ECOLOGICAL MANAGEMENT PLAN FOR THE MAKARA PEAK MOUNTAIN BIKE PARK

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Makara Peak
Mountain Bike Park

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Wildlands

R3096

ECOLOGICAL MANAGEMENT PLAN FOR THE MAKARA PEAK MOUNTAIN BIKE PARK

After school bike class, Makara Peak Mountain Bike Park, March 2013

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1. INTRODUCTION

In 1998 Wellington City Council set aside 200 ha of land with the express purpose of developing Makara Peak Mountain Bike Park (Makara Peak). The initiative has been backed, from the very beginning, by the Makara Peak Mountain Bike Park Supporters Inc. (Makara Peak Supporters). This energetic and enthusiastic group is made up of local residents, mountain bikers, and conservationists; ordinary people who enjoy the outdoors and want to give something back to their environment. Together they have a vision for a mountain bike park of international repute that is also a conservation showcase. The group at the core of the Makara Peak Supporters has, with the aid of many volunteers, undertaken track building, planted thousands of plants, and implemented pest control. Control of weeds and pest animals has also increased the rate of natural regeneration of indigenous forest and shrubland. Makara Peak is recognised as a Key Native Ecosystem by Greater Wellington Regional Council and as an Enhancing the Halo[1] project within Wellington City.

During the first year of operation - 1998 - six tracks were built and 4,000 indigenous seedlings were planted. A significant effort was also put into controlling possums and goats which were damaging the pockets of indigenous vegetation in the Park. By 2006, twenty-five kilometres of track had been built, ranging in difficulty from 'Easy' to 'Extreme'[2]. Today Makara Peak Mountain Bike Park covers approximately 250 ha (Figure 1) with about 43 kilometres of tracks and in excess of 32,000 seedlings have been planted[3].

Wellington City Council commissioned this management plan to guide work being done by them and Makara Peak Supporters at the Makara Peak Mountain Bike Park.

2. PREVIOUS MANAGEMENT PLANS

Two previous management plans have been developed for Makara Peak, in 1998 and 2001 (both are included as Appendix 1). The 2001 plan refined the objectives of the 1998 plan. Makara Peak Supporters have already achieved a number of goals set out in those plans:

1998 Management Plan

2. Control possum[4] numbers to less than 10% of current levels.
4. Reduce the numbers of rodents, mustelids, magpies, hedgehogs, feral cats and pigs.
5. Eradicate feral sheep by 1999.

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1 Halo.org.nz. Enhancing the Halo aims to make Wellington New Zealand's natural capital by making all back yards into safe havens for indigenous wildlife, and to restore a full dawn chorus and see wings over all of Wellington.

2 Explore Wellington: Skyline Track. WCC pamphlet.

3 http://www.makarapeak.org/conservation.

4 Scientific names of the introduced animal species are: possum (*Trichosurus vulpecula*), goat (*Capra hircus*) sheep (*Ovis aries*), rodents includes ship rat (*Rattus rattus*) and Norway rat (*Rattus norvegicus*), magpie (*Gymnorhina tibicen*), hedgehog (*Erinaceus europaeus*), feral cat (*Felis catus*) and pig (*Sus scrofa*), and mustelids includes stoat (*Mustela ermine*), ferret (*Mustela furo*), weasel (*Mustela nivalis vulgaris*).

6. Steadily increase the range and diversity of indigenous plants throughout the park to approach that of pre-European times.
8. Provide for the return of kererū to Makara Peak by 2010.

2001 Management Plan

1. Reduce possum numbers to a residual trap catch rate of 5% or less by the end of 2001 and hold them at that level.
3. Reestablish missing/threatened indigenous canopy trees - rimu, rata, titoki, white maire, kohekohe, hinau, tawa, kahitatea, miro, pukatea, matai and totara[1].
4. Encourage kererū[2] (wood pigeon) and other indigenous birds into the park to help distribute seeds by planting - tree fuchsia, pigeonwood, cabbage tree, tree Lucerne, ngaio, lemonwood, flax, kāpukakapuka, and kōwhai[1].
5. Remove pest plants and plant the riparian zone alongside Karori Stream within the park.
8. Reduce mustelid numbers in areas with high tūī or korimako nesting.
11. Improve the legal protection of land in the park.

A number of goals have not yet been fully achieved:

From the 2001 Plan

2. Control the goat population to less than five goats[3] in total in the park and maintain a 200 m wide goat-free buffer zone around the park.
6. Plant high fire-risk areas with fire resistant indigenous species (e.g. flax and ngaio).
7. Control the spread of key weed species such as old mans' beard, tradescantia , African clubmoss, buddleia, German ivy, Japanese honeysuckle, pampas and pine trees[4].
9. Eliminate feral stock and pigs from the park.
10. Gain a better understanding of the restoration process on Makara Peak.

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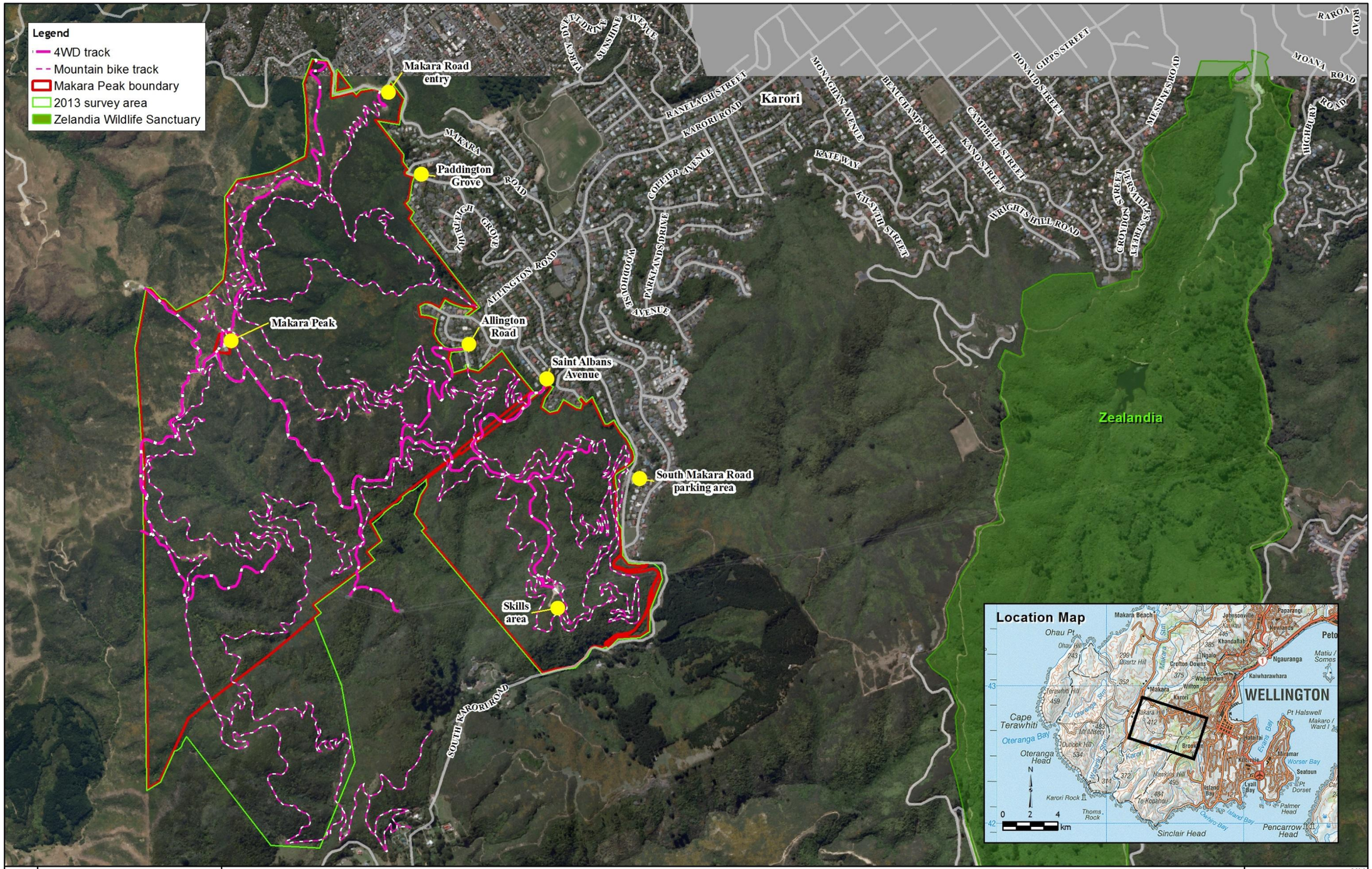
1 Scientific names of the plants species are: rimu (*Dacrydium cupressinum*), rata (*Metrosideros robusta*), titoki (*Alectryon excelsus*), white maire (*Nestegis lanceolata*), kohekohe (*Dysoxylum spectabile*), hinau (*Elaeocarpus dentatus*), tawa (*Beilschmiedia tawa*), kahitatea (*Dacrycarpus dacrydioides*), miro (*Prumnopitys ferruginea*), pukatea (*Laurelia novae-zelandiae*), matai (*Prumnopitys taxifolia*), totara (*Podocarpus totara*), tree fuchsia (*Fuchsia excorticata*), pigeonwood (*Hedycarya arborea*), cabbage tree (*Cordyline australis*), tree lucerne (*Chamaecytisus palmensis*), ngaio (*Myoporum laetum*), lemonwood (*Pittosporum eugenioides*), flax includes two species mountain flax/ whahariki (Phormium cookianum) and harakeke (*Phormium tenax*), kāpuka (*Griselinia littoralis*), and kōwhai (*Sophora microphylla*).

2 Scientific names of the indigenous bird species are: kererū (*Hemiphaga novaeseelandiae*), tūī (*Prosthemadera novaeseelandiae novaeseelandiae*), korimako (*Anthornis melanura*).

3 This was achieved between 2001 to 2004, however changes to the hunting regime have allowed numbers to increase again.

4 Scientific names of pest plant species are: old man's beard (*Clematis vitalba*), tradescantia (*Tradescantia fluminensis*), African clubmoss (*Selaginella kraussiana*), buddleia (*Buddleja davidii*), German ivy (*Delairea odorata*), Japanese honeysuckle (*Lonicera japonica*), pampas (*Cortaderia selloana*), and pine (*Pinus radiata*).



Data Acknowledgment

Imagery surce. http://gis.wcc.govt.nz/arcgis/services/Basemap/Aerial_Photo/MapServer/WMSServer?
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Figure 1. Makara Peak Mountain Bike Park

0 200 400 m

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www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:12,500
Date: 14/11/2013
Cartographer: FM
Format: A3R

3. VISION AND GOALS

The long term vision for Makara Peak Mountain Bike Park is:

> ***"To create a world class mountain bike park, with dual use (cycling and walking) tracks for all levels of rider, in a restored native forest."*** Kennett Bros 1998

Makara Peak Supporters have also adopted a focus species, the korimako or bellbird, with a goal to:

> ***"Have a healthy and audible population throughout Makara Peak, such that mountain bikers stop to listen."***
> Makara Peak Supporters website 2013

This is seen as an achievable goal that will nevertheless require considerable work.

Mountain bikers prefer riding in a setting of indigenous vegetation and local residents enjoy living next to a indigenous forest with abundant indigenous birds and other fauna species. Wellington City Council is aiming to create an ecological corridor - the 'Outer Green Belt' - by linking areas of indigenous vegetation, including Makara Peak.

While it is recognised that Makara Peak can never be restored fully to its original (pre-human) condition, it is feasible and practicable to restore it to a more functional indigenous ecosystem that sustains populations of key indigenous species.

Goals for 2013-2018

Goals identified through discussion with the Makara Peak Supporters for the next five years are:

- Park users enjoy being in Makara Peak, using the tracks and interacting with nature.
- Threats to Makara Peak, such as pest animals and pest plants, have been further reduced.
- Increased dominance and diversity of indigenous plant species within Makara Peak.
- Makara Peak supports thriving populations of indigenous fauna, including breeding populations of kererū and korimako.
- There is greater knowledge and understanding of fauna species using Makara Peak, in particular birds, fish, lizards, and bats[1].

Management targets and implementation details are further discussed in the management section (Section 8).

[1] Attaining greater knowledge and understanding of fauna species will benefit from the Bioblitz planned for 2014. A BioBlitz is a unique opportunity for biologiest, students and the public to experience the vast array of species living in an urban reserve. A Bioblitz usually lasts for 24 hours and the goal is to count as many species as possible in that time. The emphasis is on recording the total number of species, not naming every creature that has been found.

4. ECOLOGICAL CONTEXT

Overview

Makara Peak is in the southwestern part of the Wellington peninsula, near the suburb of Karori (Figure 1). It is within Wellington Ecological District, which is characterised by steep, strongly faulted hills and ranges, windy conditions, and characteristic, hardy vegetation (McEwen 1987).

Climate

Wellington is known for its wind and the higher you are, and the closer you are to Cook Strait, the windier it can be. This is because the prevailing westerly winds bend along the path of least resistance, the gap between the North and South Islands. Makara Peak ridge is one of several on this part of the peninsula that take the brunt of these strong winds. Wind farm turbines have been constructed on adjacent ridges. Winds from the south can also be strong.

As well as being windy, the climate of Wellington is moderately sunny, with moderate temperatures but few extremes (Salinger 2000). However, cloud is frequently observed over the Makara Peak ridge, lowering the temperature and increasing humidity. Sunshine hours for the year are almost 20% less than those for Wellington City. Frosts are common in the suburb of Karori, but rare in the valleys of Makara Peak. Rainfall is about 1,400 mm a year, with roughly two thirds of that falling in winter.

The park has a predominance of south, and southeast facing slopes. These receive lower levels of sunshine and slightly higher levels of rainfall which means that they are colder and wetter than the slopes to the northwest of the Makara Peak ridge. North facing slopes in southern part of the park are shaded by Makara Peak ridge in the late afternoon and therefore may not be as dry as the north western slopes of the park.

Topography

Land on the Wellington peninsula has been shaped by two major periods of tectonic uplift (in the early Cretaceous and the late Miocene) with periods between and after when the land has eroded. As the result, Makara Peak straddles two ridge lines of steep hills: one oriented southwest-northeast and the other, which comes from the highest point on that ridge, is oriented approximately north/south. It also includes two catchments: Karori Stream and Makara Stream.

Altitude varies between 100-400 m above sea level with the highest point being spot height 412 m.

Soils

Korokoro and Makara Brown Soils are present (Bruce 2000). Korokoro series soils occur on the upper parts of moderately steep to steep slopes as well as on some rolling ridge crests. The soils have developed in greywacke colluvium, with angular stones,

overlying weathered greywacke at depths varying from 50-90 cm. Makara soils occur on steep to very steep slopes (18 to >30°). They have shallow stony profiles over rock, the depth to which varies between 30 cm and 75 cm.

Vegetation Prior to European Settlement

Pre-European settlement this part of the Wellington peninsula was covered with podocarp/broadleaf forest. An almost continuous forest cover was likely and signs of this can still be seen in the form of tree stumps and weathered pieces of wood on the grassy tops of even the highest areas (WCC 2004). The following extract from the Otaki Historical Society Journal (Blake 2002) describes the nearby "Makara Valley" (probably Ohariu Valley) forest in 1851:

"*Away to the south west lies the Makara Valley, so thickly wooded as far as the eye can reach that it has the appearance of an undulating meadow; the density and uniformity of the tree tops, which at intervals are dotted with the crimson Christmas flowers or rata blossoms, heightened the illusion*."

Other early explorers have described the vegetation on the gently rolling hills and broad valley floor of what is now suburban Karori. Charles Heaphy described the Karori Valley in 1839 as:

"*Covered with forest…and here is found to be the finest timber in the vicinity of Port Nicholson. From one spot in this valley I have counted fifty trees around me that would each make a top mast for a large vessel*." (Heaphy1842, 1879).

Judge Chapman described land in Karori that he purchased in 1844:

"*The land is not too heavily timbered but nevertheless in parts of the section there are magnificent trees of all kinds, maire, mai (matai), rimu (red pine), kahikatea (white pine), totara, rata, taiia (tawa), rewarewa, hinau etc. I saw a red pine (rimu) today 10 feet in diameter.*"

Descriptions of vegetation typical of the Makara Peak area in pre-settlement times are presented in Appendix 2. Hill tops are likely to have been covered with cloud forest with kamahi (*Weinmannia racemosa*)-toro (*Myrsine salicina*) canopy on the northern slopes, with miro (*Prumnopitys ferruginea*) and Hall's totara (*Podocarpus cunninghamii*) as emergents. Pigeonwood (*Hedycarya arborea*), another moisture-loving species, would also have been present, along with a profusion of mosses, liverworts, and lichens. On the ridges, vines of bush lawyer (*Rubus* spp.) would have hung from the wind stunted trees (Gabites 1993). No remnants of this forest type remain at Makara Peak or in the Terawhiti area. The nearest examples of cloud forest are on hill tops in the Akatarawa and Whakatiki catchments, near Upper Hutt.

During the 1990s Geoff Park undertook a survey to identify and delineate areas of 'original' indigenous vegetation within Wellington City. Delineation was based on inclusion of canopy trees species characteristic and/or from the ecological character of the original forest (Park 1999). He distinguished between remnants of pre-1840 indigenous forest (referred to as "prime remnants") and more modified primary or advanced secondary forests (referred to as "site remnants"). No remnant pre-1840

forests were identified within Makara Peak, but part, or all, of ten "site remnants" occur within the Park, and many more are nearby (Appendix 4, Figure 2.1).

Fauna Prior to European Settlement

Heaphy (1879) remembered much about the bird life of Wellington as it was in 1839. He recalled vast flocks of water birds on the rivers and stated that the forests were teeming with birds including 12 or 14 small bird species and larger birds including kokako (*Callaeas cinerea wilsoni*), weka (*Gallirallus australis greyi*), pukeko (*Porphyrio melanotus*), indigenous pigeon (*Hemiphaga novaeseelandiae*), kākā (*Nestor meridionalis septentrionalis*) and huia (*Heteralocha acutirostris*). Elizabeth Hollard, an early settler, recalled that parakeets (*Cyanoramphus* spp.) were then very numerous in Karori.

5. METHODS

Existing Information

Information was collated from previous vegetation surveys, other relevant reports, and plant species lists for the area from the New Zealand Pland Conservation Network. GPS coordinates for possum bait stations, possum traps, stoat traps, and the Makara Peak Supporter five-minute bird count stations were provided by the Makara Peak Supporters. The location of tracks and Council five-minute bird count stations, were provided by Wellington City Council.

Consultation

On 1 February 2013 a meeting was held with key members of the Makara Peak Supporters to understand their requirements, establish the vision and goals for Makara Peak, and determine what information may be available to inform the management plan.

A draft report was sent to the Makara Peak Supporters in August 2013 to ensure that the management plan included all desired aspects and to clarify some matters.

