

STATE OF THE ENVIRONMENT  
ASSESSMENT FOR THE CATCHMENTS  
OF THE KAIMAI RANGE AND  
NORTHERN MAMAKU PLATEAU

FEBRUARY 2010

Report No. 2075

Prepared by Wildland Consultants Ltd for:

DEPARTMENT OF CONSERVATION  
P.O. BOX 9003  
TAURANGA 3142

ENVIRONMENT BAY OF PLENTY  
P.O. BOX 364  
WHAKATANE 3158

ENVIRONMENT WAIKATO  
P.O. BOX 4010  
HAMILTON 3247



# CONTENTS

CONTENTS	1
ACKNOWLEDGMENTS	5
1. PROJECT OUTLINE	6
2. EXECUTIVE SUMMARY	8
3. INTRODUCTION	15
3.1 Catchment description	15
3.2 History of land use	17
3.3 Present functions and uses	21
4. OVERVIEW AND CONTEXT	21
4.1 Land tenure and status	21
4.2 Geology and landforms	23
4.3 Climate	30
4.4 Land use and erosion	31
4.4.1 Land use capability	32
4.4.2 LUC and land cover	33
4.4.3 Past and present erosion	36
4.5 Water quality	38
4.5.1 Waihou River catchment	38
4.5.2 Tauranga Harbour catchment	39
4.5.3 Stream characteristics	40
4.6 Resource management roles and responsibilities	44
4.6.1 Department of Conservation	44
4.6.2 Regional Authorities: Environment Waikato and Environment Bay of Plenty	44
4.6.3 Territorial Authorities: District Councils	45
4.6.4 Iwi	45
4.7 Ecological context	45
4.8 Vegetation	50
4.8.1 Land cover	51
4.8.2 Indigenous forest - broad pattern	53
4.8.3 Indigenous forest on the range and plateaus	56
4.8.4 Other vegetation and habitat inventories	58
4.9 Flora	59
4.9.1 Weed Impacts	61
4.10 Indigenous forest ecology	63
4.11 Indigenous fauna	66
4.11.1 Avifauna - historic	66
4.11.2 Avifauna - current	68
4.11.3 Fish	74
4.11.4 Terrestrial invertebrates	77
4.11.5 Aquatic invertebrates	79
4.11.6 Herpetofauna	80

4.11.7	Bats	83
4.12	Introduced mammals	84
4.13	Recreation	87
5.	CURRENT MANAGEMENT	90
5.1	Department of Conservation	90
5.2	Environment Waikato	112
5.3	Environment Bay of Plenty	116
5.4	Other management and monitoring	118
5.5	Care groups	120
6.	CATCHMENT SUMMARIES	123
6.1	Waihou catchments	123
6.1.1	Waihi	123
6.1.2	Paeroa	124
6.1.3	Te Aroha	124
6.1.4	Middle Waihou	125
6.1.5	Upper Waihou	126
6.2	Tauranga-Bay of Plenty catchments	126
6.2.1	Waiau	126
6.2.2	Tuapiro	127
6.2.3	Uretara	127
6.2.4	Rereatukahia	128
6.2.5	Aongatete	129
6.2.6	Te Puna	130
6.2.7	Wairoa	130
6.2.8	Omanawa	131
6.2.9	Waimapu	132
6.2.10	Otawa	133
7.	KEY FINDINGS AND CONCLUSIONS	134
7.1	Geology and landforms	134
7.2	Catchments	134
7.3	Land cover	134
7.4	Human influences	135
7.5	Soil and water conservation	135
7.6	Climatic influences	135
7.7	Diversity of ecosystem types	135
7.8	Vegetation and floral diversity	136
7.9	Ecological values of vegetation	136
7.10	Indigenous avifauna	137
7.11	Bats, lizards, and fish	138
7.12	Vegetation monitoring	139
7.13	Concluding statement	143

## APPENDICES

1.	Catchment-based ecological overviews	190
	- Waihi	191
	- Paeroa	204
	- Te Aroha	216
	- Middle Waihou	229
	- Upper Waihou	241
	- Waiau	255
	- Tuapiro	266
	- Uretara	278
	- Rereatukahia	290
	- Aongatete	302
	- Te Puna	314
	- Wairoa	327
	- Omanawa	341
	- Waimapu	354
	- Otawa	367
2.	Water quality indicators	380
3.	Land use capability	390
4.	Land environment classifications for sub-catchments	402
5.	Landcover and stream gradients within sub-catchments	405
6.	Forest classes within sub-catchments	409
7.	Care group summary	412
8.	Vegetation types represented in ecological reserves	417
9.	Photographs of selected parts of project area	425

## FIGURES

1.	Location of project area	3
2a.	Department of Conservation (DOC) protected areas	24
2b.	All protected areas	25
3.	Geology	27
4.	Land Use Capability (LUC) classes in the Waihou and Tauranga catchments (pie graph)	33
5.	LUC classes in the Kaimai-Mamaku catchments (map)	34
6.	LUC and land cover within the Waihou and Tauranga catchments (bar graph)	35
7.	Landcover and stream pattern and gradients	43
8.	Land environment threat classifications and ecological district boundaries	48
9.	Indigenous forest pattern	52
10.	Vascular plant lists and threatened plant records	62
11.	DOC database weed records	65
12a.	OSNZ Atlas records 1969-1979 for common forest birds	70

12b.	OSNZ Atlas records 1999-2004 for common forest birds	71
12c.	Kiwi records and OSNZ records for less common forest birds	72
13.	Indigenous fish records	76
14.	Koi carp sites in Tauranga catchment	79
15.	Lizard and frog records	82
16.	DOC goat and possum control operations	93
17.	DOC goat kills 2004-2007	94
18.	DOC goat kills 2008-2009	95
19.	DOC management zones at Opuiaki	98
20.	DOC bait station and trap line layout at Opuiaki	99
21.	DOC pest control treatment area at Mokaihaha	101
22.	Overall vegetation monitoring network	104
23.	DOC vegetation monitoring network in the northern Kaimai Range	105
24.	DOC vegetation monitoring network in the southern Kaimai Range	106
25.	DOC vegetation monitoring network at Opuiaki	107
26.	DOC vegetation monitoring network in the Otanewainuku-Otawa Range	108
27.	New Zealand Forest Service transects for faecal pellet assessments	112
28.	DOC track and hut network in the Kaimai-Mamaku project area	114
29.	Otanewainuku Kiwi Trust pest control operational area	120
30.	Aongatete Forest Restoration Trust pest control operational area	123
31.	Care groups	124

## PROJECT TEAM

William Shaw - Report author.

