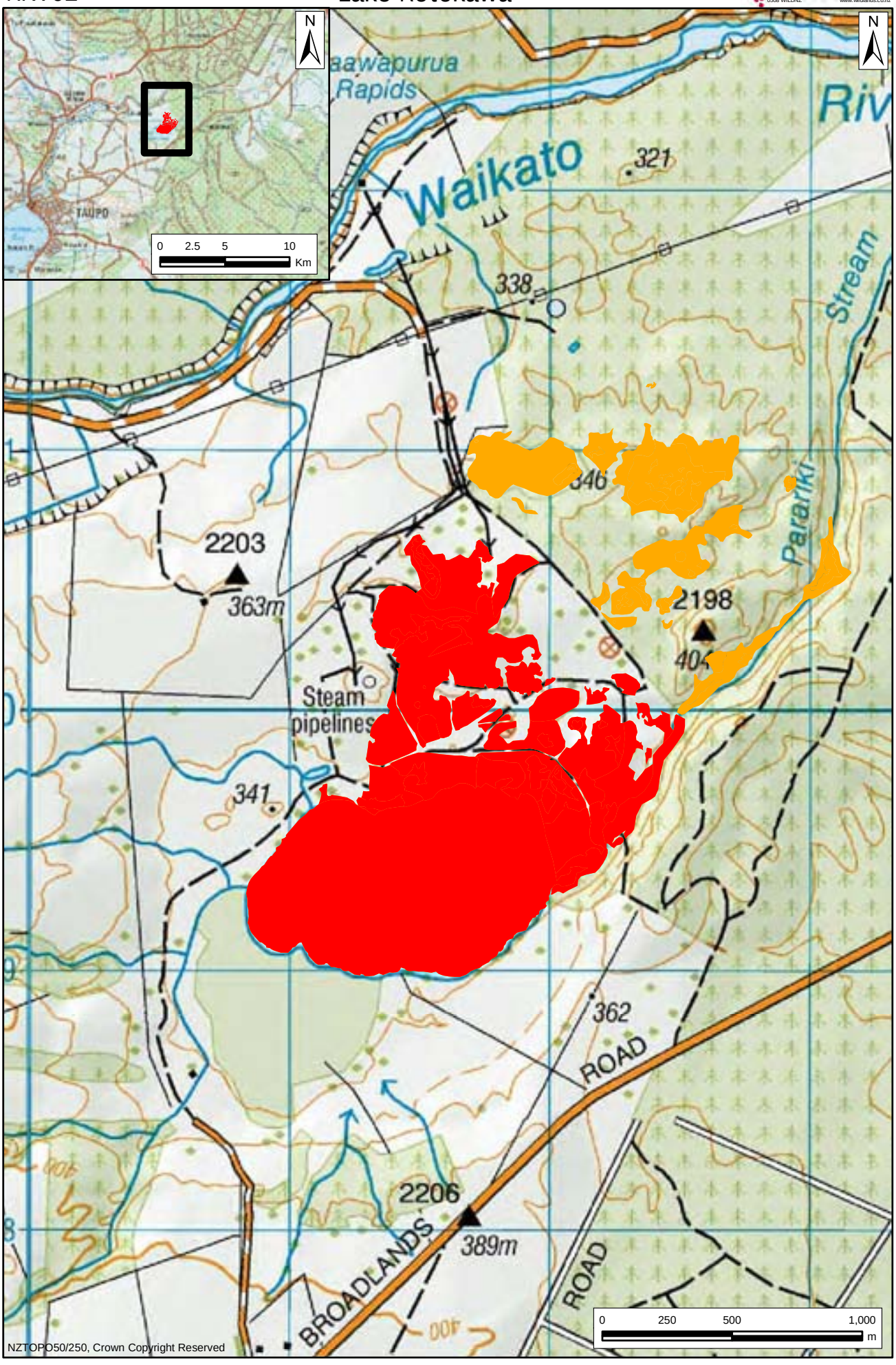
Significance Justification: This site is of regional significance because it comprises a large area of geothermal vegetation, a nationally uncommon vegetation and habitat type. While parts are degraded in quality, an „At Risk' species (prostrate kanuka) covers extensive areas and small populations of *Dicranopteris linearis* and *Nephrolepis flexuosa* (also classed as „At Risk') are present.

Notes: This area was not surveyed in Beadel & Bill (2000).

References: Merrett & Burns 1997; Merrett *et al*. 2003; Wildland Consultants 2004.