Vegetation and Habitats

Makara Peak was visited in February, March, and June 2013 to map and describe the current vegetation and habitats. Vegetation types were drawn on to aerial photographs at a scale of 1:3,000. These vegetation types were then mapped using ARCGIS 10.1.

Waterway Surveys

Fish and riparian habitat surveys were undertaken on 26 April 2013 in two of the Karori Stream tributaries. This involved traversing the streams and undertaking spotlighting searches for aquatic species.

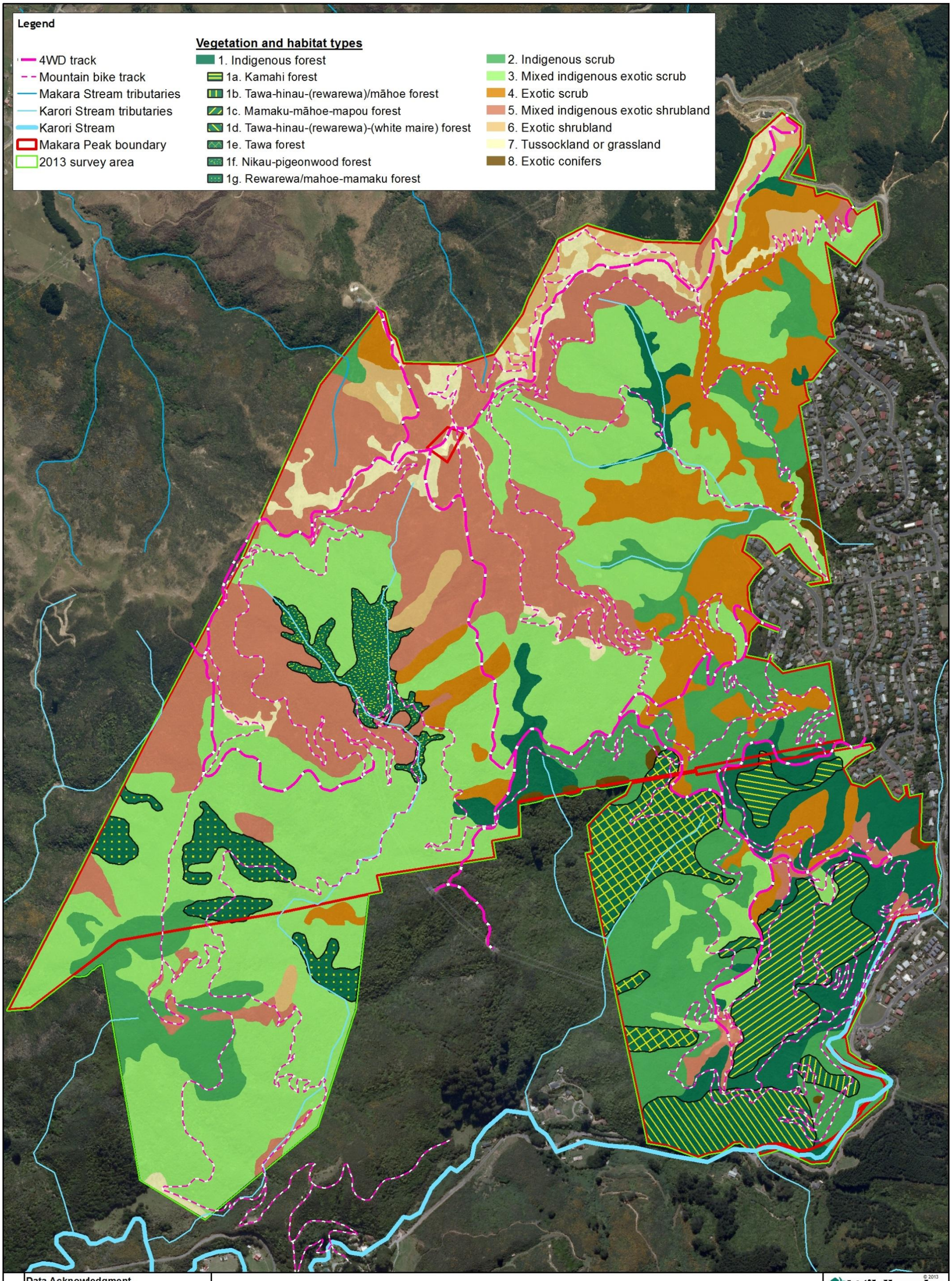

Figure 2. Vegetation and habitat types within Makara Peak Mountain Park, 2013

6. ECOLOGICAL INFORMATION

6.1 Current vegetation and habitat types

Vegetation within Makara Peak is highly varied. Nine broad vegetation types were identified and mapped, and these are summarised in Table 1, mapped in Figure 2 and described in Appendix 2. Structural classes follow Atkinson (1985).

Makara Peak, when established in 1998, was 'retired farmland', with indigenous remnants, and the current vegetation pattern reflects natural regeneration, lanting, and weed control since then.

Figure 2 shows the extent of each of the vegetation types identified and mapped in 2013. More detailed descriptions of these vegetation types are provided in Appendix 2.

Generally speaking, vegetation on the ridges comprises grassland and/or tussockland with varying amounts of indigenous and exotic shrubs, or planted flax (*Phormium tenax* and *P. cookianum*). Below this zone, vegetation is most commonly dominated by Darwin's barberry (*Berberis darwinii*) (Plate 2), gorse, and a variety and variable amounts of indigenous species, including tauhinu, *Coprosma dumosa*, manuka, tree ferns, and cabbage tree (Plate 3). Upper slopes tend to be shrubland (Plate 1), grading into scrub communities at lower elevations.

Areas of shrubland (defined as a 20% to 80% canopy cover of shrubs) and scrub (greater than 80% cover of shrubs) have been classified as either exotic, mixed exotic-indigenous, or indigenous vegetation according to the proportion of indigenous plants in the canopy (Appendix 2). Indigenous shrubland species include manuka (*Leptospermum scoparium*), tauhinu (*Ozothamnus leptophyllus*), rangiora (*Brachyglottis repanda*), mahoe (*Melicytus ramiflorus*), tree hebe (*Hebe parviflora*), kanono (*Coprosma grandifolia*), whaariki (*Phormium cookianum*), kakaha (*Astelia fragrans*), and scattered cabbage tree (*Cordyline australis*). The understorey, beneath open canopy, includes rank pasture grass species, *Leucopogon fraseri* and the regionally rare Spaniard (*Aciphylla squarrosa*).

Scrub communities, in some places, may be dominated by only one or a few species (e.g. manuka, hebe, or mahoe) or include a mixture of the canopy species listed above, along with hangehange (*Geniostoma ligustrifolium* var. *ligustrifolium*), fivefinger (*Pseudopanax arboreus*), mapou (*Myrsine australis*) and scattered wharangi (*Melicope ternata*).

Within the barberry and/or gorse, shrubland to scrub zone (Vegetation Types 3, 4, 5, and 6) indigenous and introduced species occupy somewhat different micro-habitats, such as mānuka on windswept spurs and tree ferns in protected gullies (Plate 3). Gorse is often more prominent on north-facing slopes and at lower altitudes, while Darwin's barberry is more often present on shady slopes and at higher altitude. Indigenous species are strating to overtop Darwin's barberry inmany places (Plate 4).

Table 1: Vegetation types at Makara Peak 2013.

Vegetation No.	Vegetation Type	Location	Key Canopy Species	Structural Class	Indigenous or Exotic
1	Indigenous forest	Lower slopes and valleys.	Mahoe (*Melicytus ramiflorus*), manuka (*Leptospermum scoparium*), mamaku (*Cyathea medullaris*), tree hebe (*Hebe parviflora*).	Forest	Indigenous
1a	Kamahi Forest	Gully south of St Albans Avenue access track.	Kamahi (*Weinmannia racemosa*) with tawa (*Beilschmiedia tawa*) in gullies.	Forest	Indigenous
1b	Tawa-hinau-(rewarewa)/ māhoe forest	East of Starfish Track.	Tawa and hinau (*Elaeocarpus dentatus*) with some emergent rewarewa (*Knightia excelsa*).	Forest	Indigenous
1c	Mamaku-māhoe-mapou forest	Slopes to the east of and adjoining Starfish Track.	Mamaku, mahoe, mapou (*Myrsine australis*), wineberry (*Aristotelia serrata*) and fivefinger (*Pseudopanax arboreus*).	Forest	Indigenous
1d	Tawa-hinau-(rewarewa)-(white maire) forest	Between South Karori Road and Koru Track.	Tawa-hinau, rewarewa, white maire (*Nestegis lanceolata*), kamahi, pigeonwood (*Hedycarya arborea*), mahoe, lesser amounts of northern rata (*Metrosideros robusta*), tarata (*Pittosporum eugenioides*), and pukatea (*Laurelia novae-zelandiae*).	Forest	Indigenous
1e	Tawa forest	West of Koru Track and South of Salley Alley.	Tawa, rewarewa, puka (*Griselinia littoralis*), hinau, pigeonwood, mamaku, mapou, pukatea, mahoe, rimu (*Dacrydium cupressinum*), and totara (*Podocarpus totara*).	Forest	Indigenous
1f	Nikau-pigeonwood forest	Between 4WD Ridge Line Access Road and Aratihi Track, mostly outside Makara Peak.	Nikau (*Rhopalostylis sapida*), pigeonwood, puka, mamaku, mahoe, rewarewa, mapou, wineberry, hinau, putaputaweta (*Carpodetus serratus*).	Forest	Indigenous
1g	Rewarewa/mahoe-mamaku forest.	Several small areas around the Lower Leaping Lizard Track.	Rewarewa, mahoe, mamaku, mapou, putaputaweta (*Carpodetus serratus*), wineberry, pigeonwood, kohukohu (*Pittosporum tenuifolium*), putaputaweta, mānuka, and kanuka (*Kunzea ericoides*).	Forest	Indigenous
2	Indigenous scrub	Lower to midslopes and some valleys.	Mānuka scrub, māhoe scrub, tree hebe scrub, tauhinu (Ozothamnus leptophyllus) scrub. Rangiora (*Brachyglottis repanda*), kanono (*Coprosma grandifolia*), cabbage tree (*Cordyline australis*), hangehange (*Geniostoma ligustrifolium* var. *ligustrifolium*), fivefinger (*Pseudopanax arboreus*), mapou and scattered wharangi (*Melicope ternata*).	Scrub	Indigenous
3	Mixed indigenous exotic scrub	Mid to upper slopes, some side ridges.	Darwin's barberry (*Berberis darwinii*)-tauhinu-manuka scrub (higher altitude) and gorse (*Ulex europaeus*)-manuka-tree hebe-mahoe scrub (lower altitude).	Scrub	Exotic
4	Exotic scrub	Mainly on ridges and side ridges, some faces.	Darwin's barberry scrub and gorse scrub.	Scrub	Exotic
5	Mixed indigenous exotic shrubland	Main ridges.	Darwin's barberry-tauhinu-*Coprosma dumosa* shrubland and gorse-manuka-tauhinu shrubland.	Shrubland	Exotic

Vegetation No.	Vegetation Type	Location	Key Canopy Species	Structural Class	Indigenous or Exotic
6	Exotic shrubland	Mainly the northern boundary.	Barberry (higher altitude) and/or gorse (lower altitude) over pasture grassland species.	Shrubland	Exotic
7a	Tussockland	Highest ridges, along access tracks.	Tussock (*Poa cita*).	Grassland	Indigenous
7b	Pasture grassland	Highest ridges, along access tracks	Exotic grass species.	Grassland	Exotic
8	Exotic conifers	Mainly along urban boundaries.	Radiata pines or macrocarpa.	Treeland	Exotic
9	Harakeke flaxland	Upper ridges and faces, too small to be mapped.	Planted. Wharaki (*Phormium cookanium*) is more common but harakeke (*Phormium tenax*) also occurs.	Flaxland	Indigenous

The lower slopes of Makara Peak are covered with a range of forest types of differing age and canopy species combinations (Table 1, Figure 2, and Appendix 2). There are large areas of relatively young mahoe-dominant forest, with pockets of more mature tawa, kamahi, kohehoke, rewarewa, or nikau forest, often in and around gully systems. There are also some areas dominated by tree ferns.

6.2 Flora

One hundred and ninety-six indigenous species occur naturally at the site. Forty-three of these species have also been planted at the site, and twelve other indigenous species have been planted. These are all listed in Appendix 5.

One hundred and one adventive species have been recorded from the Park, and are also listed in Appendix 5. Twenty-six of these are environmental pest plant species (refer to Appendix 7).

Kakabeak (*Clianthus puniceus*)[1] is a Nationally Critical species and rengarenga (*Arthropodium cirratum*) a regionally endangered species, both of which have been planted in Makara Peak. Spaniard (*Aciphylla squarrosa*) is ranked as Regionally Vulnerable (Sawyer 2004). Many of the podocarp species (kahikatea (*Dacrycarpus dacrydioides*), rimu (*Dacrydium cupressinum*), miro (*Prumnopitys ferruginea*), and matai (*Prumnopitys taxifolia*)) and northern rātā (*Metrosideros robusta*) are scare in the Wellington area, due to previous logging and forest clearance.

6.3 Aquatic habitats

There are a number of small first and second order streams draining the two main ridges at Makara Peak. All but two of these streams flow south to Karori Stream, which discharges to Wellington's south coast. The remaining two small first order streams flow down the northern face of the Makara Peak ridge to the Makara Stream, which discharges to the sea in the north at Makara Beach (Figure 3). Neither of these streams is listed in the Regional Freshwater Plan (GWRC 1999) as being significant. Makara Stream is, however, listed in the Plan as needing enhancement for ecosystem services purposes.

The branch of the Karori Stream into which the tributaries flow is highly urbanised and subjected to significant urban stormwater contamination (Perrie *et al*. 2012). It has poor water quality. Extensive riparian planting was carried out along the Karori Stream within Makara Peak in the early 2000s, but this comprises only a small part of the catchment and has not resulted in significant water quality (Perrie *et al*. 2012). Overall, the poor water quality in the mainstem of Karori Stream means biodiversity values there are unlikely to be high.

The northern part of Makara Peak lies in the Makara Stream catchment. Water quality in the Makara Stream is good with only two out of fourteen median water

[1] When the Makara Peak Supporters started work in the Park in 1998, there was a kakabeak near the top of Upper Leaping Lizard on the south side of 4WD track. It is not know you it arrived there (Simon Kennett pers.comm. 9 December 2013).

quality values exceeding the guideline/trigger values, compared with 6/14 for the Karori Stream (Perrie *et al*. 2012).

Water quality in the tributary stream within Makara Peak has not been tested, but is expected to be good.

Fish and habitat surveys were undertaken in April 2013 in two of the Karori Stream tributaries. There are no known barriers to fish passage for the tributary in the Nikau Valley Track area. However, the other tributary, Trickle Falls, for which the Trickle Falls Track is named, lies upstream of a network of urban stormwater pipes. These pipes will limit access for fish species that are not climbers. The Nikau Valley Track and Trickle Falls Track cross, or run alongside, the streams, and all but one of the stream crossings is bridged. The Trickle Falls Track follows the bank of the stream closely in places, with only a retaining wall between the track and the stream which could potentially cause sediment issues (Appendix 6, Plate 12).

Aquatic habitat in the Nikau Stream was of moderate quality, with riparian vegetation comprising gorse and barberry with kaikomako (*Pennantia corymbosa*), tree fuchsia, mahoe (*Melicytus ramiflorus*), dense pohuehue (*Muehlenbeckia australis*) and a wide variety of indigenous seedlings. The stream along the reach surveyed follows a natural course, and the 1.5 m wide channel was linked with its floodplain. The stream had a variety of pools, riffles and runs, and in-stream cover of woody debris. There were high levels of fine sediment lying on the gravel/cobble substrate which is unusual for a stream with its headwaters in well-developed, regenerating, indigenous forest. There is one ford across this stream, on the Nikau Valley Track but this may not be the source of the fine sediment.

Trickle Falls Stream lies in well developed, regenerating indigenous forest with a tall canopy of mahoe. As its name implies, the upper part of the catchment is very steep, but apart from issues with the track eroding and contributing sediment into the stream in places, the catchment appears stable with no unusual erosion. There is little fine sediment on the bedrock/boulder/cobble substrate of the 1.5 m wide channel and a variety of fish habitat including pools, riffles, runs and cascades. There is plenty of in-stream debris for cover.

6.4 Linkages to other indigenous habitat

Makara Peak is part of Wellington City's Outer Green Belt, which is based on the concept of a continuous green belt defining the outer limits of the City. The aim for the Outer Green Belt is to restore indigenous vegetation and provide an informal recreation network that is widely accessible (Wellington City Council 2004). The Outer Green Belt includes private land such as farms and a number of significant Wellington City Reserves, including Wrights Hill, Karori Wildlife Sanctuary (Zealandia), Careys Gully, Johnston's Hill Reserve, Otari-Wiltons Bush, Killmister Tops, Mt Kaukau (Khandallah Park), and Spicer Forest at the Porirua City (northern end) of the ridge.