Matt Renner - Information compilation, report author.

Richard Gillies - Fauna, report author.

Astrid van Meeuwen-Dijkgraaf - GIS analysis.

Federico Mazzieri - GIS mapping and analysis.

Marlé Rossouw - GIS mapping.

Scott Thomas - Bibliography.

## **Reviewed and approved for release by:**




---

W.B. Shaw  
 Director/Principal Ecologist  
 Wildland Consultants Ltd

## ACKNOWLEDGMENTS

- Andrew Baucke (DOC) - project liaison.
- Brad Angus (DOC) - information on DOC pest control and monitoring operations.
- Brendon Christensen (DOC) - information on DOC management activities.
- Carlton Bidois (Pirirakau) - Pirirakau perspective.
- Chris Clarke (DOC) - project liaison.
- Chris Dench (Tauranga Environment Centre) - care group activity within Tauranga City.
- Dave Wills - information on Otanewainuku Kiwi Trust operations.
- Gareth Evans (EBOP) - LUC analysis.
- Jeanie McInnes (EW).
- John Heaphy (DOC) - information on short-tailed bats.
- John Simmons (EW).
- Kate Akers (NZ Landcare Trust).
- Katrina Knill (DOC) - project liaison.
- Keith Owen (DOC) - information on short-tailed bats.
- Margaret Honey (Wildlands) - word processing.
- Mark Bougen (Western Bay of Plenty District Council) - information on care groups.
- Matt Bloxham (EBOP) - information on stream monitoring.
- Paul Cashmore (DOC) - information on threatened plants, and vegetation condition.
- Peter Maddison (Forest and Bird) - for sharing Forest and Bird's vision for the project area.
- Rien van der Wetteringh (EW) - for information on Waihou Management Scheme and providing the LUC analysis.
- Rob McGowan (DOC) - for information on Nga Whenua Rahui activities.
- Robyn Skelton (EBOP) - project liaison.
- Roz Perry (EBOP) - for information on care groups and pest plants.
- Sarah Crump (DOC) - weed records from DOC database.
- Tom Pyatt (DOC) - supplying various GIS layers.

### Photographs

Cover - Wairere Falls, Department of Conservation

Plates 1-4 - Wildland Consultants Ltd

Plate 5 - Environment Waikato

Appendix 9 - Wildland Consultants Ltd



## 1. PROJECT OUTLINE

The Department of Conservation, Environment Bay of Plenty, and Environment Waikato have formed a working party to cooperatively explore options for a joint planning and management approach for the Kaimai-Mamaku Ranges, in order to protect and enhance the significant catchment, conservation, and recreational values that this area provides for the region. The working party acknowledges the need to work with local communities and stakeholders in planning and implementing such a joint management approach and as a first step have begun to collect information from stakeholders and interested parties throughout the community, regarding what they want from the Kaimai-Mamaku Forest Park and the management actions they believe are required. The working party also recognised the need to report on the environmental state of the ranges and commissioned Wildland Consultants Ltd to deliver this output.

The project objective is to:

**“Provide a comprehensive report on the environmental state of the Kaimai Range.”**

The project scope includes:

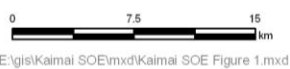
- Review and reference all relevant environmental data/information on the Kaimai Mamaku Ranges, including all relevant data held by the Department of Conservation, Environment Waikato, and Environment Bay of Plenty.
- Summarise and report on key findings and environmental trends.
- Identify and prioritise threats, risks, pressures, and impacts.
- Review past and current management and land use practices on public and private land, and measure these against predicted environmental state of health trends for the next 20 years.
- Identify any data deficiencies or monitoring gaps.

The project excludes specific environmental monitoring services.

For the purpose of this project the Kaimai-Mamaku project area includes all stream catchments that flow from the Kaimai Mamaku Ranges into the Tauranga Harbour and Waihou River (refer to Figure 1). It also encompasses the northern catchments of the Otanewainuku-Otawa Range that extend north-east from the Mamaku Plateau. The total project area is more than 240,000 ha, encompassing 15 adjoining sub-catchments that flow westwards into the Waihou River (5 sub-catchments) and eastwards to the Tauranga Harbour (10 sub-catchments), as summarised in Table 1. The northern boundary is the Ohinemuri River, while the southern boundary is defined by the catchment of the Otawa Stream (Tauranga Harbour catchment) and Oraka Stream (Waihou River); the western boundary defined by the course of the Waihou River; and the eastern boundary by the line of mean high water spring as it follows the oceanic and harbour coastlines of the Bay of Plenty.



**Figure 1: Kaimai - Mamaku Project Area and Sub-catchment Boundaries**



E:\gis\Kaimai SOE\mxd\Kaimai SOE Figure 1.mxd



Scale: 1:280,000  
Date: 27/10/09  
Cartographer: FM



Table 1: Sub-catchments and areas (in hectares) within the Kaimai-Mamaku Project Area.

Waihou Sub-Catchments	Area (ha)	Tauranga Sub-Catchments	Area (ha)
Waihi	16,625	Waiau	5,885
Paeroa	10,379	Tuapiro	6,622
Te Aroha	3,055	Uretara	5,336
Middle Waihou	15,381	Rereatukahia	6,173
Upper Waihou	72,986	Aongatete	12,543
		Te Puna	8,630
		Wairoa	36,930
		Omanawa	17,330
		Waimapu	13,029
		Otawa	9,862
<b>Total</b>	<b>118,426</b>	<b>Total</b>	<b>122,340</b>

Source: GIS analysis undertaken by Wildland Consultants Ltd.

