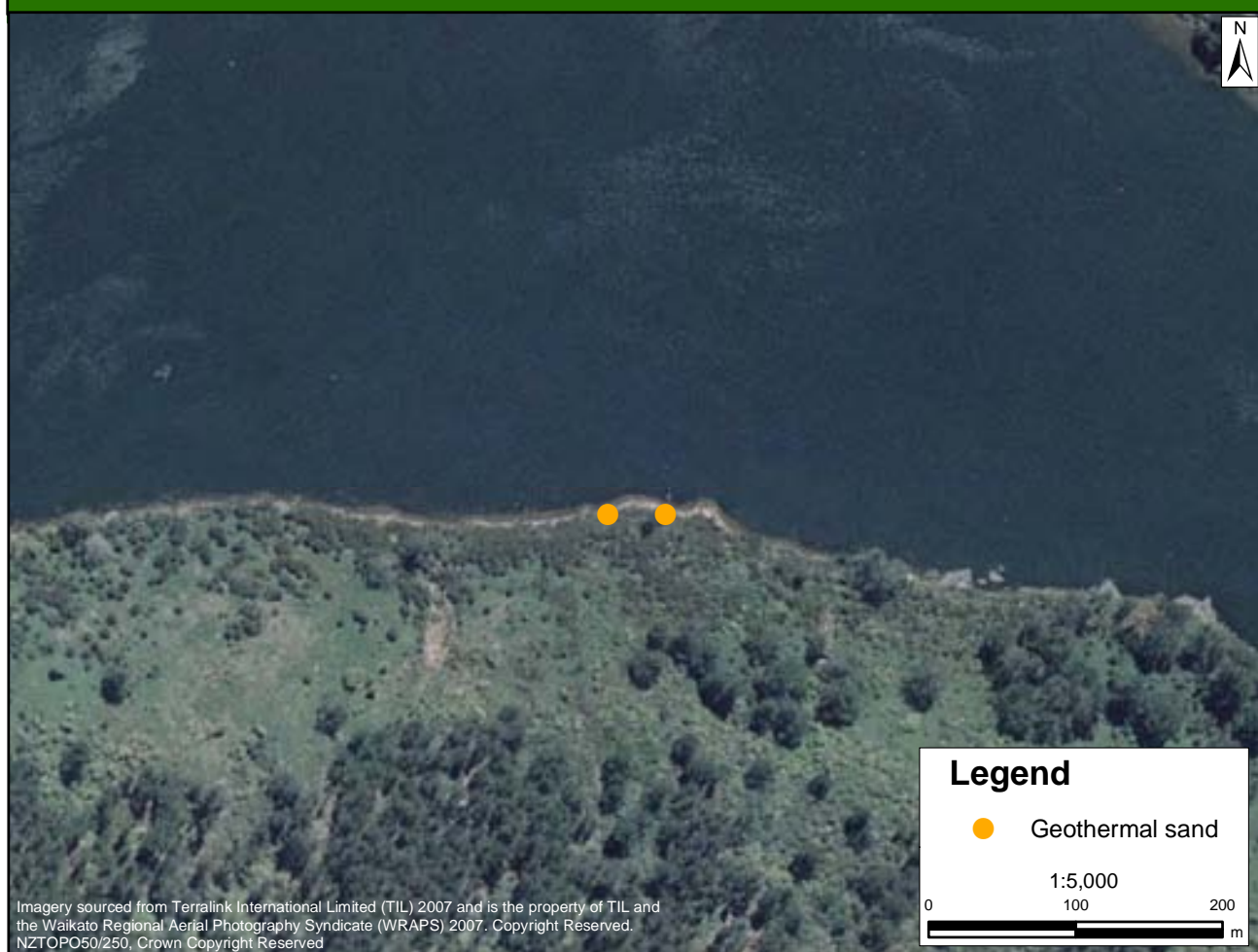
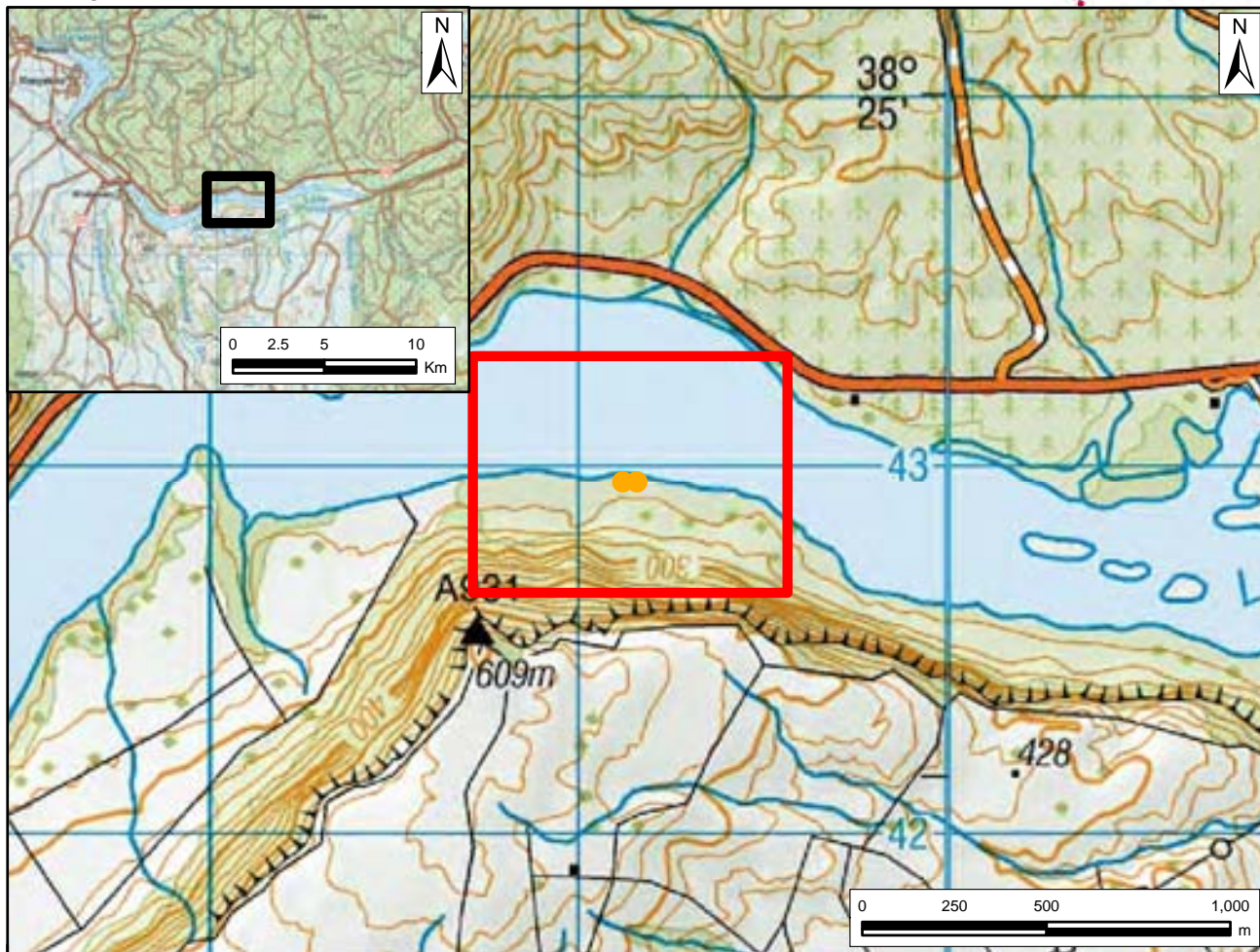


1.4 MOKAI GEOTHERMAL FIELD

List of Geothermal Sites

MKV01	Whakamaru
MKV02	Waipapa Stream
MKV03	Tirohanga Road
MKV04	Paerata Road



Legend

- Geothermal sand

1:5,000

0 100 200 m

WHAKAMARU

Site Number: MKV01¹
Grid Reference: NZTopo50 BF35 511 429
GPS Reference: NZTM E1851114 N 5742958
Local Authority: Taupo
Ecological District: Atiamuri
Geothermal Field: Whakamaru
Bioclimatic Zone: Lowland
Tenure: Unprotected private land
Altitude: c.220 m
Extent of Geothermal Habitat: <0.1 ha
Extent of Geothermal Vegetation: <0.1 ha
Date of Field Survey: 17 February 2008

Code	Type	Landform	Extent
28.01	Nonvegetated raw-soilfield	Beach	<0.1 ha
28.01.03	Geothermal sands Several hot pools in lakeshore sands around the margins of Lake Whakamaru. Two pools were noted during the field visit with temperatures of 45.7°C and 46.2°C, but more geothermal pools are likely to be present. The pools are surrounded by occasional <i>Morelotia affinis</i> , and manuka seedlings. Canopy comprises kanuka scrub.		