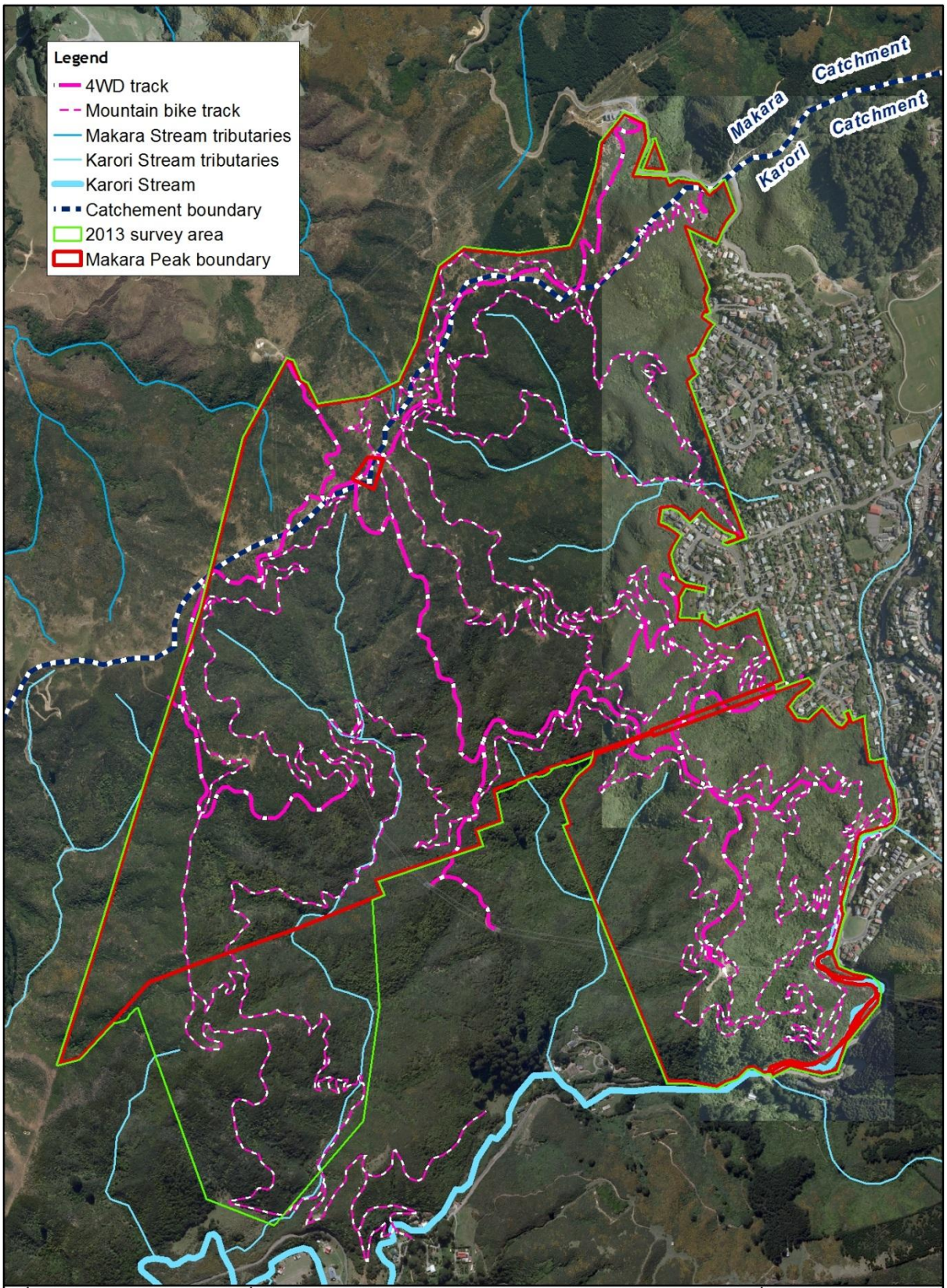

Figure 3. Makara Peak streams and catchments

The Outer Green Belt Management Plan, in general terms, promotes a combination of densely-forested slopes and gullies with areas of grazed, open hilltops to retain views (Wellington City Council 2004). Makara Peak also provides habitat linkages between west coast forests and habitats, and Wellington City.

The Skyline Track and the Colonial Knob Summit Track provide recreational linkages with Wellington's northern suburbs and Porirua. Wrights Hill tracks link Makara Peak with Zealandia and the southern and eastern Wellington suburbs.

6.5 Fauna

6.5.1 Birds

Council Bird Surveys

In 2001 Wellington City Council (WCC) initiated annual surveys of the distribution and abundance of indigenous forest birds in several city reserves, including Wrights Hill and Johnston Hill in Karori. These reserves are adjacent to Makara Peak and have well-developed, regenerating indigenous forest.

Monitoring is undertaken because birds in the city had begun to increase in both numbers and diversity as a result of habitat improvement and predator control (Miskelly *et al.* 2005). Species that had been locally extinct were reintroduced to Zealandia and Matiu-Somes Island in Wellington Harbour from 2000, and simultaneously self-colonised, probably from Kapiti Island, the Tararua Range and the Rimutaka Range (Miskelly *et al.* 2005). Birds that began to be seen in the Karori area for the first time in many years included korimako[1] (*Anthornis melanura melanura*), hihi (*Notiomystis cincta*), falcon (*Falco novaeseelandiae*), saddleback (*Philesturnus carunculatus rufusater*), whitehead (*Mohoua albicilla*), tomtit (*Petroica macrocephala toitoi*) and robin (*Petroica australis longipes*).

In 2011 Greater Wellington Regional Council (GWRC) and WCC reviewed the city bird monitoring programme and modified the survey design (McArthur *et al.* 2012). The revised programme, implemented by Greater Wellington, has a network of 100 bird count stations across Wellington and the Hutt Valley, eleven of which are in Makara Peak (Figure 4). The purpose of this monitoring programme is to describe trends in the diversity, abundance and distribution of indigenous bird species in Wellington and the Hutt Valley.

Makara Peak Supporters Surveys

Makara Peak Supporters are also monitoring birds in Makara Peak and have undertaken five-minute bird counts at 20 stations every three years since 2006 (Figure 4). Their goal is to monitor the presence and trends in abundance of indigenous bird species over time. Because they rely on volunteers to carry out the

[1] When Makara Peak opened in 1999 one of the local residents reported that a bellbird lived in the bush remnant 300 m south of the carpark. A bellbird was still resident and responded to taped bell bird calls in early 2001. At that time there was a nesting box up a miro tree. However the bellbird has not been reported since this sighting (S. Kennett pers. comm., 23 September 2013).

counts they cannot manage annual counts, and it is not always possible to carry out four counts at each station, or to use the same people for each count.

The stations are well distributed across the Park, mostly associated with indigenous vegetation. On average the stations are about 280 m apart, with the shortest distance being 140 m. This is sufficient to reduce the incidence of double counting the same birds.

The most common indigenous species observed during the Makara Peak Supporters surveys are: tūī (*Prosthemadera novaeseelandiae*), grey warbler (*Gerygone igata*) and silvereye (*Zosterops lateralis*) (Figure 5). This fits with other bird observations from across Wellington City and reflects the ability of these species to cope with a modified and fragmented forest habitat. It is expected that as more complex habitat develops at Makara Peak and neighbouring reserves, and as pest control continues, a greater number and diversity of indigenous birds will utilise the area and breed successfully. This trend is already evident in the survey results (Figure 5), despite a reduction in survey effort.

Figure 6 illustrates the frequency of non-indigenous bird species counted at the Makara Peak Supporters bird count stations.

Table 2 lists indigenous bird species recorded from Makara Peak during Council and Makara Peak Supporters five minute bird surveys, and from casual observations.

Table 2: Indigenous bird species recorded at Makara Peak 2006-2012 From five-minute bird count data (Makara Peak 2006, 2009, and 2012; Greater Wellington (GW) 2011 and 2012), from anecdotal reports (Nikki McArthur, GW, pers. comm.) and casual observations (Karl Yager Makara Peak Supporters pers. comm.). .

Common Name	Scientific Name	Threat Status[1]
Kākā	*Nestor meridionalis septentrionalis*	Nationally Vulnerable
Bush falcon	*Falco novaeseelandiae* "bush"	Nationally Vulnerable
Pipit	*Anthus novaeseelandiae novaeseelandiae*	At Risk-Declining
Kakariki	*Cyanoramphus novaeseelandiae novaeseelandiae*	At Risk-Relict
Korimako (bellbird)	*Anthornis melanura*	Not Threatened, but regionally rare
Fantail	*Rhipidura fulginosa*	Not Threatened
Grey Warbler	*Gerygone igata*	Not Threatened
Harrier Hawk	*Circus approximans*	Not Threatened
Kererū	*Hemiphaga novaeseelandiae*	Not Threatened
Kingfisher	*Halcyon sancta*	Not Threatened
Morepork	*Ninox novaeseelandiae*	Not Threatened
Shining Cuckoo	*Chrysococcyx lucidus lucidus*	Not Threatened
Silvereye	*Zosterops lateralis*	Not Threatened
Tūī	*Prosthemadera novaeseelandiae*	Not Threatened
Whitehead	*Mohoua albicilla*	Not Threatened

[1] Miskelly *et al.* 2009.

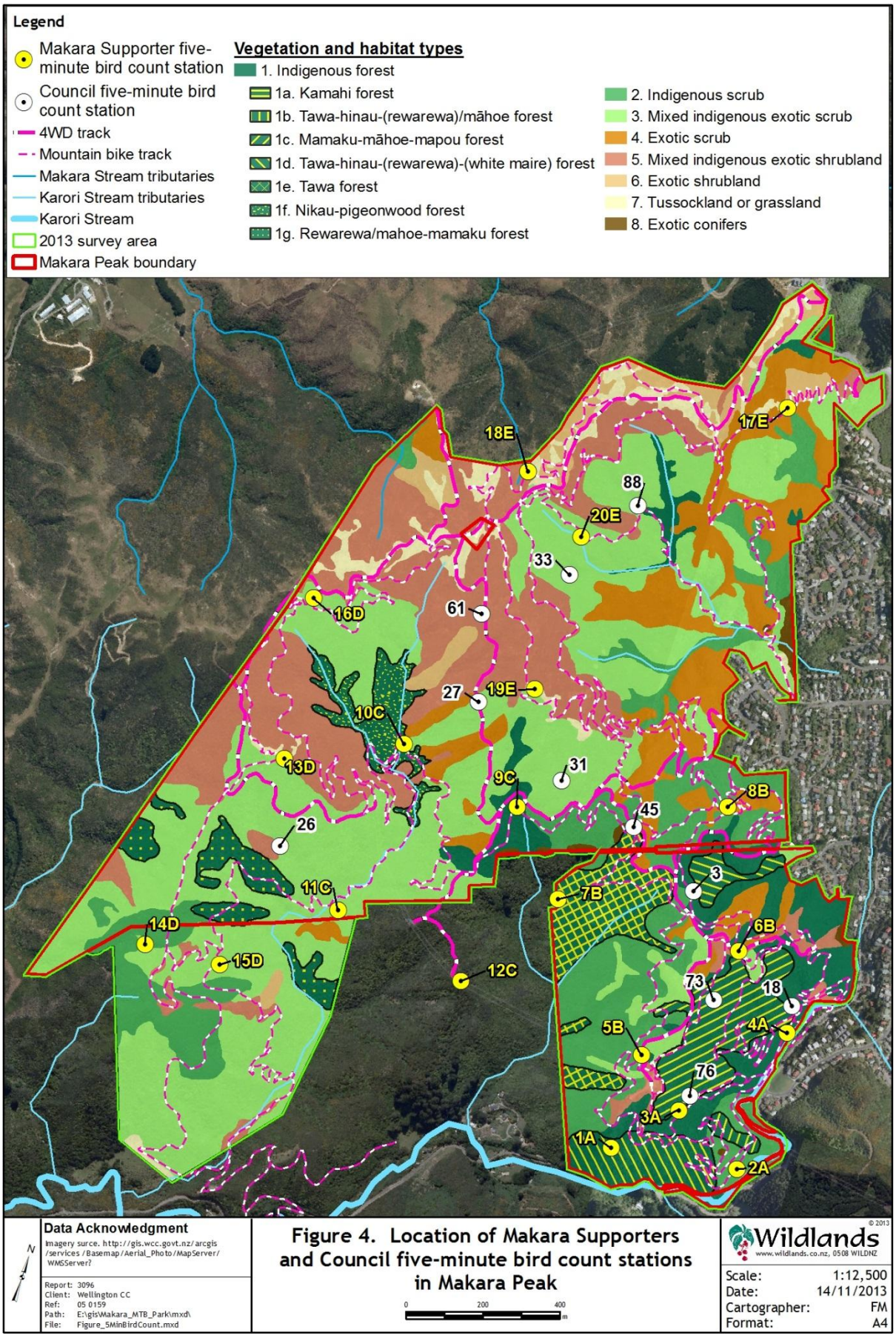

Figure 4. Location of Makara Supporters and Council five-minute bird count stations in Makara Peak

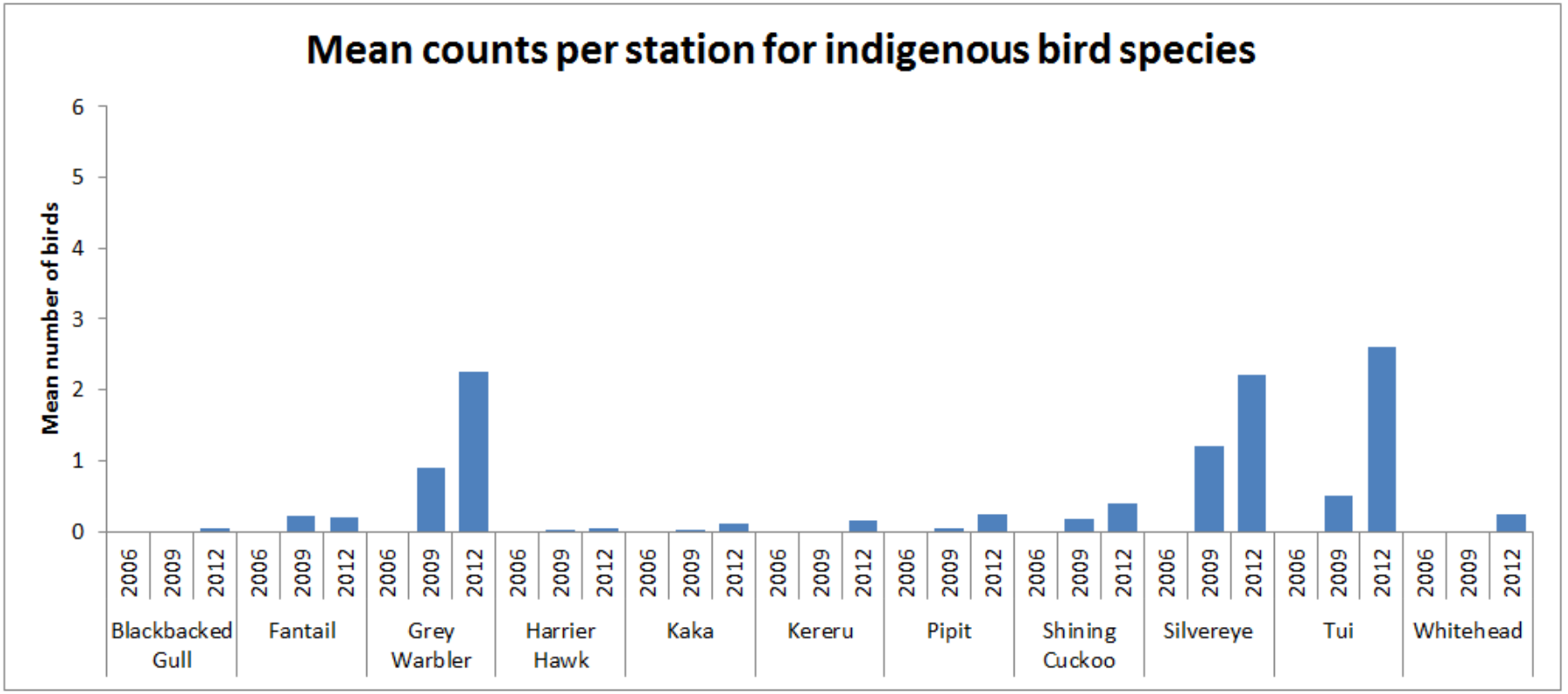

Figure 5: Mean number of bird counts for indigenous species per five-minute bird count station for the three survey years undertaken by Makara Peak Supporters.

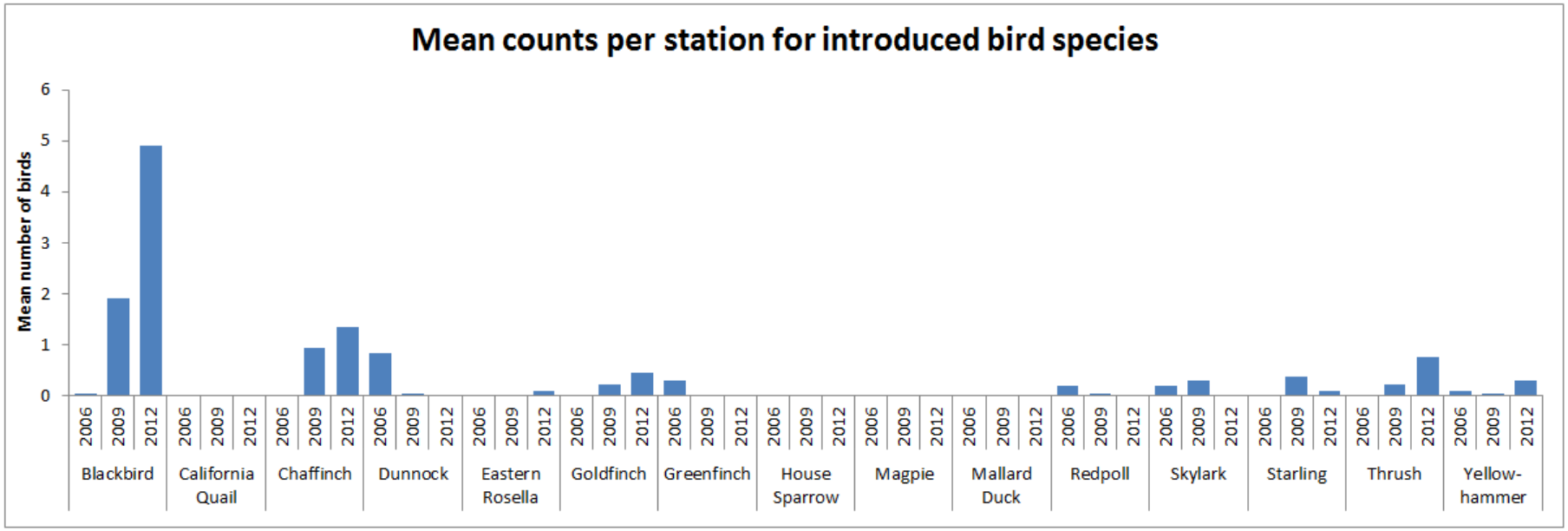

Figure 6: Mean number of bird counts for introduced species per five-minute bird count station for the three survey years undertaken by Makara Peak Supporters.

The relatively immature vegetation present on most of Makara Peak may provide only marginal bird habitat for some of the rarer species present at Zealandia (Karori Wildlife Sanctuary). Makara Peak is about one kilometre from Zealandia, which may limit the range of species that will use Makara Peak habitat, either permanently or intermittently. Nevertheless, uncommon indigenous species observed at Makara Peak to date include kākā, red-crowned parakeet[1], korimako[2] and whitehead. These species all have relatively strong dispersal abilities.

6.5.1 Bats

Long-tailed bats (*Chalinolobus tuberculatus*, Threatened - Nationally Vulnerable, O'Donnell *et al*. 2010) are occasionally recorded from Zealandia and surrounding areas (Wildland Consultants 2009). No bat surveys have been undertaken at Makara Peak, but it would not be surprising to find long-tailed bats within the more mature forest or foraging across shrublands, or on margins. A Park neighbour reported a cat eating a bat in 2003.

6.5.2 Lizards

Twelve lizard species occur on the mainland in the Wellington region (Romijn *et al*. 2012), and seven of these are known to occur at Karori (Table 3).

Table 3: Indigenous lizard species recorded at Karori, Wellington[3].

Common Name	Scientific Name[4]	Threat Status[5]
Brown skink	*Oligosoma zelandicum*	At Risk-Declining
Forest gecko	*Mokopirirakau* "southern North Island "	At Risk-Declining
Green gecko	*Naultinus punctatus*	At Risk-Declining
Ornate skink	*Oligosoma ornatum*	At Risk-Declining
Common gecko	*Woodworthia maculata*	Not Threatened
Common skink	*Oligosoma polychroma*	Not Threatened
Copper skink	*Oligosoma aeneum*	Not Threatened

Wellington City Council intends to undertake a lizard survey at Makara Peak in 2014.