The Tauranga Harbour sub-catchments (122,340 ha) are mainly individual catchments originating on the Kaimai-Mamaku ranges with single discharge points into the harbour, while the Waihou sub-catchments (118,426 ha) are groups of smaller tributary catchments with similar characteristics (stream type, geology, topography) generally running parallel to each other and discharging into the Waihou and Ohinemuri Rivers at various points.

## 2. EXECUTIVE SUMMARY

### Background

The Department of Conservation, Environment Bay of Plenty, and Environment Waikato have formed a working party to cooperatively explore options for a joint planning and management approach for the Kaimai-Mamaku Ranges, in order to protect and enhance the significant catchment, conservation, and recreational values that this area provides. The objective for this project was to “provide a comprehensive report on the environmental state of the Kaimai Range”, including all stream catchments that flow from the Kaimai-Mamaku Ranges into Tauranga Harbour and the Waihou River, also encompassing the northern catchments of the Otanewainuku-Otawa Range that extend north-east from the Mamaku Plateau.

### Project Area

The project area encompasses a distinctive suite of prominent landforms and the Kaimai Range, in particular, is very prominent from the Waikato and the Bay of Plenty, and is highly valued by the people of both regions. With the exception of the plains and downlands on the western and eastern sides of the range and plateaus, these landforms are largely of volcanic origins, with fault uplift resulting in the large western scarp rising above the Waikato Basin. North-south, the project area spans almost 90 km, and c.40 km west-east at its widest point, encompassing more than 240,000 ha, in 15 sub-catchments. Five of these sub-catchments - Waihi, Paeroa, Te Aroha, Middle Waihou, Upper Waihou - flow into the Waihou River and drain the northern part of the Kaimai Range, the steep western flanks of the range, and the

western parts of the northern Mamaku Plateau. The other ten - Waiau, Tuapiro, Uretara, Rereatukahia, Aongatete, Te Puna, Wairoa, Omanawa, Waimapu, and Otawa - drain from the northern hill country near Waihi Beach, the eastern flanks of the Kaimai Range, the Whakamarama Plateau, the north-eastern parts of the northern Mamaku Plateau, and the Otawa-Otanewainuku hills to the Tauranga Harbour. The Tauranga Harbour sub-catchments (122,340 ha) are mainly individual catchments originating in the Kaimai-Mamaku ranges, with single discharge points into the harbour, while the Waihou sub-catchments (118,426 ha) are groups of smaller tributary catchments with similar characteristics (stream type, geology, topography) that discharge into the Waihou and Ohinemuri Rivers.

### Land Use Capability

There is a long history of land use, including extensive forest clearance by Māori burning, followed by further clearance and modification for farming, logging, and mining. People also actively introduced many exotic animals and plants, some of which have had dramatic effects on indigenous vegetation, flora, and fauna. The steeply uplifted nature of the Kaimai Range and the steeply-incised character of streams draining the Range and plateaus means that the forested headwaters have very high values for water and soil conservation. More than half of the project area is hill country in Land Use Capability (LUC) Classes 6, 7, and 8 (Waihou catchment 58%; Tauranga Harbour catchment 64%). From a catchment management perspective, these are the classes of land at risk of erosion and damaging run-off if not managed appropriately. Management of existing forest cover is therefore important to minimise erosion and run-off. Class 8 land is not suitable for productive use while production/protection forestry or other erosion control measures may be required on Class 6 and 7 farmland. It should also be noted that activities such as cultivation, earthworks, and stock management on LUC Classes 1-4, particularly adjacent to waterways, also require appropriate management with regard to potential impacts on water quality. Particularly steep catchments are the Te Aroha sub-catchment in the Waihou (75% hill country) and Wairoa (76%) in the Tauranga Harbour catchment. Approximately two-thirds of the hill country has a cover of forest and scrub (Waihou catchment 70% and Tauranga Harbour catchment 66%), although some sub-catchments such as Paeroa (33%) in the Waihou catchment and Waiau (56%), Te Puna (44%), Waimapu (50%) and Otawa (48%) in the Tauranga catchment have a lower proportion of forest and scrub cover on steeper slopes. A considerable proportion of the hill country in these sub-catchments is used for farming.

### Catchment Management, Flood Protection and Water Quality

Patterns of land tenure and land use on the western and eastern sides of the Kaimai Range and Mamaku Plateau are quite different, with mainly dairy farming and plantation forest on the western side and many lifestyle blocks and orchards on the eastern side, with fewer larger farms. As land clearance progressed in the upper western (Waihou) catchments, erosion also started to become a significant problem. Large quantities of soil, gravel, and other debris were regularly washed off the steep Kaimai Range, infilling channels, and were deposited on farm land and in urban areas, damaging property and infrastructure. Severe storms and flooding required stop-banking to protect farm land and urban areas. The need for upper catchment protection, together with improved flood protection, culminated in the Waihou Valley

Scheme, integrating upper and lower catchment works. Access to high quality water resources is particularly important as many streams provide water for settlements, rural dwellers, and domestic stock. There is a general pattern of decreasing water quality in the Waihou with increasing distance down the catchment, and a similar pattern is evident in the lower reaches of the Tauranga catchments (the regional councils have well-developed water quality monitoring networks on both sides of the range). Sediment losses into streams and estuaries is also an ongoing concern, and steep gradient streams in pasture are a recognised sediment source on the eastern side of the range. There is a high level of community concern in the lower catchments, in particular regarding erosion, sedimentation of receiving streams, rivers, and the Tauranga Harbour; and deteriorating water quality moving downstream, as shown by the proliferation of care groups, particularly in the lower catchments. Environment Waikato and Environment Bay of Plenty have environmental programmes in place to assist private landowners to protect biodiversity and water and soil functions.