Indigenous Flora: Species typical of geothermal habitats are present near the geothermal springs including kanuka, manuka, *Morelotia affinis*, and *Cyperus ustualtus*.

Fauna: No fauna was noted.

Current Condition (2008 Assessment): The site is small and is used recreationally by boat users. Values are not greatly significant in terms of its vegetation component for a geothermal site.

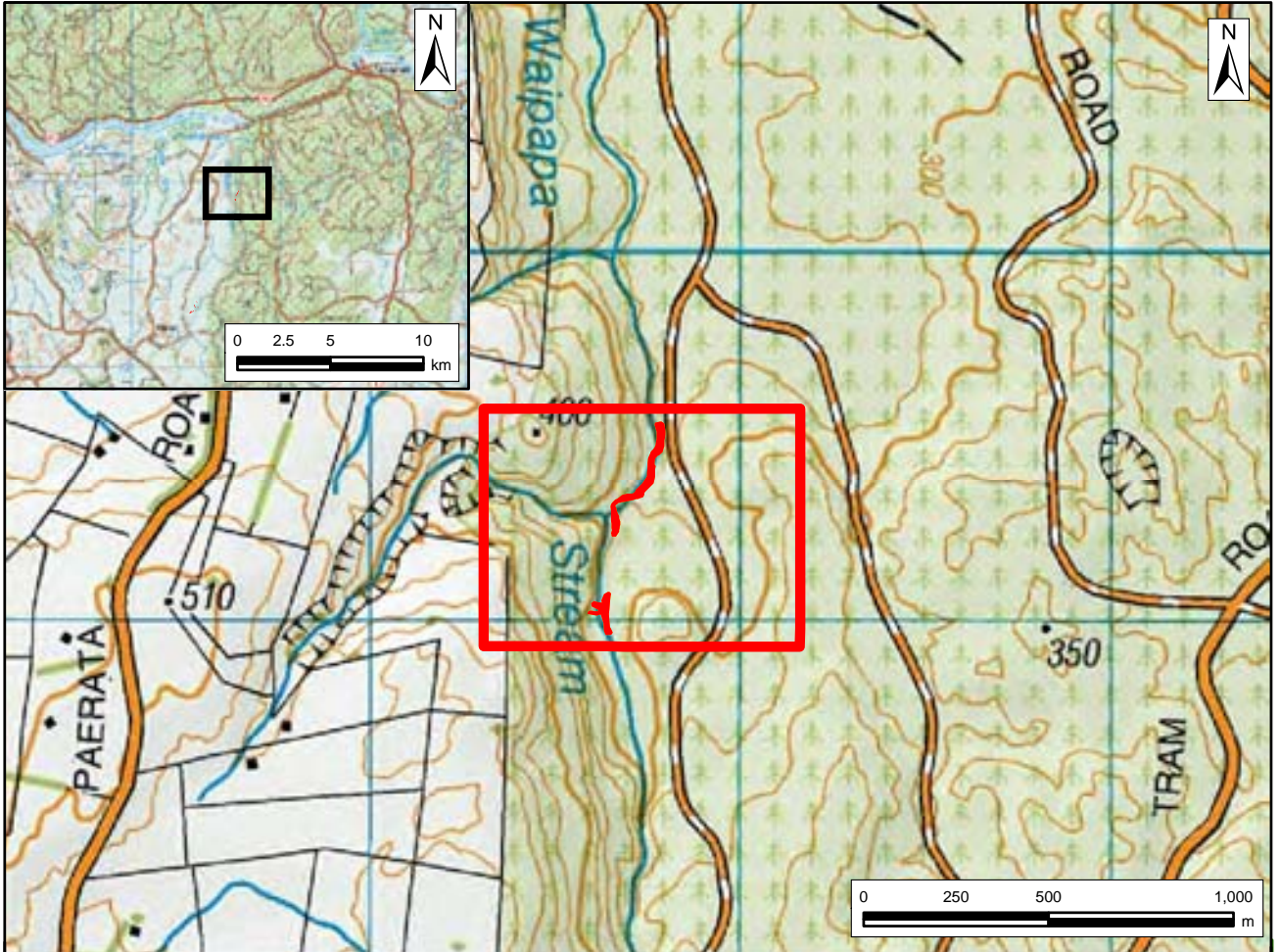
**Threats/Modification/
 Vulnerability:**

Invasive pest plants (2008 Assessment): No serious pest plant issues noted.

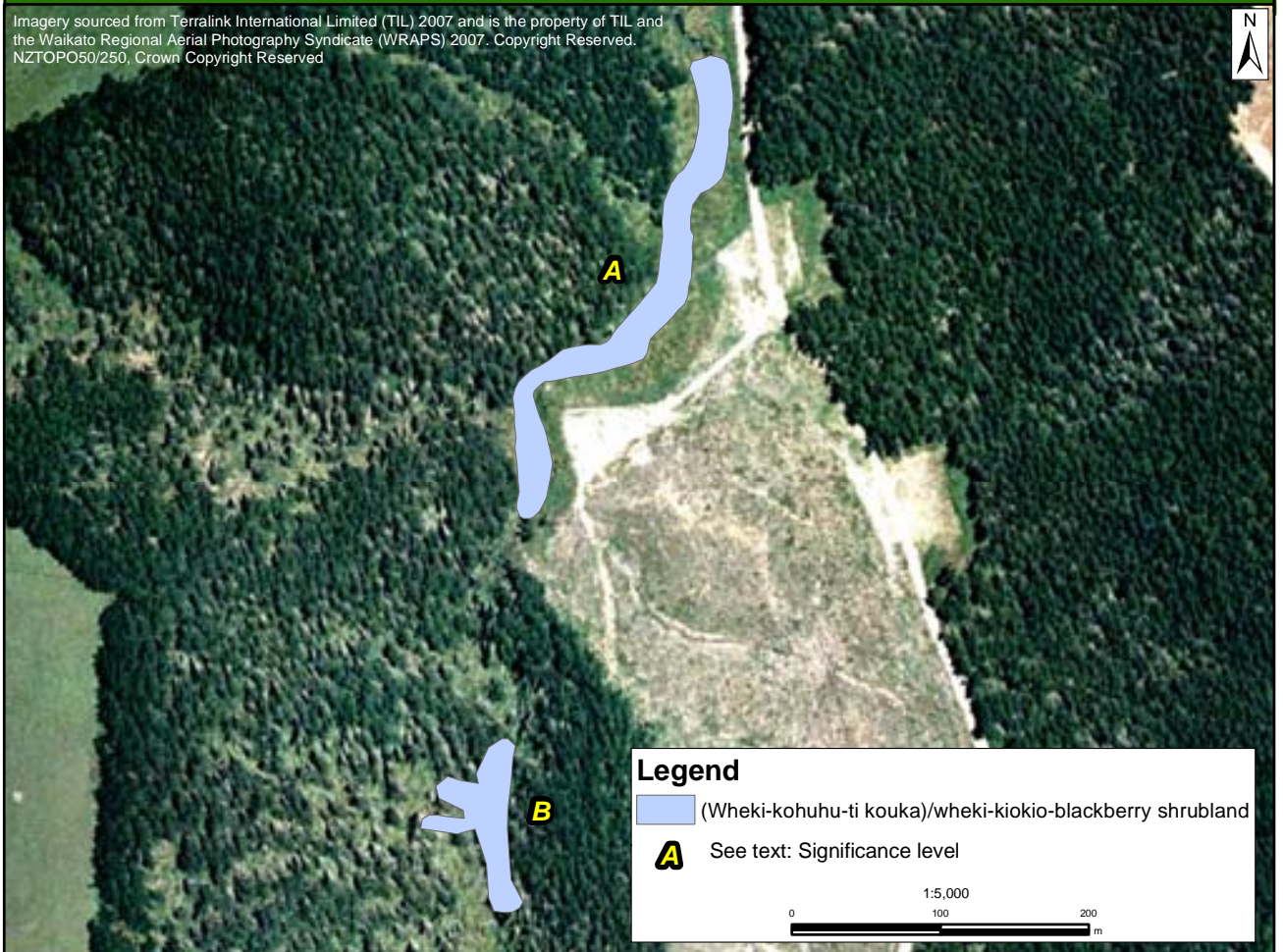
Human impacts (2008 Assessment): Holes are often dug in the sand to create small hot water pools for bathing by people who access the site by boat.