6.5.3 Fish

There are no New Zealand Freshwater Fish Database NZFFDB database records for Makara Park. However, there are fish database records for the smaller tributaries of the Karori Stream (Figure 7 and Table 4).

1 McArthur *et al.* 2012.
2 GWRC unpublished data November 2012 survey.
3 Raewyn Empson, Zealandia pers. comm. 20/06/2013.
4 Gecko genera as per Nielson *et al*. 2011.
5 Hitchmough *et al.* 2012.

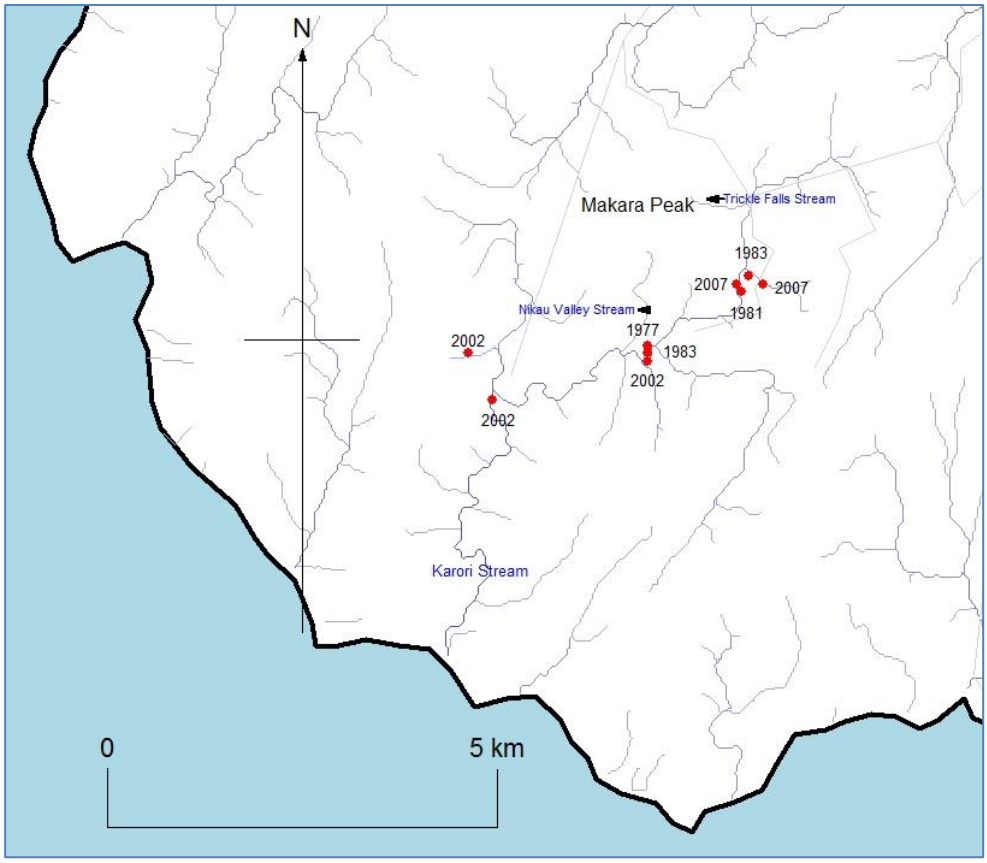

Figure 7: Karori Stream catchment with sites of previous fish surveys marked in red (NZFFDB), and the two sites surveyed in April 2013 marked in black.

Table 4: Freshwater fish found in the Karori Stream catchment (NZFFDB accessed 19 April 2013) (records 1977-2007). Species marked ***** were observed during the April 2013 survey.

Common Name	Scientific Name	Threat Status[1]
Inanga	*Galaxias maculatus*	Threatened Declining
Kōaro*****	*Galxias brevipinnis*	Threatened Declining
Piharau (lamprey)	*Geotria australis*	Threatened Declining
Longfin eel*****	*Anguilla dieffenbachia*	Threatened Declining
Banded kōkopu*****	*Galaxias fasciatus*	Not Threatened
Shortfin eel	*Anguilla australis*	Not Threatened
Upland bully	*Gobiomorphus breviceps*	Not Threatened
Brown trout	*Salmo trutto*	Introduced

Both the Nikau Valley Stream and Trickle Falls Stream were surveyed by spotlight in April 2013. Kōaro and banded kōkopu were observed in the Nikau Valley Stream, while only banded kōkopu were observed in Trickle Falls Stream. All fish populations had a wide size range, from juveniles to adults - kōaro (70-110 mm) and banded kōkopu (70-200 mm) - indicating no fish barriers and a healthy population structure. Two longfin eels (*Anguilla dieffenbachii*) of 500 and 700 mm respectively were observed in Trickle Falls Stream.

[1] Allibone *et al.* 2010.

6.6 Overview of ecological values

Makara Peak is ecologically important because it includes a relatively large area with a cover of indigenous vegetation, including some taller forest remnants. The ecological values are increasing through natural succesStion and the restoration and pest control work undertaken by the Makara Peak Supporters and Wellington City Council. It is also valuable because it connects to a range of other reserves, and is a substantial contribution to the size of the Outer Green Belt,

Makara Peak is considered to be a Key Native Ecosystem by Greater Wellington Regional Council. It is also recognised as an Enhancing the Halo project (http://halo.org.nz/makara-peak-heroes/), aiming is to make Wellington New Zealand's natural capital by making all backyards into safe havens for indigenous wildlife.

Bird species already seem to be increasing in both number and diversity and this is likely to continue if animal pest control is maintained (and in some instances improved). Makara Peak could become valuable additional habitat for the rarer species that have been reintroduced to Wellington via Zealandia. As well as a range of bird species and freshwater fish, and Makara Peak is likely to support populations of lizards and long-tailed bats.

Populations of fauna will continue to increase and become more diverse if pest animal management is maintained and enrichment planting is continued.

7. MANAGEMENT TO DATE

Each year the Makara Peak Supporters prepare a conservation plan that briefly outlines the work proposed for the coming year, with associated costs and funding sources. The management summaries below are drawn, in part, from the conservation plans that were available.

7.1 Track maintenance and creation

Currently there is 8 km of 4WD track and 35 km of purpose-built single-track mountain bike tracks (Appendix 5, Figure 5.1; Appendix 5, Plate 5). Single-track routes have been designed for a wide range of abilities, from beginner to expert.

A new track from the end of Sally Alley to the start of JFK is planned to be built during the period 2013 to 2015. New tracks are always popular and, provided that existing tracks are maintained, it is likely that there will be ongoing track contruction at a rate of about 0.5 km per year. Bridges are preferred where tracks cross streams, but there is at least one ford, on the Nikau Valley Track.

Once built, tracks can deteriorate from use and heavy rainfall, and vegetation grows over them. Most tracks require the efforts of half a dozen people for a day or two per year to be kept in good condition. Users are encouraged to adopt a track. Makara Peak Supporters can provide tools, notify a construction or maintenance day via the

website, provide experience and advice, and coordination with Wellington City Council and other track people.

Some tracks are more popular than others - such as Ridgeline, Trickle Falls, Leaping Lizard, and Livewires - and are maintained on a regular but casual basis. Some tracks are maintained in advance of important events, such as the Creek to Peak Relay. However, not all tracks are well-used or well-maintained, and it can be difficult to get volunteer help for track maintenance.

As plants become larger, some of the species planted along tracks are proving to be somewhat problematical. For instance, flax (harakeke and whararikі) leaves can be very slippery and can be caught in wheels or chains. Shrubs that grow laterally, rather than upwards, need to be trimmed more frequently. Most species will grow laterally to a certain extent when next to a track, as plants tend to grow towards light. Where a track is close to a steam, erosion can contribute to sediment input into the stream. Another potential issue, for new users, is adequate, or sufficiently obvious, signage to direct people along the correct tracks.

7.2 Pest animal control

The goal is to control possums, goats, feral sheep, rabbits and stoats, and monitor pigs (year round with focus on spring season). With possums under control (less than 5% RTC) in Makara Peak, goats are the most significant threat to ongoing conservation efforts (Appendix 6, Plate 15).

Wellington City Council, as landowner, is jointly responsible with the Makara Peak Supporters for pest control within Makara Peak. Both Wellington City Council and Greater Wellington Regional Council support pest control within Makara Peak financially and/or logistically. Ideally, pest control would be coordinated with other nearby conservation minded groups, in particular Friends and Residents of Karori Stream (FROKS) and the Karori Wildlife Sancturary (Zealandia).

7.3 Weed control

Weed control is focused on two main outcomes: removal of overtopping non-indigenous plants from around newly-established seedlings (i.e. releasing), and controlling specific weed species or weed control in specific locations. Releasing is usually undertaken from October through to early December. Volunteer work parties are supported by barbeques or pizza evenings.

Site-led projects within Makara Peak include areas near the South Karori carpark, and along Karori Stream. They mostly target species such as African club moss, to try and keep it under control. Along the northwestern boundary of the Park the focus is on reducing the density of gorse, to reduce fire risk. Species-led projects include drilling and poisoning pines and cherry trees, and controlling groundcover weeds such as tradescantia. Where possible, areas that have been cleared of weeds are planted up with indigenous species, and this has commonly been undertaken after blackberry clearance,

7.4 Planting

It is estimated that, between 1998 and 2012, approximately 35,000 indigenous plants have been planted throughout Makara Peak. Planting has focused on:

- Park entrances (South Karori Road carpark (title page photograph) and Karori Stream (Appendix 6, Plate 11), near the water tank on Makara Road (Appendix 6, Plate 10), Allington Road, and St Albans Avenue);
- Reducing barberry and maintaining views from Makara Peak (e.g. low-growing species such as flax have been planted) (Appendix 6, Plate 9);
- Preventing the establishement of gorse and barberry in pasture;
- Reducing fire risk at the northern end of Makara Peak;
- Along cycle tracks.

There are many different reasons for planting:

- Reintroduction of species, such as podocarps, that are missing or sparse at Makara Peak.
- Providing food sources for birds and other animals, by planting fruit- and nectar-producing indigenous species.
- Reducing the fire risk by interplanting gorse with less flammable species.
- Increasing the dominance of indigenous species by interplanting gorse and Darwin's barberry.
- Reduction of track-side mowing by planting indigenous shrubs and flax.
- Beautification of areas using indigenous species, especially near the South Karori Road carpark.
- Reducing weed dominance by planting with indigenous species after weed control has been undertaken.
- Providing shelter in exposed places and along exposed tracks.

Plantings are released one year after establishment, and also again in the subsequent year if required. Releasing from blackberry and other woody weeds can be ongoing; in some places this is still an issue after 14 years. Trimming of plants is undertaken to keep tracks clear, and to create light wells where canopy species have been planted in the understorey.

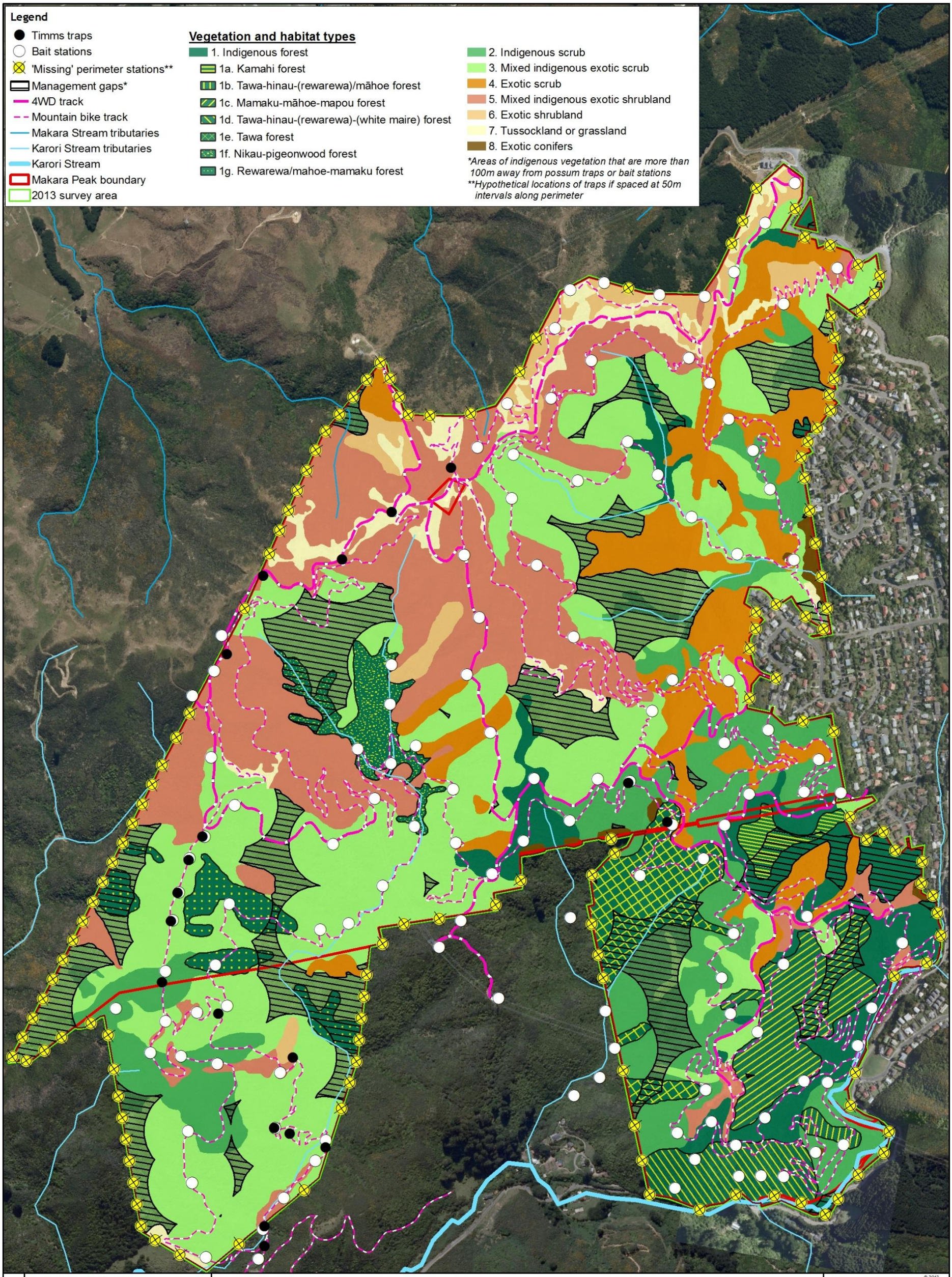

Figure 8. Location of possum control stations and identification of management gaps

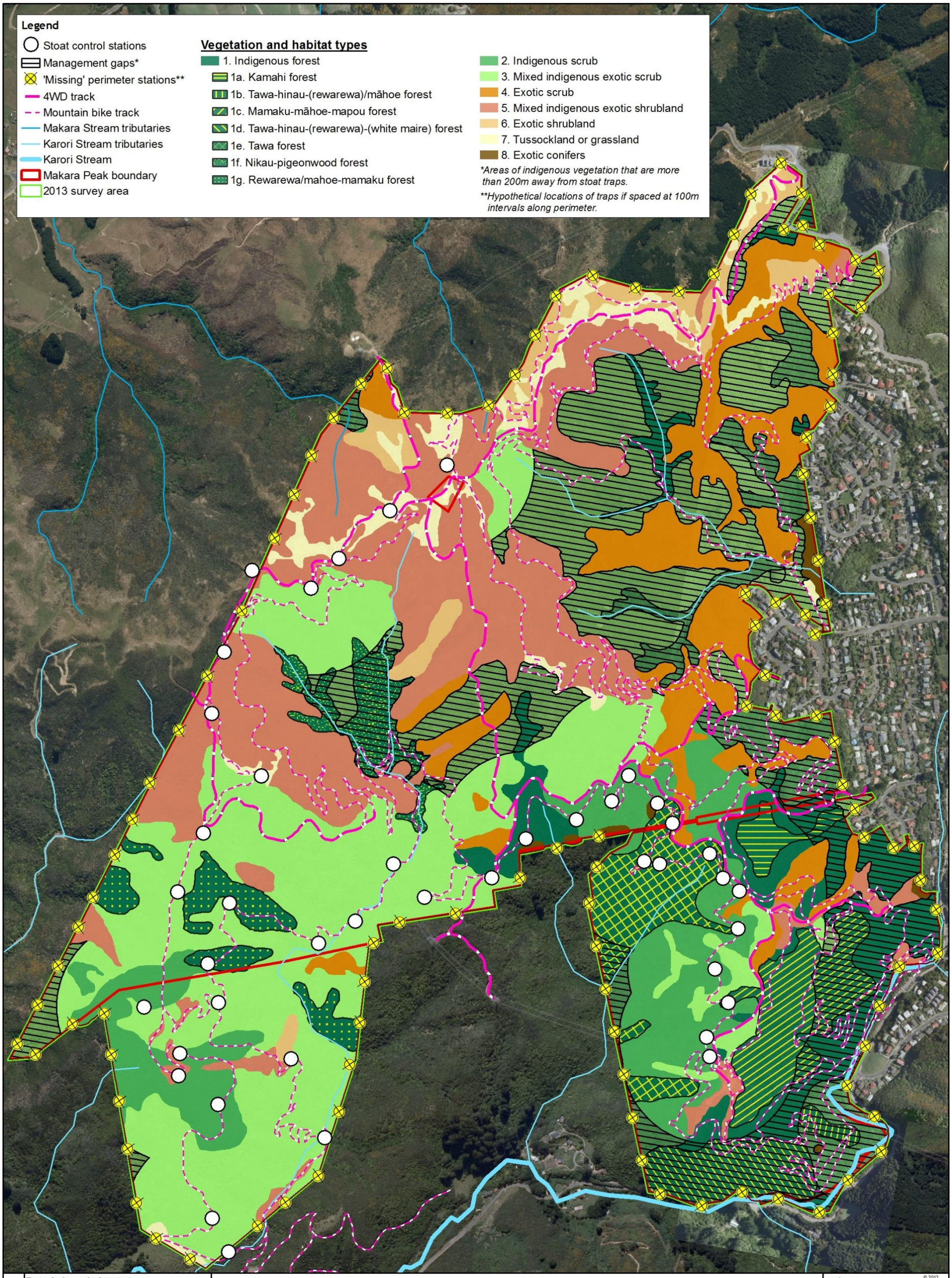

Figure 9. Location of stoat control stations and identification of management gaps

7.5 Reduction of fire risk

Rank grass and gorse can be a significant fire hazard during dry conditions. If a fire were to start within Makara Peak then good work undertaken to restore indigenous ecosystems would be lost. Makara Peak Supporters have been reducing the density of gorse along the north western boundary, in part to reduce the fire risk. Planting of the more open upper slopes with shrubs will also assist with reducing the amount of rank grass available.