RKV02

Lake Rotokawa



RKV02

Lake Rotokawa

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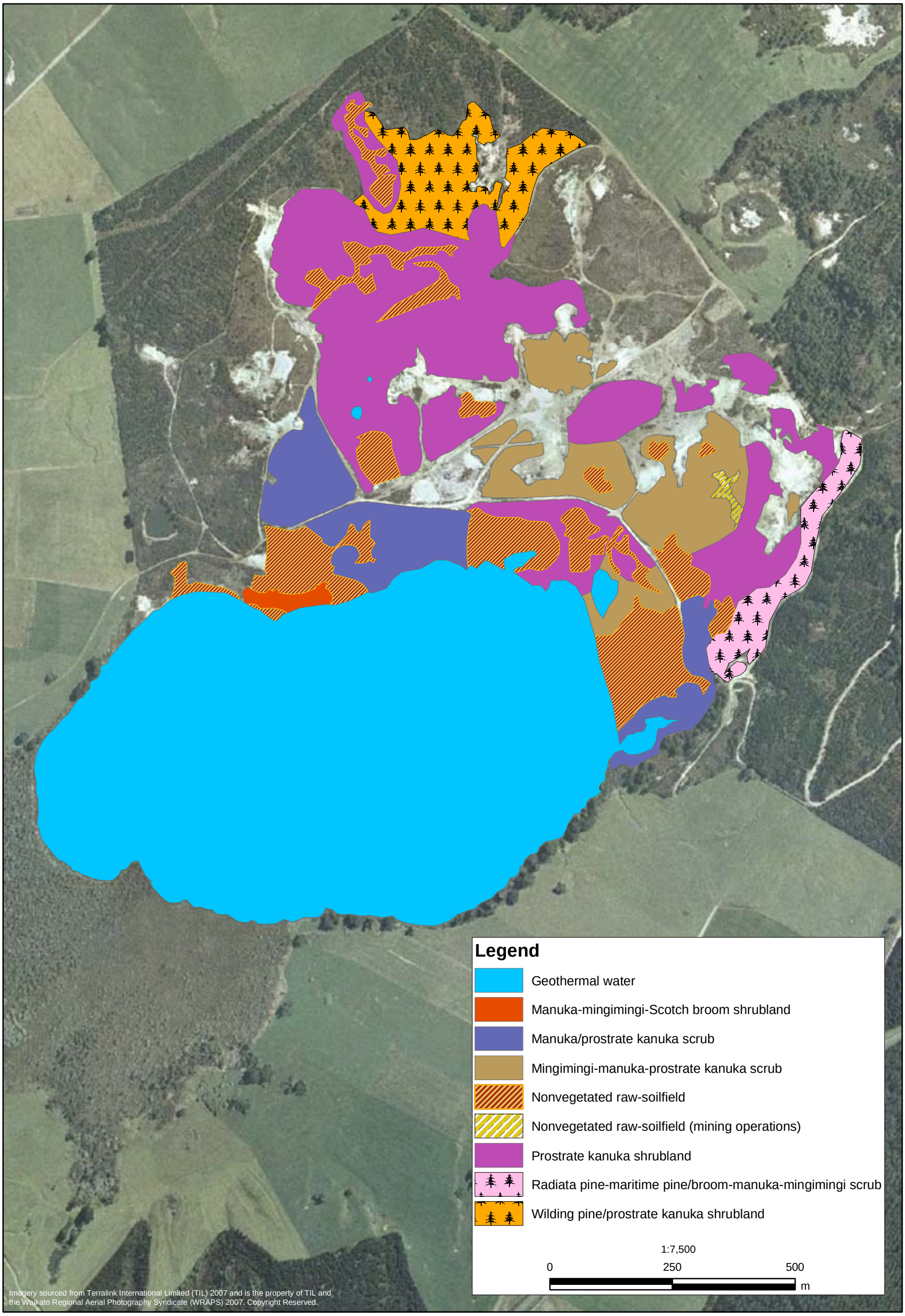

LAKE ROTOKAWA

Site Number: RKV02[1]
Grid Reference: NZTopo50 BG37 778 198
GPS Reference: NZTM E1877887 N5719763
Local Authority: Taupo
Ecological District: Atiamuri
Geothermal Field: Rotokawa
Bioclimatic Zone: Submontane
Tenure: Protected (Lake Rotokawa Conservation Area) and unprotected private land
Altitude: *c.*340-360 m
Extent of Geothermal Habitat: *c.*137.3 ha
Extent of Geothermal Vegetation: *c.*69.3 ha
Date of Field Survey: 14 April 2004