¹ Previously identified as T17/7 in Wildland Consultants (2004).

<i>Grazing (2008 Assessment):</i>	This site is not grazed by stock.
<i>Adjoining land use (2007 Assessment):</i>	Lake Whakamaru; indigenous forest and scrub
Site Change:	
<i>Recent change:</i>	Unknown; this site was only surveyed in 2008.
<i>Historical:</i>	Part of the site is likely to have been drowned when the Whakamaru Dam became operational in 1956 (http://www.mightyriverpower.co.nz/Generation/AboutUs/HydroStations/Whakamaru/Technical.aspx . Accessed 27 June 2010).
	This site is too small to see any evidence of change since 1949 (Historical photos: SN 258 Run 1071 Photos 72-73, 1949).
Management Requirements:	None noted
Significance Level:	Local (Table 1 - Criterion 5; Table 2 - Factor 19)
Significance Justification:	Whakamaru is a locally significant site because it comprises a small example of a nationally uncommon habitat type.
Notes:	The above information is based on a site visit with the Rotorua Botanical Society on 17 February 2008.
References:	Department of Conservation 1998; Unpublished Atiamuri PNAP data 1995; Wildland Consultants 2004.



Imagery sourced from Terralink International Limited (TIL) 2007 and is the property of TIL and the Waikato Regional Aerial Photography Syndicate (WRAPS) 2007. Copyright Reserved. NZTOP050/250, Crown Copyright Reserved



WAIPAPA STREAM

Site Number: MKV02¹
Grid Reference: NZTopo50 BF36 577 393
GPS Reference: NZTM E1857719 N5739348
Local Authority: Taupo
Ecological District: Atiamuri
Geothermal Field: Mokai
Bioclimatic Zone: Lowland
Tenure: Unprotected private land
Altitude: 286 m
Extent of Geothermal Habitat: c.1.1 ha
Extent of Geothermal Vegetation: c.1.1 ha
Date of Field Survey: 30 March 2011

Code	Type	Landform	Extent
05.10 05.10.02	<p>Mixed indigenous-exotic shrubland (Wheki-kohuhu-ti kouka)/wheki-kiokio-blackberry shrubland</p> <p>Tall wheki (c.2-3m tall), kohuhu and ti kouka are emergent over kiokio, wheki, whauwhaupaku, blackberry and bracken along the stream margins. Tutu (<i>Coriaria arborea</i> var. <i>arborea</i>), koromiko, mahoe (<i>Melicytus ramiflorus</i> subsp. <i>ramiflorus</i>), <i>Austroderia fulvida</i>, buddleia, and fleabane are scattered throughout. There is also local <i>Cyperus ustulatus</i>, <i>Paesia scaberula</i>, and <i>Christella</i> aff. <i>dentata</i> (“thermal”). Occasional pampas and grey willow are present.</p> <p>At least two geothermally heated tributary streams, c.75 m long, flow into the main stream through cutover plantation. Vegetation includes the above species, but the canopy cover is younger and lower, and there are dead and fallen radiata pine and localised patches of greater bindweed (<i>Calystegia silvatica</i>). Occasional radiata pine seedlings occur on the outer margins of this vegetation type.</p> <p><i>Christella</i> aff. <i>dentata</i> (“thermal”) occurs on the margins of the stream, and springs, hot steam vents and small geothermally heated tributary streams that feed into the main stream. Apart from one plant at the southern site, the <i>Christella</i> aff. <i>dentata</i> (“thermal”) occurs at the northern site.</p>	Alluvial terrace	c.1.1 ha
05.13 05.13.03	<p>Blackberry dominant shrubland (Wheki-mingimingi)/blackberry-bracken-kiokio shrubland (not mapped)</p> <p>Blackberry is dominant in association with bracken and kiokio, on the margins of a small, heated pool. Green and yellow algae are present on the pool surface. Fern species on the margins include <i>Gleichenia microphylla</i>, wheki, <i>Paesia scaberula</i>, and <i>Christella</i> aff. <i>dentata</i> (“thermal”). Karamu, kanuka, harakeke, koromiko, mingimingi, and <i>Cyperus ustulatus</i> are scattered throughout, with local patches of <i>Lycopodiella cernua</i>.</p>	Stream gully	

¹ Previously identified as T17/1 in Wildland Consultants (2004).

Code	Type	Landform	Extent
07.06	<i>Christella</i> aff. <i>dentata</i> ("thermal")-dominant fernland	Stream	
07.06.01	<i>Christella</i> aff. <i>dentata</i> ("thermal") fernland (not mapped) Small populations of <i>Christella</i> aff. <i>dentata</i> ("thermal") occur along stream banks adjacent to hot steam vents and seepages. These populations occur on both sides of the Waipapa Stream over a distance of c.1 km.	gully	

Indigenous Flora: A large population of c.400 plants of *Christella* aff. *dentata* ("thermal") (classed as „At Risk-Declining’ in de Lange *et al.* 2009) was recorded in 2004, and c.200-300 plants were recorded in other surveys (Beadel & Clarkson 1986, Beadel & Bill 2000, Merrett & Fitzgerald 2004). *Christella* aff. *dentata* ("thermal") populations appear to be stable in 2011 (current study) although the number of plants was not counted. *Lycopodiella cernua* (recorded in this survey) and *Psilotum nudum* (not recorded in the current survey (Beadel & Clarkson 1986)), which are both characteristic species of geothermal areas, occur at this site.

Fauna: Common indigenous and introduced bird species, including fantail, whitehead, North Island robin, Californian quail, magpie, blackbird, Australasian harrier hawk and other species typical of these habitats are present.

Current Condition (2011 Assessment): Several areas of geothermal vegetation occur in association with hot springs and seepages. Although there are areas of indigenous vegetation along the stream margins, which provide a buffer between the plantation and the threatened fern populations, it appears that recent harvesting has disturbed the indigenous vegetation with tree fall across the stream. There is a log jam at one place in the stream.

**Threats/Modification/
Vulnerability:**

Invasive pest plants (2011 Assessment): Invasive pest plants include blackberry with a cover in localised patches of 6-25% (overall cover is 1-5%). Radiata pine, buddleia, Himalayan honeysuckle, Japanese honeysuckle (*Lonicera japonica*) and mint (*Mentha* sp.) have a cover of less than 1%. Australian fireweed (*Senecio bipinnatisectus*) and fleabane are present in the harvested areas, and are encroaching into open areas of this site (however cover of these species is less than 1% in the site at present). Waikato Regional Council has recently undertaken control of pines, broom, and buddleia at this site.

Human impacts (2011 Assessment): In the 1970s the pine plantation at the southern half of the site was harvested. Following this, the populations of *Christella* aff. *dentata* ("thermal") were disturbed for several years (Beadel & Clarkson 1986). Recent harvesting to the west of the stream may have impacted on the presence of *Christella* aff. *dentata* ("thermal") as only one plant was located here during this survey. Elsewhere the population appears to be stable.

It is unclear if the Mokai geothermal field extraction continues to have little effect on the seepages and springs of this site as reported by Merrett & Smale (1999). There is a well used track leading to the key geothermal sites.

Wilding pines in the northern site have been controlled. However, the site should be inspected regularly for threats and management requirements, and further control of pest plants should be undertaken in the future.

*Grazing
(2011 Assessment):*

Domestic livestock are not a threat to this area but feral goats have been recorded at this site in the past (Beadel & Bill 2000).

*Adjoining land use
(2011 Assessment):*

Plantation forestry surrounds this site.

