

Priorities for ecological management at geothermal sites in the Waikato Region - 2023 Update

Peer reviewed by:
Katherine Luketina

Date October 2023

Approved for release by:
Michelle Begbie

Date May 2024

Prepared by:
Angela McQuillan, Chris Bycroft (Wildlands
Consultants Ltd)

For:
Waikato Regional Council
Private Bag 3038
Waikato Mail Centre
HAMILTON 3240

Publication: June 2023

Disclaimer

This technical report has been prepared for the use of Waikato Regional Council as a reference document and as such does not constitute Council's policy.

Council requests that if excerpts or inferences are drawn from this document for further use by individuals or organisations, due care should be taken to ensure that the appropriate context has been preserved, and is accurately reflected and referenced in any subsequent spoken or written communication.

While Waikato Regional Council has exercised all reasonable skill and care in controlling the contents of this report, Council accepts no liability in contract, tort or otherwise, for any loss, damage, injury or expense (whether direct, indirect or consequential) arising out of the provision of this information or its use by you or any other party.

PRIORITIES FOR ECOLOGICAL MANAGEMENT AT GEOTHERMAL SITES IN THE WAIKATO REGION - 2023 UPDATE



 providing
outstanding
ecological
services to
sustain
and improve our
environments



PRIORITIES FOR ECOLOGICAL MANAGEMENT AT GEOTHERMAL SITES IN THE WAIKATO REGION - 2023 UPDATE

Contract Report No. 2755b

June 2023

Project Team:

Jo McQueen - Project management, peer review

Sarah Beadel - Peer review

Angela McQuillan - Report author

Chris Bycroft - Report author

Prepared for:

Waikato Regional Council

Private Bag 3038

Waikato Mail Centre

Hamilton 3240

CONTENTS

1.	INTRODUCTION	1
2.	METHODS	1
	2.1 Information sources	1
	2.2 Prioritisation of sites for management	2
3.	FINDINGS	2
	3.1 Pest plants	2
	3.2 Pest animals	7
	3.3 Exclusion of domestic animals	9
	3.4 Other threats to geothermal sites	10
4.	SUMMARY	12
	ACKNOWLEDGMENTS	12
	REFERENCES	13
1.	Threats to geothermal sites in Waikato Region - 2023	14
2.	Definition of fields used to assess the threats to sites with geothermal vegetation in the Waikato Region	29
3.	Year of most recent field survey at each geothermal site in the Waikato Region	31

Reviewed and approved for release by:



Sarah Beadel
Director
Wildland Consultants Ltd

© *Wildland Consultants Ltd* 2023

This report has been produced by Wildland Consultants Ltd for Waikato Regional Council. All copyright in this report is the property of Wildland Consultants Ltd and any unauthorised publication, reproduction, or adaptation of this report is a breach of that copyright.

1. INTRODUCTION

The management priorities for all known sites containing geothermal vegetation and/or habitat in the Waikato Region have previously been assessed in 2006, 2011, and 2014 (Wildland Consultants 2006, 2011, and 2014).

This report updates the priorities for management of geothermal sites in the Waikato Region, based on the most up to date ecological information for each of the 46 sites (Wildland Consultants 2023a). These sites occur within 14 Geothermal Systems (and 17 Geothermal Fields - three of the Geothermal Systems each contain two Geothermal Fields).

The objective of this project is to update the 2014 report (Wildland Consultants 2014) by identifying priorities for pest plant control, pest animal control, and fencing for all of the mapped geothermal sites in the Waikato Region. Each site is to be ranked in order of priority for pest plant control, pest animal control, and fencing requirements (i.e. exclusion of domestic animals) (if deemed relevant).

2. METHODS

2.1 Information sources

Information presented in the 2023 geothermal vegetation of the Waikato Region report (Wildland Consultants 2023a) that was collected during field surveys and a desktop exercise, was used as the basis to assess and rank the management requirements of sites for pest plant, pest animal, and domestic animal threats (i.e. fencing requirements). This report includes data from earlier published and unpublished assessments and reports, aerial photographs, and local knowledge of the sites. Information on each site was collated and presented in a table (Appendix 1). A definition of each of the table fields and relevant methods used to populate each field is presented in Appendix 2. Fields include:

- Site Name;
- Size of site;
- Extent of geothermal vegetation at site (this is a new field that was added to this assessment in 2023);
- Significance level;
- Key values of the site;
- Threats;
- Vulnerability;
- Description of threats;
- Action required;
- Ecological benefit;
- Priority;
- Ecological change since previous assessment (Wildland Consultants 2014);
- Changes to management since previous assessment (Wildland Consultants 2014);
- Comments.

Twenty-six sites were inspected during field surveys in 2022 or 2023 (Wildland Consultants 2023a). The year of most recent field survey at each geothermal site in the Waikato Region is listed in Appendix 3.

2.2 Prioritisation of sites for management

Prioritisation of site requirements for pest plant control, pest animal control, and fencing considered the following factors:

- The overall value of the site (significance ranking).
- Specific ecological values (e.g. Threatened and At-Risk species) threatened because of pest plants, domestic animals, or other threats.
- Ongoing restoration management activities.
- Potential effectiveness/cost effectiveness of the management effort.

3. FINDINGS

Key pest plant, pest animal, and domestic animal threats for each of the 46 sites are summarised in Appendix 1. The vulnerability of each site to those threats, the actions required to address them, and the benefits and priority of ecological management are presented. In the following sections, sites that are of a high, medium, or lower priority for pest plant control, pest animal management, and/or management of domestic animals are identified.

3.1 Pest plants

Invasive exotic plants, particularly wilding exotic conifers (mainly radiata pine, *Pinus radiata*; and maritime pine, *Pinus pinaster*) and blackberry (*Rubus fruticosus* agg.), are the most obvious threat to most geothermal sites. While some sites have been subject to weed control efforts, pest plants are an ongoing threat. At least 42 of the exotic plant species that have been recorded from geothermal habitats in the Waikato Region are considered to be serious pest plants. Many of the pest plant species are widespread and occur at a large number of the sites, although there are several pest plant species that occur at only a few sites.

The priority for pest plant control at each geothermal site in the Waikato Region is listed in Table 1, with further information about the requirements for pest plant control presented in Appendix 1.

Immediate Priorities

Thirteen geothermal sites require immediate pest plant control. All of these sites are of Regional to International significance. In particular, immediate control of wilding exotic conifers is required at Ohaaki Steamfield (both East and West), Orakonui, Rotokawa, Te Kopia, and Waiotapu. Other pest plants that require control at these sites include pampas (*Cortaderia selloana*), silver birch (*Betula pendula*), blackberry, broom

Table 1: **Pest plant control** priorities at geothermal sites in the Waikato Region. Descriptions of the threat to each site and the control actions that are required are summarised in Appendix 1.

Immediate	High	Medium	Lower	No Priority
Golden Springs	Akatarewa Stream	Hall of Fame Stream	Akatarewa East	Ketetahi
Hipaua	Craters of the Moon	Lower Sections: Te Kiri o Hinekai Stream and Wairākei Stream	Horohoro	Rotopaunga
Ngarotopounamu/Red Crater	East Taupō	Maunganamu	Longview Road	Te Maari Craters
Ohaaki Steamfield East	Maunga Kākaramea (Rainbow Mountain)	Murphy's Springs	Matapan Road	Whakamaru
Ohaaki Steamfield West	Maungaongaonga	Waikato River Springs/ Mangamingi Stream	Northern Paeroa Range	4 sites
Orakonui	Orākei Kōrako and Red Hills	Waipapa Stream	Paerata Road	
Rotokawa	Otumuheke	6 sites	Tauhara South	
Te Kopia	Te Kiri o Hinekai		Taupō Shoreline	
Tokaanu	Te Rautehuia-Wairākei		Tirohanga Road	
Tokaanu Lake Shore Wetland	Waihunuhunu		Tukairangi/Karapiti Forest	
Waikite Valley	Whangapoa Springs		Whangairorohea	
Waiotapu	11 sites		Wharepapa Road	
Waipahihi Valley			12 sites	
13 sites				

(*Cytisus scoparius*), and ornamental cherry (*Prunus* spp.). A long-term ecological restoration plan should be prepared for Ohaaki Steamfield East, then implemented in a timely manner. Restoration plans that have been prepared for Rotokawa (Wildland Consultants 2023b) and Ohaaki Steamfield West (Wildland Consultants 2021) should continue to be implemented.

Pest plants are relatively uncommon at Hipaua and within most of the Tokaanu and Tokaanu Lake Shore Wetland sites. A field survey is required to update information on the condition and management requirements at Hipaua. If pampas is confirmed to be present at Hipaua, it should be controlled. Willows (crack willow, *Salix fragilis*; and grey willow, *Salix cinerea*) should be controlled where they are present on the site margins at Tokaanu and Tokaanu Lake Shore Wetland. Considerable improvements can be made by undertaking willow control, as has been undertaken in the northern part of Waikite Valley since 2012. The aim for Hipaua, Tokaanu, and Tokaanu Lake Shore Wetland should be to keep these sites as “weed free” as possible.

At Golden Springs, Tokaanu, Waikite Valley, and Waipahihi Valley there are amenity plantings of exotic species that have naturalised (such as ivy, *Hedera helix*; and arrow bamboo, *Pseudosasa japonica*). These species should be removed as they are smothering geothermal vegetation and habitats present on steamy streamside margins (or have the potential to do so). A plan for management of pest plant issues should be prepared for Golden Springs, Waipahihi Valley, and Waikite Valley (part of this site is already under management by the Department of Conservation), that will also ensure that the populations of nationally Threatened and/or At Risk indigenous ferns present¹ are maintained and enhanced, and are protected during pest plant control works². The plans should be implemented in a timely manner. At Waikite Valley, urgent control of ivy and *Cyperus alternifolius* subsp. *flabelliformis* is needed downstream of Te Manaroa Spring.

Ngarotopounamu (part of the Ngarotopounamu/Red Crater site) contains a pest plant of concern - bulbous rush (*Juncus bulbosus*). This species may be displacing indigenous species within the lake and in the gully immediately above the lake. The Department of Conservation undertook an eradication programme, following a survey in 2018 (Wildland Consultants 2018). The effectiveness of this control effort should be assessed, and further control undertaken, if required, to ensure that bulbous rush is eradicated.

High Priorities

Eleven sites have been identified as a high priority for pest plant control. Although considerable wilding exotic conifer control work has already been undertaken, further control of wilding conifers is required at Craters of the Moon, East Taupō, Maunga Kākarama (Rainbow Mountain), Orākei Kōrako and Red Hills, Otumuheke, Te Kiri o

¹ Indigenous ferns present at each of these three sites include, Golden Springs: *Christella* aff. *dentata* (“thermal”) (Threatened-Nationally Endangered, as per de Lange *et al.* 2021); Waikite Valley: *Nephrolepis flexuosa*, At Risk-Naturally Uncommon; Waipahihi Valley: *Cyclosorus interruptus*, At Risk-Declining).

² Weed control methods need to avoid or minimise risk to geothermal vegetation. For example, removal of pest plants may make geothermal ferns more susceptible to damage during frosts if the canopy providing shelter is removed. Pest plant control can also pose a risk to Threatened and At-Risk fern species that occur alongside stream margins by making stream banks more vulnerable to erosion.

Hinekai, and Te Rautehuia-Wairākei. Control (initial) of wilding exotic conifers should also be undertaken at Akatarewa Stream and Maungaongaonga.

A management plan to address pest plant issues needs to be prepared for the Te Rautehuia-Wairākei site, in its entirety. In the Upper Wairakei Stream (Geyser Valley) part of the site, there are large infestations of grape (*Vitis vinifera*), Tasmanian blackwood (*Acacia melanoxylon*), and Chinese privet (*Ligustrum sinense*) that require management. Careful management is also needed to prevent areas that are retired from grazing from becoming dominated by pest plants particularly blackberry, and to ensure that the indigenous vegetation present can be maintained in good condition in areas where there are declines in geothermal activity.

A plan for pest plant control (grey willow and blackberry) should be prepared and implemented at Waihunuhunu. This site in Orākei Kōrako Geothermal System contains extensive geothermal wetland habitat, is of National significance, and has high potential for ecological restoration.

Whangapoa Springs is a small site in Ātiāmuri Geothermal System but is of high priority for pest plant control due to it being a Scientific Reserve. The condition of vegetation surrounding the two larger pools in the eastern part of the site has greatly improved as a result of pest plant control and restoration planting since 2003. Control of pest plants (particularly blackberry and broom) and restoration planting could be undertaken around the two areas in the western part of the site. Regular maintenance should be undertaken throughout the site, particularly on the margins.

An important priority for geothermal wetlands is to monitor for, and promptly control any royal fern (*Osmunda regalis*) that establishes. Royal fern has been recorded at two geothermal sites in the Waikato Region: Orākei Kōrako and Red Hills (two plants were found and removed in March 2009; no royal fern was observed at this site in November 2022) and Waikite Valley (a small population recorded in northern wetland in November 2022, then subsequently controlled by the Department of Conservation). Royal fern can form large, dense colonies that can displace small-stature indigenous wetland plants and expand to displace virtually all other species in the understory. This fern can invade a range of wetland types and can also grow under a canopy of willows and/or mānuka (*Leptospermum scoparium* agg.). The large fronds of royal fern can grow up to three metres long and 75 cm wide. Once established at a site, royal fern can spread easily from spores and root fragmentation. It is most effective to control royal fern while infestations are small.

Medium Priorities

Six sites have been identified as a medium priority for pest plant control.

A small population of Asiatic knotweed (*Reynoutria japonica*) was recorded at Lower sections: Te Kiri o Hinekai Stream and Wairākei Stream. This infestation may have been present for some time, but should be prioritised for control as Asiatic knotweed is listed in the Eradication programme of the Waikato Regional Pest Management Plan (Waikato Regional Council 2022).

Further control of pest plants (including wilding pines and blackberry) should be undertaken at these three sites: Lower sections: Te Kiri o Hinekai Stream and Wairākei Stream; Hall of Fame Stream; and Waipapa Stream. Careful management is needed at these sites to ensure that the populations of nationally Threatened and/or At-Risk indigenous ferns present¹ are protected during pest plant control works.

A brief restoration plan should be prepared for Murphy's Springs to guide the management of weeds (particularly wilding pines and blackberry) and enhance indigenous vegetation within the steamy habitats around the geothermal springs and the stream.

Although information about the Maunganamu site in Tokaanu-Waihi-Hipaua Geothermal System is dated, the main management priorities for this site are controlling crack willows within the geothermal wetland and excluding domestic animals from any areas where they still have access to the wetland (see Section 3.3).