### Land Tenure and Status

The Kaimai Range has had a long history of strong public interest, having previously been the subject of a campaign, in the 1970-1980s, to establish a National Park in this area. The Kaimai-Mamaku Forest Park (37,141 ha) was initially established largely for soil and water conservation purposes, although the Forest Park has also been subject to considerable ecological evaluation, with representative segments gazetted as 'Ecological Areas', which are located throughout the forest tract. Many other protected areas are present within the project area, including QEII covenants, Nga Whenua Rahui kawenata, and covenants established as a condition of resource consents for land subdivision. Although a large proportion of the forest-covered range and plateaus is in public ownership, there are also significant areas of indigenous forest in private ownership, which have significant soil and water functions as well as biodiversity values. Various statutory plans contain controls on vegetation clearance and riparian protection. Crown conservation lands are primarily on steeper, higher altitude lands associated with the Kaimai Range and the Mamaku plateau, and the greater part of the main Kaimai Range is administered by the Department of Conservation, although significant areas of freehold and Māori lands are intermixed with Department of Conservation lands along the southern Kaimai Range, particularly on the Mamaku Plateau.

### Extent of Indigenous Vegetation

The total area of indigenous vegetation is nearly 89,000 ha, of which c.70% is formally protected. Much of the forested part of the project area is managed by the Department of Conservation but there are also large areas of indigenous vegetation (more than 25,000 ha) in private and Māori ownership. Most indigenous vegetation is located in the upper catchments, on steeper country, and on the extensive plateaus in the south, although large parts of the Mamaku Plateau have been converted to exotic plantation forest. In the middle reaches of the catchments there are many smaller remnants of indigenous vegetation, including many that extend along streams to the east. Relatively little indigenous vegetation remains in the lower altitude parts of most of the 15 sub-catchments, with large swathes of landscape now classed as acutely threatened (<10% indigenous cover remaining) or chronically threatened (<20% remaining), with the limited remnants often degraded by grazing or weed

invasion. Various pest animal species are present throughout, often having pervasive effects. Increasing numbers of privately-owned remnants are legally protected, and subject to active restoration management.

### Indigenous Forest Pattern

At lower levels and closer to the coast, coastal ecosystems are prevalent, with pohutukawa prominent. Semi-coastal forest, with species such as kohekohe and puriri, occurs along the eastern flanks of the range, with a similar pattern evident, at lower levels, on the western side of the range. Podocarp/tawa and tawa-dominant forest is predominant on lower and mid-slopes, and on the plateaus. In the north, however, there are complex mixtures of tawa, beeches, and kauri, with local kauri stands on both sides of the range (many of which have been logged). Red beech-silver beech and silver beech forest occurs on some of the higher ridges, with upland bog forest on flatter terrain at higher altitude. Extensive volcanic rock outcrops (e.g. Wahine Rock, Kakarahi) on the main Kaimai Range provide significant habitats for a diverse range of plants of open sites. The effects of climate on vegetation and habitats across the project area results from a complex set of interactions with altitude, vegetation composition and land use, distance from the coast, and landforms and soils. A strong climatic influence is evident on the highest parts of the range where a cloud or fog cap is a characteristic feature for nearly two-thirds of the year. This feature, combined with sporadic extreme droughts, means that these higher altitude forests, which have developed to suit wet climatic conditions, are vulnerable to drought-induced dieback. Drought events in the early and middle parts of the 20<sup>th</sup> century triggered widespread dieback of indigenous vegetation in ‘cloud forest’, and these effects are still very evident along the highest ridges today, resulting in the “scruffy” vegetation that is present in these areas.

### Indigenous Biodiversity

The high degree of ecological diversity within the project area is a reflection of the considerable diversity of basal geology, landforms, and altitude, combined with distributional limits for various key species. Geologically, the northern Kaimai is distinctly different from the central Kaimai and the southern plateaus. Ecologically, the northern Kaimai Range has strong affinities with the Coromandel, while the Mamaku plateau is characteristic of the central North Island. The distinctive transition zone, in the central part of the Range, has affinities to both, including various northern and southern distributional limits. Thus, the Range is a key connection and gradation between the forests of the central North Island and the Coromandel. This ecological transition zone includes northern limits for silver beech, kamahi, and pink pine, and southern limits for *Coprosma dodonaefolia* and towai. Kauri forest reaches its southern limit on the eastern side of the North Island within the project area. The range of ecosystem diversity is reflected in the formal recognition of seven separate gazetted Ecological Areas and a Forest Sanctuary across the north-south extent of the project area. The northern section of the range, from Karangahake Gorge to the Ngatamahinerua Ridge and the Kaimai tunnel area, just south of Gordon, can be considered to be “unique”, on the basis that this area is geologically distinct from the main Coromandel Range to the north and the Kaimai Range to the south, it rises to a higher altitude than either and has a very varied terrain, and it contains a multitude of complex forest types. The degree of diversity

across the project area, on a wider landscape scale, is illustrated by subdivision of the project area into eight ecological districts, within four ecological regions. The Kaimai Range and plateau environments, in spite of the presence of pest animals, still have very important biodiversity values, with large areas of the tract ranked as having 'Exceptional' botanical conservation values. The diversity of ecosystem types represented across a wide altitudinal range, from coastal to montane, means that there is a great diversity of vascular plants, with 500-600 indigenous taxa present, including at least 30 threatened or 'at risk' species, and another six taxa considered to be uncommon on a regional basis. The fauna complement is also very significant, with a diverse range of threatened avifauna, including kokako, kiwi, kākā, falcon, and long-tailed cuckoo. A now typical suite of common forest birds is present throughout. Falcon occur throughout but kākā are only itinerant visitors over much of the tract, other than the northern Mamaku Plateau. Long-tailed bats are probably present throughout indigenous forest associated with the main forest tract, but short-tailed bats are only known from Opuiaki and Mokaihaha. Records of common lizards are present throughout. Hochstetter's frog occurs at Ottawa (just outside of the project area) and in the northern Kaimai Range. A diverse complement of invertebrates is present, including rare species such as the Te Aroha stag beetle. There are still significant populations of indigenous fish in streams, including some threatened species. Upper catchments provide high quality fish habitats but it is evident that the lower reaches of most waterways are heavily modified and are under considerable pressure from catchment land uses. Ongoing connectivity to the sea is critical for migratory indigenous species, and downstream habitat quality is important for those species that utilise lowland habitats, either at key stages of their life cycles or on an ongoing basis. It is clear, from the data available, that there is a concentration of remnant threatened species in the south. It also appears that there is a more diverse complement of common species in the northern Kaimai than there is in the central part of the Range. This may be related to the relative extent and diversity of habitats available in different parts of the project area.