Site Change:

Recent change:

Recent harvesting operations adjacent to the southern part of the site has impacted negatively on the stream and adjacent vegetation with tree falls altering natural water flows and damaging the stream banks. It appears that populations of *Christella* aff. *dentata* (“thermal”) may have been negatively affected. However, the narrow indigenous buffer will allow habitat for this species to remain, and a recovery as recorded in 1986 (Beadel & Clarkson 1986) is likely to occur. Management of wilding pines at the site has been undertaken by the landowner since 2004. Changes were evident with some of the geothermal pools on the eastern side of the stream at the northern part of the site being partly damaged by floods and sediment deposition. The condition of the southern part of the site prior to the 2011 survey is unknown, as this part of the site has not been previously assessed.

Historical:

Site not assessed, no historical photos found.

**Management
Requirements:**

Harvesting operations and subsequent management of the surrounding plantations require care to ensure that this site does not continue to be disturbed. Monitoring of any impacts relating to power draw-off from the Mokai geothermal field should continue. Ongoing protection of *Christella* aff. *dentata* (“thermal”) from the potential impacts of wilding and planted radiata pine trees (outlined in Wildland Consultants 2004a) will assist in the stabilisation of these populations.

Significance Level:

A: National (Table 1 - Criteria 3, 5, 9; Table 2 - Factor 7).
B: Local (Table 1 - Criteria 3, 5; Table 2 - Factor 19).

**Significance
Justification:**

A: The part of the site identified as A on the map is of national significance as it comprises the third largest population of *Christella* aff. *dentata* (“thermal”) (an ‘At Risk-Declining’ species) in New Zealand. This species is known from only 14 other sites in New Zealand.

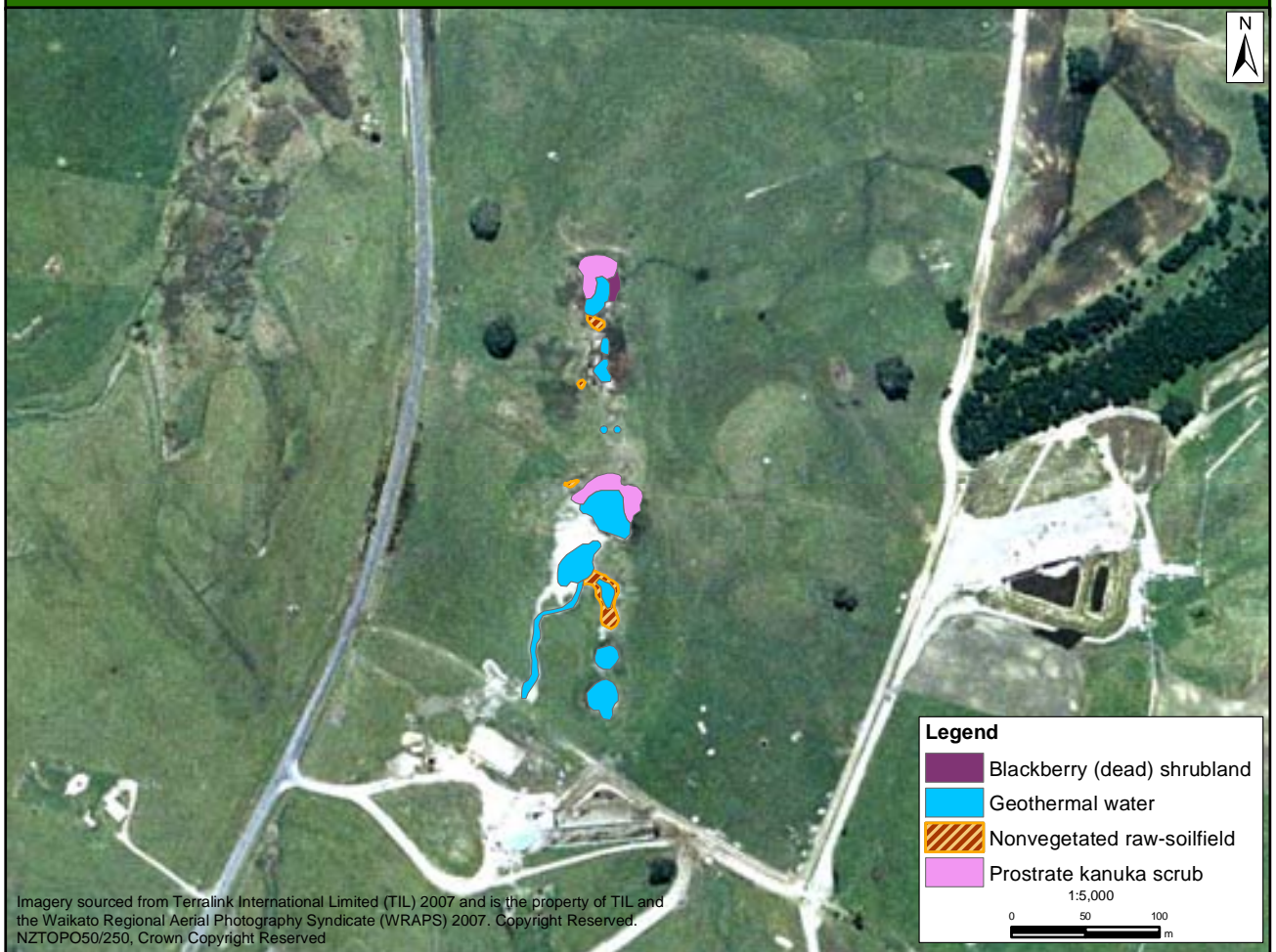
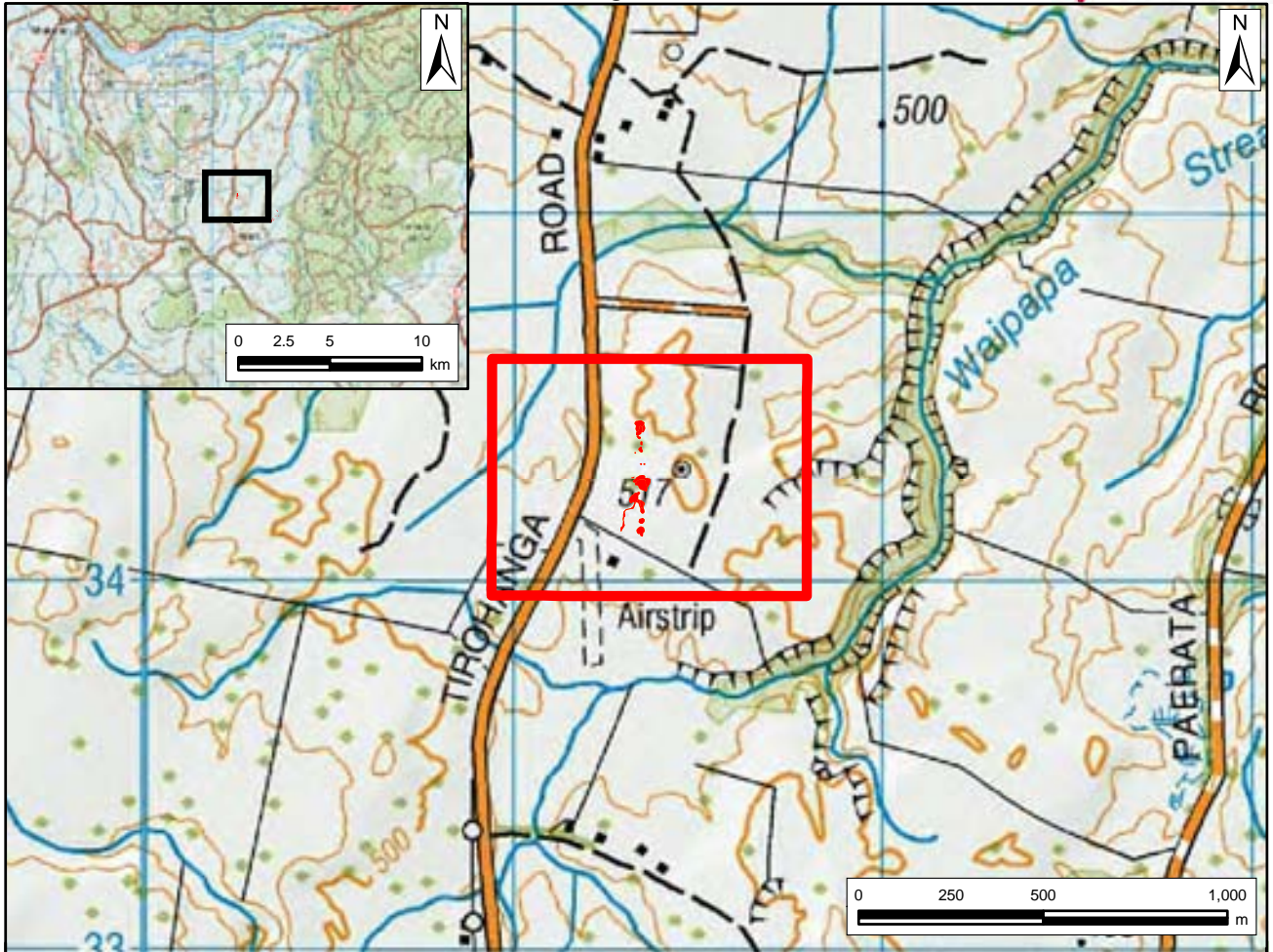
B: The part of the site identified as B is of local significance as it comprises a small example of geothermal habitat - a nationally uncommon vegetation type.