Much of the Waikato River Springs/Mangamingi Stream site is dominated by exotic pest plants (including grey willow, wilding pines, and Chinese privet). It would be worthwhile preparing a management plan for this site. Access to undertake pest plant control may be challenging due to the water levels present and control of some species (such as reed sweetgrass, *Glyceria maxima*; and Mexican water lily, *Nymphaea mexicana*) may be of limited benefit unless other infestations of these species are also controlled further upstream on the Waikato River margins.

Lower Priorities

Twelve sites have been identified as a lower priority for pest plant control. Apart from Longview Road (part Regional significance), these are sites of Local significance.

Longview Road (Reporoa Geothermal System) has a relatively low pest plant cover compared with most mānuka and mingimingi-dominant geothermal sites in the Waikato Region. Maintenance of fencing is a higher priority than pest plant control at this site (see Section 3.3).

At the remaining sites in this priority category, there is a wide range of pest plants that threaten the ecological character and condition. These sites are often small and/or fragmented so pest plant control will be an ongoing priority on the site margins. Indigenous restoration plantings could be undertaken on the margins of some of these sites (as has been undertaken at Tirohanga Road since 2011) to create a buffer around the site that could help to reduce the ongoing rate of pest plant reinvasion and reduce the potential for damage from adjoining land uses.

No Priorities

Four sites have been identified as having no priority for pest plant control.

¹ *Christella* aff. *dentata* ("thermal") (Threatened-Nationally Endangered) is present at all three of these sites. *Hypolepis dicksonioides* (At Risk-Naturally Uncommon) is present at Lower Sections: Te Kiri o Hinekai Stream and Wairākei Stream.

Three of these sites are in Tongariro Geothermal System. While no pest plants are currently known from these sites, regular monitoring should be undertaken to ensure that any threats that arise can be addressed in a timely manner. In particular, Ketetahi is a high priority for field survey because it has not been visited by the authors since the track was closed and information on this site is dated (>25 years old).

The Whakamaru site is very small (<0.1 hectares) and no pest plants have been recorded here. Regular monitoring should be undertaken to ensure that any threats that arise can be addressed in a timely manner.

3.2 Pest animals

Pest animals can threaten the health and viability of indigenous vegetation and habitats associated with geothermal sites. For example, possums (*Trichosurus vulpecula*), lagomorphs (European rabbit, *Oryctolagus cuniculus*; brown hare, *Lepus europaeus*), and ungulates (feral deer, *Cervus* spp.; and pigs, *Sus scrofa*) can damage vegetation through browsing, disturbing plant roots, or trampling on foliage. In addition, rats (*Rattus* spp.), mice (*Mus musculus*), and mustelids (ferrets, *Mustela furo*; stoats, *Mustela erminea*; weasels, *Mustela nivalis vulgaris*) are significant predators and threaten populations of indigenous fauna. The impacts of Dama wallabies (*Macropus eugenii*) on fragile geothermal vegetation are likely to be high if the existing populations are allowed to increase and expand in the Waikato Region.

Pest animal management requirements for each site were assessed during the most recent field surveys which were often a single site visit. Impacts of pest animals are not always able to be identified during a single site visit, although likely impacts can be assessed based on the vegetation and landforms present. Information is often based on information provided by the landowner/manager(s) about any current pest animal control work or pest animal observations, as well as existing knowledge about pest animals that are likely to be present in or near these sites.

The priority for pest animal control at each geothermal site in the Waikato Region is listed in Table 2, with further information about the requirements for pest animal control presented in Appendix 1.

One site, Waiotapu, has been identified as an immediate priority for pest animal control because feral pigs have been causing extensive damage to the geothermal wetlands in the south and southwestern parts of the site (Orotu Wetland). Trampling damage from feral pigs, as well as signs of feral deer and possums, was evident throughout these wetlands in 2011 and 2023. Populations of Threatened and At-Risk indigenous birds (including weweia/New Zealand dabchick (Threatened-Nationally Increasing as per Robertson *et al.* 2021) utilise the wetland and pond habitats and will be threatened by introduced predators (such as mustelids and rats). These are the best quality geothermal wetlands in New Zealand and control of pigs (as well as other pest animals) should be undertaken to reduce their impacts on this site.

Table 2: Priorities for **pest animal control** at geothermal sites in the Waikato Region¹.

Immediate	High	Medium	Lower
Waiootapu	East Taupō	Akatārewa Stream	Akatārewa East ²
1 site	Hipaua	Craters of the Moon	Golden Springs
	Maunga Kākāramea (Rainbow Mountain)	Maungaongaonga	Hall of Fame Stream ¹
	Te Kiri o Hinekai	Ngarotopounamu/Red Crater	Horohoro ¹
	Te Kopia	Ohaaki Steamfield East	Ketetahi
	Tokaanu	Ohaaki Steamfield West	Longview Road
	Tokaanu Lake Shore Wetland	Orākei Kōrako and Red Hills	Lower Sections: Te Kiri o Hinekai Stream and Wairākei Stream
	7 sites	Orakonui	Matapan Road ¹
		Otumuheke	Maunganamu
		Rotokawa	Murphy's Springs ¹
		Te Maari Craters	Northern Paeroa Range ¹
		Te Rautehuia-Wairākei	Paerata Road
		Waikite Valley	Rotopaunga
		Waipahihi Valley	Tauhara South ¹
		Waipapa Stream	Taupō Shoreline ¹
		15 sites	Tirohanga Road
			Tukairangi/Karapiti Forest ¹
			Waihunuhunu
			Waikato River Springs/Mangamingi Stream
			Whakamaru ¹
			Whangairorohea ¹
			Whangapoa Springs ¹
			Wharepapa Road
			23 sites

Seven sites have been identified as a high priority for pest animal control. These include two sites (Tokaanu Lake Shore Wetland and Tokaanu) that have good quality geothermal wetlands and contain populations of Threatened and At-Risk indigenous birds (including matuku hūrepo/Australasian bittern (Threatened-Nationally Critical)) that will be threatened by introduced predators. The other five sites of high priority for pest animal control are some of the larger sites in the Waikato Region. Monitoring and management of feral ungulates (pigs and deer), and possums is required at Te Kopia, Maunga Kākāramea (Rainbow Mountain), and Te Kiri o Hinekai. Further pest animal control could be undertaken at East Taupō, in addition to continuation of the current community-led initiatives, because this is a large and regionally significant site near to Taupō township. Although there have been no recent field surveys at Hipaua, control of pest animals is likely to be a high priority to ensure that this nationally significant site remains in good condition.

Fifteen sites have been identified as a medium priority for pest animal control. These sites (listed in Table 2) all have very high ecological values that are threatened by pest animal impacts. Of particular note, monitoring and control (as required) of feral pigs should be undertaken at Craters of the Moon, Orākei Kōrako and Red Hills, Orakonui, Rotokawa, Te Rautehuia-Wairākei, and Waikite Valley. At all 15 of these sites, pest animal control should be encouraged to be undertaken (and existing work continued) for the wide range of pest animals that will be present.

¹ Descriptions of the threat to each of these sites and the control that is required are summarised in Appendix 1.

² Very small site, less than one hectare.

The remaining 23 sites have been identified as a lower priority for pest animal control. A range of pest animals will be present and pest animal control should be encouraged (and ongoing existing control work continued) as part of the management of the wider landscape. Twelve of these sites are very small (such as Matapan Road and Tauhara South) so management of pest animals at a site level will be of limited benefit due to high rates of reinvasion from the surrounding landscape. Any areas that are currently grazed by domestic animals are not considered a priority for pest animal management until fencing of geothermal habitat to exclude stock has been undertaken.

3.3 Exclusion of domestic animals

Where domestic animals (e.g. farmed cattle, sheep, deer) have access to geothermal vegetation they are a major threat to its viability, and stock-proof fencing is a high priority. Livestock cause damage to vegetation by grazing, trampling and pugging of the ground surface and opening up sites for weed invasion. Stock can also cause considerable damage to sites by congregating in the warm areas during cold weather.

Considerable areas of geothermal vegetation have been fenced by farmers in the last 20 years. Most of the geothermal sites within farmland are currently fenced to exclude domestic animals, although there are sites where parts remain unfenced. At most sites, the existing fencing was in a good condition when inspected in 2022/2023. Where existing fencing is in a poor condition, maintenance is recommended, e.g. the eastern edge of the Orākei Kōrako and Red Hills site.

The priority for work to exclude domestic animals from 22 geothermal sites in the Waikato Region is listed in Table 3. Further information about each site and the requirements is presented in Appendix 1. At the remaining 24 sites, fencing is not currently required to protect the ecological values, given the current surrounding land use (e.g. forestry, industrial or tourism facilities, and conservation land).

No sites have been identified as an immediate priority for work to exclude domestic animals.

Three sites have been identified as a high priority: East Taupō, Te Rautehuia-Wairākei, and Waiotapu. Fencing should be established around the remaining unfenced areas at these sites to exclude stock. Following the establishment of fences around geothermal areas that have previously been accessed by stock, pest plants such as blackberry and pampas will often establish rapidly on the disturbed margins. It is therefore important that a plan for managing pest plants on the margins of geothermal sites is prepared and implemented following fencing.

Seven sites have been identified as a medium priority and a further seven sites have been identified as a lower priority for work to exclude domestic animals. Some of these sites have parts that require fencing. The sites of lower priority are generally relatively small sites.

Five sites that are within farmland (at least in part) have been identified as having no priority for work to exclude domestic animals. Regular maintenance of fences will be required at these sites.

All sites (particularly areas where the site adjoins farmland) should be inspected on a regular basis to ensure fences are maintained to a good condition and stock are excluded from geothermal vegetation and habitats.

Table 3: Priorities for fencing (or maintenance of fences) to exclude **domestic animals** at geothermal sites in the Waikato Region¹.

High	Medium	Lower	No Priority
East Taupō	Longview Road	Matapan Road	Golden Springs
Te Rautehuia-Wairākei	Maunganamu	Murphy's Springs	Horohoro
Waiotapu	Orākei Kōrako and Red Hills	Northern Paeroa Range	Maunga Kākaramea (Rainbow Mountain)
3 sites	Rotokawa	Ohaaki Steamfield East	Waikato River Springs/ Mangamingi Stream
	Te Kopia	Paerata Road	Whangapoa Springs
	Waikite Valley	Tauhara South	5 sites
	Wharepapa Road	Tirohanga Road	
	7 sites	7 sites	

3.4 Other threats to geothermal sites

There are additional threats to geothermal sites other than those listed above. A full description of known threats to geothermal sites in the Waikato Region is summarised in Section 11 of Wildland Consultants (2023a). These include:

- Use of geothermal fields for energy production;
- Tourism and recreation where it is not managed well;
- Dumping of rubbish;
- Management of neighbouring plantation forests and shelterbelts;
- Herbicide drift;
- Fire;
- Genetic pollution;
- Wetland infilling and drainage;
- Industrial/residential/roading development.

A list of the sites where other such threats have been identified in Wildland Consultants (2023a) is presented in Table 4, along with identification of priorities for management action. Further description is provided in Appendix 1.

¹ These 22 sites are within or adjoining farmland. The remaining 24 sites are not listed in Table 3 because they do not currently require fencing to protect the ecological values, due to the current surrounding land use (e.g. forestry, industrial or tourism facilitates and conservation land). Descriptions of each of the sites and the fencing work that is required are summarised in Appendix 1.

Table 4: Geothermal sites in the Waikato Region where **other** threats and priorities for management action have been identified¹.

Damage from Adjoining Plantation Forestry	Bathing	Tourism and/or Recreation ²	Fire	Clearance for Industry or Rooding	Dumping of Rubbish	Use for Energy Production
Priority: High	Priority: High	Priority: Immediate	Priority: Medium	Priority: Medium	Priority: Medium	Priority: Medium
Orakonui	Waipahihi Valley	Golden Springs	East Taupō	East Taupō	East Taupō	Craters of the Moon
Priority: Medium	Priority: Medium	Priority: Medium		Priority: Lower	Waikite Valley	East Taupō
Akatarawa Stream	Waihunuhunu	Craters of the Moon East Taupō		Lower Sections: Te Kiri o Hinekai Stream and Wairākei Stream	Priority: Lower	Ohaaki Steamfield East
Craters of the Moon	Priority: Lower	Maunga Kākaramea (Rainbow Mountain)		Maunganamu	Paerata Road	Ohaaki Steamfield West
Murphy's Springs	Tokaanu	Maungaongaonga		Tauhara South	Waiotapu	Orakonui
Rotokawa	Waikite Valley	Ngarotopounamu/Red Crater		Tukairangi/Karapiti Forest	Wharepapa Road	Otumuheke
Te Kopia	Wharepapa Road	Orākei Kōrako and Red Hills		Waiotapu		Rotokawa
Te Rautehuia-Wairākei	No Priority	Otumuheke				Te Kiri o Hinekai
Waiotapu	Akatarawa Stream	Te Kopia				Te Rautehuia-Wairākei
Waipapa Stream	Horohoro	Te Rautehuia-Wairākei				Waipahihi Valley
Priority: Lower	Whangairorohea	Tokaanu				Waipapa Stream
Akatarawa East		Waiotapu				Priority: Lower
Paerata Road		Priority: Lower				Tirohanga Road
Tukairangi/Karapiti Forest		Taupō Shoreline				Tukairangi/Karapiti Forest
Whangairorohea		No Priority				
		Akatarawa Stream				
		Hall of Fame Stream				
		Hipaua				
		Ketetahi				
		Rotopaunga				
		Te Maari Craters				
		Whakamaru				

¹ Often these threats are already under a form of management at the identified sites. Descriptions of each of the sites and the other threats present is summarised in Appendix 1. Not all sites are listed for each of these “other threats” - sites are only mentioned when the relevant threat was addressed on the site information sheet in Wildland Consultants (2023a).

² In some cases, this includes bathing.

4. SUMMARY

Information about each of the 46 geothermal sites assessed in this study is summarised in Appendix 1. The threat mechanisms operating at each site, their vulnerability to those threats, the actions required to address them, and the benefits and priority of ecological management are identified. The numbers of sites which were identified as having immediate, high, medium, or lower priority for management for each factor (pest plants, pest animals, domestic animals) are presented in Table 5.

Pest plant control was identified as an immediate priority at 13 sites and a high priority at 11 sites. Pest animal management was identified as an immediate priority at one site and as a high priority at seven sites, whilst work to exclude domestic animals is of high priority at three sites. At the single site with an immediate priority for pest animal control (Waio tapu), pest plant control is also ranked as an immediate priority.

Table 5: Number of geothermal sites in the Waikato Region where pest animal control, pest plant control, or exclusion of domestic animals is of immediate, high, medium, or lower priority.