### Pest Animals

There is a ubiquitous suite of introduced pest animals present across the entire tract and, where not under active management, these have had, and continue to have, significant negative effects on indigenous vegetation and fauna, resulting in the steady decline and ongoing loss of key elements from remaining indigenous ecosystems. Introduced predators such as mustelids, rats, cats, hedgehogs, mice, and pest invertebrates (e.g. wasps) have taken a heavy toll on terrestrial indigenous fauna, especially birds, lizards, and invertebrates. These predators are ubiquitous across the entire tract. Limited fauna monitoring data is available, and pest control to protect indigenous avifauna is undertaken at a limited number of sites. Pest fish (koi carp) are present in some eastern catchments but are subject to an eradication programme. It is also evident that elements of the vegetation have been severely affected by introduced browsing animals such as goats and possums, with deer also present and increasing in parts of the central Kaimai Range. These animals have altered canopy composition and condition, as well as understorey composition and structure and regeneration sequences. Nevertheless, there are still parts of the northern Mamaku Plateau - such as Opuiaki - that have not been heavily impacted by introduced browsing animals and forest structure is relatively intact.

## Pest Animal Control

Goat control has been implemented widely for many decades. Currently, this is strongly focussed on the northern Kaimai, but has previously involved considerable monitoring and hunting responses in central and southern Kaimai. Goat control has also been undertaken at Orokawa Bay, along with control of feral pigs and possums. Possum control has been undertaken by the Department of Conservation in the Waiorongomai Valley, at Opuiaki (5,600 ha), at Mokaihaha (1,130 ha), and at Otanewainuku (900 ha), and Ottawa (adjacent to the project area). Control of mustelids and ship rats has also been undertaken by the Department of Conservation at Opuiaki, and of ship rats only at Mokaihaha. Other possum control has been undertaken at Whakamarama and Otanewainuku-Otawa (adjacent to the project area). Integrated pest control is also being implemented on conservation land and Māori land at Whakamarama, and at Mokaihaha, as part of a pest control research project undertaken by Landcare Research. There are now also two community-based trusts undertaking intensive pest control in forested areas (at Otanewainuku and Aongatete) and a care group doing the same (at Puketoki).

## Pest Plants

The diversity of habitats, combined with the high degree of fragmentation, urban settlement and rural subdivision, has led to a great proliferation of pest plants and this problem will not diminish over time as there is a considerable lag time for further expansion of species spreading by wind, birds, and garden waste dumping. The regional councils and DOC all have well-developed surveillance, recording, and control programmes in place, but this will require ongoing commitment.

## Vegetation Monitoring

The Department of Conservation has vegetation monitoring in place in various parts of the wider tract, with a strong focus on the northern Kaimai. In the north, this monitoring includes a network of rata view sites, permanent 20 × 20 m vegetation plots, foliar browse lines, and exclosures. In the central and southern zones, the main focus is on foliar browse assessments. Most catchments have some vegetation monitoring infrastructure, and those that don't, often have comparable monitoring sites in adjacent catchments in similar vegetation types. The notable exception is upland forest in the Te Hunga and Waiteariki Ecological Areas. While the monitoring data that is available is somewhat patchy in terms of geographic spread, there is enough information available to formulate a picture of the current state of the vegetation. Post-2000 monitoring assessments in various parts of the project area have shown declines in the canopy condition of northern rata in the northern Kaimai, but have indicated that other possum-preferred species were in moderate to good condition there. In the southern Kaimai, monitoring has indicated kamahi to be in poor condition, but other species have improved in condition. This 'picture' is related to the pattern and history of possum control, and a similar 'picture' is evident in relation to the effects of deer and goats. Current monitoring data for feral red deer and possums appears to be lacking. Other biodiversity monitoring, in the lower Tauranga catchments, is being undertaken by Western Bay of Plenty District Council, Environment Bay of Plenty, and Tauranga City Council.

## Forest Health and Threats

There is wide concern that the forests of the Range not currently under intensive management are on the verge of experiencing collapse, and that the indigenous fauna - vertebrates and invertebrates - have suffered catastrophic population collapses. It is, however, readily evident that forests on the northern Mamaku Plateau are in relatively good condition, especially areas where possums are being managed and where more intensive integrated pest management has occurred in the recent past. It is also evident that forests of the northern Kaimai are in reasonable condition and that adequate levels of vegetation monitoring are in place to detect changes. The northern Kaimai is also under active management for goat control, and possum control has been implemented over one block where rata condition is of concern. Tawa-dominant forest is predominant on lower and mid-slopes on the central Range, with a recognised deer population. These forests now have limited vulnerability to browse impacts, subject to pest populations not attaining high levels. Upland forest on the Range appears to be in a poor state, but this is due primarily to the effects of drought-related forest dieback, triggered by two key drought events in the early and mid-20<sup>th</sup> Century. Browsing animals do, however, play an important role in regeneration at dieback sites, and possums are also a known factor in kaikawaka decline. There may be a need to increase monitoring (and management) effort in upland forests on the highest ridges, and this needs further evaluation. Indigenous fauna, especially birds, are of particular concern, but the major declines and local extinctions due to predation have already occurred, as for extensive areas of most mainland habitats, and it is now a matter of determining where management effort should be directed. There is probably a need for further targeted surveys of key species, to underpin selection of further intensive management sites, although this is only one factor that should be taken into account in the evaluation of priorities for ecosystem management. Monitoring (and management) within the 'core' Kaimai-Mamaku tract is somewhat patchy and has become focussed on particular locations and there would be merit in taking a more holistic approach to future management. There is enough monitoring information to indicate that more active management is required in representative parts of the upper catchments (in addition to the areas already subject to intensive management), to halt and reverse the decline of indigenous biodiversity. There is also sufficient information available to indicate the types of recovery (and recovery trajectories) that can be expected if a wider programme of active management is put in place. The previous delineation of key representative vegetation sequences and special features in Ecological Areas and a Forest Sanctuary needs greater recognition. These areas are currently receiving active management in the northern Kaimai (goat control) and northern Mamaku (recent control of possums, stoats, rats), but need more emphasis in the central and southern Kaimai Range.