Notes:

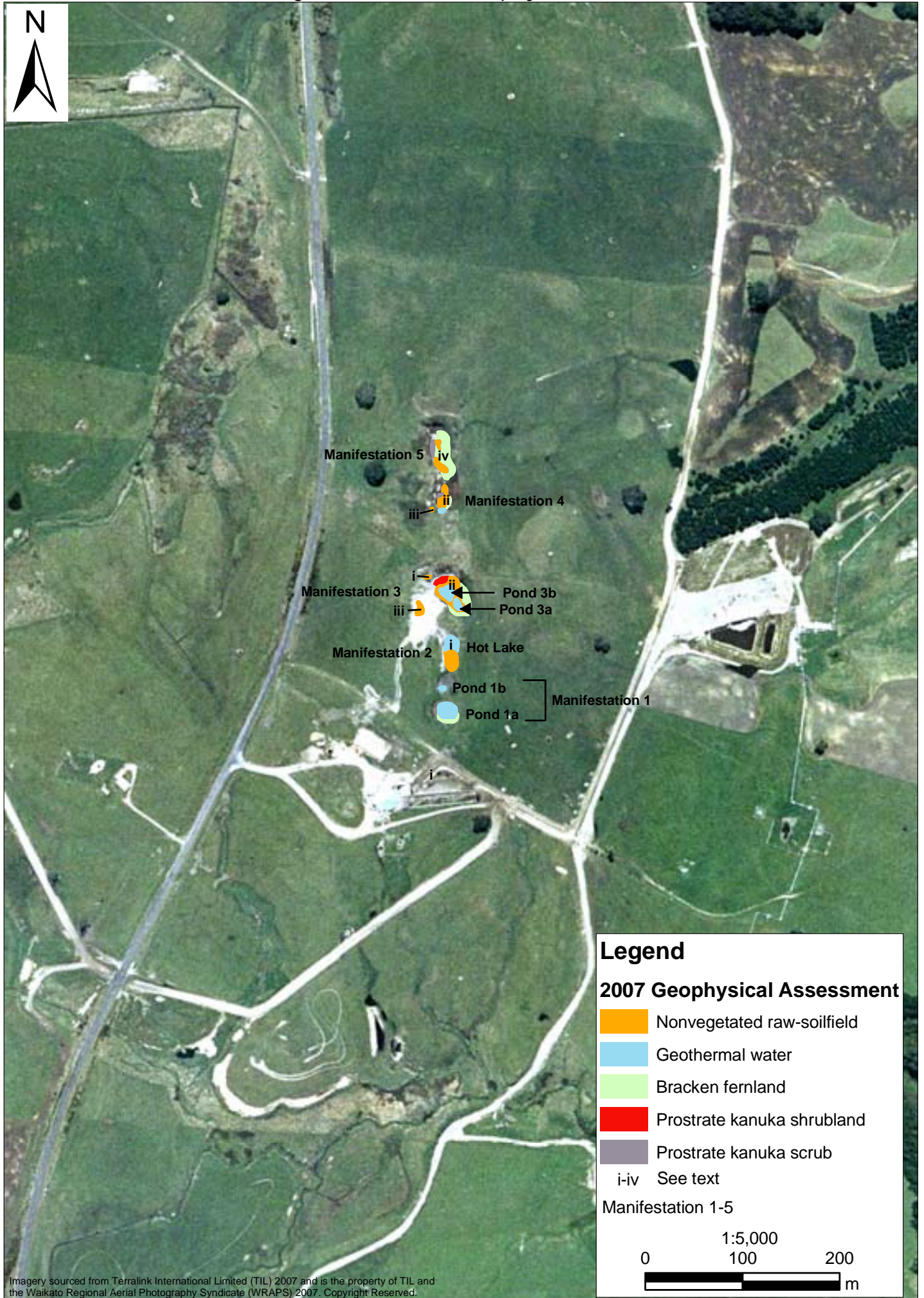
Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region, and this site was classed as Category B - the second highest category.

References:

Beadel & Bill 2000; Beadel & Clarkson 1986; Given 1989a & 1996; Merrett 2001a & 2001b; Merrett *et al.* 1999; Merrett & Fitzgerald 2004; Merrett & Smale 1999; Unpublished Atiamuri PNAP data 1995; Wildland Consultants 2004a.



Imagery sourced from Terralink International Limited (TIL) 2007 and is the property of TIL and the Waikato Regional Aerial Photography Syndicate (WRAPS) 2007. Copyright Reserved. NZTOPO50/250, Crown Copyright Reserved



TIROHANGA ROAD

Site Number: MKV03¹
Grid Reference: NZTopo50 BF36 533 342
GPS Reference: NZTM E1853319 N5734204
Local Authority: Taupo
Ecological District: Atiamuri
Geothermal Field: Mokai
Bioclimatic Zone: Submontane
Tenure: Unprotected private land
Altitude: 498 m
Extent of Geothermal Habitat: c. 0.4 ha
Extent of Geothermal Vegetation: <0.1 ha
Date of Field Survey: 2 March 2011

Code	Type	Landform	Extent
04.01 04.01.01	Prostrate kanuka-dominant scrub Prostrate kanuka scrub Occasional manuka, mingimingi, and kamahi (less than 5 m tall) occur over prostrate kanuka scrub (to c.1 m) tall surrounded by rank exotic grasses (e.g. Yorkshire fog, brown top and Indian doab) with occasional patches of <i>Paesia scaberula</i> . Blackberry patches (both alive and dead from herbicide spray) occur on the margins. Small areas of nonvegetated raw-soilfield are present in this vegetation type.	Crater rim	c.0.1 ha
05.13 05.13.04	Blackberry-dominant shrubland Blackberry (dead) shrubland An area of sprayed, dead blackberry occurs around the northern most geothermal pool.	Crater rim	<0.1 ha
20.01 22.01.01	Geothermal water Geothermal water A series of geothermal pools, oriented in a north-south series, with browntop grassland with patches of blackberry (alive, sprayed, and dead), bracken and Californian thistle (<i>Cirsium arvense</i>) around the margins. There are occasional patches of <i>Histiopteris incisa</i> and Yorkshire fog, and some small isolated patches of nonvegetated raw-soilfield.	Base of craters	c.0.3 ha
28.01 28.01.01	Nonvegetated raw-soilfield Nonvegetated raw-soilfield Heated soil, vents and mud pools occur along the length of this site. Indian doab, paspalum (<i>Paspalum dilatatum</i>), browntop, Yorkshire fog, sheep's sorrel (<i>Rumex acetosella</i>), fleabane, and bracken occur on the margins of these areas.	Crater; gently sloping; geothermal hole	<0.1 ha

Geophysical Assessment²:

Overview of field work and background: The thermal manifestations close to the Tirohanga Road in the Mokai Field were visited during the late morning on 5 February 2007 (refer to map

¹ Previously identified as T17/4 in Wildland Consultants (2004).