	Immediate	High	Medium	Lower	No Priority
Pest plant management	13	11	6	12	4
Pest animal management	1	7	15	23	0
Exclusion of domestic animals ¹	0	3	7	7	5

Other threats to the geothermal sites were also identified and priorities assessed. Generally, these threats are already under ongoing management at the relevant sites.

Implementation of management at sites where priorities are immediate or high should be instigated as soon as is practicable. Holistic management of sites should also be considered. For example, if management of one factor, e.g. pest plants, pest animals, or fencing, is to be undertaken at a particular site because it has been identified as of immediate or high priority, then it may be cost-effective to undertake other management actions at that site at the same time.

ACKNOWLEDGMENTS

This project was undertaken for Waikato Regional Council (WRC). Katherine Luketina (WRC) instigated the project and provided project liaison and support.

¹ At the remaining 24 sites fencing is not currently required to protect the ecological values, given the current surrounding land use (e.g. forestry, industrial or tourism facilities, and conservation land).

REFERENCES

- de Lange P.J., Rolfe J.R., Barkla J.W., Courtney S.P., Champion P.D., Perrie L.R., Beadel S.M., Ford K.A., Breitwiser I., Schönberger I., Hindmarsh-Walls R., Heenan P.B., and Ladley K. 2018: Conservation status of New Zealand indigenous vascular plants, 2017. *New Zealand Threat Classification Series 22*. Department of Conservation, Wellington. 82 pp.
- Given D.R. 1995: Geothermal vegetation – an assessment of botanical values of selected geothermal sites in the Taupō Volcanic Zone. David Given and Associates, Christchurch.
- Robertson H.A., Baird K.A., Elliott G.P., Hitchmough R.A., McArthur N.J., Makan T., Miskelly C.M., O'Donnell C.J., Sagar P.M., Scofield R.P., Taylor G.A., and Michel P. 2021: Conservation status of birds in Aotearoa New Zealand, 2021. *New Zealand Threat Classification Series 36*. Department of Conservation, Wellington. 43 pp.
- Waikato Regional Council 2022: Waikato Regional Pest Management Plan 2022-2032. *Policy Series 2022/04*. Waikato Regional Council, Hamilton. 203 pp.
- Wildland Consultants 2006: Priorities for pest plant and animal control, and fencing at geothermal sites in the Waikato Region. *Wildland Consultants Ltd Contract Report No. 1291a*. Prepared for Environment Waikato. 23 pp.
- Wildland Consultants 2011: Priorities for pest plant control, pest animal control, and fencing at geothermal sites in the Waikato Region in 2011. *Wildland Consultants Ltd Contract Report No. 2755*. Prepared for Environment Waikato. 27 pp.
- Wildland Consultants 2014: Priorities for pest plant control, pest animal control, and fencing at geothermal sites in the Waikato Region - 2014 update. *Wildland Consultants Ltd Contract Report No. 2755a*. Prepared for Waikato Regional Council. 31 pp.
- Wildland Consultants 2018: Preliminary evaluation of an eradication strategy for bulbous rush in the lower Emerald Lake, Tongariro National Park. *Wildland Consultants Ltd Contract Report No. 4236b*. Prepared for Department of Conservation and Ngāti Tūwharetoa. 13 pp.
- Wildland Consultants 2021: Biodiversity management plan for Ohaaki, Waikato. *Wildland Consultants Ltd Contract Report No. 5650*. Prepared for Contact Energy and Ngāti Tahu Tribal Lands Trust. 48 pp.
- Wildland Consultants 2023a: Geothermal vegetation of the Waikato Region, 2023. *Wildland Consultants Ltd Contract Report No. 3330d*. Prepared for Waikato Regional Council. 591 pp.
- Wildland Consultants 2023b: Restoration plan for Tauhara North whenua at Rotokawa, Taupō. *Wildland Consultants Ltd Contract Report No. 6693*. Prepared for Tauhara North No. 2 Trust. 53 pp.

**THREATS TO GEOTHERMAL
SITES IN WAIKATO REGION - 2023**

A definition of each information field in the table is provided in Appendix 2 of this report.

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
Akatarewa East	Orākei Kōrako (Orākei Kōrako)	0.1	0.1	Local	Contains a small example of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - heated ground (dry) and hydrothermally altered ground (now cool)).	Pest plants	High	Plantation radiata pine forest is present on the margins and wilding pines are present within the site. Blackberry is also present.	Pest plant control, particularly of wilding pines.	Medium	Lower	Ecological: Following the removal of stock from the surrounding land, geothermal vegetation has increased in height and cover. The area of geothermally influenced bare ground has also reduced, as vegetation has established on previously grazed parts of the site. Management: Since 2011, the area surrounding this site has changed from farmland to plantation pine forest. Stock no longer have access to site as a result of this land use change. However, the geothermal areas are now negatively impacted from shading by tall plantation trees. Comments: None.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Other - adjoining forestry	Medium	Potential for damage to site during management of plantation radiata pine forest, including during harvest and spraying.	Create a larger setback buffer from geothermal areas. Inform the forestry company of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Medium	Lower	
Akatarewa Stream	Orākei Kōrako (Orākei Kōrako)	2.1	1.8	National	Contains an important population of a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")) and one of the largest populations of this taxon in Aotearoa New Zealand. Contains nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal streamsides and geothermal wetland).	Pest plants	Medium	Pest plants are common, particularly wilding conifers, blackberry, and pampas.	Pest plant control, particularly of wilding pines and patches of dense blackberry scrub. Restoration planting of stream margins.	Medium	High	Ecological: No obvious change since 2007. Management: None recorded. Comments: None.
						Pest animals	Medium	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Medium	Medium	
						Other - tourism and/or recreation	Lower	A campground, walking tracks, several bridges, and culverts are present.	None. Continue appropriate management.	N/A	N/A	
						Other - bathing	No threat	Natural pools in the stream are used for bathing.	None.	N/A	N/A	
						Other - adjoining forestry	High	Potential for damage to site during management of plantation radiata pine forest, including during harvest and spraying.	Create a larger setback buffer from geothermal steamy habitat alongside stream margins. Inform the forestry company of the location of the site so that any effects on the site and any damage to the <i>Christella</i> aff. <i>dentata</i> ("thermal") population can be avoided, especially during harvest or spraying.	Medium	Medium	
Craters of the Moon	Wairākei-Tauhara (Wairākei)	36.4	36.4	National	Contains a good quality representative example of nationally uncommon habitat - geothermal (five naturally uncommon ecosystem types - heated ground (dry), fumaroles, geothermal streamsides, geothermal wetland, and hydrothermally altered ground (now cool)). Contains one of the best examples of geothermal vegetation zonation in New Zealand, which has developed in response to varying soil temperatures, and is an area of high geothermal activity. Four plant species that are classified as Threatened or At Risk are present.	Pest plants	High	Wilding pines and eucalyptus are scattered through the site. Other pest plants present include pampas, blackberry, Chinese privet, and cotoneaster. The cover of pest plants is higher in the small area to the north. Some areas of indigenous vegetation (e.g. <i>Cheilanthes sieberi</i> fernland) have been adversely affected by herbicide spraying to control pest plants.	Control of wilding pines and other pest plants needs to continue. Ensure careful and appropriate control methods are used.	High	High	Ecological: Ecological condition has improved slightly. Management: Some pest plant control work has been undertaken recently by site managers. Techniques to discourage the use of informal tracks have been implemented by the Craters of the Moon Trust. Comments: An additional area has been added to the site, based on higher quality aerial photography taken by a UAV in 2016.
						Pest animals	Lower	Feral pig sign was recorded in the northern area in 2021. Ungulates and possums may threaten fragile geothermal habitats.	Monitor and implement pest animal control as required.	Medium	Medium	
						Other - use for energy production	Lower	Associated with geothermal power stations in the Wairākei-Tauhara Geothermal System. There have been many changes in geothermal activity at this site as a result of the use of this Geothermal System for energy production.	Continue monitoring of ecological effects associated with energy production.	Lower	Medium	
						Other - tourism and/or recreation	Lower	Includes a tourism venture with a formed walking track through the geothermal site.	Continue to encourage appropriate management and use of formed tracks.	Lower	Medium	
						Other - adjoining forestry	Medium	Potential for damage to site during management of plantation radiata pine forest, including during harvest and spraying. Harvesting of plantation forest occurred very close to the boundary of the small northern area between September 2019 and December 2020. There may have been minor loss of geothermal vegetation and habitat during this harvest.	Establish a setback buffer between the plantation forest and geothermal site. Inform the forestry company of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Medium	Medium	
East Taupō	Wairākei-Tauhara (Tauhara)	56.8	56.8	Part: Regional, Part: Local	R: Most of this site is of regional significance because it comprises a relatively large example of geothermal habitat (including four naturally uncommon ecosystem types - heated ground (dry), hydrothermally altered	Pest plants	High	Pest plants remain a considerable issue in most parts of the site, in particular wilding conifers, blackberry, and broom.	Crown Road part: A restoration plan should be developed and implemented. Broom, blackberry, and wilding pines should be controlled. Broadlands Road part: Wilding pines and other pest plants	High	High	Ecological: Crown Road part: The extent and cover of geothermal vegetation has increased slightly in parts of the site where fencing to exclude stock was established in 2014. Geothermal kānuka shrubland has recovered since a fire in 2002. Broadlands Road part:

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
					ground (now cool), geothermal streamsides, and fumaroles). It contains a large area of vegetation dominated by geothermal k�nuka (Threatened-Nationally Endangered). L: Remaining areas are locally significant because they contain small lower quality and isolated areas of geothermal vegetation and habitat amongst farmland and other developed land, including heated ground (dry), a naturally uncommon habitat type.				(e.g. strawberry tree, silver birch, and grey willow) should continue to be controlled. Crown Park part: Ongoing monitoring and control of pest plants should be undertaken, including wilding pines, banksia, strawberry tree, male fern, broom, and silver birch.			Geothermal vegetation is recovering following a large fire in 2015. Crown Park part: The height and cover of geothermal k�nuka has increased, while the extent of geothermally influenced bare ground has decreased. Vegetation has recovered following a fire between 2012 and 2013. Management: Crown Road part: Pest plant control has been undertaken alongside SH1 by Waikato Regional Council since 2014. Small loss of site due to industrial development since 2014. Broadlands Road part: Small loss of site due to industrial development since 2014. There was a large fire in 2015. Some pest plant control has been undertaken by the Department of Conservation. Crown Park part: Some restoration planting (on non-geothermal margins) and pest plant control has been undertaken. There appears to have been a decrease in geothermal activity. Comments: None.
						Pest animals	Medium	Feral cats, rabbits, and brown hares were observed at this site in 2020. Possums may also damage fragile geothermal vegetation. Some pest animal control is undertaken by a community group at the Crown Park and Broadlands Road parts of the site.	Further pest animal could be undertaken, particularly as this is a large site near to Taup� township.	Medium	High	
						Domestic animals	Medium	Areas in the Crown Road and Broadlands Road parts of the site are not fenced to exclude stock and are farmed.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Regular maintenance of fences.	High	High	
						Other - use for energy production	Lower	Associated with geothermal power stations in the Wair�kei-Tauhara Geothermal System.	Continue monitoring of ecological effects associated with energy production.	Lower	Medium	
						Other - tourism and/or recreation	Medium	There are informal walking tracks within part of Crown Road part of the site. There are both formal and informal walking tracks within Crown Park part of the site.	Continue to encourage appropriate management and use of formed tracks.	Medium	Medium	
						Other - fire	Medium	There was a large fire in the Broadlands Road part of the site in 2015, vegetation is now recovering well. There was also a fire in the Crown Park part previously.	Discourage smoking by any visitors at geothermal sites. Following any fires, pest plant control is generally required to support the recovery of appropriate indigenous vegetation.	High	Medium	
						Other - dumping of rubbish	Lower	Rubbish is occasionally present in the Crown Road and Crown Park parts of the site.	Remove dumped rubbish and discourage further dumping.	Lower	Medium	
						Other - clearance for industry or roading	Lower	There has been a small loss of extent in the Crown Road and Broadlands Road parts of the site due to industrial development since 2014. Other losses have occurred previously in all parts of the site.	Continue to inform landowners/managers of the geothermal site and encourage protection of the site.	Medium	Medium	
Golden Springs	Reporoa (Reporoa)	0.9	0.8	Regional	Contains important habitat for a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")) and an example of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal streamsides and geothermal wetland).	Pest plants	High	Pest plants are common, including aesthetic plantings within the camping ground. Without management, some pest plants such as bamboo, will potentially smother steamy habitats on streamside margins.	Western part: A plan for management should be prepared to reduce pest plant issues. Eastern part: Management plan should be prepared for the camping ground.	High	Immediate	Ecological: Extent and abundance of pest plants has increased. Management: None recorded. Comments: This site has high potential for ecological restoration. The priorities of pest plant control and the management plan for this site should be to maintain and enhance the population of <i>Christella</i> aff. <i>dentata</i> ("thermal").
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	No threat	Parts within farmland on western side of SH5 have well maintained fences that exclude stock.	Regular maintenance of fences.	N/A	N/A	
						Other - tourism and/or recreation	High	Part on eastern side of road is within a camping ground and is affected by recreational activities and aesthetic plantings.	Guidelines for the manager(s) of the camping ground that will enable them to maintain and enhance the ecological condition of the site.	High	Immediate	
Hall of Fame Stream	Wair�kei-Tauhara (Tauhara)	0.3	0.2	Regional	Contains a small population of a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")) and an example of nationally uncommon habitat - geothermal (one naturally uncommon ecosystem type - geothermal streamsides).	Pest plants	Medium	Most of the site is dominated by blackberry and wilding radiata pines.	Pest plant control, particularly of wilding pines and blackberry. Ensure that the population of <i>Christella</i> aff. <i>dentata</i> ("thermal") is not threatened by any pest plant control work undertaken.	Medium	Medium	Ecological: Little change. Management: Some control of wilding pines has been undertaken. Comments: None.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage the continuation of community-led ecological restoration work, including pest animal control near this site.	Lower	Lower	
						Other - tourism and/or recreation	No threat	A track is present within the gully. Maintenance has not adversely affected the site.	Continue to encourage appropriate management and use of tracks.	N/A	N/A	
Hipaua	Tokaanu-Waihi-Hipaua (Hipaua)	12.7	12.7	National	Likely to be of national significance because it is a relatively large area of a nationally uncommon habitat type -	Pest plants	Medium	Some pampas appears to be present, based on aerial photographs.	If pampas is present, then it should be controlled.	High	Immediate	Ecological: None recorded. Management: None recorded.