VEGETATION		LANDFORM	EXTENT
CODE	**TYPE**		
04.02 04.02.16	**Mingimingi-dominant scrub** **Mingimingi-manuka-prostrate kanuka scrub** Mingimingi, manuka, and prostrate kanuka (prostrate kanuka is at a much lower density in this type than when it occurs within prostrate kanuka shrubland) form a cover up to *c.*2 m high. Occasional maritime pine and radiata pine are present with small patches of monoao and nonvegetated raw-soilfield.	Flat and gentle hillslopes	*c.*9.6 ha
04.03 04.03.11	**Manuka-dominant scrub** **Manuka/prostrate kanuka scrub** Manuka to 2 m tall dominates this vegetation type, with patches of prostrate kanuka in warmer areas, and scattered patches of nonvegetated raw-soilfield.	Flat	*c.*9.1 ha
04.09 04.09.02	**Exotic-dominant scrub** **Radiata pine-maritime pine/ broom-manuka-mingimingi scrub** Radiata pine (some planted) and maritime pine are emergent over broom, manuka, mingimingi, and occasional prostrate kanuka. Broom dominates some areas.	Flat and gentle slopes	*c.*3.0 ha
05.01 05.01.01	**Prostrate kanuka-dominant shrubland** **Prostrate kanuka shrubland** Prostrate kanuka is dominant with mingimingi scattered throughout. Kanuka, manuka, monoao, prickly mingimingi, and bracken are locally common on cooler soils; broom and buddleia are common along the northern lake margin, and wilding pines (mostly maritime pine) are scattered throughout. Groundcover is patchy, comprising mainly lichens (*Cladia* and *Cladonia*). Fumaroles, thermal springs and gas vents are scattered throughout this area.	Flat and gentle hillslopes	*c.*27.9 ha

[1] Previously identified as U17/7 in Wildland Consultants (2004).

VEGETATION		LANDFORM	EXTENT
CODE	TYPE		
05.01.14	**Wilding pine/prostrate kanuka shrubland** Maritime pine and some radiata pine appear to be establishing in large areas of prostrate kanuka shrubland. Some control is evident in some parts with recently felled trees. *Lycopodiella cernua*, bracken, *Gleichenia microphylla*, and *Paesia scaberula* are scattered throughout.	Flat and gentle hillslopes	*c.*6.0 ha
05.03 05.03.19	**Manuka-dominant shrubland** **Manuka-mingimingi-broom shrubland** Mingimingi (up to 2 m high) dominates this area in association with broom. Manuka and wilding pines (mostly maritime pine and radiata pine) are emergent throughout. Also present are prickly mingimingi and patotara (*Leucopogon fraseri*). The groundcover is sparse with occasional tawiniwini and turutu, as well as mosses, liverworts and lichens. Bracken and exotic grasses (particularly Yorkshire fog) dominate large areas within this vegetation type.	Gentle hillslopes	*c.*0.6 ha
22.01 22.01.01	**Geothermal water** **Geothermal water** Lake Rotokawa, geothermal lakes, hot streams, and mud lakes.	Flat and gentle hillslopes	*c.*67.9 ha
28.01 28.01.01	**Nonvegetated raw-soilfield** **Nonvegetated raw-soilfield** Sinter deposits, fumeroles, mud pools. Patches of prostrate kanuka, and broom.	Flat	*c.*12.9 ha
28.01.02	**Nonvegetated raw-soilfield (mining operations)** Areas of open pumice loamfield which has been mined for sulphur are present throughout.	Flat	*c.*0.3 ha

Indigenous Flora: Prostrate kanuka (classed as „At Risk' in de Lange *et al*. 2009) and *Lycopodiella cernua* are present. At least 70 plants of *Calochilus robertsonii* (classed as „At Risk-Naturally Uncommon' in de Lange *et al*. 2009) were recorded from the site in a Rotorua Botanical Society trip to the site in November 2007 (Bycroft 2008). Prostrate kanuka is endemic to geothermal sites, and *Lycopodiella cernua,* is a characteristic feature of geothermal areas.

A field survey of the site by Rotorua Botanical Society on 3 November 2007 recorded a total of 27 indigenous and 24 naturalised vascular plant species (Bycroft 2008). Other indigenous species typical of geothermal habitat include monoao, tawiniwini, manuka, prickly mingimingi, mingimingi, potatara, *Lycopodiella cernua*, *Gleichenia microphylla*, *Histiopteris incisa*, turutu, and bracken.

Fauna: Banded dotterel and North Island fernbird (classed „Threatened-Nationally Vulnerable' and „At Risk-Declining' respectively in Miskelly *et al.* 2008) are present (Merrett & Burns 1997). Banded dotterel breed at this site. Banded dotterel and N.I. fernbird were not recorded in the 2004 survey. Pied stilts (also classed as „At Risk-Declining' in Miskelly *et al.* 2008), nesting black backed gulls and other water birds are also present on and

around the lake. A leech, *Helobdella*, which is not found anywhere else in New Zealand, occurs in the lake (Department of Conservation 1990). Bellbird and spur-winged plover were also recorded at the site.