## Community Interest and Involvement

The Waikato and western Bay of Plenty are major population centres, with intensive land subdivision occurring in the western Bay of Plenty. Levels of increased use in adjacent lowlands is being reflected by increased use (and related interest in management regimes) in the forests along the range, with c.200,000 annual visitors. As well as walking/tramping, there is significant interest in historic interpretation, hunting, mountain biking, 4WD, whitewater kayaking, and trout fishing. There is

now considerable pressure from the wider community for increased active management in the wider forested tract, as well as throughout much of the lower sections of the 15 sub-catchments. Ecological restoration is a strong focus in these degraded environments, as shown by the more than 50 community-based ecological care groups operating (with only a few exceptions), mainly in the lower to middle reaches of the Tauranga catchments. These care groups are well aware of the importance of sound ecological management and sustainable rural land use for receiving environments such as Tauranga Harbour and the Waihou River and Firth of Thames.

### Conclusion

With growing population pressure, particular in the Bay of Plenty and changing land uses such as advancing urban and rural interfaces but also agricultural intensification within the Kaimai-Mamaku catchments, conservation efforts need to strategically align with and contribute to social and economic policies. This can only realistically be achieved by proactive long-term engagement with communities within and adjacent to the project area. It is also obvious that it is beyond the capabilities of a single agency, an agency collective, or even the combined efforts of agencies and the wider community, to achieve ecosystem recovery uniformly across the project area. It will be necessary to pick “winners”, in terms of representative swathes of indigenous forest and selected catchments, in which to implement additional restoration management. It will also be necessary to expand and integrate the monitoring network, to be able to continue to evaluate condition and trend within these systems, and to report on achievements over time. If these matters are addressed, it is feasible to sustain and restore the indigenous biodiversity of the Kaimai-Mamaku into the future.

## 3. INTRODUCTION

### 3.1 Catchment description

The Kaimai Range and Mamaku Plateau are prominent volcanic-origin landforms dominating landscapes of the eastern Waikato and western Bay of Plenty.

West of the Kaimai Range and Mamaku Plateau, catchments flow into the Waihou River. The upper Waihou River and its tributaries are largely spring fed, as water from the Mamaku plateau infiltrates into and percolates through thick ignimbrite sheets before emerging in springs. Water in the streams along the Kaimai Range is mainly sourced from run off. The Waihou, as it increases in flow from run off, flows down the Hauraki Rift and into the Firth of Thames, which is part of the Hauraki Gulf Maritime Park.

Rivers and streams flowing from the Kaimai Range are typically heavily-incised, with steep drops and valley sides. To the east (see Plates 1 and 2), catchments within the project area all flow into the Bay of Plenty. Catchments to the east and west of the Kaimai Range have similar characters, being bouldery with relatively steep falls before levelling out in alluvial landscapes in lowlands on either side of the Range. However, catchments flowing from the plateau have distinctly different characters.





Plate 1: Crest of main Kaimai Range, viewed from eastern side, showing steep faces and landslide scars.



Plate 2: Easy terrain on eastern side of Kaimai Range, with Whakamarama Plateau in background.

Western catchments originate on the crest of the plateau either on the immediate edge or just above the top of a steep fault scarp (see Plate 3). The streams fall steeply over a short distance into the Waihou River and then meander over an extensive flood plain, which follows the downthrown section of crustal rift associated with the Hauraki fault, into the Firth of Thames. Eastern catchments draining the plateau initially cross the plateau where they step down over a series of ignimbrite shelves within heavily-incised gorges, before flowing through generally more evenly-sloping sections draining hill country around the edge of the Tauranga Basin and Tauranga Harbour. These waterways drain into Tauranga harbour via short estuarine sections.

### 3.2 History of land use

#### Tauranga

Māori burnt extensive areas of lowland vegetation, resulting in the replacement of tall forest by a mosaic of fernland, shrubland, remnants of primary forest and secondary forest, and areas under cultivation for kumara and taro. Areas were cultivated on a rotational basis, through a cycle of burning, then planting and cultivation for several seasons, then leaving the land to lay fallow (Stokes 1980).

European settlement on a significant scale began on the Tauranga and Te Puke lowlands in the 1870s and soon extended over open country further inland. The major clearing of forest in the Whakamarama, Kaimai, and Oropi areas and south-west of Te Puke had been made by 1900. Clearings in the Whakamarama area were the sites of settlement during the Hauhau conflict of the 1860s.

Podocarps and tawa were logged in parts of the southern Kaimai from the mid-1920s, particularly from the foothills. Remnants of tramways used to extract timber dating to the 1920s and 1930s are present within the Puketoki Reserve, on the north-eastern edge of the Whakamarama Plateau. Logging had ceased by 1972 (Dale and James 1977).

Virtually all forests on easier terrain have been logged for podocarps and broadleaved species. Before 1945, only softwoods were felled, but since then some of the more numerous hardwoods have also been extracted. Logging started about Whakamarama in the early 1900s, and continued until about 1970, leaving untouched only the forest above 500 m in the western quarter. Apart from very minor light operations, logging did not begin on the northern Mamaku Plateau before 1920 where, until 1945, logging was confined largely to forest on those parts of the plateau within reach of tramways and steam-driven log haulers. This included felling of red beech (*Nothofagus fusca*) for fencing and mining timbers. Over the ensuing 30 years, most of the previously logged forest was roaded and re-logged, as were many particularly inaccessible areas, including broken country in the north-west quarter of the Mamaku Plateau and the western side of the Papamoa Range (Beadel 2006).