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
					geothermal (two naturally uncommon ecosystem types - heated ground (dry) and fumaroles). Comprises important habitat for a Threatened plant species (geothermal kānuka) near the southern end of its geographical range. Vegetation types present are representative of the ecological character of the Waikato Region. The vegetation is highly intact, displaying good zonation and high indigenous component (Given 1995), and it is well buffered. The site is part of an extensive natural area and ecological sequence which includes a wide range of habitat types (geothermal, forest, wetland, subalpine) extending from the shores of Lake Taupō to the summit of Maunga Kākaramēa, Tihia, and Pihanga and including Lake Rotopounamu and Lake Rotoaira.	Pest animals	Medium	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	High	High	Comments: High priority for field survey. Has not been field surveyed by the authors. Information on the condition and management requirements is now very old.
						Other - tourism and/or recreation	No threat	The site is virtually unaltered by human interference.	The current low levels of human impact should be maintained and the site should be monitored regularly to ensure that it remains in good condition.	N/A	N/A	
Horohoro	Horohoro (Horohoro)	0.1	0.1	Local	Contains a small example of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal wetland and geothermal streamsides).	Pest plants	Medium	Pest plants, particularly blackberry, Spanish heath, radiata pine, montbretia, and grey willow threaten to change the character of the site and outcompete indigenous vegetation.	Pest plant control, particularly of grey willow and pines which are currently in low abundance. Blackberry and Spanish heath on the pool margins could be controlled and these areas could be restored with indigenous plant species.	Medium	Lower	Ecological: Large increase in pest plant abundance. Wetland has improved in quality. Management: Both areas have been fenced and stock has been excluded. Comments: None.
						Pest animals	Lower	Although a range of pest animals will be present, they are not considered to be a notable threat to this small site.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Lower	Since 2014 both areas have been fenced and stock have been excluded. However, fencing maintenance is required for the gully surrounding the southwestern pool.	Regular maintenance of fences.	N/A	N/A	
						Other - Bathing	No threat	The northeastern larger pool has bathing facilities at its eastern end. Users do not appear to impact the geothermal features.	No action required.	N/A	N/A	
Ketetahi	Tongariro (Tongariro)	8.5	8.5	International	Based on historic information, the site is an excellent example of a nationally uncommon habitat -geothermal (five naturally uncommon ecosystem types - heated ground (dry), fumaroles, geothermal streamsides, acid rain systems, and hydrothermally altered ground (now cool)). Part of an extensive natural area and ecological sequence which includes a wide range of habitat types (geothermal, forest, wetland, subalpine) extending from the shores of Lake Taupō to the summit of Kākaramēa, Tihia, and Pihanga and including Lake Rotopounamu and Lake Rotoaira. Although not legally protected, the site is fully surrounded by a UNESCO World Heritage Site and Tongariro National Park. The hot springs are of considerable importance to Ngāti Tūwharetoa.	Pest plants	No threat	No significant pest plants are known to occur at this site.	No pest plant control actions are required. Regular monitoring is recommended.	N/A	N/A	Ecological: Not assessed. Management: Not assessed. Comments: High priority for field survey. Has not been field surveyed by the authors and information on this site is dated (>25 years old).
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Other - tourism and/or recreation	No threat	About 25 years ago, a walking track passed through this site and it was a popular bathing spot. Public access is now restricted, the walking track has been relocated, and the site is now rarely visited by people.	No action required.	N/A	N/A	
Longview Road	Reporoa (Reporoa)	6.3	6.0	Part: Regional, Part: Local	Most of the site is protected by a Conservation Covenant. Contains examples of nationally uncommon habitat - geothermal (three naturally uncommon ecosystem types - heated ground (dry), hydrothermally altered ground (now cool), and geothermal streamsides). The best example of geothermal vegetation in the Reporoa Geothermal System.	Pest plants	Lower	Blackberry is common in the narrow mānuka shrubland alongside drains outside of the covenanted part. Few weeds are present within the covenanted part.	Pest plant control, particularly of blackberry.	Lower	Lower	Ecological: No obvious change. Management: Quality of fences has declined. Comments: Covenanted part of the site is in good condition. Drains are likely to have lowered water tables within this site.
						Pest animals	Lower	Possum sign has been recorded.	Possum control is recommended. Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Medium	The covenanted areas are fenced to exclude stock, but the fences are in poor condition. The margins of the geothermal creeks and drains in neighbouring farmland are unfenced.	Fence maintenance. The margins of the geothermal creeks and drains in neighbouring farmland require fencing to exclude stock.	High	Medium	
Lower Sections: Te Kiri o Hinekai	Wairākei-Tauhara (Wairākei)	3.0	2.6	Regional	Contains a moderate-sized population of a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")) and an At Risk	Pest plants	Medium	Pest plants are common, particularly on margins. Key pest plants that should be controlled include	Pest plant control, with a management plan that considers the populations of Threatened and	Medium	Medium	Ecological: Pest plants have increased in abundance over time. The populations of ferns at Lower Wairākei Stream have declined over time

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
Stream and Wairākei Stream					plant species (<i>Hypolepis dicksonioides</i>). It also contains an isolated population of <i>Anogramma leptophylla</i> (Threatened-Nationally Vulnerable). Contains a relatively large area of a nationally uncommon habitat - geothermal (one naturally uncommon ecosystem type - geothermal streamsides).	Pest animals	Lower	pampas, wilding conifers, tradescantia, silver birch, ivy, Asiatic knotweed, and blackberry. Pest animals threaten the condition of geothermal vegetation and habitats present.	At Risk ferns. Regular monitoring of <i>Christella</i> aff. <i>dentata</i> ("thermal") and <i>Hypolepis dicksonioides</i> . Encourage control of pest animals as part of the management of the wider landscape, including continuation of the community-led ecological restoration work that is currently underway near part of this site.	Lower	Lower	(The number of <i>Christella</i> aff. <i>dentata</i> ("thermal") clumps have reduced from 47 in 2007, to six in 2014, to three in 2020), partly due to the spread of pest plants and clearance of vegetation. Management: Clearance of pest plants has recently been undertaken on the immediate margins of Lower Wairākei Stream. Contact Energy has established a restoration plan for part of this stream. Comments: Lower Te Kiri O Hinekai Stream was not surveyed prior to 2020.
						Other - clearance for industry or roading	Lower	The following infrastructure is present on-site boundaries: Wairākei Power Station, tourist facilities, recreational bathing hot pools, access tracks, roads, and mountain bike tracks.	Management of this infrastructure should consider the features of the geothermal site.	Lower	Lower	
Matapan Road	Ātiamuri (Ātiamuri)	<0.1	<0.1	Local	Contains a very small example of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal wetland and geothermal streamsides).	Pest plants	Lower	In the current condition, rank exotic grasses may compete with indigenous species on geothermal stream margins. If fenced, control of weeds such as blackberry should be undertaken until an indigenous canopy is established.	A low priority for management, but would benefit from management of pest plants, particularly if the springs are fenced.	Lower	Lower	Ecological: Not assessed, although site appears similar on 2021 aerial photographs. Management: Not assessed, although site appears similar on 2021 aerial photographs. Comments: Has not been field surveyed since 2011. If site is fenced to exclude farm animals, then management of pest plants (e.g. blackberry) should be undertaken until an indigenous canopy is established.
						Pest animals	Lower	Although a range of pest animals will be present, they are not considered to be a notable threat to this small site.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Lower	Unfenced and grazed by domestic stock.	Fencing to exclude domestic stock. Restoration planting on margins. Regular maintenance of fences.	Lower	Lower	
Maunga Kākaramea (Rainbow Mountain)	Waikite-Waiotapu-Waimangu (Waiotapu)	68.0	64.4	International	Part of the largest and best quality example of geothermal vegetation in New Zealand. Contains a good quality representative example of an ecological sequence grading from geothermal vegetation to tall forest over an elevation gradient of 380-743 meters. The site has a high diversity of vegetation types related to thermal activity, subsequent cooling, and succession after periodic burning. The geothermal vegetation is a good example of the distinctive vegetation zones which progress over increasingly cool ground into indigenous scrub and forest. A range of Threatened species are present.	Pest plants	Medium	The Department of Conservation undertakes a pest plant control programme in geothermal areas in this reserve with a particular focus on wilding conifers. The cover of wilding pines in geothermal areas is currently very low (<1%). Pampas is present in some geothermal areas. Willows are present on stream margins and wetlands.	Further ongoing pest plant control.	High	High	Ecological: Condition of geothermal vegetation has improved markedly. Management: Ongoing control of wilding conifers has been undertaken by the Department of Conservation. Comments: Additional areas have been added to the site since 2014, based on better quality aerial photographs.
						Pest animals	Medium	Pest animals threaten the condition of geothermal vegetation and habitats present. The Department of Conservation will be undertaking some pest animal control in geothermal areas within this Scenic Reserve. Dama wallabies may be a threat to geothermal vegetation if they establish at this site.	Continue to undertake pest animal control, as required.	High	High	
						Domestic animals	No threat	A small part of the site had stock access in 2010, but has since been fenced to exclude stock.	Regular maintenance of fences.	N/A	N/A	
						Other - tourism and/or recreation	Lower	There are public access tracks to some of the geothermal areas, and these tracks appear to be well maintained and adhered to.	Continue to encourage appropriate maintenance and use of tracks.	Lower	Medium	
Maunganamu	Tokaanu-Waihi-Hipaua (Tokaanu)	2.1	2.1	Part: Regional, Part: Local	Maunganamu West and Maunganamu North Wetland parts of the site are of regional significance because they are partly protected and managed by the Department of Conservation, and form part of an extensive ecological sequence that extends from the shores of Lake Taupō to the summit of Kākaramea, Tihia, and Pihanga, and which includes Lake Rotopounamu and Lake Rotoaira. This ecological sequence includes extensive areas of geothermal habitat. Maunganamu East and Tokaanu Tailrace Canal parts of the site are locally significant as they are very small examples of geothermal wetland (nationally uncommon habitat).	Pest plants	Medium	In 2007, pest plants were present on some of the wetland margins, including crack willow, Japanese honeysuckle, and blackberry.	Pest plant control, particularly of crack willows.	Medium	Medium	Ecological: Not assessed. Management: Not assessed. Comments: Has not been field surveyed since 2007. Information on this site is dated.
						Pest animals	Medium	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Medium	Fences were poorly maintained in some areas in 2007, however because the site is surrounded by dense blackberry, stock access is probably minimal.	Fencing to exclude domestic stock. Fence maintenance.	Medium	Medium	
						Other - clearance for industry or roading	No threat	The two eastern areas are located by an artificial canal that is used for hydro-electricity. The western wetland has a road within 10 metres of it.	Management of this infrastructure should consider the features of the geothermal site.	Lower	Lower	
Maungaongaonga	Waikite-Waiotapu-Waimangu (Waiotapu)	9.2	9.1	National	Comprises a very high quality example of geothermal vegetation and habitat - nationally uncommon habitat (three naturally uncommon ecosystem types (fumaroles, hydrothermally altered ground (now cool) and heated ground (dry)). Part of an indigenous ecological	Pest plants	Lower	Pest plants are present at low abundance, including blackberry, wilding pines, Spanish heath and gorse (1% to <1% cover).	Ongoing control of pest plants, particularly wilding pines on the margins.	Medium	High	Ecological: No real change. Management: None recorded. Comments: Some changes to site boundary since 2014, based on improved quality of aerial photographs.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Medium	Medium	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
					sequence that extends from geothermal vegetation to tall forest and a stepping stone to other geothermal sites nearby. The vegetation is of good quality and is relatively unmodified and provides habitat for Threatened and At-Risk plant species. The site is protected as a Scenic Reserve.	Other - tourism and/or recreation	Lower	Vulnerable to trampling, however informal tracks are only used occasionally by local residents and hunters.	Further use and establishment of informal tracks should be discouraged.	Lower	Medium	
Murphy's Springs	Te Kopia (Te Kopia)	0.1	0.1	Part: Regional, Part: Local	Contains important habitat for a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal"). Contains a very small example of a nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal wetland and geothermal streamsides).	Pest plants	Lower	Pest plants, particularly blackberry and wilding pines, are having an impact on site margins.	A brief restoration plan should be prepared to guide the management of weeds and enhance indigenous vegetation within the steamy habitats around the geothermal springs and the stream.	Medium	Medium	Ecological: Improved ecological condition since previous field survey in 2010. Management: Since 2010: A buffer has been created between forestry and the site. The site has been fenced to exclude stock. Comments: An additional area was found during the 2023 field survey that was not identified in the previous field survey (2010).
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	No threat	Site is fenced to exclude stock or is surrounded by plantation forestry.	Regular maintenance of fences. Ensure owners of plantation forest are aware of values of geothermal features and vegetation.	Lower	Lower	
						Other - adjoining forestry	Lower	Parts of the site are surrounded by plantation forest. Potential for damage to site during management of plantation radiata pine forest, including during harvest and spraying.	Create a larger setback buffer from geothermal areas. Inform the forestry owners of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Medium	Medium	
Ngarotopounamu/ Red Crater	Tongariro (Tongariro)	12.1	11.1	International	Located within the part of Tongariro National Park that is listed as a UNESCO World Heritage Site. Part of an extensive natural area and ecological sequence which includes a wide range of habitat types (geothermal, forest, wetland, subalpine) extending from the shores of Lake Taupō to the summit of Kākarama, Tihia, and Pihanga and including Lake Rotopounamu and Lake Rotoaira.	Pest plants	High	Ngarotopounamu/Emerald Lake contains a pest plant of concern - bulbous rush. This species may be displacing indigenous species.	Assess effectiveness of previous work to control bulbous rush, and undertake further control if required.	High	Immediate	Ecological: Probably little change. Management: A management plan to control bulbous rush was prepared in 2018. The Department of Conservation subsequently undertook an eradication programme, but the effectiveness of this has not been determined. Comments: Mostly in an excellent condition.
						Pest animals	Medium	Pest animals threaten the condition of geothermal vegetation and habitats present. The Department of Conservation will be undertaking some pest animal control as part of management of the Tongariro National Park.	Continue to undertake control of pest animals as part of the management of the wider landscape.	Lower	Medium	
						Other - tourism and/or recreation	Lower	The site is impacted by trampling from tourists, particularly around the lake margins.	Continue to encourage appropriate use of tracks.	Lower	Medium	
Northern Paeroa Range	Waikite-Waiotapu-Waimangu (Waikite)	0.4	0.4	Local	Comprises several small examples of a nationally uncommon habitat - geothermal (four naturally uncommon ecosystem types - heated ground (dry), hydrothermally altered ground (now cool), fumaroles, and geothermal wetland).	Pest plants	Medium	Pest plants are common on margins, including blackberry, grey willow, and radiata pine.	Pest plant control, particularly of willows and any wilding trees. Ensure that geothermal features or vegetation is not damaged during any felling of trees that surround the site.	Medium	Lower	Ecological: There has been a marked increase in the cover of pest plants surrounding the site. Management: Site has been fenced to exclude stock between 2011 and 2023. Comments: None.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Lower	The site is fenced to exclude stock.	Regular maintenance of fences.	Lower	Lower	
Ohaaki Steamfield East	Ohaaki (Ohaaki)	5.3	5.3	Part: Regional, Part: Local	Most of the Ohaaki Steamfield East is of regional significance because it is protected by a QEII National Trust covenant. Contains nationally uncommon habitat - geothermal (four naturally uncommon ecosystem types - heated ground (dry), geothermal streamsides, fumaroles, and hydrothermally altered ground (now cool)).	Pest plants	High	Weeds are abundant, particularly blackberry, wilding pines, Spanish heath, and broom, which together cover c.50% of the site.	Pest plant control, particularly of wilding pines and pampas. Restoration planting on margins. Ideally a long-term restoration implementation plan is required.	High	Immediate	Ecological: Geothermal kānuka has established in an area that was previously geothermally-influenced bare ground, but at risk of spread of woody weed species. Blackberry has increased in dominance. The spread of wilding conifers and pampas are a particular threat. Management: Dumping of geothermal wastewater into this site has ceased. Comments: None.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Monitor and implement pest animal control as required.	Lower	Medium	
						Domestic animals	Lower	Most of the site is fenced to exclude stock, but the area of geothermally-influenced bare ground in south (Local) is within a grazed paddock.	Area within paddock could be fenced to exclude stock, but if this is undertaken the area is likely to become invaded with blackberry unless managed appropriately.	Lower	Lower	
						Other - use for energy production	Lower	Associated with the Ohaaki Geothermal Power Station. Based on general observations, no ecological effects from the power station have been observed to date.	Establish and undertake regular monitoring as part of current monitoring associated with the power station.	Lower	Medium	
Ohaaki Steamfield West	Ohaaki (Ohaaki)	15.0	13.1	Regional	Contains a relatively large area of nationally uncommon habitat - geothermal (five naturally uncommon ecosystem types - heated ground (dry), hydrothermally altered ground (now cool), fumaroles, geothermal streamsides, and geothermal wetland).	Pest plants	High	Wilding conifers are the most prominent threat, with a total cover of at least 20%, and the cover will increase further without control. Other pest plants present include silver birch, blackberry, broom, grey willow, Cotoneaster sp., and ornamental cherry. Changes to the dynamics of the geothermal	Control of pest plants, particularly wilding pines. Implementation of the restoration plan (Wildland Consultants 2021).	High	Immediate	Ecological: Vegetation change has occurred as a result of land subsidence associated with the power station. Despite ongoing wilding conifer control efforts since 2004, the abundance and threat of wilding conifers has continued to increase in many areas.