² Undertaken by Hochstein in 2007

Tirohanga Road - 2007 Geophysical Assessment). The sky was overcast and air and surface (ground) temperatures were between 18° and 20°C. These manifestations comprise a number of north-south aligned, often north-south elongated craters and small canyons which occur over a distance of c.300 m. In the past, steam was discharged along this fracture zone segment which derived from boiling of thermal water at a few hundreds of meters depth. Some of the acid condensates accumulated in a few muddy pools. When the Mokai Field was developed for electric power production in 2000, the separated thermal waste water from the power house was re-injected into a few drill holes c.500 m to the east of the then steaming mud pools. This led most likely to some quenching of underground vapour ascending in the fracture zone and thermal steam discharges ceased during 2005. All water-filled craters had cooled and exhibited ambient temperatures (c.20°C) when visited the previous time by M. Hochstein on 30 March 2006 (see Hochstein 2006).

During our visit on 5 February 2007 it was found that thermal water (not steam) is again entering most of the pools which had cooled down to quasi-ambient temperatures a year ago. The findings of the visit are listed in sequence, going from south to north along the c.300 m long segment of manifestations.

*Manifestation 1A -
Crater and Pond 1A:*

This is the southern most, water-filled crater. It exhibits at present a thin strip of black mud along its margin. The pond surface covers an area of c.300 m² (all areas cited in this report are order of magnitude estimates only using stepped out distances). Its present level is significantly higher than that observed a year ago when the pond area was much smaller (<30 m²) exposing a large area covered with black mud. The surface temperatures of the pond on 5 February 2007, when measured with the IR-gun, were between 28 and 29°C. The water exhibits now a dark, muddy colour. It is likely that the elevated surface temperatures are due to some input of thermal water.

*Manifestation 1B -
Crater and Pond 1B:*

This small crater lies c.20 m north of Pond 1A. The pond in the crater covers an area of <50 m². It contains muddy, grey-brownish water with surface temperatures between 22° and 24°C. The pond might not be re-charged by thermal water.

*Manifestation 2 - Hot
Lake:*

The hot lake lies c.50 m north of Pond 1B and covers an area of c.500 m² with surface temperatures (IR-gun) between 53 and 56°C. There appears to be a small up-flow zone near its south margin where a maximum temperature of 67.1°C was measured at c.0.2 m water depth with a thermocouple device. About 10 m to the south is a deep (2 m) collapse pit with c.53°C stagnant water at its bottom. Elevated ground temperatures of c.27°C occur at 0.2 m depth on land, half way between the lake and the collapse feature. At the northwest margin of the lake there is a shallow trickle outflow of lake water (<1 kg/s) which infiltrates the ground. Further downstream to the south, another shallow, small outflow emerges. There was no lake at this site a year ago although it was occupied by bare, partly steaming ground prior to 2000; it is likely that the hot lake is fed by thermal water which derives from re-injected water now ascending in the fracture zone.

*Manifestation 3A -
Large Mud Pool 3A:*

About 50 m north of the new hot lake lies the old, large mud pool (3A), used in the past as a rubbish tip but now almost cleared of rubbish. The pool area is covered by a muddy grey-brown coloured lake with an estimated surface area of *c.*500 m². The maximum surface temperature in the centre of the lake was *c.*30°C, observed within a large discoloured water patch (up-flow?) near its centre (elsewhere the surface lake temperature was 28°C). The present day colour of the lake water is quite different from that observed 10 months ago when it was a dark-brown (humic-acid coloured?) stagnant water. In comparison to a survey in March 2006, the present-day lake surface area of 3A has not increased significantly (although a minor increase was noticed along its western shore).

On top of the western rim of Pool 3A, a small strip of thermally altered ground is exposed. Its ground temperature at 0.2 m depth was found to be 19°C (i.e. non active ground).

*Manifestation 3B -
Adjacent Smaller
Muddy Pool 3B:*

Directly adjacent to the southeast margin of Pool 3A lies a smaller (*c.*150 m² large), water-filled, almost circular crater (Pool 3B), exhibiting a surface temperature of 35°C (36.0°C when measured with a thermocouple at 0.2 m depth). The elevated temperatures point to some significant input of thermal water. The level of the smaller pond (3B) was *c.*1 m above that of the larger Lake 3A. Some water of the smaller pond appears to seep through a small, *c.*1 m wide dam which separates the two and which could be breached at any time. The surface temperature of the larger lake (3A) was *c.*34°C just adjacent to the dam. In March 2006, the surface level of Pool 3B was below that of the larger Pool 3A (Hochstein 2006).

*A Deep Pit (Acid
Leaching?):*

About 35 m to the south-west of Pool 3A was a *c.*2.5 m deep, almost circular pit (*c.*3 m diameter), which exhibits almost vertical walls (E1853320 N5734250). The temperature on the dry bottom was *c.*20°C (i.e. non active feature). Pits with a similar wall structure occur in the Waiotapu geothermal field where they are caused most likely by slow dissolution of pumice layers involving acid (steam) condensates. It is possible that some pits and canyons of the Tirohanga Road manifestations are also caused by 'acid leaching'.

*Manifestation 4 - Deep
Canyon:*

An almost 15 m deep and *c.*40 m elongated (in north-south direction) 'canyon' lies *c.*100 m north of Manifestation 3. The bottom of the gully (Feature 4) is covered by a small lake. The surface temperature of the northern part of the lake was *c.*28°C. There is a small, up-welling, muddy pool at the south end, associated with some wafting steam. The temperature at its southern margin was between 30° and 50°C when measured from the rim with the IR gun. The walls of the canyon were too steep to climb to the bottom for closer inspection. However, some thermal water is obviously entering the bottom of this canyon.

*Manifestation 5 -
Canyon at the Northern
End of the Tirohanga
Road Manifestations:*

Another *c.*50 m long, deep canyon (Feature 5) lies at the north end of the north-south aligned craters and canyons. This feature contains no pools nor does it exhibit any visible thermal activity. However, at the northern end of the deep, elongated structure lies an old Maori 'steam pit (umu)' where the ground temperature at the bottom was *c.*38°C (0.4 m below surface). Some residual prostrate kanuka shrubs were found along the northernmost western rim. However, ground temperatures at 0.2 m depth beneath 1.0-1.5 m high prostrate kanuka was *c.*18°C (i.e. non-thermal ground).

Interpretation of Findings:

It is likely that the thermal water now emerging in five manifestations (Features 1A, 2, 3A, 3B, and 4) derives from thermal waste fluids discharged by the geothermal power station (located *c.*3.5 km to the south-east of the Tirohanga Road manifestations), from where they are transmitted by surface pipes to three re-injection wells (MK 4, 8, 9) which lie *c.*400 to 500 m east of the Tirohanga Road craters and pools. Since the commissioning of the plant in 2000 until 2005, *c.*800 t/hr of separated thermal waste water was injected into two of the three re-injection wells, down to depths of about 400 m. This rate was increased to *c.*1,400 t/hr from May/June 2005 onwards when the abstraction rates from hot bores supplying hot fluids to the power station were increased. During the first period of re-injection (i.e. from 2000 to *c.*2004) the injected wastes started to accumulate at depth and around the injection wells, which led to the quenching of naturally discharging steam beneath and within the Tirohanga Road thermal manifestations, which ceased to discharge steam by 2004/5. All manifestations then cooled down and elevated ground temperatures could no longer be observed at the beginning of 2006. When the injection rate of the plant was increased in 2005 and after the quenching of ascending steam, thermal waste water must have started to ascend to the surface, as it was noticed during our visit on 5 February 2007.

The Mokai Geothermal Power Plant managers must have been aware about the underground pressure build-up around the re-injection wells, since deeper re-injection has been considered. One of the new, deep re-injection wells is presently being drilled near one of the old injection wells. Since rapid changes in the natural discharge rate of the injected waste fluids might occur, some detailed monitoring of the Tirohanga Road manifestations should be considered.

Indigenous Flora:

Prostrate kanuka (classed as „At Risk-Naturally Uncommon’ in de Lange *et al.* 2009) is present on the crater rims.

Fauna:

Common indigenous and introduced bird species are present, including Australasian magpie, yellowhammer, and goldfinch.

Current Condition (2011 Assessment):

Geothermal habitat is surrounded by rank exotic grasses and blackberry, some of which has been sprayed. The entire geothermal area has been fenced to exclude stock, and there is potential for restoration plantings.