There is no literature available on the relative flammability of Darwin's barberry, but a related species, Japanese barberry (*Berberis thunbergii*), does not appear to increase the fire hazard[1]. During 1999 the Makara Peak Supporters were informed by the WCC rural fire control officer that Darwin's barberry was not considered a particularly flammable species. Also, fire is not likely to be a useful management tool for Darwin's barberry as the information available on the related Japanese barberry shows that fire is likely to only top-kill Japanese barberry, doing little damage below ground. Japanese barberry is likely to sprout from the root crown or rhizomes after fire, as was observed after prescribed burning and cutting treatments in Massachusetts forests.

7.6 Habitat enhancement for fauna

Birds

The current management practice for birds at Makara Peak consists of planting to increase and improve habitat, and to provide more sources of food, and control of pest animals to increase bird survival. The 2001 management plan had a goal to encourage kererū and other indigenous birds. Discussions in February 2013 with the Makara Peak Supporters identified that they would also like to see korimako (bellbird) established and abundant in the Park.

In addition to these species, it may be possible, over time, to encourage other species to recolonise Makara Peak. Zealandia, about one kilometre from Makara Peak, has established new colonies of species that have been absent from Wellington for many years: kākā, whitehead, tomtit, robin, korimako, and saddleback (Miskelly *et al*. 2005). The area between Makara Peak and Zealandia is mostly covered with indigenous scrub or pine forest, and this may allow birds to move into the Park from Zealandia as part of the halo effect[2].

Mobile species - such as kākā and falcon - can easily travel between Zealandia and Makara Peak. A falcon has been regularly seen at Makara Peak over the last year, and they may establish and breed at Makara if conditions are suitable.

Less mobile species may take longer to reach Makara Peak. Their arrival may depend on suitability of habitat and the level of pest animal control undertaken between the

[1] http://www.fs.fed.us/database/feis/plants/shrub/berthu/all.html#FIRE%20ECOLOGY

[2] A halo effect is when there is spill over from a colony as populations increase, local food sources are depleted and competition increases for nesting sites (Miskelly *et al.* 2005, Froude 2007, McArthur *et al.* 2012).

two sites. However the George Denton/Waimapihi/Polhill area, immediately to the east of Zealandia, was thought to be an area of marginal bird habitat, due to low plant species diversity and the immaturity of the regenerating forest. Nevertheless, saddleback pairs and robins have established territories there and a pair of kakariki successfully fledged young there in the 2012-2013 season (Matiu Booth pers. comm. 11 March 2013).

Lizards

The current management regime is to improve habitat for lizards with planting and pest control. Indigenous forest free from browsing pest animals is expected to enhance the success of any existing lizard populations.

Other Fauna

No monitoring or management is currently specifically undertaken for other fauna species.

7.7 Monitoring

- Tracks are monitored and repaired, to ensure that they are safe to use. Track repair equipment is stored close to the site, for easy access.
- Possum bait stations are checked seven or eight times per year. Timms traps are checked weekly. Some records are kept of bait take and bait condition for bait stations or the species caught for each Timms traps.
- Species caught in stoat traps are recorded for each trap.
- Vegetation in the goat exclosures is assessed using photopoints. These were set up (in June/July 2000) and more sets of photographs were taken at random times a few years later. The final set was taken in November 2012 (but from a different angle) because the original photopoints had overgrown. Informal height estimates are currently used to monitor progress[1].
- Five-minute bird counts are undertaken every three years by the Makara Peak Supporters, and annually by Greater Wellington Council.

8. MANAGEMENT PROPOSED 2013-2018

Makara Peak Supporters have been doing a fantastic job of managing Makara Peak as a mountain bike park and improving the biodiversity values within the Park, working collaboratively with WCC. They have achieved many of their goals and this section sets out targets and approaches for the next five years to address threats and to continue to enhance biodiversity values. Key threats to the Park are weeds, pest animals, fire, and inappropriate track development.

[1] "We simply stand on the edge of the exclosures and look up at the top of the kahikatea and other planted species. The quicker our necks get sore, the happier we are." (Simon Kennett pers. comm 23 September 2013)

8.1 Targets 2013-2018

Goals for the management of Makara Peak were developed in discussion with Makara Peak Supporters (Section 0). Targets have been identified to support the goals and continue enhancement of biodiversity values within the Park:

- Identify routes for new mountain bike tracks.
- Identify areas that require additional pest animal control .
- Maintain possum numbers at a residual trap catch rate of 5% or less.
- Maintain effective mustelid trapping, to provide safe breeding habitat for birds within Makara Peak.
- Work with Wellington City Council and neighbouring landowners to control the goat population to less than five goats in total within Makara Peak and maintain a 200 m wide goat-free buffer zone around Makara Peak.
- Work with Wellington City Council to achieve zero-density of feral stock and pigs in Makara Peak.
- Identify key weed species and locations, then work with Wellington City Council and neighbours to manage and reduce weed pressures. Educate neighbours about weed disposal via garden waste.
- Identify high fire-risk areas and plant these with fire-resistant indigenous species.
- Identify and record (map) areas within Makara Peak where views and open areas are to be maintained.
- Continue to increase the diversity of canopy and understorey species, using ecosourced species ecologically appropriate to Makara Peak, as opportunities arise. Aim to plant at least one tree for every metre of new track created.
- Encourage a wider range of bird species to breed in the Park by creating suitable habitat and maintaining pest control. Identify potential core habitat for key species and focus on improving the diversity of food-producing plants and reducing pest animal numbers in these locations. The five year focus is to increase bellbird within the Park.
- Gain a better understanding of restoration processes at Makara Peak through ongoing monitoring of plants and animals.
- Establish lizard and bat monitoring.
- Improve the legal protection of the WCC water treatment land at the southern end of the Park. The land is currently scenic reserve, managed by the Parks and Gardens section of WCC.

8.2 Summary of actions proposed 2013-2018

This section summarises the actions that will help to achieve the targets (Section 8.1) and thus attain the goals identified by the Makara Peak Supporters. Subsequent sections (Sections 8.3 to 8.10) explain the rationale for these proposed actions in more detail. They have been collated below to make the action points easier to locate in the document.

Track Maintenance and Creation

- Identify the purpose for any new tracks and ensure that they are carefully planned to fulfill that (those) purpose(s).
- Improve sediment capture or redirection of sediment on tracks near streams.
- Identify track-friendly plant species for future planting.

Pest Animals

- Continue to work with Wellington City Council to control goats.
- Work with Wellington City Council and neighbours to ensure that fences are in good condition.
- Identify areas where fences need to be built or upgraded.
- Use corflute plant shelters to protect seedlings from rabbits.
- Keep a record of anecdotal observations of rabbits and rabbit damage, and control using rabbit-specific toxins if required.
- Work with Wellington City Council to control pigs and educate neighbours about how to recognise pig damage so that it can be reported and acted upon promptly.
- Identify core habitat where rat control may be warranted. Set up rat control lines and monitor success: bait take, catch records, wax tag lines, or other tracking indices.

Possums

- Set up additional possum bait station lines, or relocate stations, to improve coverage.
- Record bait take from possum bait stations (full, half-full, bait empty, bait mouldy) and kills from traps. After one year, analyse results using spatial analysis to determine hot spots. Review baiting and trapping effort, if required, to better deal with possum hotspots.
- Continue with annual possum bait/trap monitoring, review of hotspots, and refining location of bait stations or traps.
- In collaboration with WCC, undertake Residual Trap Catch (RTC) monitoring of possums every five years to ensure the capture index is 5% or less.

Mustelids

- Review the locations of mustelid traps. Set up additional trap lines, or relocate traps, to improve coverage.
- Record kills from mustelid traps. After one year, analyse results using spatial analysis to determine hotspots. Review trapping effort, if required, to address hotspots more effectively.
- Continue with annual monitoring of mustelid traps, review of hotspots, and refine trap locations.

Increased Fauna Diversity

- Consider the use of artificial cover objects to monitor the presence and relative abundance of lizard species.
- Undertake a survey of bats within the Park, preferably using automatic bat boxes, and repeat at five-yearly intervals.
- Raise awareness with neighbours about in-stream water quality and species present in the streams.
- Involve neighbours in the 2014 Bioblitz, to increase their awareness of and support for Makara Peak.

Birds

- Continue the planting of indigenous species with fruits of various sizes, nectar-producing flowers, or leaves with high nitrogen content. For korimako, focus on species with fruits up to about 9 mm and moderate to large nectar-producing flowers.
- Identify potential core bird habitat areas (more mature indigenous vegetation) and consider undertaking more intensive pest animal control in these areas, including rat control, during the main bird breeding season.
- Combine and share bird monitoring data with Greater Wellington Regional Council and Wellington City Council.

Weed Control

- Map the locations of key weed species, undertake control, monitor effects of control, and replant any canopy gaps.
- Undertake annual or bi-ennial surveys of road and track ends, along boundaries and where seedlings are grown or stored. Control environmental weeds to prevent further spread.
- Work with landowners at road ends, to educate local residents about management aims in the Park and how they can help.

- To hasten the transition from Darwin's barberry-dominant vegetation, plant clumps (nodes) of indigenous species in and amongst the barberry, especially in any open areas. Another method is to selectively cut and poison barberry where indigenous species have already established, to increase the dominance of indigenous species.

Planting

- Identify which areas are to be planted, and which areas are to be kept clear, and the reason(s) for keeping them clear, e.g. view shafts, overhead power lines.
- Use species ecologically appropriate to Makara Peak and match species to the habitats and site conditions where they are planted.
- Keep a record of which species do well under particular circumstances, to help inform future planting and volunteers.
- Monitor the success of future planting, including whether the planting achieved the goals set for that area.

Reduction of Fire Risk

- Identify areas most at risk from fire, such as boundaries, along tracks, beneath pylons, other infrastructure, large areas of gorse or rank grass, and plant low-flammability species to reduce fire risk.

8.3 Track maintenance and creation

Further track construction should be planned carefully and limited to areas dominated by exotic vegetation. An exception would be to facilitate access to areas of indigenous vegetation that have been identified as requiring pest and/or weed control. In this instance, key features should be identified prior to construction and the track routed to avoid these features. If possible, maintain at least 5 m between a stream and a track, to reduce the potential for sediment input. Stream crossings should be bridged, rather than forded.

Where existing tracks sidle closely alongside streams, reduce run-off from the tracks to minimise sediment input. This can be achieved by capturing surface runoff to a sediment settling pond, changing the camber so that sediment does not flow directly into the stream, and/or increasing ground cover vegetation density between the track and the stream, to help capture any sediment.

A range of plant species have already been planted alongside tracks. Identify species that are proving problematical (e.g. slippery harakeke leaves, rapid lateral growth that needs continual trimming, spikey, or hard landing) and which species are track friendly (slower or lower-growing, upright growth forms, soft landing). Species that match the latter characteristics are to be used for future trackside planting.

8.4 Pest animal control

Pest animal control is undertaken to promote ongoing improvement of indigenous vegetation and to protect indigenous fauna species.

Pest animal control can be time- and labour-intensive so, for species such as possums, rats, and mustelids, it is worthwhile monitoring the development of new technology, such as self-resetting traps. However, there are still technological 'bugs' with these traps, so there may be no advantage to switching until problems are resolved. Also self-resetting traps are considerably more expensive than bait stations and traditional traps, and additional funding is likely to be required.

Goats

Goat control is undertaken to protect vegetation condition, recent plantings, and understorey composition.

Continue to work with Wellington City Council to manage goats. Find ways to convince all neighbours to allow goat control on their land, to reduce reinvasion of Makara Peak.

Possums

Control of possums is undertaken to protect possum-palatable plant species and nesting birds (including species as large as kererū) and invertebrates (c.f. Nugent *et al.* 2000).

Bait stations (and traps) should be placed no more than 150 metres apart (i.e. one per 2.25 hectares) in forest habitats[1]. Ideally they would be laid out on grids by compass bearing, or in rough terrain, placed on ridges and spurs with additional lines located on 100 metre contours (using an altimeter). Spacing should be established as precisely as possible since inaccurate location of lines may result in pockets where high possum numbers can persist. Along forest-pasture margins and operational boundaries, bait stations should be positioned at 50 m to 100 m intervals, to reduce reinvasion. As shown in Figure 10 (possum bait stations) there are gaps where topography or vegetation type makes site access difficult. For these areas, consider placing several bait stations or traps nearby, to ensure that all possums can encounter a station.

Bait stations should be attached on the dry side of trees, with the opening 25-30 cm above the ground, to optimise use by possums and avoid rain and water splashing off the ground and affecting bait quality.

Alternation of bait types, toxins, lures and techniques is important in ongoing control programmes. Continuous use of a single pesticide is not recommended as it can result

[1] More information on best practice bait station placement can be obtained from the local Department of Conservation office, the pest control officer at Wellington City council or in http://pestdss.landcareresearch.co.nz/Content/BestPractice/7%20Possums%20-%201080%20carrot%20or%20apple%20in%20bait%20stations.pdf

in bait-shyness. Other environmental effects also need to be considered. Brodifacoum is supplied by WCC, but can accumulate in soils and animals (Department of Conservation 2007) and, as a precaution, is not recommended in areas where people hunt to consume game (Eason *et al.* 2001). Brodifacoum is biodegradable but this process takes weeks (or months in some circumstances) rather than days as in the case of 1080 (Ministry for Primary Industries 2013).

Careful recording of the amount of bait used and retrieved can allow better estimates of future needs, and help to better target which bait stations need to be serviced less frequently or more often. High rat numbers may affect bait take and higher application rates may be needed to compensate for baits eaten by rats.

Possum reinvasion into controlled areas can be reduced by using natural boundaries, such as waterways and pasture, and treating buffer zones at least three kilometres wide, although this would be difficult at Makara Peak. Reinvasion is usually through juvenile dispersal and is most likely to occur during winter and spring (Cowan and Clout 2000, Fletcher and Selwood 2000), so a concerted baiting effort during August to November may be sufficient if possum numbers are already low. It may also be possible to improve effectiveness by placing bait stations near known possum-preferred food sources, e.g. mahoe forest, areas of tree fern or five finger.

Mustelids

The main focus of mustelid control is to protect fauna species. Birds are most at risk during breeding and until the young have fledged. During the nesting season, birds often have relatively small territories centered on key food sources. It is likely that the best food sources are associated with patches of indigenous vegetation, although adjacent gardens may provide additional sources.

Ideally[1], trap lines should follow habitat perimeters, ridges, tracks, altitudinal contours, or waterways. Trap lines will protect a strip approximately 400m either side of the line. Traps set 100-200 m apart should ensure that female stoats are put at risk of being caught. Set trap stations about 50 metres apart in areas where threatened bird breeding (e.g. kākā) is likely to occur. As shown in Figure 11 (stoat traps), not all of areas of indigenous vegetation are covered by the current stoat trap deployment.

Timing of trap inspections can vary from weekly, or more frequently, during high stoat and/or rat numbers and key parts of the breeding season to 6-12 weeks at sites or in seasons when stoat numbers are low or when lures are not rotting. Maximum stoat numbers and dispersal occurs from late October to February and young stoats travel about with their mother and later disperse independently (King and Murphy 2005). If records are kept of catches then it may be feasible to adjust the frequency of trap inspections based on capture rates: more frequently for traps with high capture rates, and less frequently for traps that hardly catch anything, or seasonally as stoat numbers fluctuate.

[1] More information on stoat trapping best practice is presented at www.predatortraps.com/downloads/techniques_stoat_trap.doc

Sheep

Sheep are excluded to protect understorey plant species.

Work with Wellington City Council and neighbours to ensure that fences are in good condition: undertake an annual fence inspection and report findings to WCC. Identify areas where additional fencing may be required. Report any sightings or sign of stock to WCC for them liaise with landowners (or to remove animals).

Rabbits

Rabbits damage plants and kill seedlings, and can damage tracks.

Continue to use corflute tree protectors to protect seedlings. Keep a record of anecdotal observations of rabbits and rabbit damage. If levels appear to be increasing, consider the use of rabbit-specific toxins at that particular location to reduce rabbit numbers, and impacts.

Pigs

Pigs can damage tracks and understorey species. They are omnivores and consume fruits, roots, invertebrates, large snails, lizards, frogs, eels, ground-nesting birds and eggs, mice, rats, young rabbits, and carrion (McIlroy 2005).

Report any sightings or sign to Wellington City Council, for them to undertake hunting. Work with Wellington City Council to educate neighbours about pig impacts and encourage them to ring Wellington City Council if they see pigs or anybody releasing pigs.

Rats

Rats eat a wide range of invertebrates, fruits and seedlings (c.f. Wilson *et al.* 2003), and are known to prey on eggs and chicks (Innes 2005a, 2005b). Rat numbers have been known to increase where possums are being controlled (e.g. Sweetapple *et al.* 2006, Sweetapple and Nugent 2007) and this has resulted in increased consumption of seeds, fruits and invertebrates (Sweetapple and Nugent 2007), and may give rise to increased predation of birds and lizards.

Undertaking rat control across all of Makara Peak will be too time consuming to undertake with volunteers. It is suggested that core areas are identified, and that effort is focussed on these areas. Core areas are likely to be patches of more mature vegetation that are more attractive to indigenous bird species (and rats), and support a greater diversity and population of lizard and invertebrate species.

Within core areas, the spacing of traps or bait stations should be no greater than 100 m × 25 m apart with perimeter traps or bait stations 25 m apart[1]. Place the traps or bait stations on grids by compass bearing or, in rough terrain, along ridges and

[1] Summarised from http://pestdss.landcareresearch.co.nz/Content/BestPractice/24%20Rats%20-%20kill%20trapping.pdf

spurs with additional lines located on 100-metre contours (using an altimeter). Spacing should be established as precisely as possible as gaps in coverage can result in pockets of high rat numbers.

Timing of servicing for bait stations or traps is critical, and depends on what is being protected. For ongoing ecosystem management, timing should be related to rat-tracking indices and the vulnerable periods of those components in the system being protected. For example, to protect korimako during the breeding season, rat indices must be low while the korimako are on the nest and until the chicks fledge. To protect invertebrates and lizards, rats should be controlled year-round.

For traps, they should initially be checked every 1-2 days because a trap with a dead rat in it is not available to catch others. Bait stations may need to be filled fortnightly initially, subject to bait-take. Once knockdown has been achieved, as indicated by low catch-rate or low bait-take, and verified by tracking tunnel data, traps only need to be checked once every 2-3 weeks and bait stations filled monthly. When rat numbers increase, trap-checking frequency and bait filling frequency also needs to increase.

8.5 Increased fauna diversity

Makara Peak is part of a significant green belt. Increasing fauna diversity within Makara Peak will contribute to the biodiversity of the surrounding areas, and vice versa. Additionally, there will be opportunities to work with neighbouring groups - such as FROKS - Friends and Residents of Karori Stream, and Karori Wildlife Sanctuary - to improve ecological corridors between Zealandia, Wrights Hill, Johnsons Hill, and Makara Peak.