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
								manifestation, particularly cooling soils are increasing the opportunities for exotic plant species to invade geothermal vegetation at the site.				Management: Ongoing pest plant control (wilding pines and pampas) is being undertaken by Contact Energy and Waikato Regional Council.
						Pest animals	Lower	The site would benefit from pest animal control, particularly of possums and ungulates. Rabbits are also present. If Dama wallabies establish at this site in the future, they would be likely to degrade the site further.	Continue monitoring presence of pest animals during other work associated with the power station. Undertake pest animal control, if required. The network of roads and tracks provide a good basis for pest animal control at this site.	Lower	Medium	Comments: A restoration plan has been prepared for the site (Wildland Consultants 2021). Additional areas have been identified since 2014, based on improved knowledge of site.
						Other - use for energy production	Lower	Associated with the Ohaaki Geothermal Power Station. Based on monitoring to date, temperatures are cooling at this site. Vegetation has been cleared to develop roads and infrastructure associated with the power station.	Continue monitoring. Avoid clearance of areas within geothermal site.	Lower	Medium	
Orākei Kōrako and Red Hills	Orākei Kōrako (Orākei Kōrako)	71.0	70.5	National	Contains one of the best quality areas of geothermal vegetation in the Waikato Region. Contains good quality examples of nationally uncommon habitat - geothermal (five naturally uncommon ecosystem types - heated ground (dry), geothermal streamsides, geothermal wetland, fumaroles, and hydrothermally altered ground (now cool)). Includes populations of Threatened and At-Risk plant taxa, including <i>Christella</i> aff. <i>dentata</i> ("thermal") and one of the largest populations of <i>Dicranopteris linearis</i> in New Zealand.	Pest plants	High	Orākei Kōrako part: Some small areas of wilding pines remain present. Bamboo on the western side of the river near the tourist area should be a high priority for control because it is spreading into geothermal habitat. Other species that should be controlled include black wattle, blackberry, Japanese honeysuckle, and pampas. Red Hills part: Ongoing control of wilding pines is needed to control reinvasion. Other species that should be controlled include Chinese privet and pampas.	Pest plant control, particularly of wilding pines, black wattle, and pampas.	High	High	Ecological: Ecological condition has improved following removal of wilding pines. Management: Wilding pines have been removed from large parts of the eastern side of Lake Ohakuri. Comments: Most of the site is in excellent ecological condition. Additional areas have been identified since 2014, based on improved knowledge of site.
						Pest animals	Medium	Damage from feral pigs and possums was evident during the 2022 field survey. Other ungulates are also likely to cause damage to geothermal vegetation and habitats.	Monitor. Undertake pest animal control if required. In the first instance, it would be appropriate to focus pest animal control at the tourist site and along farm margins.	Medium	Medium	
						Domestic animals	Lower	A small area in the northeastern part of the site is within farmland and is not fenced to exclude stock. Large parts on the western side of Lake Ohakuri are also not fenced. Some fence maintenance is also needed on the eastern side of the site, as existing fences are in a poor condition.	Fencing to exclude domestic stock. Fence maintenance, with the highest priority being the boundary with farmland on the eastern boundary of the site.	Lower	Medium	
						Other - tourism and/or recreation	Lower	Orākei Kōrako part is managed as a tourist facility, with well-maintained tracks and viewing sites. Direct human impacts are low within other parts of this site. There is a bath and some litter present near the southern end of the Red Hills part.	Continue to encourage good management of tourist facilities and bathing areas.	Lower	Medium	
Orakonui	Nga Tamariki (Ngā Tamariki)	1.3	1.1	Regional	Mostly within a Scenic Reserve, provides important habitat for one Threatened (geothermal kānuka) and one At Risk plant species (<i>Cyclosorus interruptus</i>), and contains examples of nationally uncommon habitat - geothermal (four naturally uncommon ecosystem types - heated ground (dry), geothermal streamsides, geothermal wetlands, and hydrothermally altered ground (now cool)).	Pest plants	Medium	Pest plants are an ongoing significant threat to the character of the site, and compete with indigenous geothermal plant species. Key pest plants are wilding radiata pines, grey willow, Tasmanian blackwood, pampas, and Chinese privet.	Control the remaining radiata pines, other pest trees and pampas.	High	Immediate	Ecological: In 2014, spray drifted into the site from herbicide application on the adjacent land. This spray killed the arrow grass population that was present and as a result this species has been lost from the site. Some geothermal kānuka was also damaged by the spray drift, but has recovered. <i>Dicranopteris linearis</i> has not been recorded here since 2015 and the habitats present may no longer be suitable for this species. The condition of indigenous vegetation in the northern part of the site has improved significantly following pine control. Management: Some pest plant control work (pampas and wilding pines) was undertaken between 2018 and 2020. Comments: None.
						Pest animals	Medium	Possum and ungulate (deer and pig) sign has been recorded at this site. Pest mammals have damaged vegetation on sinter terraces at this site in the past.	Continue monitoring as part of current monitoring associated with the power station. Undertake pest animal control if required. Neighbouring landowners should be encouraged to undertake animal pest control as part of the wider landscape.	Lower	Medium	
						Other - use for energy production	Lower	Monitoring of effects associated with the Nga Tamariki Geothermal Power Station is undertaken. No ecological effects have been observed to date. Informal access tracks are used for monitoring.	Continue monitoring. Where possible, use defined tracks to minimise trampling of vegetation and habitats for monitoring and management purposes.	Lower	Medium	
						Other - adjoining forestry	Medium	Potential for damage to site during management of plantation radiata	Fell the remaining exotic trees on margins of site, so that they fall away from geothermal features	Medium	High	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
								pine forest, including during harvest and spraying.	and vegetation. Create a larger setback buffer from geothermal areas, preferably to the top of the steep scarp on each side of the valley.			
Otumuheke	Wairākei-Tauhara (Tauhara)	8.6	8.5	Part: National, Part: Local	Otumuheke part is of national significance because it is a good quality example of geothermal habitat (including naturally uncommon ecosystem types - geothermal streamsides, heated ground (dry), and hydrothermally altered ground (now cool)). The geothermal wetland at the head of the Otumuheke Stream was previously in excellent condition, but has declined in condition since 2010. It contains the largest geothermal wetland in the Wairākei-Tauhara Geothermal System. This part of the site contains populations of four Threatened or At-Risk plant species, including a sizeable population of <i>Christella</i> aff. <i>dentata</i> ("thermal"). Spa Thermal Park part of the site is of local significance because it is a modified example of geothermal vegetation and habitat (including naturally uncommon ecosystem types - geothermal streamsides, heated ground (dry), and hydrothermally altered ground (now cool)).	Pest plants	Medium	A wide range of pest plants are present. Blackberry dominates the stream margin in places. Management of pest plants is recommended as the springs have retreated down the valley.	Priorities for ongoing control are blackberry, pampas, grey willow and wilding pines. Any further disturbance of Threatened or At-Risk plants needs to be minimised during future weed and restoration of the site.	High	High	Ecological: Geothermal wetland and habitats in the northwestern arm of the site have declined in geothermal activity since 2010 and are now in relatively poor condition. The total size of the population of <i>Cyclosorus interruptus</i> appears to have declined. Populations of <i>Nephrolepis flexuosa</i> appear to have been lost between 2014 and 2020. Geothermal vegetation and habitat is no longer present at Kathleen Springs. Management: Since 2010, extensive pest plant control has been undertaken and restoration planting has been undertaken along the lower stream margins and at the stream mouth. A restoration plan has recently been prepared for the site. The bathing area was upgraded in 2018 to include changing rooms, toilets, and seating areas. Comments: The population of <i>Cyclosorus interruptus</i> should be monitored regularly to see if it recovers. There is a real threat of losing <i>Cyclosorus interruptus</i> from the Wairākei-Tauhara Geothermal System if the apparent decline of geothermal activity at this site continues, because all other populations of <i>C. interruptus</i> near Taupō are small.
						Pest animals	Lower	A range of pest animals will be present. Some pest animal control is undertaken by a community group in the Spa Thermal Park part of the site.	Continue to undertake pest animal control as part of the management of the wider landscape.	Lower	Medium	
						Other - use for energy production	Lower	Associated with geothermal power stations in the Wairākei-Tauhara Geothermal System.	Continue monitoring of ecological effects associated with energy production.	Lower	Medium	
						Other - tourism and/or recreation	Lower	Most of the lower part of the site is within a public recreation park. There is a popular bathing spot at the confluence of Otumuheke Stream and the Waikato River.	Continue to encourage appropriate management and use of the park, bathing spot, and tracks.	Lower	Medium	
Paerata Road	Mokai (Mokai)	1.5	1.3	Local	Contains an example of nationally uncommon habitat - geothermal (three naturally uncommon ecosystem types - heated ground (dry), hydrothermally altered ground (now cool), and geothermal streamsides). Contains the largest area of geothermal kākūka shrubland in Mokai Geothermal Field.	Pest plants	Medium	Blackberry remains present (1-5% cover) throughout much of the site. Also, occasional grey willow, wilding pines, and broom.	Pest plant control, particularly of wilding pines.	Medium	Lower	Ecological: Growth of plantation pines around geothermal areas. Management: None recorded. Information poor. Comments: Has not been field surveyed since 2011. Information on this site is dated.
						Pest animals	Lower	Rabbits were present in 2022. Other pest animals such as ungulates may also threaten geothermal vegetation and habitats at this site.	Encourage control of pest animals as part of the management of the wider landscape.	Medium	Lower	
						Domestic animals	Lower	Some areas are not fenced and are grazed by stock.	Fencing to exclude domestic stock. Regular maintenance of fences.	Medium	Lower	
						Other - dumping of rubbish	Lower	Rubbish has been dumped into stream/geothermal vegetation margin.	Remove dumped rubbish and discourage further dumping.	Medium	Lower	
						Other - adjoining forestry	Medium	Radiata pines are planted within five metres of geothermal features. There was some loss of indigenous vegetation occurred as a result of herbicide application during preparation for planting of radiata pines. Large wilding pines have been felled into geothermal areas.	Improved management of plantation forest, including creating a larger setback buffer from geothermal areas.	Medium	Lower	
Rotokawa	Rotokawa (Rotokawa)	217.8	144.8	National	Comprises a large, relatively good quality area of geothermal vegetation (nationally uncommon habitat, including five naturally uncommon ecosystem types). The site includes a wide diversity of geothermal habitats and provides habitat for several Threatened and At Risk plant and bird species. It is one of the largest areas of geothermal kākūka scrub and shrubland and contains one of the biggest known populations of <i>Calochilus robertsonii</i> in Aotearoa New Zealand. While the site has a long history of modification, the quality of the site is noticeably improving following the implementation of ecological management by the Department of Conservation.	Pest plants	High	Pest plants are common within the northern part of the site, particularly wilding pines (6-80% cover). Extensive pine control has been undertaken near the lake in recent years, so pines are no longer dominant here (currently about 1% cover).	The restoration plan which has recently been prepared for the northern part of this site (Wildland Consultants 2023b) should be implemented. The spread of wilding pines and other exotic trees needs to be contained, with emphasis on those areas which are still predominantly indigenous. Control of pampas and grey willow should be undertaken in the part of the site near the Waikato River. Regular follow-up pest plant control should be undertaken throughout the site.	High	Immediate	Ecological: In the northern part, cover and abundance of wilding pines has increased markedly. Pest plant control has improved the condition of the part of the site near the lake. Geothermal kākūka shrubland has established on several areas that were previously geothermally-influenced bare ground. Management: Pest plant control, particularly of wilding pines, has been undertaken within the parts of the site near the lake. Comments: Additional areas have been identified since 2014, based on improved knowledge of site.
						Pest animals	Medium	Some control of pest animals is currently undertaken. The populations of Threatened and At-Risk birds, particularly associated with the lake, will be threatened by pest animals. Pests present include feral pigs, possums, and rabbits.	Continue to implement regular pest animal control, and expand control programme to the remainder of the site.	Medium	Medium	