Threats/Modification/Vulnerability:

Invasive pest plants (2011 Assessment):

Recent spraying of blackberry has been partially successful, and ongoing control is recommended.

Human impacts (2011 Assessment):

A small amount of rubbish was present at this site during the current survey. This site is vulnerable to draw-off from the geothermal field and the vegetation and geothermal features underwent large changes with the establishment of Mokai Power Station. Parts of the geothermal site have been used as a rubbish dump in the past, and some of this material was still present in 2007 (Wildland Consultants 2007a). A cooking pit (umu) is present at the north of the site.

Grazing (2011 Assessment):

Whilst stock gained access to the site in 2007 (see Wildland Consultants 2007a), this situation appears to have been rectified, and stock currently do not have access to this site.

*Adjoining land use
(2011 Assessment):*

This site is surrounded by pastoral land.

Site Change:

Recent change:

It appears that the fence excluding stock has been relocated further away from the geothermal expressions (parts of the old fence remain). Recent spraying has killed large areas of blackberry; as well as prostrate kanuka scrub and manuka (and possibly *Histiopteris incisa*). Between the geothermal expressions and the fence, brown top-Yorkshire fog-paspalum grassland dominates.

Waste material that had been dumped into geothermal features, noted in 2007, appears to have been removed from site.

Historical:

Site not assessed, no historical photos found.

**Management
Requirements:**

Changes to geothermal vegetation that appear to be associated with draw-off from the geothermal field should be monitored. A management plan for restoration of this site should be developed by an ecologist with an understanding of the ecological values and management issues of this site.

Significance Level:

Local (Table 1 - Criteria 3, 5; Table 2 - Factor 19).

**Significance
Justification:**

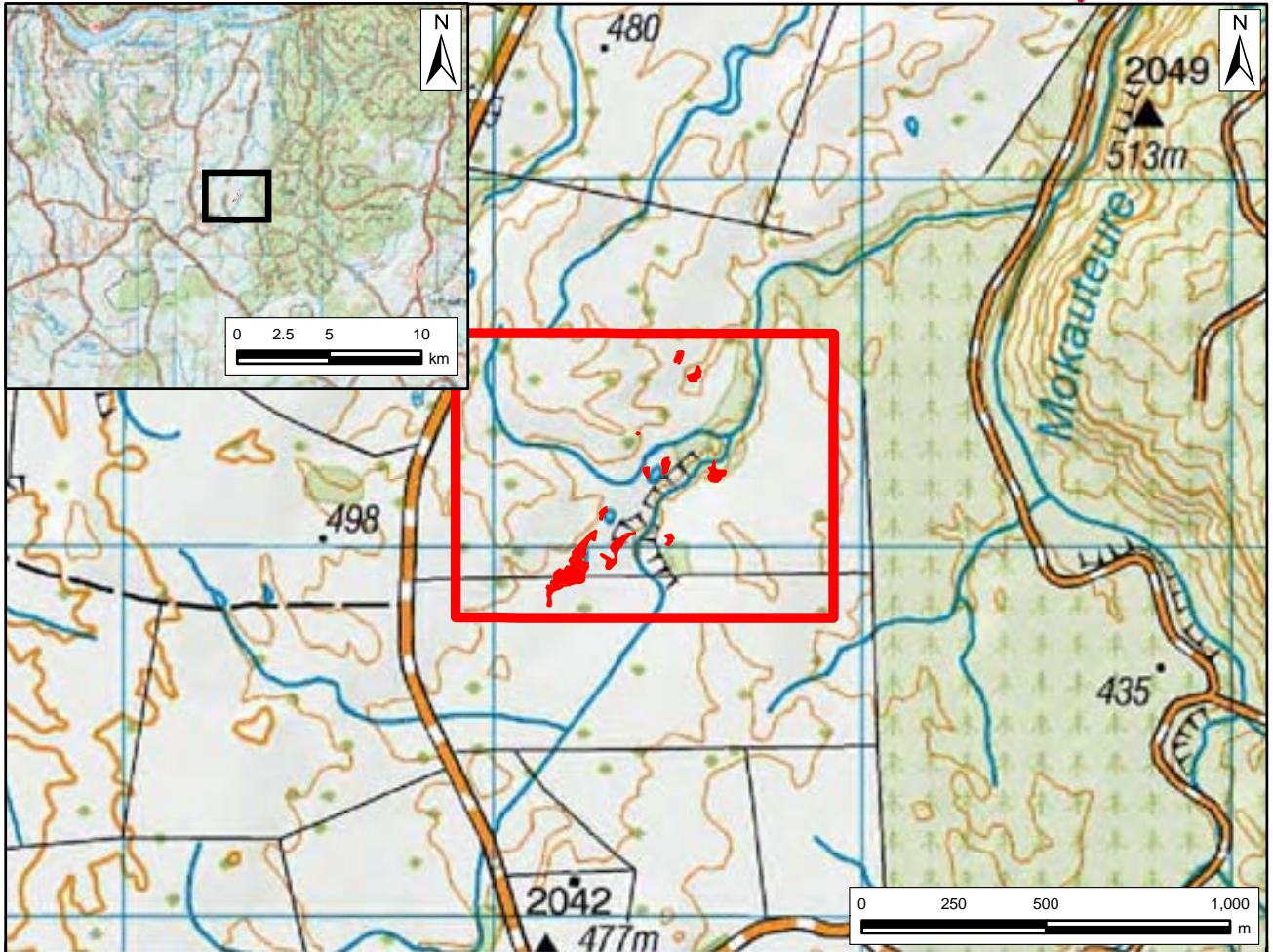
Tirohanga Road is of local significance because it is a small example of a nationally uncommon habitat type and it contains a small population of prostrate kanuka, an „At Risk’ species.

Notes:

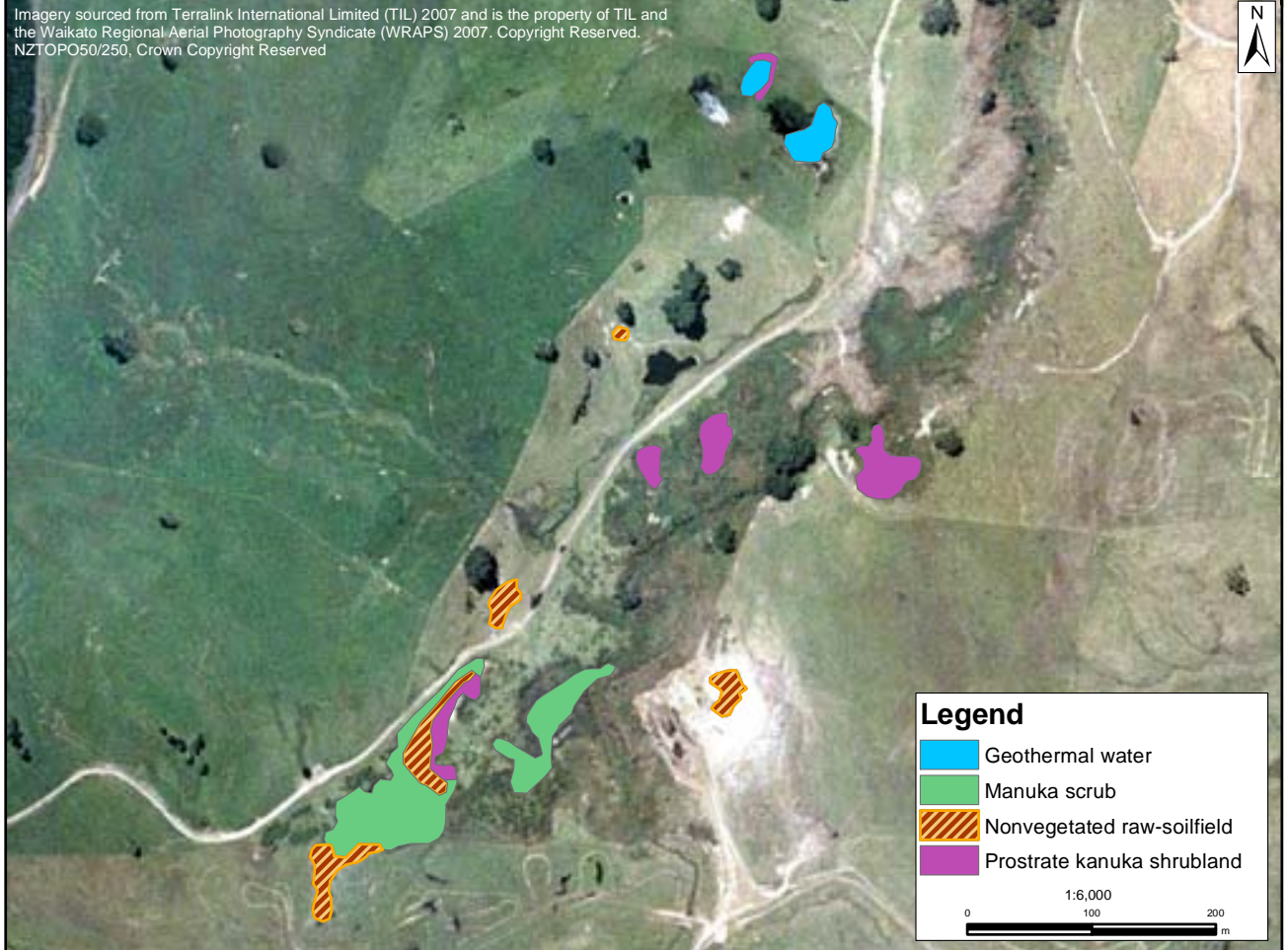
Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region and in this study, this site was classed as Category C - the third highest category.