Between 1900 and 1920, many blocks were opened and farmed around Ngawaro and Kaharoa. Although many ventures were initially unsuccessful, many abandoned farms were re-occupied in the 1950s and 1960s. Much secondary forest was cleared for farming alongside SH33 in the 1960s.





Plate 3: Steep section of main Kaimai Range, central part of middle Waihou catchment.

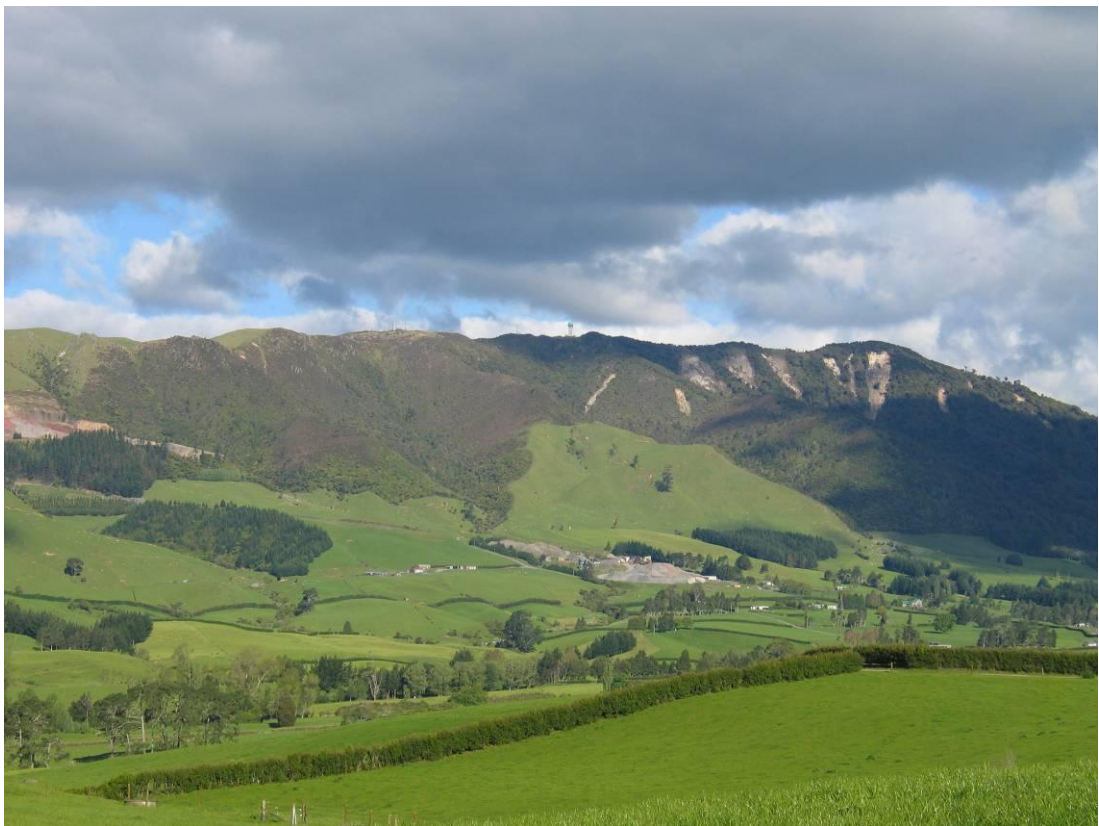


Plate 4: Farmland and secondary shrubland extending to crest of main Kaimai Range, in the vicinity of Te Weraiti, northern end of upper Waihou catchment.

Towns were originally established around mission stations and sites selected for establishment of settlements. The latter was facilitated, in part, by the redistribution of land confiscated from local Māori after the New Zealand wars (Stokes 1980). Tauranga has become a major entry and exit point for goods in New Zealand, particularly timber and timber products, and the growth of the port has been partially responsible for the growth of Tauranga's population, and the geographical expansion of urban and peri-urban areas (Wildland Consultants 2008).

Conversion of pastoral land to orcharding, primarily avocados and kiwifruit, has seen significant land use changes over the previous few decades.

### Kaimai

Timber extraction commenced in the Ohinemuri and Karangahake areas around 1880 and continued into the 1920s (Dale and James 1977). The Waitawheta valley was the focus of kauri timber extraction using trip damming, tramways and steam haulers, and nearly all the accessible kauri has been logged (Dale and James 1977). Logging was associated with frequent burning of the country surrounding mills.

The discovery of gold at Te Aroha in 1879 led to a gold rush in the Waiorongomai Valley in 1881. Large capital investment in infrastructure within the valley during the 1880s and 1890s did not pay off as gold yields from the rock proved lower than anticipated. When capital dried up as a result of the low returns, mining efforts were abandoned, leaving most of the equipment of infrastructure on-site. In more recent years, zinc and lead ores have been mined on the slopes of Te Aroha. The Tui Mine was opened by Norpac Mining Ltd in 1967 to mine copper, lead, and zinc. However, unacceptable levels of mercury were found in the ore, and for this and other reasons, Norpac went into liquidation in 1975 and the Tui Mine was abandoned. Remediation of the toxic tailings dump is currently in progress.

### Mamaku

Logging of forests on the Mamaku Plateau began in 1888 with the establishment of the Steele Brothers mill, just north of the current Mamaku township. The main species logged was rimu. Logging intensified through the late 1890s, following the completion of the railway line to Mamaku in 1894 and the construction of tramways into the surrounding plateau (Beveridge *et al.* 2009). Forest clearance for farming began following the establishment of Mamaku township. Logging of cut-over forest continued until the 1970s when focus of forestry activities shifted to conversion to pine plantations. Large areas of cut-over forest on the southern side of the Mamaku plateau were clear-felled and planted in pines. Forest clearance and conversion to pine continued into the late 1980s.