Birds

Increased presence of kererū and korimako in the Park have been identified as goals by Makara Peak Supporters. Resident kākā[1] may also be feasible within a 5-10 year period.

To attract target bird species, continue to diversify habitat character with appropriate indigenous canopy and understorey species. Kererū prefer large fruits (more than 1 cm diameter), and nitrogen-rich flowers and foliage. Korimako are generalist feeders that eat fruits (up to about 9 mm diameter) and nectar, but prefer insects during breeding season. Kākā are also generalist feeders (fruit, nectar, insects) but they can tackle larger fruits and cones with their tough beaks, and dig grubs out of rotting wood (Heather and Robertson 1996, DOC bird website 2013).

Continue to undertake possum and mustelid control, as introduced predators are a key cause of decline for indigenous bird species. Control of rats may also be required to ensure successful establishment of smaller bird species, and even kererū can abandon nests due to rat interference. One option is to undertake more intensive control of mustelids, possums, and rats within core, good quality, bird habitat, to increase the breeding rates of birds using that habitat, and to make it more attractive to additional

[1] Kaka are already occasionally seen within Makara Peak.

species. Consider increasing effort or, alternatively, focusing pest control effort during the main bird breeding season.

Depending on food availability, kererū, korimako, and kākā can all nest from September through to April. Korimako can raise two broods over this period and they prefer to nest in trees with dense foliage, for cover. The female incubates and both parents will feed the chicks. Korimako are strongly territorial during the breeding season (Heather and Robertson 1996, DOC bird website 2013).

Kākā nest in tree hollows, and incubation is carried out solely by the female, potentially putting her at greater risk of predation. Male kākā help feed and rear the chicks, and it can take five months before they are independent. In areas away from tracks and other structures, it may be beneficial (although unslightly) to leave dead pine trees standing to provide potential future nest holes and a source of grubs (c.f. Heather and Robertson 1996, DOC 2013). Consider the use of nest boxes for kākā. Collaborate with Zealandia to identify suitable locations and the best next designs.

Kererū build a flimsy nest of sticks and lay one egg at a time, but can have several nests in a season, depending on food availability. Incubation is shared between the male and female, and both will defend preferred food sources within their territory. Distinctive swooping dives are usually associated with breeding (including nest failure) (Heather and Robertson 1996, DOC 2013, Mander *et al*. 1998).

Lizards

A lizard survey is scheduled for 2014, as part of a wider Wellington City Council project[1]. This will help to identify which species occur within Makara Peak, and where they are most likely to be found. Following the survey, it may be worthwhile to set up lizard monitoring using artificial cover objects (as per Lettink and Cree 2007, Lettink 2013) in target areas. It should be noted that lizard recovery rates can be slow, and may depend on the level of pest animal control undertaken.

As well as pest control, planting of species with small fruits and nectar-producing flowers, or species with a tangled (divaricating) growth form, may help to increase lizard abundance.

Invertebrates

Makara Peak Supporters have indicated that there is interest in finding out more about terrestrial and stream invertebrates within Makara Peak. Correct identification of terrestrial invertebrates, in particular, can be difficult and time-consuming.

A Bioblitz is scheduled for 2014. During a Bioblitz participants identify as many different species as possible within a designated area and within a fixed (usually 24 hours) time period. The Bioblitz is scheduled to coincide with the 15th anniversary of Makara Peak (March 2014). Such a Bioblitz will significantly improve the knowledge of the invertebrate fauna within Makara Peak, along with other biota.

[1] http://wellington.govt.nz/your-council/news/2013/02/spotted-any-lizards-lately

Aquatic Species

The range of aquatic species in a stream depends, to a large degree, on habitat quality. There may be opportunities to work with neighbouring groups - such as FROKS - to improve water quality in the Karori Stream catchment and raise awareness of water quality issues. This could perhaps be undertaken as part of the Bioblitz, or as a separate programme using annual spotlighting for fish, to increase people's awareness and interest.

Bats

If possible, borrow and deploy automatic bat boxes over the period December to February, to determine whether bats are using the Park. Depending on the number of bat passes recorded, it may be worthwhile to search for roosting trees. Long-tailed bats tend to move frequently between roost trees, but if a tree is regularly used then it may be worthwhile undertaking intensive pest control (including cat trapping) anound such a roost. If resources (especially bat boxes) are available, consider undertaking annual monitoring, where bat boxes are deployed for up to one month each year. This will provide ongoing information on the presence of any local bat population.

8.6 Weed control

Research has shown that it is difficult for Darwin's barberry (*Berberis darwinii*) to invade intact indigenous forest, probably because seedlings require relatively high light environments to establish successfully (McAlpine & Jesson 2008). Although Darwin's barberry can produce copious quantities of bird-dispersed seeds, research has also shown that first year survival of Darwin's barberry seedlings is low in intact forest where canopy openness is 10% or less (McAlpine 2005).

Adult plants are, however, relatively-shade tolerant and can survive being overtopped by other species (Allen 1991). So seedlings that establish in light gaps can grow to maturity and persist for many years, but adult plants appear to produce few flowers when growing in the shade, so such pockets of persistence do not necessarily become a source of further invasion (McAlpine and Wotton 2012).

At Makara Peak, areas of Darwin's barberry are being colonised by indigenous species (Appendix 6, Plate 4). Planting of clumps (nodes) of indigenous species in and amongst extensive areas of Darwin's barberry may hasten colonisation and eventual dominance by indigenous species. Use existing clearings whenever possible (e.g. Appendix 6, Plate 8). Of lesser priority, and subject to availability of resources, small areas of Darwin's barberry can be killed (cut the stem and wipe with Vigilant herbicide or equivalent, Ward & Henzell 2004) and these new clearings can then be planted some months later. Alternatively, cut and paste Darwin's barberry in areas where indigenous species have colonised to give indigenous species an advantage. Darwin's barberry is unlikely to be a fire risk (see Section 7.5 above).

The locations and extent of key weed species should be mapped (more detail provided in Appendix 6). Then, jointly with the landowner Wellington City Council, undertake control of these species and monitor success. When an infection has been cleared

from an area, any gaps need to be planted up with indigenous species to prevent weeds from re-establishing[1]. Appendix 4 provides additional information on the relative priorities for weed control, and which species to target first. Key weed species at Makara Peak include:

- Buddleia (*Buddleja davidii*) can form dense hard-to-control stands but a biocontrol agent is now available (it is overtopped regardless);
- Broom (*Cytisus scoparius*) unlike gorse broom is not always successfully overtopped by other species;
- Elaeagnus (*Elaeagnus* ×*reflexa*) along track just inside the St Albans Avenue entrance; very hard to control (Appendix 6, Plate 14);
- Montbretia (*Crocosmia* ×*crocosmiiflora*) can form very dense stands; hard to eliminate all bulbs;
- Japanese honeysuckle (*Lonicera japonica*) has bird-dispersed fruits and is a persistent climber;
- Old man's beard (*Clematis vitalba*) wind- and water-dispersed seeds and is a persistent climber, can smother mature tall trees;
- Ornamental cherry (*Prunus* sp.) spread widely by birds;
- Blackberry (*Rubus* sp. *(R. fruticosus* agg.) spread widely by birds, with extremely rapid growth;
- Crack willow (*Salix fragilis*) will resprout from fragments;
- Tradescantia (*Tradescantia fluminensis*) dense ground cover, prevents other species from establishing, fragments carried on boots, bikes, or via water;
- Arum lily (*Zantedeschia aethiopica*) can develop dense hard-to-control stands;
- Pampas (*Cortaderia selloana*) is wind-dispersed, with rapid growth and forms dense stands; and
- Pine trees (*Pinus radiata*) are prominent and persistent, and will seed into surrounding areas.

In addition there are key areas that need to be surveyed for weeds, probably annually or biennially, including Park entrances and along boundaries with residential neighbours, and places where seedling trays or seedlings are stored (Appendix 6, Plate 13). Keeping seedling areas free from environmental weeds will reduce the transfer of weeds to other parts of Makara Peak. Any environmental weeds found in these locations need to be removed.

[1] In 2004 the Makara Peak Supporters put in a big effort to clear Darwin's barberry from Makara Peak. Cleared areas were then mostly planted, with flax species, to maintain views.

Makara Peak supporters should work collaboratively with Wellington City Council to contact and educate adjacent landowners. Let landowners know what the issues and aims are, and how they can help (e.g. by not dumping weeds over the back fence or at road ends, reporting of weed dumping).

8.7 Planting

There is a need to identify which areas are to be kept open as view shafts and these areas should not be planted. Planting should be avoided beneath power lines and around existing structures unless the owners of those structures agree to any proposed planting (Appendix 6, Plate 17). If possible, don't plant tall-growing species immediately beside vehicular access routes, to reduce maintenance costs and the risk of access routes being closed through branch or tree-fall.

Makara Peak Supporters will have a reasonable idea of which plant species do well in which locations and under what conditions. This information needs to be recorded, to inform future planting decisions, and to assist future volunteer coordinators. This includes identification of the species best suited for planting along tracks. If possible, use relatively slow-growing species, or species that grow upwards rather than laterally, to reduce maintenance requirements. Some species should probably be avoided along tracks: flax (harakeke and wharariki) is slippery in the wet and can tangle in wheels; *Aciphylla* is very sharp and can puncture tyres.

If information on planting success is not readily available then monitoring of planting is required: how many plants of each species were put in the ground and how many succeeded? Identify the reason(s) why planting is undertaken and monitor (photopoints are effective) to ensure that the desired outcomes are achieved. If planting is undertaken to increase the presence of birds, then include some of these locations in bird monitoring.

Planting of indigenous species can help to reduce fire risk (Section 8.8) and weed dominance (Section 8.6).

There has been a large amount of planting already undertaken on Makara Peak. Future planting should focus on areas that require planting following weed control, or for reducing fire risk. Suites of species suitable for planting for reducing fire risk are discussed above.

Other planting should be aimed at recreating the vegetation that would have occurred naturally on the site prior to human occupation. This is described in Section 6.1 above and Appendix 3. Open spaces, or sites recently-cleared of weeds, should be planted with fast-growing early successional species such as manuka, kanuka, *Coprosma* species, tree hebe, and mahoe. Once a canopy has established, or in areas where there is existing cover, then later successional stage species - such as podocarps, tawa, and hinau - can be planted.

Specific schedules should be prepared for each site to be planted, using only species that would have occurred naturally at the site. Planting stock should also be ecosourced, from within the Wellington Ecological District.

Maintenance of View Points

View points that the Makara Peak Supporters wish to retain should be identified. These can be maintained by regular control of vegetation to the level required. Judicial planting of low-growing species - such as harakeke, wharariki, and toetoe (*Cortaderia fulvida*) - can also be used to help maintain view points. Care needs to be taken that the plants used do not cause user or maintenance issues, e.g. slippery leaves for track users.

8.8 Reduction of fire risk

Potential sources of fire include:

- Urban boundary - people disposing of matches, cigarette butts, hot ashes, flammable material, garden waste, or other debris.
- Access tracks - used matches and cigarette butts, sparks from vehicles.
- Power pylons - possible arcing during certain types of weather; maintenance and explosive work producing sparks.
- Communications tower - maintenance work producing sparks.
- Where the Park is close to urban and rural roads, especially Makara Road - risk of discarded matches, cigarette butts, sparks from vehicles, and vehicles being set alight.
- Arson.

Areas where fire can be particularly problematical are similar to the potential sources in most cases:

- Urban boundary - risk to houses and urban infrastructure.
- Damage to infrastructure - power lines and communications tower.
- Access tracks.
- Significant loss of vegetation due to lack of fire-fighting resources, e.g. vehicle assess, lack of water, lack of firebreaks.

Recent research has established that a 'green firebreak' of low flammability indigenous species is a more effective way of slowing the spread of fire than a short 'grass firebreak'[1]. Thus a potential solution is to plant low flammability species adjacent to any sites that may be of concern. Tracks through areas of high fire risk vegetation - dense gorse or rank pasture - could be planted on both sides with low flammability species, to create firebreaks in otherwise nearly continuous vegetation.

[1] Sourced from http://www.pcc.govt.nz/A-Z-Services/Firebreaks and http://www.pcc.govt.nz/A-Z-Services/GetImage.aspx?ImageID=3e1015a6-af93-4912-b4e8-d718b9a92e2f

The width of the green firebreak depends on the steepness of the slope, as fire travels more quickly uphill. Suggested minimum widths are set out in Table 5.

Table 5: Green firebreak widths suggested based on relative slope steepness[1].

Slope of Land	Recommended Width of Green Firebreak*
Flat (0-10°)	5-7 m wide
Slightly sloping (11°- 20°)	7-10 m wide
Steeply sloping (21°- 45°)	10-15 m wide
Almost vertical (46°- 90°)	25 m wide

* The width of a green firebreak may vary depending on the vegetation adjacent to the fire break

The most fire-resistant species, and therefore the best species to plant, include (in order from low to low/moderate flammability, Fogarty 2001):

Low Flammability

- Broadleaf/kapuka (*Griselinia littoralis*)
- Fuchsia (*Fuchsia excorticata*)
- Poroporo (*Solanum aviculare*)
- Lancewood (*Pseudopanax crassifolius*)
- Five finger (*Pseudopanax arboreus*)
- Kawakawa (*Macropiper excelsum* subsp. *excelsum*)
- Karamu (*Coprosma robusta*)
- Kanono (*Coprosma grandifolia*)
- Hangehange (*Geniostoma ligustrifolium* var. *ligustrifolium*)
- Putaputaweta/marbleleaf (*Carpodetus serratus*)

A lesser quantity of Low/Moderate flammability species could be used to provide diversity, including the following:

- Koromiko (*Hebe stricta*)
- Mahoe/whiteywood (*Melicytus ramiflorus*)
- Makomako/wineberry (*Aristotelia serrata*)
- Ngaio (*Myoporum laetum*)
- Kohuku (*Pittosporum crassifolium*)
- Tarata/lemonwood (*Pittosporum eugenioides*)

These species all occur naturally at Makara Peak and could be used to create "green firebreaks". A potential drawback, though, is that if this was to be done extensively it may result - in the short term - in the Park having a patchwork appearance with visibly different vegetation composition (colour and texture) in linear bands alongside tracks.

[1] Sourced from http://www.pcc.govt.nz/A-Z-Services/Firebreaks and http://www.pcc.govt.nz/A-Z-Services/GetImage.aspx?ImageID=3e1015a6-af93-4912-b4e8-d718b9a92e2f

8.9 Monitoring

Monitoring has already been discussed in previous sections. Although monitoring can be time consuming it is necessary to ensure that goals are being met and to record and celebrate progress. One benefit of monitoring and recording of observations is that is becomes much easier to pass information on to other people, including funding organisations.

In addition to the monitoring discussed above, a simple network of photopoints should be established. Each photopoint site should be selected carefully, to ensure that it will be useable (i.e. not overgrown) for a reasonable time period, say 10-20 years, and a particular feature is the subject of monitoring.

It would also be useful to set up a recording system or blog where people can add their observations. Such citizen monitoring, particularly photopoints, and can help to indicate problems or areas of success. This could include observations of goats, pigs, domestic stock, waste dumping, key indigenous species, canopy browse damage, other possum damage, track conditions, first flowering rata of the year, and arrival of the first pipiwharauroa (shining cuckoo).

8.10 Other issues

Other issues have been identified through discussions with Makara Peak Supporters or in the field, mostly related to public relations.

Signage is needed to identify that Makara Peak is not a good place to bring dogs and let them run free. There is an active possum poisoning programme, with cases of dogs dying after eating poisoned possums.

There also seems to be a trend of hanging bags of dog faeces in trees, or tossing them into bushes. All plastic bags should be taken removed, as plastic is persistent (and unsightly) in the einvironment.

9. CONCLUSIONS

Makara Peak Supporters, with the assistance of both Wellington City Council and Greater Wellington Regional Council, are doing a great job of managing Makara Peak for its recreational and biodiversity values. The Park is actively used by a wide range of cyclists, walkers, and dog walkers, showing its popularity.

Sizable areas of exotic vegetation have been removed or managed to a state where they vegetation is now dominated by indigenous species. The Makara Peak Supporters have planted a large number of species and undertaken control of many pest plants and pest animals within the Park.

Management improvements mainly relate to the modification or extension of pest animal control operations, to ensure that all of Makara Peak is adequately covered. It would be useful to identify habitats - such as more mature forest and areas with high plant species diversity - that may support a more diverse fauna population and ensure

that these areas receive more intense integrated pest control, for goats, pigs, rabbits, possums, stoats, and rats.

Pockets of environmental weeds, still occur within the Park and require ongoing management and priorities for weed control have been identified. Monitoring of planting, weed control, and pest animal control operations needs to be improved, to help inform future management. Fire risk within the Park is being reduced gradually through planting and increasing dominance by less fire-prone indigenous species. Further planting with indigenous species in target areas may help to further reduce this risk.

The Makara Peak Supporters have a proven track record of habitat enhancement and their vision of cycling or walking through a forest ringing with bird song, including koromiko, will become a reality if this work continues.

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PREVIOUS MANAGEMENT PLANS

Makara Peak Conservation Plan 2nd Draft

24 Sept 1998

Contents

Prepared by the Kennett Bros

Part One - Background

In June 1997 the Wellington City Council (WCC) commissioned landscape architects Titchener Monzingo Aitken Ltd (TMA Ltd) to identify the most suitable site for a mountain bike park on WCC land. While the park would contain a track network designed to cater for mountain bikers, it would also remain open to walkers and runners. TMA Ltd evaluated the suitability of a number of sites based on the existing and potential track network, car parking, compatibility of recreational activities and proximity to the central city. At the end of this process, Makara Peak was considered the best available site.[1]

Makara Peak is a hilly 100 hectare block of land adjacent to Wellington's western suburb of Karori. It was farmed until the early 1990s when the council acquired the land. There are a number of service vehicle roads on the block which are used to access a BCL transmitter at the summit (418m), a TV3 transmitter and a number of TransPower pylons. There are no formed walking/riding tracks, no council signage at the entrances and consequently, there is relatively little recreational use.

In August 1997, TMA Ltd went on to complete an Environmental Impact Assessment (EIA) for the Makara Peak Mountain Bike Park. As a part of this EIA, they commissioned Geoff Park Landscape Ecology & History to complete a survey of vegetation patterns and ecological trends.[2] They found that Makara Peak was comprehensively cleared of native

vegetation and that pastoral grassland prevailed, even in the deeper gullies, until the 1970s. One very small remnant of pre-European forest exists in the SW corner of the Makara Peak block.

Today Makara Peak is dominated by secondary vegetation. Approximately 20% of the block (primarily the gullies and lower south-facing slopes) is dominated by mahoe low forest, with kawakawa, raurekau, rangiora and mamaku also relatively common in some areas. Far less common are putaputaweta, houhere (lacebark), makomako (wineberry) and porokaiwhiri (pigeonwood).