References:

Beadel & Bill 2000; Beadel & Clarkson 1986; Department of Conservation 1998; Given 1996; Hochstein 2006 & 2007; Merrett & Fitzgerald 2004; Wildland Consultants 2004 & 2007a.



Imagery sourced from Terralink International Limited (TIL) 2007 and is the property of TIL and the Waikato Regional Aerial Photography Syndicate (WRAPS) 2007. Copyright Reserved. NZTOPO50/250, Crown Copyright Reserved



PAERATA ROAD

Site Number: MKV04¹
Grid Reference: NZTopo50 BF36 552 329
GPS Reference: NZTM E1855210 N5732941
Local Authority: Taupo
Ecological District: Atiamuri
Geothermal Field: Mokai
Bioclimatic Zone: Submontane
Tenure: Unprotected private land
Altitude: 447 m
Extent of Geothermal Habitat: c.1.8 ha
Extent of Geothermal Vegetation: c.1.6 ha
Date of Field Survey: 2 March 2011

Code	Type	Landform	Extent
04.03 04.03.01	Manuka-dominant scrub Manuka scrub A discontinuous canopy of manuka of varying height (c.0.5-1.5 m high), with mingimingi, blackberry and broom scattered throughout. The understorey comprises <i>Histiopteris incisa</i> , bracken and blackberry with local turutu and kiokio, and small patches of sedges, rushes, ferns (including kiokio) and prostrate kanuka. Occasional grey willow are also present.	Flat to undulating farmland; small gullies	c.0.8 ha
05.01 05.01.01	Prostrate kanuka-dominant shrubland Prostrate kanuka shrubland Prostrate kanuka dominates the depression faces around geothermal mud pools (not mapped separately). Blackberry, broom, mingimingi, manuka, bracken, and <i>Histiopteris incisa</i> are scattered throughout.	Geothermal depressions	c.0.4 ha
22.01 22.01.01	Geothermal water Geothermal water An area of geothermal water with nonvegetated raw-soilfield, and patches of prostrate kanuka, mingimingi and exotic grasses (including Yorkshire fog and browntop) on its margins.	Flat to undulating farmland	c.0.2 ha
28.01 28.01.01	Nonvegetated raw-soilfield Nonvegetated raw-soilfield Bare ground and hot water pools (not mapped). Introduced grasses (mainly Yorkshire fog, browntop, and Indian doab), <i>Gonocarpus micranthus</i> subsp. <i>micranthus</i> and <i>Campylopus capillaceus</i> occur around the margins of these areas with scattered manuka, koromiko, mingimingi, prostrate kanuka, broom, bracken, <i>Histiopteris incisa</i> , <i>Paesia scaberula</i> , and blackberry on cooler sites.	Flat to undulating farmland	c.0.4 ha

Indigenous Flora: A small population of prostrate kanuka (classed as 'At Risk-Naturally Uncommon' in de Lange *et al.* 2009), an endemic plant species restricted to geothermal areas, is present. *Lycopodiella cernua* and *Psilotum nudum*,

¹ Previously identified as T17/3 in Wildland Consultants (2004).

both species characteristic of geothermal areas, occur at this site (the latter species was last seen in 1986, see Beadel & Clarkson 1986).

Fauna: Common indigenous and introduced birds typical of the habitat are present, including Australasian harrier, spur-winged plover, fantail, and paradise shelduck.

Current Condition (2011 Assessment): Most of the site is in poor ecological condition, with much of the site farmed; margins have been planted as part of a pine plantation, and common pest plants are present. Vegetation clearance has occurred in the vicinity of some of the geothermal features. Blackberry on a steep bank above a geothermally-influenced stream has been sprayed with herbicide which has, either intentionally or accidentally, also been applied to the edge of the manuka scrub. Rubbish has also been dumped down the bank and into the stream/geothermal vegetation margin. Radiata pines have recently been planted on the margins of some of the features and future shading by the pines may adversely affect indigenous vegetation. Some geothermal features have been fenced to exclude stock, however a sheep was grazing within a fenced area during the site inspection (possibly an escapee from a nearby paddock).

**Threats/Modification/
Vulnerability:**

Invasive pest plants (2011 Assessment): Blackberry control has occurred over a large part of this area, however blackberry still comprises 1-5% cover of the site. Several large wilding pines have been killed. Planted radiata pine seedlings may shade geothermal vegetation in the future and prostrate kanuka is not tolerant of complete canopy closure.

Human impacts (2011 Assessment): Radiata pine have recently been planted (during the last year) within 5 m of some geothermal features. In preparation for planting, large areas of blackberry were sprayed and, in some cases, adjacent manuka (and possibly other indigenous plant species) have died as a result of herbicide application. This site has been used as a rubbish dump, with refuse present adjacent, and encroaching into, geothermal areas. Large wilding radiata pines have been felled into areas of prostrate kanuka.

Grazing (2011 Assessment): Geothermal features between the stock race and the eastern stream edge are fenced to exclude stock (one sheep was present at the time of survey). All other areas (to the west of the stock race) are not fenced and are grazed.

Adjoining land use (2011 Assessment): This site occurs within farmland and a large part of the site has recently been planted with radiata pine (to the east of the farm race).

Site Change:

Recent Change: Blackberry has been sprayed and radiata pine planted. Some geothermal vegetation has been cleared and some has been sprayed with herbicide.

Historical: Site not assessed, no historical photos found. As most features are small, changes are unlikely to be evident on historical photos.

Management Requirements: A set back is recommended of at least 10 m from the edge of all geothermal areas for the radiata pine plantation.

Unfenced areas require fencing to prevent further damage from stock. Restoration activities at these sites would be beneficial.

Significance Level: Local (Table 1 - Criteria 3, 5; Table 2 - Factor 19)

Significance Justification: Paerata Road is of local significance because it comprises geothermal habitat, a nationally uncommon habitat type, and it includes a small population of an „At Risk’ species, prostrate kanuka.

Notes: This site was identified as a recommended area for protection (RAP) under the Protected Natural Areas Programme (Unpublished Atiamuri PNAP data 1995).

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

In a previous assessment (Wildland Consultants 2004) this site was divided into parts for the assessment of relative significance as it was appropriate at the time. Parts were assessed as being locally significant and other parts were assessed as being of regional significance because they provide habitat for an „At Risk’ species, prostrate kanuka. In the current study, the entire site is assessed as being of local significance because human disturbance at the site since 2004 has resulted in a significant reduction in the extent of prostrate kanuka. However, if stock is excluded, and pest plants are managed, prostrate kanuka has the potential to re-establish at this site.

This site still contains the largest area of prostrate kanuka shrubland in the Mokai geothermal field.

References: Beadel & Bill 2000; Beadel & Clarkson 1986; Given 1989 & 1996; Merrett 2001; Merrett & Fitzgerald 2004; Unpublished Atiamuri PNAP data 1995; Wildland Consultants 2004.