Foothills and hill country timber industries were operative on the plateau until the late 1970s. Podocarps and tawa were logged in parts of the southern Kaimai from the mid-1920s. Logging had ceased by 1972 (Dale and James 1977). The Woods Mill block was logged between 1933 and 1942 (Wills 1994), and forests to the west of Mokaihaha were logged by the Bartholomew Timber Company of Te Whetu (1905-76), whose tramway terminated less than half a kilometre from the current boundary of the Mokaihaha Ecological Area (Smale *et al.* 1997). The eighty-eight year history

of podocarp logging on the plateau ended in 1976 with the termination of New Zealand Railways operations in the vicinity of Mokaihaha. Most logged areas were subsequently clear-felled and replaced by plantations of exotic conifers under schemes implemented by the New Zealand Forest Service in the late 1970s and early 1980s (Crook 1978; Smale *et al.* 1997).

### Waihou

The settlement of Paeroa township started in 1840, with the arrival of the Thorp family, and by 1870s the township was being developed. The discovery of gold at Karangahake in 1869 led to the opening of the Ohinemuri Goldfield on 3 March 1875. In 1889 the cyanide process was trialled by the New Zealand Crown Mines Company at Karangahake. This was the first time cyanide extraction had been used on a large scale for commercial mining. Waihi township developed around the Martha mine, and when gold production peaked in 1909 the town had a population of 9,000.

The Mining Act 1891 designated rivers in the Hauraki District as “sludge channels” for the transport of mines tailings. This Act gave several mining companies at Karangahake, Waitekauri, and Waihi licence to dump mining tailings - the talcum-like residue after the bullion had been extracted-into the Ohinemuri River and its tributaries. An estimated 100 tons of tailings entered the Ohinemuri each day and it is estimated that, between 1895 and 1952, the Victoria battery alone dumped 11 million tones of tailings into the Ohinemuri River. When tailings reached the slow-moving waters of the Ohinemuri in the flat areas around Paeroa, the sediment settled and built up the river beds, making the river channel progressively shallower. Major floods in 1904 and 1907 prompted local residents to call for an investigation into the causes of flooding. A Royal Commission was established in 1910 to investigate the flooding and to make recommendations on remedies to overcome these disastrous events. The Commission found fault with the 1895 Act of Parliament, but did not recommend its repeal, and instead proposed a flood control scheme for the district under the banner “The Waihou and Ohinemuri Rivers Improvement Scheme” (Watton 2006). However, the scale of the proposed scheme was considered too costly for local landowners to meet and it was reduced in size. Stopbank construction started in 1912 and continued until around 1924. The scheme saw stopbanks constructed on both sides of the Ohinemuri, through Paeroa to its confluence with the Waihou River. The Waihou River was also stopbanked for some distance above and below Paeroa. However, the Ohinemuri River continued to silt up until the Mining Act was eventually repealed in 1955 after the Waihi Gold Mining Company’s Victoria battery at Waikino ceased operations in 1953 (Watton 2006). Major floods occurred in 1917, 1924, 1936, 1954, 1960, 1964, and again in 1976, with other minor annual floods. The Komata River stopbanks were breached during the floods of 1960 and 1964. In response the Hauraki Catchment Board proposed a new scheme, the Waihou Valley Flood Protection and Erosion Control Scheme for the entire Waihou River catchment, from its mouth at Thames to the headwaters, in the Mamaku Range (Watton 2006).

The Edmeades family settled and began to farm the land along the Upper Waihou River in 1938. At this stage the river area was heavily covered with fern and “titree” (manuka), which was cleared for farming.

### 3.3 Present functions and uses

The ranges and plateau are mostly forest-clad and provide multiple services at local, regional, and national levels. They provide an important recreation resource for hunters, walkers, trampers, and school groups, who value the cultural heritage and the landscape, but also the indigenous plants and animals. Four wheel drivers, motorbike riders and mountain bikers also value the challenges the terrain offers. The natural heritage of the Kaimai-Mamaku Ranges includes rare vegetation types and vegetation associations, many rare and threatened taxa, including numerous threatened plants, North Island brown kiwi, kokako, short tailed bat, Hochstetter's frog, Te Aroha stag beetle, striped skink and kereru. Kereru was historically the subject of cultural harvest. Today cultural and recreational harvest in the ranges and plateaus centres on the deer and pigs that are popular with recreational hunters. The ranges also harbour pest plants and animals, including goats, deer, possums, stoats, and rats, and these pose a serious threat to indigenous wildlife. The ranges are also a repository of historical artefacts, including earthworks, structures, and implements associated with historical timber and mining industries and their associated railway and tramway infrastructure. Foothills and plateaus have agriculture and exotic plantation forest intermixed with indigenous forests, with large areas of horticulture, primarily avocado and kiwifruit. Some of the high points on the Kaimai Range have telecommunications infrastructure, including T.V. aeriels and radio transmitters. One river has hydro-electric power generation infrastructure. The ranges play an important role in maintaining water quality for water supply. The ranges also play an important role in the hydrology of the catchments of the Waihou and Tauranga Harbour, as the indigenous forest cover helps to reduce peak flows and buffer streambanks from flood events. Management to promote a healthy forest cover will maintain and enhance this role, reduce sedimentation and improve water quality, as well as have positive outcomes for indigenous biodiversity and the experience of visitors.

## 4. OVERVIEW AND CONTEXT

### 4.1 Land tenure and status

The Kaimai Range has had a long history of strong public interest, having previously been the subject of a campaign to establish a National Park in this area. The Kaimai-Mamaku Forest Park was initially established for soil and water conservation purposes. Although a large area of the forest-covered ranges is in public ownership, there are also significant areas of indigenous forest along the foothills in private ownership, which have significant soil and water functions as well as biodiversity values.

The Kaimai-Mamaku part of the Waihou River catchment encompasses 118,426 ha, 75% of which is in private ownership. The Waihou catchment is primarily a developed landscape, with primary land uses for dairy and beef farming, with some exotic plantation forest in upper catchments.

The Tauranga Basin catchments encompass 122,340 ha, 73% of which is in private ownership. Land holdings within the Tauranga Basin are generally smaller than those in the Waihou, there being more lifestyle blocks and orchards, and fewer dairy farms.