Around 50% of the Makara Peak block is dominated by gorse, Darwin's barberry, tauhinu and manuka, and constitutes a high fire risk. Park estimates that the secondary forest succession is so rapid that half of this area will have passed the high fire risk stage within 15-25 years if fire can be excluded.

The remaining 30% of the park land is pasture or shrub/grassland mosaic and is about to enter the acute fire risk state (dominated by gorse and Darwin's barberry). Unlike gorse, barberry is shade tolerant and its seed is bird dispersed. Park estimates it may take as long as 100 years for barberry to be out-competed by native species (compared with 15-30 years with gorse).

With the exception of gorse, and Darwins barberry, no serious weed infestations have yet been identified on Makara Peak. However, it clearly does have some serious pest problems. Despite a cull of 450 goats in the area in November 1997, goats persist in the park and appear to be unaffected by the extensive fencing upgrade that has just been completed. Goats are abundant in some neighbouring farmland.

A recent regional council possum survey has determined that they exist at an average density of five per hectare on Makara Peak.[3] Rabbits, magpies, feral cats, feral pigs and some feral sheep have also been seen on Makara Peak. It is highly likely that rodents, hedgehogs and mustelids are also present.

While local residents report regularly seeing tūī in the area during winter (and korimakos have been heard), Park found that no kererū (wood pigeon) have been seen in the Makara Peak area for many decades. Without large birds such as kererū distributing the large seeds of late successional tree species, those species are unlikely to become a significant part of the forest on Makara Peak (unless planted by human volunteers).

Attracting kererū (and other native fauna) back to Makara Peak is realistic. Makara Peak is part of the proposed 'Outer Green Belt' - an ecological corridor that will connect it to Wrights Hill, Karori Wildlife Sanctuary, Te Kopahou Reserve, Johnston Hill, Otari Native Botanic Garden, Khandallah Park, Mt Kaukau and on north to the regional parks and state forest parks of the southern North Island.[4] Otari, just three kilometres to the north east already has a resident population of kererū.

Karori Sanctuary, just two kilometres to the south east, will be operational by 2000 and will no doubt attract kererū in the near future. Wrights Hill, which connects Karori Sanctuary with Makara Peak has been the focus of a local revegetation effort for many years. Many species attractive to kererū have been planted there already. Also, many of Makara Peak's rural neighbours are pro-conservation and are planting natives and shooting or trapping pests.

Finally the Wellington City Council plans to increase its spending on revegetation and pest control programmes to $802 000 p.a and $350 000 p.a respectively, for the next five years.[4]

Part Two - Key Principles and Assumptions

A survey of several texts on forest restoration and revegetation projects, and discussions with people experienced in such projects, has led to a number of key principles and assumptions.

Firstly, the involvement of as many stakeholder groups as possible will result in far more effective management of a public restoration project.5 This involvement can range from simply reading community newsletters about the project, to consultation, and/or participation in working bees. At present, the key stakeholder groups at Makara Peak are the local urban community, the rural neighbours, the mountain bike community, the Wellington City Council and tangata whenua, Te Atiawa.

Te Atiawa's interest in the area was traditionally for its rich bird life. There do not appear to be any pa sites or wahi tapu (sacred sites) on Makara Peak. It would appear that nearly all of the walkers and conservationists currently interested in Makara Peak are from the local (South Karori) community. No doubt this will change with time as the area develops. It should also be noted that several marijuana plots have been discovered on Makara Peak and there have been a number of unregistered hunters seen operating in the area. It will be interesting to see if these groups move elsewhere as recreation use increases.

A restored native forest will provide a myriad of services. These include improved landscape amenity, shelter for recreationalists, reduced fire risk, reduced run-off and erosion during flood events, an accessible area with significant natural heritage values (both native flora and fauna), a CO2 sink, and some insurance against the collapse of highly modified and simplified ecosystems which cover most of New Zealand. For one or more of these reasons, the plan to restore the forest on Makara Peak currently has the support of all the key stakeholders. WCC carries out occasional surveys to gauge rate-payer support for various projects. It is hoped that a survey of stakeholder satisfaction with the Makara Peak project will be carried out within the next five years.

A key part of planning and implementing strategies for achieving long term conservation objectives listed above is recognising the limits of the resources available. The 1998/99 budget for Makara Peak is $120,000. Most of this will be spent on a car park, a new fence for the SE boundary, and materials for track construction (largely one-off costs). $10,000 has been budgeted for revegetation (enough for 3 000 plants from the WCC nursery), $2,000 for possum control and $2,000 for goat control. It may be that the City Council choose to drastically reduce funding for Makara Peak next year. The possum and goat control will generally be carried out by volunteers. Track construction and the planting of native seedlings will also be carried out by volunteers.

Wellington has several revegetation projects in progress which rely heavily on volunteer labour. As a result it may be unrealistic to expect that the Makara Peak project will attract significant numbers of volunteers outside of the Wellington mountain biking or South Karori residents' communities. From experience, a turn out of 12 volunteers willing to work solidly for four hours should be considered about average. It is also important to bear in mind the time span over which volunteer interest must be maintained. Fire prevention and planting

efforts need to be maintained for 15-20 years. Possum and goat control requires a committed effort for the foreseeable future - possibly indefinitely. Similarly, weed control is likely to be an ongoing commitment. It is vital that volunteers not become overextended or burnt out.

Recognising these limits, it is vital to set some key priorities before undertaking a raft of ambitious objectives. The EIA sees **fire risk management** as the top priority, which seems sound given the frequency of fires in scrub in the Wellington metropolitan area. Clearing and planting on high risk boundaries will be one of the keys to reducing the fire risk and this will also help protect the edge of the eventual forest from weed invasions and wind damage.

Animal pest control must also be a top priority since pest damage to native seedlings is slowing the progress from the flammable gorse to fire resistant mahoe low forest. And where there is mahoe forest, its under storey is barren due to browsing by goats and possums.

Thirdly, late successional/climax **species attractive to kererū** must be established on Makara Peak in greater numbers. Without the return of kererū the forest will be devoid of a large seed disperser and will largely fail to proceed beyond a mid-successional, mahoe dominated forest.

The revegetation of an open site through the natural succession process is nicely simplified in the Wellington Town Belt Management Plan[6]:

Bare site, grassland or low shrub cover

⇩

Plant with early-mid successional species
(1-2 metre spacing)

⇩

Planted canopy closes over in 5-7 years

⇩

Interplant with late successional/climax species
(in suitable areas)

⇩

Climax species dominate the forest canopy
(after 50-80 years)

This can be applied to the 30% of Makara Peak that is currently grassland or pasture/scrub mosaic. In the 20% of the block that is dominated by mahoe low forest and areas of manuka or tauhinu, planting of late successional/climax species can begin next year. With these two large portions of Makara Peak available for planting, planting within gorse is not a priority. Gorse is an excellent nursery plant as it has a limited lifespan, it enriches the soil with nitrogen and only young gorse is attractive to goats. There are adequate numbers of birds distributing small native seeds, and native seedlings are plentiful under mature gorse.

Part Three - Goals & Objectives

The overall goal for the Makara Peak Mountain Bike Park is:

To create a world class mountain bike park, with dual-use tracks for all levels of rider, in a restored native forest.

The final part of this goal recognises mountain bikers' preference for riding in a native forest setting, the local residents desire to live next to a native forest, and the council's goal of creating a native forest ecological corridor (an 'Outer Green Belt') which includes Makara Peak. While it is recognised that Makara Peak can never be fully restored to its original condition, it may be possible to restore it to a functioning native ecosystem with sustainable populations of key forest species.

Wellington City Council's Strategic Plan contains the following objectives:[4]

1. *To protect and enhance the range of native habitats for plants and animals in the City's open spaces*
2. *To protect and enhance the natural processes which sustain the City's natural landscapes and ecosystems*

From these fairly broad goals, the following, more specific objectives can be drawn:

1. Reduce the fire risk on Makara Peak over the next 15 - 20 years
2. Control possum numbers at less than 10% of current levels
3. Control goat numbers at less than 15 on Makara Peak permanently
4. Reduce the numbers of rodents, mustelids, magpies, hedgehogs, feral cats and pigs
5. Eradicate feral sheep by 1999
6. Steadily increase the range and diversity of native plants throughout the park to approach that of pre-European times
7. Where practical, limit the impact of alien weed species
8. Provide for the return of kererū to Makara Peak by 2010
9. Gain a better understanding of the change in, and health of, the native forest ecosystem on Makara Peak
10. Have all of the Makara Peak Mountain Bike Park covered by some form of legal protection by 2008

Part Four - Strategies

The strategies detailed below are, in part, based on the key principles and assumptions outlined in part two, above. These strategies should be reassessed periodically (say annually) and adjusted to take into account their effectiveness and the resources available at the time.

The following strategies are grouped according to the numbered objectives listed above.

1. Reduce the **fire risk** on Makara Peak over the next 15-20 years

Declare Makara Peak a 'No Smoking Area'
Keep the edges of tracks and rest areas free of gorse
Plant native plants on the edges of tracks and rest areas
Remove gorse from high risk boundaries
Plant native plants on high risk boundaries
Plant native plants on boundaries currently in pasture
Build a fire fighting reservoir on Makara Peak
Inform the parks neighbours of the level of fire risk

2. Control **possum** numbers at less than 10% of current levels
   - Set up a volunteer group to maintain lines of brodifacoum bait stations at 150m intervals
   - Offer the urban residents the loan of Timms traps
   - Have a volunteer shooter (with .22 rifle and silencer) patrol the park
   - Monitor possum numbers annually

3. Control **goat** numbers at less than 15 on Makara Peak permanently
   - Have volunteer goat hunters patrol the park during school hours
   - Supplement the volunteer hunters with WRC hunters (close to residential areas)
   - Offer the services of volunteer hunters to neighbours with high goat numbers
   - Monitor goat numbers

4. Reduce numbers of **rodents, mustelids, rabbits, magpies, hedgehogs, feral cats and pigs**
   - Establish the scale of the problem with these alien species
   - Have a volunteer hunter shoot magpies and rabbits
   - Bring in a volunteer pig hunter periodically
   - Consider extra bait stations or traps for rodents and mustelids
   - Monitor the situation

5. Eradicate **feral sheep** by 1999
   - Complete upgrading of the rural fence lines
   - Have the volunteer goat hunters shoot feral sheep

6. Increase the **range and diversity of native plants** throughout the park
   - Set up one or more nurseries for rare or extinct Makara Peak species
   - Plant these species out when ready
   - Plant out boundaries with 2000 - 3000 native plants per year
   - Release previous years plantings if necessary

7. Where practical, limit the impact of **alien weed species**
   - Periodically survey the park for alien weed species
   - Control the spread of alien weed species into areas dominated by native species
   - Where practical, eradicate isolated infestations of those alien weed species that pose a significant threat to native forest succession

8. Provide for the return of **kererū** to Makara Peak by 2010
   - Maintain the pressure on introduced species numbers (possums, rodents and mustelids, etc)
   - Ensure that a mix of species is planted that will provide a food source throughout the year for kererū (see plant species lists in appendix)

9. Gain a better **understanding** of the native forest ecosystem
   - Set up and photograph (annually) vegetation monitoring sites
   - Local residents to monitor native bird life in the area
   - Have a survey of herpetofauna and invertebrates completed
   - Have a second vegetation survey completed in 2002
   - Encourage a post-graduate ecology student from Victoria University to carry out a study of the health of the native forest ecosystem on Makara Peak

10. Have Makara Peak covered by some form of **legal protection** by 2008
    Makara Peak to be re-zoned from 'rural' to 'open space' land in late 1998
    Wellington City Council to proceed, when appropriate, with gazetting the entire Makara Peak Mountain Bike Park as recreation reserve under the Reserves Act 1977

End note: This draft plan has been critiqued by Jonathan Kennett (BSc, ecology), Derek Thompson (WCC, Commissioning), the Makara Peak Community Working Group, and Chris Horne & Barbara Mitcalfe (Wellington Botanical Society).

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Appendices

Preliminary Annual Work Plan

(Based largely on the Wrights Hill Revegetation Plan[7])

Month	**Key Tasks**
January	Pest control to be carried out year round (with an extra effort in spring) Care of nursery plants to be carried out year-round Seed collecting

	Clear boundaries of gorse
February	Seed collecting Weed monitoring and control Locate suitable sites for late successional/climax species
March	Clearing boundaries and track edges of gorse Seed collecting Order next years plants
April	Begin planting damp sites Clearing track edges of gorse
May	Planting
June	Planting
July	Planting
August	Planting Monitoring (of plants, pests and bird life)
September	Release previous years planting
October	Release previous years planting
November	Seed collecting Release previous years planting
December	Seed collecting

Potential Sources of Volunteer Groups

- Karori Residents
- Wellington Mountain Bike Community (in general)
- Wellington Tramping and Mountaineering Club
- Karori Schools
- Local Church Groups
- Victoria University Environmental Group
- Whitireia Polytechnic Adventure Tourism Class
- Wellington Forest & Bird
- Karori Service Groups
- Wellington Volunteers Organisation
- Conservation Corps
- Periodic Detainees

Suitable Plant Species

For boundary plantings, species are required that are fast growing, fire resistant, affordable, unpalatable to goats and possums, tolerant of strong winds, frosts and exposure to sun, and that are happy with fast draining, rocky ground. Species naturally present in the Wellington ecological district are preferable, and for those plants that will be planted adjacent to farm land, a tolerance of herbicide spray drift is a bonus. I have been unable to find any plant species that meet all of these requirements, although there are several that meet most of them.

Of the species planted on Makara Peak in July 1998 manuka, ti kouka, karamu and twiggy coprosma were almost completely eaten (presumably by goats) within six weeks. Tauhinu, akeake, karo and kapuka appear to be surviving well. None of the later species however, are noted for their fire resistant qualities. The Wellington Botanical Society have objected to karo on the grounds that it is not native to the southern North Island. Ngaio and mountain flax are hardy, fire resistant and fast-growing[10], but have yet to be tested on Makara Peak. A test planting will be carried out this year, before the selection of next years plants. Mapou seedlings planted in previous years also appear unscathed by browsers.

A list of species not prefered by goats prepared by Atkinson in 1964[8], shows the following species from a survey in the Rimutaka Range: mingimingi, toro, red horopito, tauhinu, bush rice grass, *Blechnum fluviatile*, and *Histiopteris incisa.* The first two of these should also be tested on Makara Peak. Kohuhu and lemonwood are two more tough, fast-growing species worth testing on the boundaries[9] (however, lemonwood is frost tender).

Deeper into the Makara Peak block goat and possum control should allow a greater range of species to be planted, including late successional species. Park[2] identified the following species, present in the nearby Otari Native Botanic Garden, as missing from the Makara Peak forest canopy:

- Rewarewa*
- kohekohe
- Titoki
- Tawa
- Tarata*
- Hinau*
- Houhere
- Porokaiwhiri*
- Rimu*
- Matai*
- Kahikatea*
- Pukatea*
- Maire

Note: An asterisk indicates a possum-hardy species[11].

These species, together with the current forest (dominated by mahoe) would provide an excellent food source during summer and autumn, but little during winter and spring. To ensure a year-round food source, plantings of the species listed above should be supplemented with karamu*, poroporo, mingimingi, miro*, lancewood (horoeka)*, five

finger and kowhai* where practical[12 &13]. This list can be further supplemented with other species from the Wrights Hill Revegetation Plan[7] list (such as totara, kamahi, northern rata, nikau*, and karaka*).

At present, only small areas of Makara Peak are suitable for planting late successional/climax species, hence only relatively small numbers of these will be planted each year. Planting parties will concentrate on possum hardy species until monitoring confirms that possum numbers have dropped significantly.

List of Scientific Plant Names

(Taken from various references)

akeake	*Dodonaea viscosa*
Darwin's barberry	*Berberis darwinii*
five finger	*Pseudopanax arboreus*
gorse	*Ulex europaeus*
hinau	*Elaeocarpus dentatus*
houhere (lacebark)	*Hoheria sexstylosa*
kahikatea	*Dacrycarpus dacrydioides*
kamahi	*Weinmannia racemosa*
kapuka (broadleaf)	*Griselinia littoralis*
karaka	*Corynocarpus laevigatus*
karamu	*Coprosma robusta*
karo	*Pittosporum crassifolium*
kawakawa (pepper tree)	*Macropiper excelsum*
kohekohe	*Dysoxylum spectabile*
kohuhu	*Pittosporum tenuifolium*
kowhai	*Sophora microphylla*
lancewood (horoeka)	*Pseudopanax crassifolius*
lemonwood (tarata)	*Pittosporum eugenioides*
maire	*Nestigis lanceolata*
mamaku	*Cyathea medullaris*
manuka	*Leptospermum scoparium*
mapou	*Myrsine australis*
matai	*Prumnopitylis taxifolia*
prickly mingimingi	*Cyathodes juniperina*
miro	*Prumnopitys ferruginea*
mountain flax (whararikí)	*Phormium cookianum*
ngaio	*Myoporum laetum*
nikau	*Rhopalostylis sapida*
northern rata	*Metrosideros robusta*
porokaiwhiri (pigeonwood)	*Hedycarya arborea*
poroporo	*Solanum laciniatum*
pukatea	*Laurelia novae-zelandiae*
putaputaweta	*Carpodetus serratus*
rangiora	*Brachyglottis repanda*
raurekau	*Coprosma grandifolia*
red horopito	*Pseudowintera colorata*
rewarewa	*Knightia excelsa*
rimu	*Dacrydium cupressimum*

tauhinu	*Cassinia leptophylla*
tawa	*Beilschmiedia tawa*
ti kouka (cabbage tree)	*Cordyline australis*
titoki	*Alectryon excelsus*
toro	*Myrsine salicina*
totara	*Podocarpus totara*
wineberry (makomako)	*Aristotelia serrata*

Makara Peak Forest Restoration Plan (2001)

The Makara Peak Forest Restoration Plan (2001) outlines the following goals and aims:

Goal
To facilitate significant progress towards the restoration of Makara Peak to a healthy native forest

Aims
1) Reduce possum numbers to a residual trap catch rate of 5% or less by the end of 2001 and hold them at that level.
2) Control the goat population to less than five goats in total in the park and maintain a 200m wide goat-free buffer zone around the park.
3) Reestablish missing/threatened native canopy trees - rimu, rata, titoki, white maire, kohekohe, hinau, tawa, kahitatea, miro, pukatea, matai and totara.
4) Encourage kererū (wood pigeon) and other native birds into the park to help distribute seeds by planting - tree fuchsia, pigeonwood, cabbage tree, tree lucerne, ngaio, lemonwood, flax, kapuka, and kowhai.
5) Remove pest plants and plant out the riparian zone alongside Karori Stream within the park.
6) Plant out high fire-risk areas with fire resistant native species (e.g. flax and ngaio).
7) Control the spread of key weed species such as old mans' beard, wandering willy, African clubmoss, buddleia, German ivy, Japanese honeysuckle, pampas and pine trees.
8) Reduce mustelid numbers in areas with high tūī or korimakos nesting.
9) Eliminate feral stock and pigs from the park.
10) Gain a better understanding of the restoration process on Makara Peak.
11) Improve the legal protection of land in the park.