						Domestic animals	Lower	Most of the site is fenced to exclude stock, however livestock have access to some of the smaller areas.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely	Medium	Medium	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
						Other - use for energy production	Lower	Monitoring of effects associated with geothermal power stations in the Rotokawa Geothermal Field is undertaken.	to be required). Regular maintenance of fences. Continue monitoring of ecological effects associated with energy production.	Lower	Medium	
						Other - adjoining forestry	Medium	Parts of the site are surrounded by plantation forest. Potential for damage to site during management of plantation radiata pine forest, including during harvest and spraying.	Create a larger setback buffer from geothermal areas. Inform the forestry company of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Medium	Medium	
Rotopaunga	Tongariro (Tongariro)	3.2	3.2	International	Located within the part of Tongariro National Park that is listed as a UNESCO World Heritage Site. Part of an extensive natural area and ecological sequence which includes a wide range of habitat types (geothermal, forest, wetland, subalpine) extending from the shores of Lake Taupō to the summit of Kākaramea, Tihia, and Pihanga and including Lake Rotopounamu and Lake Rotoaira.	Pest plants	No threat	No pest plants recorded here.	No pest plant control actions are required. Regular monitoring is recommended.	N/A	N/A	Ecological: Unknown. Management: None recorded. Comments: None.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present. The Department of Conservation will be undertaking some pest animal control as part of management of the Tongariro National Park.	Continue to undertake control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Other - tourism and/or recreation	No threat	While the site is not directly on the Tongariro crossing, there may be some trampling damage if people choose to walk up to Rotopaunga from the Tongariro Crossing.	Continue to encourage appropriate use of tracks.	N/A	N/A	
Tauhara South	Wairākei-Tauhara (Tauhara)	0.1	0.1	Local	Contains small examples of nationally uncommon habitat - geothermal (three naturally uncommon ecosystem types - heated ground (dry), fumaroles, and hydrothermally altered ground (now cool)).	Pest plants	Lower	Alongside State Highway 5, the cover of blackberry, broom, and narrow-leaved carpet grass has increased slightly since 2013. Broom and blackberry occur locally around the margins of areas of geothermally-influenced bare ground.	Pest plant control would be beneficial for the areas alongside SH 5.	Lower	Lower	Ecological: One area (<0.1 ha) of geothermally influenced bare ground has been lost from this site (converted to pasture) since 2014. Management: One area (<0.1 ha) within paddock has been ploughed and sown in pasture since 2014. Comments: None.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Small site, lower priority than other sites. Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Medium	Cattle and horses have access to part of the site. Geothermally-influenced bare ground is trampled and vegetation on the margins is grazed.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Regular maintenance of fences.	Medium	Lower	
						Other - clearance for industry or roading	Lower	Areas alongside SH5 are likely to be disturbed during routine roadside maintenance.	Road maintenance teams should be made aware of the site and how it should be managed to ensure that the features are retained.	Lower	Lower	
Taupō Shoreline	Wairākei-Tauhara (Tauhara)	0.5	0.3	Local	Contains examples of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - heated ground (dry) and geothermal streamsides). Includes geothermal wetland and shoreline habitats on the margins of Lake Taupō, which is at least a nationally ecologically significant site.	Pest plants	Lower	Some short stature pest plants are present in low abundance, including Mexican daisy, blackberry, Japanese honeysuckle, Cretan brake, and cotoneaster.	Pest plant control.	Lower	Lower	Ecological: The extent of springs on the shoreline appears to have increased slightly since 2014. Management: None recorded.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	Comments: Previously included as part of the Waipahihi Valley site which was classed as Regionally significant in 2014. Exact locations of the springs are difficult to define and may vary depending on lake water levels.
						Other - tourism and/or recreation	Lower	The Great Lake Walkway - Lion's Walk occurs alongside this site and is a popular walking and biking track. The spring and small pool on the margin of Lake Taupō are utilised on a regular basis by bathers. Geothermal vegetation beside the spring at this location is vulnerable to human disturbance associated with maintenance of the walking track and grassy margins of the lake.	Maintenance teams and recreational users should be made aware of the site, and how it should be managed/utilised to ensure that the geothermal features are retained.	Lower	Lower	
Te Kiri o Hinekai	Wairākei-Tauhara (Wairākei)	42.9	42.8	Part: National, Part: Regional, Part: Local	National: One of the larger areas of geothermal kānuka scrub and shrubland. Contains examples of nationally uncommon habitat - geothermal (three naturally uncommon ecosystem types - heated ground (dry), fumaroles, and hydrothermally altered ground (now cool)). Contains relatively large populations of Threatened (<i>Dicranopteris linearis</i>) and At Risk (<i>Nephrolepis flexuosa</i>) plant species.	Pest plants	High	The site has been compromised by pest plant invasion in the past, particularly wilding pines. Weeds remain common on the margins of the site.	Control of wilding pines and false acacia should be continued throughout the site. Pampas and gorse should be controlled locally (where achievable).	High	High	Ecological: The cover of wilding pines has reduced since 2017. Some areas of false acacia and pampas has also been controlled. Geothermal activity of some well-known areas appears to have declined. The abundance of <i>Nephrolepis flexuosa</i> has declined between 2014 and 2020. Small areas of geothermal kānuka in the part of the site previously identified as Wairākei Borefield have increased in area between 2014 and 2020.
						Pest animals	Medium	Pest animal control stations have recently been installed near Alum Lake. Pest animals (such as possums and ungulates) threaten the condition of fragile geothermal vegetation and habitats present.	Continue to service the existing pest animal control devices, and undertake further pest animal control if feasible.	High	High	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
					Regional: Contains populations of Threatened (<i>Dicranopteris linearis</i>) and At Risk (<i>Hypolepis dicksonioides</i>) plant species. Local: Contains small populations of a Threatened (<i>Dicranopteris linearis</i>) plant species.	Other - use for energy production	Lower	Geothermal vegetation is likely being altered by energy production from the Wairākei-Tauhara Geothermal System. Infrastructure and access tracks occur around the boundaries of the site.	Continue monitoring of ecological effects associated with energy production.	Lower	Medium	Management: Wilding conifer control has recently (2017-ongoing) been undertaken within most of the site. There has also been some control of false acacia and pampas in the northern parts of the site.
						Other - tourism and/or recreation	Lower	Mountain bike trails are present within one of the southern parts of this site.	Continue to advise trail maintenance teams and recreational users about the site, and how it should be managed/utilised to ensure that the geothermal features are retained.	Lower	Lower	Comments: A management plan was recently prepared for this site which includes suggestions for pest plant control.
Te Kopia	Te Kopia (Te Kopia)	69.3	68.5	Part: International, Part: Local	Te Kopia Part: The best quality example of a relatively intact area of geothermal vegetation which is part of a high quality ecological sequence. Within Te Kopia Scenic Reserve. An excellent, high quality example of geothermal vegetation with few weeds and little human-related disturbance. Contains good populations of Threatened and At-Risk plant species, including one of the largest populations of <i>Dicranopteris linearis</i> and geothermal kāmuka in Aotearoa New Zealand, as well as good populations of three 'At Risk-Naturally Uncommon' species: <i>Nephrolepis flexuosa</i> , <i>Calochilus paludosus</i> , <i>C. robertsonii</i> , and the Threatened-Nationally Critical mistletoe, <i>Korthalsella salicornioides</i> . Western Te Kopia part and Mangamingi Station part: Contains nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - heated ground (dry) and geothermal streamsides). Contains a small population of a Threatened plant species (<i>Dicranopteris linearis</i>).	Pest plants	High	Invasion of wilding pines will be an ongoing threat. Other pest plants present include blackberry, ornamental cherry, pampas, cotoneaster, willows, and common alder.	Ongoing control of wilding pines should be undertaken and the Te Kopia part of the site should be kept as "weed free" as possible. The spread of other pest plants (including blackberry) should be monitored, with control undertaken as required. Cotoneaster and common alder should be removed from the Western Te Kopia part of the site.	High	Immediate	Ecological: Te Kopia part: Considerable wilding pine control has been undertaken. Western Te Kopia part: Changes in levels of geothermal activity have been observed. An area of grassland has become extremely geothermally active since the previous site visit. Mangamingi Station part: Some geothermal vegetation was damaged during establishment of plantation pine forest in the surrounding area. Management: Te Kopia part: Considerable wilding pine control has been undertaken. A boardwalk and viewing platform have also been established in the northern end of this part of the site. Te Kopia part: None recorded. Mangamingi Station part: The surrounding landuse has changed from farmland to plantation pine forest. Comments: A few additional areas have been identified in the Te Kopia part since 2014, based on improved knowledge of site.
						Pest animals	Medium	Possum sign was recorded at this site. Ungulates are present. Dama wallabies will be a threat if they establish at the site. Pest animals threaten the condition of geothermal vegetation and habitats present. The Department of Conservation will likely be undertaking some pest animal in the part of this site that is within Scenic Reserve.	Undertake pest animal control.	High	High	
						Domestic animals	Medium	Very small patches within the Te Kopia part of the site are unfenced and are grazed by cattle and sheep. Fences around the reserve part of Te Kopia are in good condition. The Western Te Kopia part is fenced to exclude stock. The Mangamingi Station part is no longer grazed.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Regular fence maintenance.	Medium	Medium	
						Other - tourism and/or recreation	Lower	There are a few walking tracks.	Continue regular maintenance. Avoid the creation of further additional tracks.	Lower	Medium	
						Other - adjoining forestry	Medium	An area of geothermal vegetation within the Mangamingi Station part of the site, was recently sprayed and planted with radiata pines. In the future, this area will be vulnerable to further damage by shading and treefall from the surrounding plantation pine forest.	Establish a setback buffer between the plantation forest and geothermal site. Inform the forestry company of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Medium	Medium	
Te Maari Craters	Tongariro (Tongariro)	28.5	27.1	International	Located within the part of Tongariro National Park that is listed as a UNESCO World Heritage Site. The vegetation is naturally of low diversity, but is habitat of exceptional quality, with no recorded pest plant species and few human-induced impacts.	Pest plants	No threat	No pest plants recorded.	While no pest plants are currently known from the site, regular monitoring should be undertaken to ensure any threats can be addressed.	N/A	N/A	Ecological: Changes in the vegetation composition of this site are likely to have occurred as a result of eruptions in 2012. The area of geothermal habitat present has increased markedly in recent years.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present. The Department of Conservation will be undertaking some pest animal control as part of management of the Tongariro National Park.	Continue to undertake control of pest animals as part of the management of the wider landscape.	Medium	Medium	Management: None recorded. Comments: Regular monitoring is recommended.
						Other - tourism and/or recreation	No threat	Rarely visited by the public. It is within a remote experience zone. However, there may be some trampling damage if people choose to walk here from the Tongariro Crossing.	None required, unless use by the public increases.	N/A	N/A	
Te Rautehuia-Wairākei	Wairākei-Tauhara	15.2	15.2	Part: Regional, Part: Local	Regional: Contains a relatively large example of nationally uncommon habitat - geothermal (four naturally uncommon ecosystem types - heated ground (dry), hydrothermally altered ground (now cool), geothermal streamsides, and fumaroles). Contains populations of Threatened (<i>Dicranopteris linearis</i>) and At Risk	Pest plants	Medium	Pest plants are common, particularly wilding pines and blackberry. At Upper Wairākei Stream (Geyser Valley) other key pest plants present include grape, Tasmanian blackwood, and Chinese privet.	Wilding pines should be controlled within geothermal areas. Blackberry and other pest plants should be controlled before they out-compete indigenous geothermal vegetation. A management plan to address pest plant issues is needed for all parts of the site (Te Rautehuia and Te	High	High	Ecological: Te Rautehuia part: Tracks have been established on the ridges in the northern part of the site since 2017, which has resulted in some vegetation clearance. Notable control of wilding pines has been undertaken. Te Rautehuia Stream part: The cover of blackberry on the margins of geothermal areas in the eastern parts of the site has increased since these areas were retired from grazing. Upper Wairākei Stream (Geyser Valley)