A 2007 survey of the site recorded one banded dotterel, and a number of common indigenous and exotic bird species, including Indian myna, paradise shelduck, spur winged plover, grey warbler, black-backed gull, Australian magpie, pheasant, California quail, greenfinch, skylark, and starling (Bycroft 2007).

Current Condition (2004 Assessment):

This area has been extensively modified during more than 50 years of sulphur mining, resulting in a reduction in the original extent of geothermal vegetation. However, indigenous geothermal vegetation has begun to re-establish in unvegetated areas in recent years. Invasive exotic plant species make up a large component of the vegetation, in particular wilding pines (particularly radiata pine and maritime pine, with some black pine and lodgepole pine), which in some areas dominate the canopy over a lower tier of indigenous vegetation. Geothermal vegetation remains intact in several areas, particularly to the north-east of the lake.

Threats/Modification/ Vulnerability:

Invasive pest plants (*2004 Assessment*):

Wilding pines (6-25% cover) are visually dominant, and are a serious threat to indigenous plant communities on cooler ground. Some control of wilding pines is evident at the site with recently felled trees present. In some areas pines are dominant over a lower indigenous tier comprising prostrate kanuka and mingimingi. Other invasive exotic plant species present include broom, Himalayan honeysuckle, buddleia, pasture grasses (including creeping bent, browntop, sweet vernal, Yorkshire fog and ryegrass) and blackberry, each of which has approximately 1-5% cover.

A 2007 visit to the site by the Rotorua Botanical Society recorded the following pest trees: radiata pine, maritime pine, silver birch, and tree lucerne. The Society noted the recent wilding pines control work undertaken by the Department of Conservation. Other exotic pest plants recorded were gorse, broom, blackberry, buddleia, pampas, grey willow, Montpellier broom, and Spanish heath, and exotic grassland species, including browntop, Yorkshire fog, sweet vernal, lotus, and catsear (Bycroft 2008).

Human impacts (*2004 Assessment*):

Human impacts on this area have been significant and mainly associated with the extraction of sulphur, however this has now ceased. A geothermal power station has been recently installed, but the impacts of draw-off are at present unknown. Some control of wilding pines has taken place.

Grazing (*2004 Assessment*):

The site is fenced and neither livestock nor livestock damage was observed in the current survey.

Adjoining land use (*2004 Assessment*):

Plantation forests and farmland.

Site Change:

Recent change:

The vegetation is continuing to improve in quality over time as it re-

establishes after a history of mining and road construction throughout this site. Pest plant control, mainly pines, has improved the quality of this site in recent years.

Historical:

The most dramatic change at this site from historical photographs (Historical photos: SN 172 Run 1173 Photos 10-13, 1941) taken in 1941 is that it appears that the site was farmed, and there were few wilding pines amongst geothermal vegetation and habitat. More bare ground may have been present in 1941, but this may also be indicative of human land use, rather than a decline in geothermal surface features over time.

Extensive sulphur mining was undertaken at this site between the 1960s to 1980s, stripping large areas of hot ground, destroying contours and geothermal vegetation in the vicinity (http://www.waikatoregion.govt.nz/Environmental-information/Geothermal-resources/Geothermal-systems-map/Rotokawa : Accessed 2 July 2011).

Management Requirements:

The spread of wilding pines, silver birch, and grey willow needs to be contained, with emphasis on those areas which are still predominantly indigenous. Wilding pines which occur in stands should be removed carefully, taking care not to disturb the remaining indigenous communities. Pampas should also be controlled. The site should be monitored to identify changes that may relate to geothermal power draw-off.

Significance Level:

National (Table 1 - Criteria 1, 3, 4, 5, 7, 9; Table 2 - Factor 8).

Significance Justification:

This site is of national significance because it is comprises a large, good quality, area of geothermal vegetation which is a nationally uncommon vegetation and habitat type, including a wide diversity of geothermal habitats and at risk plant and animal species. While the site has a long history of modification, the quality of the site is noticeably improving since management has moved to the Department of Conservation.

Notes:

Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region and this site was classed as Category C - the third category.

There would be significant value in reassessing the boundaries of geothermal vegetation at this site in the near future. The vegetation of the site is recovering well following cessation of mining and management of pines by the Department of Conservation. The effects on terrestrial geothermal vegetation of geothermal energy extraction from this field should be monitored.

Merrett & Burns (1997) note that the geothermal area on the northern shore of Lake Rotokawa is of biological significance for both the geothermal vegetation growing there, and as a breeding site for banded dotterel and black-billed gulls.

References:

Beadel & Bill 2000; Bycroft 2008; Clarkson *et al.* 1989; Department of Conservation 1998; Merrett & Burns 1997; Merrett & Clarkson 1999; Merrett *et al*. 2003; Unpublished Atiamuri PNAP data 1995; Wildland Consultants 2004.