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
					(<i>Nephrolepis flexuosa</i>) plant species. Local: Contain small lower quality and isolated areas of geothermal vegetation and habitat amongst farmland and plantation forest.	Pest animals	Medium	Goats and brown hares were observed at the site in 2021, along with sign of possums and feral pigs. Pest animal traps for rats and possums have recently been established at Upper Wairākei Valley (Geysers Valley). Possums and ungulates may threaten fragile geothermal vegetation and habitats.	Rautehuia Stream together, and Upper Wairākei Stream (Geysers Valley)). Continue to service the existing pest animal control devices, undertake control of feral pigs.	Medium	Medium	part: There has been growth of vegetation in parts of the site, possibly related to a decline in geothermal activity. Management: Te Rautehuia part: Tracks have been established on the ridges in the northern part of the site since 2017. Notable control of wilding pines has been undertaken. Te Rautehuia Stream part: Areas in the eastern parts of the site have been retired from grazing. Upper Wairākei Stream (Geysers Valley) part: A small part of the site was negatively affected by a fire in late 2012. Since then vegetation has regenerated considerably and some weed control has been undertaken. Some of the geothermal features have become less active since 2011, however some of the areas of geothermal vegetation and habitats remain relatively intact and in good condition. Comments: None.
						Domestic animals	Medium	The site is mostly fenced. However, farmed deer, cattle, and sheep graze within some of the Te Rautehuia and Te Rautehuia Stream parts of this site.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Further tracks should not be established to prevent loss of geothermal vegetation. Regular fence maintenance.	High	High	
						Other - use for energy production	Lower	Associated with the Wairākei Geothermal Power Station. Some decline in geothermal activity has been noted, particularly in the Upper Wairākei Valley (Geysers Valley) part of the site.	Continue monitoring of ecological effects associated with energy production.	Lower	Medium	
						Other - tourism and/or recreation	Lower	Upper Wairākei Stream (Geysers Valley) part: Includes a tourism venture with a formed walking track loop through the geothermal site. Currently no evidence of informal walking tracks created by visitors.	Upper Wairākei Stream (Geysers Valley) part: A management plan should be prepared to provide guidelines for the manager(s) of this part of the site to address pest plant issues, and to enhance the ecological values that are present. Education on ecological values and issues should continue to be provided to visitors.	Medium	Medium	
						Other - adjoining forestry	Lower	Te Rautehuia Stream part: Vulnerable to damage by shading and treefall from the surrounding plantation pine forest in places.	Establish a setback buffer between the plantation forest and geothermal site. Inform the forestry company of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Lower	Medium	
Tirohanga Road	Mokai (Mokai)	0.6	0.4	Local	Contains small examples of nationally uncommon habitat - geothermal (four naturally uncommon ecosystem types - heated ground (dry), fumaroles, hydrothermally altered ground (now cool), and geothermal streamsides).	Pest plants	Lower	Spraying of blackberry in 2011 was partially successful.	Further ongoing control of blackberry. Restoration planting on margins.	Medium	Lower	Ecological: Improvement in condition as indigenous scrub has been restored around the margins since 2011 (although information on the condition is poor). Management: Since 2011, fences have been relocated further away from geothermal areas, and indigenous plantings have been established around the margins. Rubbish that had been dumped has been removed. Comments: Has not been field surveyed since 2011. Information on this site is dated.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Lower	Domestic animals did not have access to this site in 2011.	Regular maintenance of fences.	Lower	Lower	
						Other - use for energy production	Lower	Associated with the Mokai Geothermal Power Station.	Establish and undertake regular monitoring of potential effects of the use of the Mokai Geothermal System for energy power station.	Lower	Lower	
Tokaanu	Tokaanu-Waihi-Hipaua (Tokaanu)	7.8	7.5	National	Contains populations of Threatened plant species. Protected under the Reserves Act (1977). Comprises a relatively large example of nationally uncommon habitat - geothermal (five naturally uncommon ecosystem types). Part of an extensive natural area and ecological sequence which includes a wide range of habitat types (geothermal, forest, wetland, subalpine) extending from the shores of Lake Taupō to the summit of Kākaramaea, Tihia, and Pihanga and including Lake Rotopounamu and Lake Rotoaira.	Pest plants	High	Vulnerable to pest plant invasion, particularly along track margins. The main pest plant species present include Japanese honeysuckle, ivy, exotic grasses, grey willow, and bamboo.	The site should be kept free of pest plants.	High	Immediate	Ecological: Not assessed. Management: Not assessed. Comments: High priority for field survey. Has not been field surveyed since 2004 (part in 2007). Information on this site is dated.
						Pest animals	Lower	A range of pest animals will be present. Some pest animal control is undertaken by the hot pools. Pest animals threaten the condition of geothermal vegetation and habitats present.	Continue to undertake pest animal control, including ungulates and possums.	High	High	
						Other - tourism and/or recreation	Lower	Parts of the site are highly dissected by formed walking tracks. These tracks appear to be adhered to.	Continue to encourage appropriate management and use of tracks.	Lower	Medium	
						Other - bathing	Lower	The continual draw-off of heat or hot water for the recreational baths is likely to have ongoing impacts.	Monitor impacts.	Lower	Lower	
Tokaanu Lake Shore Wetland	Tokaanu-Waihi-Hipaua (Tokaanu)	47.5	43.7	International	One of the largest and best quality examples of geothermal wetland (a nationally uncommon habitat type) in Aotearoa New Zealand. It is very different in character to the other large geothermal wetland site at Waitapu.	Pest plants	Medium	Pest plants are relatively rare within most of this site, with willow species present particularly on margins.	Pest plant control of grey willow and crack willow.	High	Immediate	Ecological: Not assessed. Management: Not assessed.
						Pest animals	High	Pest animals threaten the condition of geothermal vegetation and habitats present. Predators may	Encourage control of pest animals as part of the management of the wider landscape.	Medium	High	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
					It is one of the best examples of a wetland-geothermal sequence in Taupō Ecological District and is part of a large freshwater wetland that is in excellent ecological condition. It also provides habitat for Threatened and At-Risk indigenous bird species.			threaten populations of Threatened and At-Risk bird species.				Comments: High priority for field survey. Has not been field surveyed since 2007. Information on this site is dated.
Tukairangi/Karapiti Forest	Wairākei-Tauhara (Wairākei)	0.6	0.6	Local	Contains small examples of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal streamsides and hydrothermally altered ground (now cool)), and a small population of a Threatened species (geothermal kānuka).	Pest plants	High	As the geothermal activity has decreased, the abundance of pest plants, including wilding pines and blackberry, has increased.	Wilding pines should be controlled on a regular basis.	Medium	Lower	Ecological: Extent and condition of geothermal vegetation and habitat appears to be declining throughout this site. Pest plants have become more prominent within the site and on the margins. The best condition area remaining is around the mudpools alongside Waipuerawera Stream. Management: Geothermal activity appears to have declined during each survey since 2004. Some pest plant control has recently been undertaken near the mudpools and springs alongside the Waipuerawera Stream. Comments: Waipuerawera mudpools part of the site has been identified since 2014, based on improved knowledge of site.
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Other - use for energy production	Lower	Use of geothermal energy from Wairākei Geothermal Field may in part be exacerbating the decline in geothermal activity of this site.	Continue monitoring of ecological effects associated with energy production.	Lower	Lower	
						Other - clearance for industry or roading	Lower	Tukairangi part: A bulldozer track has recently been formed which leads to the southern margin of the crater.	Discourage any further creation of tracks.	Lower	Lower	
						Other - adjoining forestry	Medium	Vulnerable to damage by shading and treefall from the surrounding plantation pine forest.	Establish a setback buffer between plantation forest and geothermal site. Inform the forestry company of the location of the site so that any effects on the site can be avoided, especially during harvest or spraying.	Lower	Lower	
Waihunuhunu	Orākei Kōrako (Orākei Kōrako)	5.9	2.3	National	A good quality, representative example of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal streamsides and geothermal wetlands). Contains good populations of four Threatened and At-Risk plant taxa, including one of the largest populations of <i>Nephrolepis flexuosa</i> in the North Island.	Pest plants	Medium	Pest plants are common within the site, particularly grey willow and blackberry.	Pest plant control, particularly of grey willow and blackberry.	High	High	Ecological: Grey willow and blackberry have increased in cover. Management: None recorded. Comments: This site has high potential for ecological restoration.
						Pest animals	Medium	Possum and feral pig sign were recorded at this site. These pest animal species threaten the condition of geothermal vegetation and habitats.	Monitor. Pest animal control should be undertaken as part of the management of the wider landscape.	Lower	Lower	
						Other - bathing	Lower	The geothermal margins on this arm of Lake Ohakuri are used for swimming and there are access tracks. Some rubbish present.	Encourage appropriate use of bathing areas, including removal of rubbish by visitors.	Lower	Medium	
Waikato River Springs/Mangamingi Stream	Nga Tamariki (Ngā Tamariki)	4.6	4.0	Regional	Contains a small population of a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")) and nationally uncommon habitat - geothermal (three naturally uncommon ecosystem types - geothermal wetland, heated ground (dry), and geothermal streamsides). Also contains one of the largest areas of riparian geothermal habitat in the Waikato Region.	Pest plants	Medium	Exotic plant species dominate large parts of this site. Priorities for control are Chinese privet, grey willow, and radiata pine. Reed sweetgrass and Mexican water lily may be too extensive to control along this section of the Waikato River. Preparation of a management plan would be worthwhile to identify priorities.	Pest plant control, particularly of Chinese privet, grey willow, and radiata pine.	Lower	Medium	Ecological: No obvious change. Management: None recorded. Comments: Additional areas have been identified since 2014, based on improved knowledge of site.
						Pest animals	Lower	Ungulates and possums may damage geothermal vegetation, habitats, and features.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	No threat	Areas within farmland are fenced and stock is excluded from site.	Regular maintenance of fences.	N/A	N/A	
Waikite Valley	Waikite-Waiotapu-Waimangu (Waikite)	25.1	22.4	National	Contains good quality, high diversity, and representative examples of geothermal habitat types that are nationally uncommon (four naturally uncommon ecosystem types - geothermal wetland, geothermal streamsides, heated ground (dry), and hydrothermally altered ground (now cool)). It includes good quality, large, geothermal wetland habitat which contains most of the species diversity typical of geothermal wetland. The site also contains a large population of a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")). Two other Threatened and four At Risk plant species are also present. Threatened and At-Risk indigenous bird species are also present. Much of the site is a healthy representative example of its type.	Pest plants	High	Pest plants are common within the site, particularly blackberry and grey willow. A small population of royal fern was found in the northern wetland in 2022 and has since been controlled by the Department of Conservation.	Regular surveillance and control of pest plants throughout the site. Downstream of Te Manaroa Spring urgent control of ivy and <i>Cyperus alternifolius</i> subsp. <i>flabelliformis</i> is needed. A management plan for the steamy stream margins downstream of Te Manaroa Spring is a priority.	High	Immediate	Ecological: Considerable willow control in the northern wetland has restored a cover of indigenous sedges, harakeke, reeds, and rushes. The <i>Cyperus alternifolius</i> subsp. <i>flabelliformis</i> population near Te Manaroa spring has spread noticeably since 2014. Ivy is smothering populations of <i>Nephrolepis flexuosa</i> . As a result of fencing, many of the thermal ferns that were previously threatened by stock grazing and trampling on stream margins are now in good health. Management: Considerable restoration work has been undertaken in the northern parts of the site by the Department of Conservation. Additional areas have been fenced to exclude stock since 2014. Comments: Site ranges in ecological condition from very high to moderately poor. An ecological restoration plan (including an implementation plan) should be prepared for the highest priority areas of geothermal vegetation at the site (part of this site
						Pest animals	Medium	Sign of feral pigs, deer, goats, possums, rabbits and hares has been observed at the site. Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Medium	Medium	
						Domestic animals	Lower	Some small parts of the site remain unfenced and have stock access. Some populations of geothermal ferns are accessible to stock.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Regular maintenance of fences.	Lower	Medium	
						Other - dumping of rubbish	Lower	A small amount of rubbish was present around the track to Te Manaroa Spring in 2022.	Remove dumped rubbish and discourage further dumping.	Lower	Medium	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
						Other - bathing	Lower	Geothermal water is used for the swimming pools. A formed track is present from the pools to Te Manaroa Spring.	Continue to encourage good management of bathing areas.	Lower	Lower	is already under management by the Department of Conservation.
Waiotapu	Waikite-Waiotapu-Waimangu (Waiotapu)	234.4	206.6	Part: International, Part: Regional	Waiotapu part: Internationally significant because it is the largest area of geothermal vegetation and habitat in Aotearoa/New Zealand, large parts of which are in very good ecological condition. It has extensive areas of geothermal kānuka and other shrubland habitat. Includes a large range of geothermal features including wetlands, terraces, mudpools, and fumaroles. Ngapouri part: Regionally significant because it is a buffer and linkage between the largest network of geothermal manifestations in the Taupō Volcanic Zone located at Mangaongaonga, Maunga Kākaramea and Waiotapu sites. It contains examples of geothermal habitat (some of which are degraded).	Pest plants	High	Pest plants remain a considerable issue in most parts of the site, in particular wilding conifers and blackberry.	Further pest plant control should be undertaken, particularly of wilding pines, blackberry, and wattle species.	High	Immediate	<p>Ecological: In areas where wilding pines have been controlled, the quality of geothermal habitat present has improved greatly. African feather grass which was present to the north of the mudpools viewing site at the northern end of the tourist park in 2010 appears to have been eradicated. Some small losses of geothermal vegetation have occurred following harvesting of adjoining plantation pine trees; however, in most instances it appears that the land manager(s) has taken reasonable care to avoid damage to the geothermal site.</p> <p>Management: Considerable wilding conifer control has been undertaken in some parts of the site since 2010. Some small losses of geothermal vegetation have occurred as a result of plantation pine forest harvest and replanting on adjoining areas.</p> <p>Comments: Additional areas have been identified since 2014, based on improved knowledge of site. A restoration plan should be prepared and implemented to enhance the ecological values of this site. Formal protection is recommended.</p>
						Pest animals	High	Feral pigs have caused extensive damage in the southern and western wetlands. Possums and feral deer are also present. Dama wallabies may be a threat to geothermal vegetation if they establish at this site. Predators may threaten wetland birds (including Threatened and At Risk species) particularly in the southern part of the site.	Feral pigs should be controlled in the wetlands. Possums, ungulates, and Dama wallabies should be controlled if they are recorded at the site.	High	Immediate	
						Domestic animals	Lower	Some relatively small parts of the site are not fenced and are subject to grazing by stock.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Regular maintenance of fences.	Medium	High	
						Other - tourism and/or recreation	Lower	The central portion of this site is managed as a tourism venture. The tracks are well maintained and are generally adhered to.	Continue to encourage appropriate management and use of tracks.	Lower	Medium	
						Other - dumping of rubbish	Lower	Dumped refuse has been recorded previously but was not observed during the 2023 survey. Likely to be an ongoing issue in areas with public access.	Remove dumped rubbish and discourage further dumping.	Lower	Lower	
						Other - clearance for industry or roading	Lower	There is potential for herbicide and fertiliser drift or other threats alongside highways and farmland.	Continue to encourage appropriate management of roads and farmland.	Lower	Lower	
						Other - adjoining forestry	Lower	Parts of the site are surrounded by plantation forest. Potential for damage to site during management of plantation radiata pine forest, including during harvest and spraying. The forest manager(s) have taken reasonable care during the most recent harvest and this should continue.	Continue careful management of plantation forest, especially during harvest or spraying.	Lower	Medium	
Waipahihi Valley	Wairākei-Tauhara (Tauhara)	0.4	0.4	Regional	Contains examples of nationally uncommon habitat - geothermal (one naturally uncommon ecosystem type - geothermal streamsides, geothermal wetland, and hydrothermally altered ground (now cool)). Contains the southern-most population of <i>Cyclosorus interruptus</i> (At Risk-Declining) in New Zealand.	Pest plants	High	Pest plants are prevalent throughout the site, including planted ornamental species. Dense areas of blackberry, pampas, and buffalo grass are present on the stream margins in places.	The three pest plant species listed, pose a serious threat to the <i>Cyclosorus interruptus</i> population at the site and need to be monitored and controlled. However, a conservative approach to the management of these species should be undertaken to protect the <i>C. interruptus</i> from the extreme temperatures of summer or winter frost (i.e. no more than 25% of the total area of the site should be cleared of blackberry or other pest plants at one time). This would require a brief management plan to ensure that the ferns are protected during any pest plant control works.	High	Immediate	<p>Ecological: The extent of pampas and blackberry has increased in recent years. The population of <i>Cyclosorus interruptus</i> appears to have decreased in size slightly since 2010.</p> <p>Management: Although some hand control of blackberry has been undertaken, it appears to have increased in cover recently (2014-2017). Tracks have been cut through the blackberry in places.</p> <p>Comments: None.</p>
						Pest animals	Lower	A range of pest animals will be present. Some pest animal control is undertaken by the hot pool complex.	Continue to undertake pest animal control.	Lower	Medium	
						Other - use for energy production	Lower	Associated with geothermal power stations in the Wairākei-Tauhara Geothermal System.	This site should be included in monitoring of ecological effects associated with energy production.	Lower	Medium	
						Other - bathing	Lower	Waipahihi Stream has been diverted and partially channelised within the De Bretts outdoor pool area. Management of the pool complex, including lawn mowing or earthworks, may reduce the likelihood of natural regeneration of geothermal kānuka and <i>Cyclosorus interruptus</i> .	The owner of the De Bretts outdoor pools intends to restore the stream margins and the site of the old bathing pools. Development and implementation of an ecological management plan would ensure sustainable management of geothermal features and vegetation at this site.	Medium	High	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
Waipapa Stream	Mokai (Mokai)	1.2	1.2	National	Contains a large population of a Threatened plant taxon (<i>Christella</i> aff. <i>dentata</i> ("thermal")) and nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal streamsides and geothermal wetland).	Pest plants	Medium	Some parts of the site are threatened by dense blackberry scrub. Other pest plants include wilding pines and pampas, and a few grey willows that threaten the indigenous character of the site.	Pest plant control and regular inspections.	Medium	Medium	Ecological: Cover of pest plants has increased. Geothermal pools on eastern side of stream have been damaged by floods and sediment deposition. No notable change in southern part of site since 2014. Management: None recorded. Buffer between site and plantation forest was established between 2011 and 2014. Comments: None.
						Pest animals	Lower	Pest ungulates and possums threaten the condition of geothermal vegetation and habitats present.	Regular inspections, undertake pest animal control if required. Encourage adjoining landowners to undertake pest mammal control as part of the management of the wider landscape.	Medium	Medium	
						Other - use for energy production	Lower	Unclear if there are any effects on this site from the Mokai Geothermal Power Station.	Regularly monitor the condition of the geothermal vegetation and features, and provide feedback to the energy generators if conditions decline.	Lower	Medium	
						Other - adjoining forestry	Medium	Although a large buffer has been established, several pines could damage geothermal features if they are allowed to fall into the site.	Careful management of plantation forest, especially during harvest or spraying, to avoid any damage to the <i>Christella</i> aff. <i>dentata</i> ("thermal") population.	Medium	Medium	
Whakamaru	Mokai (Mokai)	<0.1	<0.1	Local	Contains a small example of nationally uncommon habitat - geothermal (one naturally uncommon ecosystem type - geothermal streamsides).	Pest plants	No threat	A very small site, no pest plants have been recorded here.	No pest plant control actions are required. Regular monitoring is recommended.	N/A	N/A	Ecological: Unknown. Management: Unknown. Comments: Has not been surveyed since 2008.
						Pest animals	Lower	Although a range of pest animals will be present, they are not considered to be a notable threat to this small site.	Encourage control of pest animals as part of the management of the wider landscape.			
						Other - tourism and/or recreation	No threat	This site is used for recreation by boat users. Holes are often dug in the sand to create hot water pools for bathing.	No action required.	N/A	N/A	
Whangairohea	Whangairohea (Whangairohea)	0.2	0.1	Local	Contains two small examples of nationally uncommon habitat - geothermal (one naturally uncommon ecosystem type - geothermal streamsides).	Pest plants	Lower	In the buffer around the geothermal pool there is blackberry, Mercer grass, buddleia, and Spanish heath. Reed sweetgrass is present around the springs on the Waikato River margin.	Control of pest plants near the springs and pool is recommended.	Lower	Lower	Ecological: Not assessed. Management: Not assessed. Comments: The springs on the margin of the Waikato River had not been surveyed prior to 2022. The pool area that was previously identified was not field surveyed in 2022
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Other - bathing	No threat	The pool is used for bathing, with a jetty and a small changing shed present.	Continue current management, avoid any further clearance of indigenous vegetation.	N/A	N/A	
						Other - adjoining forestry	No threat	There is a 20-50 metre buffer between the geothermal pool and the surrounding plantation forest.	Continue careful management of plantation forest, especially during harvest or spraying. Maintain the buffer between plantation forest and the geothermal pool.	Lower	Lower	
Whangapoa Springs	Ātiāmuri (Ātiāmuri)	0.2	0.2	Part: National, Part: Local	Part A: Scientific Reserve, At Risk plant species present. Part B: Contains a small example of nationally uncommon habitat - geothermal (two naturally uncommon ecosystem types - geothermal streamsides and fumaroles).	Pest plants	Lower	Pest plants, particularly blackberry and broom remain common. Pest plants could be controlled around the two western features, and a planting plan could be implemented to reduce the competition with pest plants. Pest plants should be controlled as required in the larger site, particularly alongside fenced margins.	Control of blackberry and other pest plants. Restoration planting on margins.	Medium	High	Ecological: Improvement in condition of vegetation surrounding the two eastern pools. Management: Most of the site has been fenced to exclude stock. Blackberry and broom have been controlled in the large eastern part of the site and planted with indigenous tree species. The remaining pest plants in this part of the site are mainly a threat on site margins Comments: None.
						Pest animals	Lower	Although a range of pest animals will be present, they are not considered to be a notable threat to this small site. Arrow grass has been affected by trampling of larger feral mammals e.g. deer at some geothermal sites.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	
						Domestic animals	Lower	Most of the site is fenced and fences are in a good condition. One small geothermal feature has a wooden barrier with a narrow buffer and may be improved by better quality fencing, but this not a high priority.	Regular maintenance of fences.	N/A	N/A	
Wharepapa Road	Reporoa (Reporoa)	4.4	4.3	Local	Contains small examples of nationally uncommon habitat - geothermal (five naturally uncommon ecosystem types).	Pest plants	High	Pest plants are common, including wilding pines, rank pasture grasses, <i>Cotoneaster franchetii</i> , blackberry, oaks, and silver birch.	Pest plant control, particularly of exotic tree species.	Medium	Lower	Ecological: Not assessed. Management: Not assessed. Comments: Has not been field surveyed since 2017. Poor ecological condition
						Pest animals	Lower	Pest animals threaten the condition of geothermal vegetation and habitats present.	Encourage control of pest animals as part of the management of the wider landscape.	Lower	Lower	

Site Name	Geothermal System (Geothermal Field)	Size of Site (ha)	Extent of Geothermal Vegetation at Site (ha)	Significance Level	Key Values of Site	Threats	Vulnerability	Description of Threats	Action Required	Ecological Benefit	Priority	Change Since Previous (2014) Assessment
						Other - dumping of rubbish	Lower	A wide range of rubbish has been dumped on areas of sinter and geothermally-influenced bare ground.	Remove dumped rubbish and discourage further dumping.	Medium	Lower	
						Other - bathing	Lower	Several geothermal baths are present.	Encourage good management of bathing areas.	Lower	Lower	
						Domestic animals	Lower	Most areas are fenced, but some of the fences are not effectively excluding stock.	Establish fencing around the remaining unfenced areas to exclude stock (if this is undertaken, management of blackberry is likely to be required). Regular fence maintenance.	Medium	Medium	

DEFINITION OF FIELDS USED TO ASSESS THE THREATS TO SITES WITH GEOTHERMAL VEGETATION IN THE WAIKATO REGION

Field	Definition
Site Name	The name given to each geothermal site in Wildland Consultants (2023).
Size of Site	Extent of each site (including water) is given in hectares.
Extent of Geothermal Vegetation	Extent of geothermal vegetation at each site is given in hectares.
Significance Level	The significance level assigned to each site in Wildland Consultants (2023) based on the evaluation criteria defined in the Waikato Regional Policy Statement.
Key Values of the Site	An indication of why the site is significant including the presence of 'Threatened' and 'At Risk' species (as per de Lange <i>et al.</i> 2018 for plants and Robertson <i>et al.</i> 2021 for birds) that have been recorded from the site in Wildland Consultants 2023 and other surveys.
Threats	The threats to the ecological values of each geothermal site and/or geothermal feature are listed under three headings: pest plants (weeds), pest animals, domestic animals. Other threats are listed for sites where they are relevant (e.g. herbicide spraying, clearance for roads, or damage during harvest of adjoining plantation forest).
Vulnerability	The vulnerability of each site to each of the threat mechanisms is evaluated as follows: <ul style="list-style-type: none"> - <i>High</i>: The indigenous plant community or geothermal feature is likely to undergo a significant decline in quality within the next five years if no measures are undertaken to control the threat. - <i>Medium</i>: The indigenous plant community or geothermal feature is likely to undergo a significant decline in quality in the next five to ten years if no measures are undertaken to control the threat. - <i>Lower</i>: The indigenous plant community is likely to undergo minor degradation due to the threat in the next ten years or so, or significant decline in quality over a longer period. - <i>No threat</i>: There is no perceived threat.
Description of Threats	A brief description of what impact each threat may have to the site if the threat is not effectively managed.
Action Required	A brief description on what measures may be undertaken to reduce or remove the presence of a threat to the ecological feature or geothermal features at the site, if any. For each site, the management actions required to address the threats are described and the level of ecological benefit and the priority (urgency) of the actions are evaluated.
Ecological Benefit	The ecological benefit of controlling the threat(s) at each site is assessed as follows: <ul style="list-style-type: none"> - <i>High</i>: The site has a high conservation value (Regional Significance Level or greater) and management of the threat is likely to significantly improve the viability of the indigenous geothermal vegetation and geothermal features at the site within the next five years.

	<ul style="list-style-type: none"> - <i>Medium</i>: The site has a high conservation value and management of the threat is likely to significantly improve the viability of the site in the next five to ten years, or The site has a moderate or lower conservation value and management of the threat is likely to significantly improve the viability and quality of the site within the next five years. - <i>Lower</i>: Management of the threat in any site category is likely to improve or maintain the viability of the site over a timeframe beyond the next ten years. - <i>Not applicable</i>: There is no perceived threat and/or no management action is required or recommended.
Priority	<p>The priority for managing each threat at each site is assessed as follows:</p> <ul style="list-style-type: none"> - <i>Immediate</i>: The highest priority sites for active management. These are generally of International or National significance, or large Regionally significant sites. Includes sites where a relatively small investment in the short term may deal cost-effectively with a management problem or threat and avoid potentially more significant problems. - <i>High</i>: Generally sites of high ecological value (e.g. large Regionally significant sites, Nationally significant sites or better) where threats do not immediately threaten the site, but management will significantly improve the viability of key ecological features. - <i>Medium</i>: Sites of Regional significance or better where management will significantly improve the long-term viability of ecological features at the site, or sites of Local significance where the management action has the potential to improve the site so that it may, in future, meet the criteria for Regional significance. - <i>Lower</i>: Either sites of Local significance where management will improve the viability of ecological values or geothermal features, or sites ranked higher where management will improve ecological viability but will require the allocation of significant resources. - <i>Not applicable</i>: No obvious threats or no action required.
Ecological Change Since Previous Assessment (Wildland Consultants 2014)	Any change to ecological features of the site since the previous assessment, taking into consideration whether changes to site descriptions are real or based on better information for the site (e.g. better quality aerial photographs or identification of previously unmapped areas of geothermal vegetation).
Changes to Management Since Previous Assessment (Wildland Consultants 2014)	Any management of ecological threats that has been undertaken since the previous assessment.
Comments	Any further comments.

YEAR OF MOST RECENT FIELD SURVEY AT EACH GEOHERMAL SITE IN THE WAIKATO REGION

Site Name ¹	Year of Most Recent Field Survey	Comments
Ātiamuri Geothermal System		
Matapan Road	2011	
Whangapoa Springs	2022	
Horohoro Geothermal System		
Horohoro	2023	
Mokai Geothermal System		
Paerata Road	2011	Landowner permission not given in 2022/23.
Tirohanga Road	2011	Landowner permission not given for entire site in 2022/23.
Waipapa Stream	2020	
Whakamaru	2008	
Nga Tamariki Geothermal System		
Orakonui	2022	
Waikato River Springs/Mangamingi Stream	2022	
Ohaaki Geothermal System		
Ohaaki Steamfield East	2022	
Ohaaki Steamfield West	2023	
Orākei Kōrako Geothermal System		
Akatārewa East	2023	
Akatārewa Stream	2022	
Orākei Kōrako and Red Hills	2022	
Waihunuhunu	2022	
Reporoa Geothermal System		
Golden Springs	2023	
Longview Road	2022	
Wharepapa Road	2017	Landowner permission not given in 2022/23.
Rotokawa Geothermal System		
Rotokawa	2023	
Te Kōpia Geothermal System		
Te Kōpia	2023	
Murphy's Springs	2023	
Tokaanu-Waihi-Hipaua Geothermal System		
Hipaua Geothermal Field		
Hipaua	-	Landowner permission not given in 2022/23.
Tokaanu Geothermal Field		
Maunganamu	2007	Landowner permission not given in 2022/23.
Tokaanu	2007	Landowner permission not given in 2022/23.
Tokaanu Lakeshore Wetland	2007	Landowner permission not given in 2022/23.
Tongariro Geothermal System		
Ketetahi	-	Landowner permission not given in 2022/23.
Ngarotopounamu/Red Crater	2018	
Rotopaunga	2018	
Te Maari Craters	2018	
Waikite-Waiotapu-Waimangu Geothermal System		
Waikite Geothermal Field		
Northern Paeroa Range	2022	
Waikite Valley	2022	

¹ Where the Geothermal Field is not listed it has the same name as the Geothermal System, e.g. Ātiamuri Geothermal System contains Ātiamuri Geothermal Field.

Site Name ¹	Year of Most Recent Field Survey	Comments
Waiotapu Geothermal Field		
Maunga Kākaramea (Rainbow Mountain)	2022	
Maungaongaonga	2022	
Waiotapu	2023	Landowner permission not given for one property on the western side of State Highway 5 in 2022/23.
Wairākei-Tauhara Geothermal System		
Tauhara Geothermal Field		
East Taupō	2022	
Otumuheke	2020	
Tauhara South	2020	
Taupō Shoreline	2020	
Waipahihi Valley	2022	
Wairākei Geothermal Field		
Craters of the Moon	2022	
Hall of Fame Stream	2022	
Lower Sections: Te Kiri o Hinekai Stream and Wairākei Stream	2022	
Te Kiri o Hinekai	2020	
Te Rautehuia-Wairākei	2021	
Tukairangi/Karapiti Forest	2021	
Whangairorohea Geothermal System		
Whangairorohea	2022	The river springs were visited in 2022, but the Whangairorohea geothermal pool was last visited in 2014.



• *Providing outstanding ecological services
to sustain and improve our environments*

Call Free 0508 WILDNZ
Ph: +64 7 343 9017
Fax: +64 7 3439018
ecology@wildlands.co.nz

99 Sala Street
PO Box 7137, Te Ngae
Rotorua 3042,
New Zealand

Regional Offices located in
Auckland, Hamilton, Tauranga,
Whakatane, Wellington,
Christchurch and Dunedin

ECOLOGY RESTORATION BIODIVERSITY SUSTAINABILITY

www.wildlands.co.nz