Note the Makara Peak supporters have a philosophy of planting one tree for every metre of track through regenerating native bush.

Key Strategies and Actions

- Fill possum bait stations throughout the park in February, July and August, September and December. Also encourage possum trapping in the park.
- Support neighbours efforts to control possums on their land.
- Encourage Jon Rosemergy to hunt goats and feral stock in the park if the goat population exceeds five.
- Plant 3000 native trees in the park each winter.
- Release seedlings in November/December.
- Have WCC engage a weed control contractor to eliminate old man's beard and control other key weed species.
- Maintain stoat trap lines int eh forest between Karori Stream and Livewires.
- Have WCC engage a pig hunting specialist to eradicate pigs in the park.
- Monitor and record the results of pest control and planting efforts (WRC to monitor possum numbers every 2 to 3 years.)
- Lobby WCC to secure legal protection (with Reserve status) for all land in the park.

VEGETATION DESCRIPTIONS 2013

The vegetation present at Makara Peak is described below below (refer to Section 5 in text for detail on methods) and mapped in Figure 2 in the text.

1. Indigenous Forest[1]

Small to medium-sized areas of indigenous forest, of varying composition, occurs scattered throughout the study area. The composition of these is described below, and their locations are indicated on the map as 1a-1g.

1a: Kamahi Forest - A small area of almost pure kamahi (*Weinmannia racemosa*) forest with tawa (*Beilschmiedia tawa*) in the gullies south of the St Albans Avenue access track, below the three-way junction.

1b: Tawa-hinau-(rewarewa)/māhoe forest - The slopes surrounding the Starfish Track are mainly covered in mahoe (*Melicytus ramiflorus*). However, there is a small area on a side ridge where tawa and hinau (*Elaeocarpus dentatus*) occur with some emergent rewarewa (*Knightia excelsa*) trees. Other species in this area include kaikomako (*Pennantia corymbosa*), mapou (*Myrsine australis*), mamaku (*Cyathea medullaris*), wineberry (*Aristotelia serrata*), fivefinger (*Pseudopanax arboreus*), heketara (*Olearia rani*), and rangiora (*Brachyglottis repanda*).

1c: Mamaku-māhoe-mapou forest - The forest around the Lazy Fern Track, and as far as the Skills area, is more recent and dominated by mamaku tree ferns with mahoe, mapou, wineberry and fivefinger starting to push up in to the canopy.

1d: Tawa-hinau-(rewarewa)-(white maire) forest - Above South Karori Road, but below Koru Track there is a sizable tawa-hinau (*Elaeocarpus dentatus*) forest remnant that also includes rewarewa, white maire (*Nestegis lanceolata*), mamaku, silver fern (*Cyathea dealbata*), kamahi, pigeonwood (*Hedycarya arborea*), mahoe, northern rata (*Metrosideros robusta*), mapou, tarata (*Pittosporum eugenioides*), pukatea (*Laurelia novae-zelandiae*), *Hebe parviflora* and kaikomako (Park 1999).

1e: Tawa forest - Forest in the valley to the west of Koru Track and south of Sally Alley is tawa forest with rewarewa, hinau, pigeonwood, mamaku, mapou, pukatea, mahoe, rimu (*Dacrydium cupressinum*), lancewood (*Pseudopanax crassifolius*) and totara (*Podocarpus totara*). Some parts within this valley are more recent forest of mahoe, mapou, heketara, pigeonwood, with some mamaku, rimu, rewarewa, wineberry, lancewood and hinau.

[1] Atkinson (1985) defines forest as "woody vegetation with a canopy cover greater than 80%, and in which trees are more numerous than shrubs. Trees are defined as having a diameter exceeding 10 cm dbh (diameter at breast height) and includes tree ferns with a dbh >10 cm."

1f: Nikau-pigeonwood forest - On the valley floor between the 4WD Ridge Line Access Road and Aratihi Track there is a small area of nikau (*Rhopalostylis sapida*) and pigeonwood forest with puka, mamaku, mahoe, rewarewa, mapou, wineberry and hinau and patches of putaputaweta (*Carpodetus serratus*), mahoe forest with mapou, pigeonwood, puka, wineberry and akiraho (*Olearia paniculata*) (Park 1999). Both the Nikau Valley Track and the Missing Link Track cross into this vegetation type.

1g: Rewarewa/mahoe-mamaku forest - The gullies running off the Lower Leaping Lizard Track has several small areas rewarewa/mahoe-mamaku forest. The species composition can vary somewhat between patches and include all, or some, of the following species; mapou, putaputaweta (*Carpodetus serratus*), wineberry, pigeonwood, kohukohu (*Pittosporum tenuifolium*), manuka, kanuka (*Kunzea ericoides*) and supplejack (*Ripogonum scandens*).

2. **Indigenous scrub**
Mānuka scrub, māhoe scrub, tree hebe scrub, and tauhinu scrub

Atkinson (1985) defines scrub as "canopy cover 80% or greater of woody shrub species". These areas comprise 50% or greater dominance by indigenous species.

Indigenous scrub communities are, in places, dominated by one or a few species. For instance nearly solid manuka (*Leptospermum scoparium*) canopy in some of the gullies above Karori, or *Hebe parviflora* on some of the higher altitude faces. In other places low growing mahoe is the predominant species. However, many scrub areas contain a mix of indigenous species, often with some Darwin's barberry or gorse still intermixed. Indigenous species include tauhinu (*Ozothamnus leptophyllus*), rangiora (*Brachyglottis repanda*), kanono (*Coprosma grandifolia*), whaririki (mountain flax; *Phormium cookianum*), cabbage tree (*Cordyline australis*), hangehange (*Geniostoma ligustrifolium* var. *ligustrifolium*), fivefinger (*Pseudopanax arboreus*), mapou and scattered wharangi (*Melicope ternata*). Vines such as tataramoa (*Rubus cissoides*) and pohuehue (*Muehlenbeckia australis*) can be found scrambling over and through the scrub. The vegetation is up to about 3 m tall, but is variable. In windswept areas the canopy reduces to *c.*1 m in height.

3. **Mixed indigenous exotic scrub**
Darwin's barberry-tauhinu-manuka scrub and gorse-manuka-tree hebe-mahoe scrub

These areas contain a similar suite of indigenous species as those present in Vegetation Type 2 above, but with a greater proportion of Darwin's barberry or gorse. Indigenous species vary from 10-50% of the cover. The canopy is generally very dense. Includes some areas of plantings.

4. **Exotic scrub**
Darwin's barberry scrub and gorse scrub

Areas of dense Darwin's barberry or gorse, often with indigenous species starting to emerge through the canopy. It can include up to 10% indigenous species, especially early successional species such as cabbage tree, tauhinu, mahoe, mamaku (in gullies),

and manuka (exposed ridges). There are small grassy clearings amongst the areas of scrub.

5. **Mixed indigenous exotic shrubland**
Darwin's barberry-tauhinu-*Coprosma dumosa* shrubland and gorse-manuka-tauhinu shrubland

Atkinson (1985) defines scrub as having a "canopy cover between 20% and 80% and between 10-50% dominance by indigenous species".

Again these areas comprise predominantly Darwin's barberry or gorse with manuka, and/or tauhinu. The canopy is more open and the understory often comprises rank pasture grass species such as browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*), Yorkshire fog (*Holcus lanatus*), and scrambling ferns such as ring fern (*Paesia scaberula*). Manuka (*Leptospermum scoparium*), and tauhinu (*Ozothamnus leptophyllus*) are common, with scattered cabbage trees (*Cordyline australis*).

At higher altitudes the indigenous species mix also includes *Coprosma dumosa* and *Gaultheria antipoda* with *Leucopogon fraseri* in the groundcover. The tops of ridges and more open rock faces support populations of the regionally rare Spaniard (*Aciphylla squarrosa*). Lower altitude shrubland include a greater abundance of rangiora (*Brachyglottis repanda*), mahoe (*Melicytus ramiflorus*), tree hebe (*Hebe parviflora*), kanono (*Coprosma grandifolia*), whahariki, and kakaha (*Astelia fragrans*).

6. **Exotic shrubland**
(Barberry)-(gorse)/pasture grassland

These areas comprise sparse barberry and/or gorse over pasture grassland or tussockland with indigenous species starting to emerge in places. This vegetation type occurs at higher altitudes. Indigenous species comprise up to 10% of the cover and include tauhinu, *Coprosma dumosa*, tree hebe, *Gaultheria antipoda* and *Aciphylla squarrosa*.

7. **Tussockland or grassland**

These two vegetation types are difficult to distinguish on aerials and tend to merge in the field. Thus they have not been separately mapped.
7a. Tussockland- dominated by tussock (*Poa cita*) with 20-100% cover of tussocks.
7b. Grassland - mainly exotic grass species provide 20-80% cover; the suite of grassland species is similar to that described for indigenous shrubland.

8. **Exotic conifers**
Radiata pines or macrocarpa

Single trees or small groups of emergent exotic conifers; mainly radiata pine (*Pinus radiata)* and macrocarpa (*Cupressus macrocarpa*).

9. **Harakeke flaxland**

Near the top of the ridge both species of flax (*Phormium tenax* and *Phormium cookanium*) have been extensively planted. Whahariki (*Phormium cookanium*) has been used more frequently. These areas are too small to show on Figure 2.

PRE-SETTLEMENT VEGETATION COVER

Descriptions of pre-settlement vegetation in Wellington City are presented in a 2002 report (Boffa Miskell 2002). In the 2002 report Wellington City is divided into ecological domains. Makara Peak Mountain Bike Park lies mainly in Ecodomain 9b, and Makara Peak, near the transmission masts, and the ridges leading up to the peak are classed as Ecodomain 10. The descriptions of these ecodomains are reproduced below.

Domain 9b

"Inland hill country and basins covering most of the south Wellington peninsula.
Pre-settlement vegetation in these areas would have varied considerably according to aspect and location, but typically included tall conifers and rata over a tawa dominated canopy with moisture-demanding or frost tolerant species such as kahikatea, pukatea and tree ferns in the wetter and more frost prone valleys.

North/south aspect slopes: Expect pre-settlement vegetation to be dominated by tall conifers and northern rata over a tawa dominated canopy. Regenerating bush and colonisation of pasture reveal marked contrasts between environments which are (i) those which are exposed to prevailing winds and are sunny (where species such as mapou and kohuhu might predominate) and (ii) sheltered from prevailing winds and are shaded (species such as rangiora, five finger, lemonwood and mahoe might predominate).

Gullies, valleys: Commonly contorted and steep with fast-flowing streams providing varied habitat for aquatic species. Valleys would be likely to lack frost-tender species and would be dominated by moisture-demanding species such as pukatea, kahikatea and tree ferns.

Basins: The basins are typically cold in winter, experiencing both air and ground frosts, and are poorly drained. Expect pre-settlement vegetation to be dominated by tall conifers, in particular kahikatea, and tree species with a tolerance of moist, heavy soils such as pukatea and pigeonwood. Frost sensitive species such as tawa, nikau and tree ferns would not be as dominant in these frost prone areas."[1]

Domain 10

"High peaks and peneplain remnants (generally over 400 m).
The pre-settlement vegetation would probably have been devoid of some of the emergents and canopy trees seen in lower altitudes (rata, tawa and hinau) and may have had a greater presence of kamahi-toro canopy on the northern slopes, and miro and Hall's totara as emergent species (no remnants of this type remain).

Through most of the North Island hill country a distinct change in indigenous hill country vegetation communities occurs at around 400 m. The tawa canopy component is replaced by kamahi and northern rata drops out, leaving rimu the dominant emergent species. Then,

[1] From Boffa-Miskell 2002.

normally at around 550 m, a cloud forest of kamahi-toro prevails, with miro, and Hall's totara the most common emergent species.

Without any remaining indigenous forest at these altitudes on the Wellington peninsula it is difficult to ascribe a vegetation zone to this ecodomain. However, it appears that lower cloud levels associated with these isolated and exposed peaks which are experiencing the full force of moist, westerly and southerly airstreams channelling through Cook Strait, are creating cloud forest environments at lower altitudes than usual. What we might expect at 550 m seems to be occurring at around 400 m."[1]

[1] From Boffa Miskell 2002.

PREVIOUS VEGETATION DESCRIPTIONS

4.1 1999 SURVEY

During the 1990s Geoff Park undertook a survey to identify and delineate areas of indigenous vegetation within Wellington City, based on canopy trees species characteristic of the original forest that would have occurred here (Park 1999). He distinguished between remnants of pre-1840 indigenous forest (from the canopy species present and/or from its ecological character) and more modified primary or advanced secondary forests (referred to as "site remnants"). No remnant pre-1840 forests were identified within Makara Peak, but part, or all, of ten "site remnants" occur within the Park, and many more are nearby, these are described in the table below.

Table 4.1: Description of site remnants that are located in or adjacent to Makara Peak (Park 1999).

Site Number	Location Description	Topographical Position	Canopy Species	Vegetation Context	Forest Type	Size (ha)	Part or Whole of Site, or Adjacent	NZ Grid Ref
0206.1	Upper Makara Hill Road	Top of steep gully above road	Karaka, kiekie, mapou. Secondary forest adjacent to road.	Gorse and tauhinu surround. Heavily browsed. No fencing present.	2	0.1	Whole	536902
0206.10	South Karori Road end of Wrights Hill reserve	Hillslope	Several rewarewa and primary remnant of tawa and hinau within mainly mahoe dominated mosaic of kaikamako, mapou, mamaku, wineberry, fivefinger, heketara, rangiora, and barberry.	Gorse-mahoe mosaic surrounds.	1, 2	1.2	Whole	540883
0206.11	South Karori Road.	Hillslope and steep stream face	Primary forest remnant of tawa, hinau, rewarewa, maire, mamaku, *Cyathea dealbata*, kamahi, pigeonwood, mahoe, northern rata, mapou, tarata, pukatea, porokaiwhiri, and kaikamako.	Gorse-mahoe mosaic surrounds.	1, 2	4.5	Whole	537881
0206.25	Makara Hill	Gully and adjacent slopes	Primary forest of nikau, porokaiwhiri, puka, mamaku, mahoe, rewarewa, mapou, wineberry and hinau with secondary forest of putaputaweta, mahoe, mapou, porokaiwhiri, puka, wineberry, and akiraho intermixing with primary remnant.	Tauhinu-gorse-manuka-kanuka mosaic with barberry.	1, 2	1.3	Whole	529888

Site Number	Location Description	Topographical Position	Canopy Species	Vegetation Context	Forest Type	Size (ha)	Part or Whole of Site, or Adjacent	NZ Grid Ref
0206.8	South Karori Road	Upper gully-hillslope	Small area of pure kamahi with tawa in gullies.	Gorse-mahoe mosaic surrounds.	2	1.7	Whole	538887
0206.9	South Karori Rd, opposite Wrights Hill reserve	Hillslope	Several rewarewa within mainly mahoe dominated mosaic. Kaikamako, mapou, mamaku, wineberry, fivefinger, heketara, rangiora, and barberry.	Gorse-mahoe mosaic surrounds.	2	8.2	Whole	540885
0106.4	South Karori Road below Makara Hill	Gully and south facing slopes	Primary forest of rewarewa, mapou, tawa, nikau (10+ trees), mahoe, porokaiwhiri, mamaku, kaikomako, kanuka, kiekie (pure on slopes), with secondary forest of mahoe, *C. areolata*, H. arborea, porokaiwhiri, lancewood and puka intermixing.	Gorse-tauhinu and reverting pasture-tauhinu-gorse mosaic.	1, 2	0.6	Part	514950
0106.9	Makara Hill.	Gully	Rewarewa, mahoe, mamaku, mapou, putaputaweta, wineberry, and H. arboreaporokaiwhiri.	Manuka-kanuka-tauhinu surrounds.	2	2.2	Part	523886
0206.24	Makara Hill	Gully and adjacent slopes	Primary forest of tawa, rewarewa, puka, hinau, porokaiwhiri, mamaku, mapou, pukatea, mahoe, rimu, lancewood and totara. Secondary forest of mahoe, mapou, heketara, porokaiwhiri, mamaku, rimu, rewarewa, wineberry, lancewood, and hinau intermixing.	Mahoe-gorse-tauhinu mosaic with barberry. Pure areas of manuka and kanuka.	1, 2	19.4	Part	535885
0206.12	South Karori Rd, Karori	Valley flat	Small pocket of hinau with mahoe, tarata, mapou, cabbage tree, and lacebark.	Macrocarpa, pines and mixed second growth surround (including exotics and natives).	1, 2	0.1	Adjacent	534879
0206.13	South Karori Rd, Karori	Hillslope	Rewarewa, tawa, kaikamako, lancewood, mahoe, wineberry, mapou, mamaku, and tarata.	Mahoe with gorse surrounds	2	0.3	Adjacent	533877
0206.14	South Karori Rd, Karori	Hillslope	Tarata, rewarewa, mahoe, and mapou.	Mahoe and gorse surrounds.	2	0.1	Adjacent	533876
0206.15	Above 300 South Karori Rd, Karori.	Hillslope	Titoki, rewarewa with mapou, mahoe, and kaikamako.	Gorse surrounds.	2	0.1	Adjacent	530875
0206.16	South Karori Rd, Karori	Steep face-gullies	Rewarewa, hinau, lancewood, mapou, mamaku, tarata, putaputaweta, mahoe, wineberry, and karaka.	Gorse with mahoe and mamaku.	2	0.1	Adjacent	532876

Site Number	Location Description	Topographical Position	Canopy Species	Vegetation Context	Forest Type	Size (ha)	Part or Whole of Site, or Adjacent	NZ Grid Ref
0206.17	South Karori Rd, Karori	Hillslope-valley floor	Titoki with mahoe.	Pasture and gorse surrounds.	2	0.0	Adjacent	531876
0206.19	South Karori Road end	Lower hillslope	Rewarewa and mahoe.	Pasture and earthworks surrounds.	2	0.6	Adjacent	527875
0206.20	South Karori Road end	Broad hillslope, valleys and spurs	Rewarewa with mahoe, mamaku, and kanuka.	Tauhinu, kanuka and mahoe surrounds.	2	1.2	Adjacent	526876
0206.21	South Karori Road end	Hillslope	Rewarewa, hinau and matai with mahoe, and mamaku.	Between road and stream. Pasture surrounds.	2	0.5	Adjacent	528875
0206.26	Makara Hill	Gully face	Rewarewa, mahoe, mapou, mamaku, kohuhu, akiraho, putaputaweta, supplejack, manuka, and kanuka.	Tauhinu-gorse-manuka-kanuka mosaic with barberry.	2	2.8	Adjacent	532883

Forest Type Classification
1. Lowland Hill Country Forest - primary.
2. Lowland Hill Country Forest - secondary forest with primary elements present.

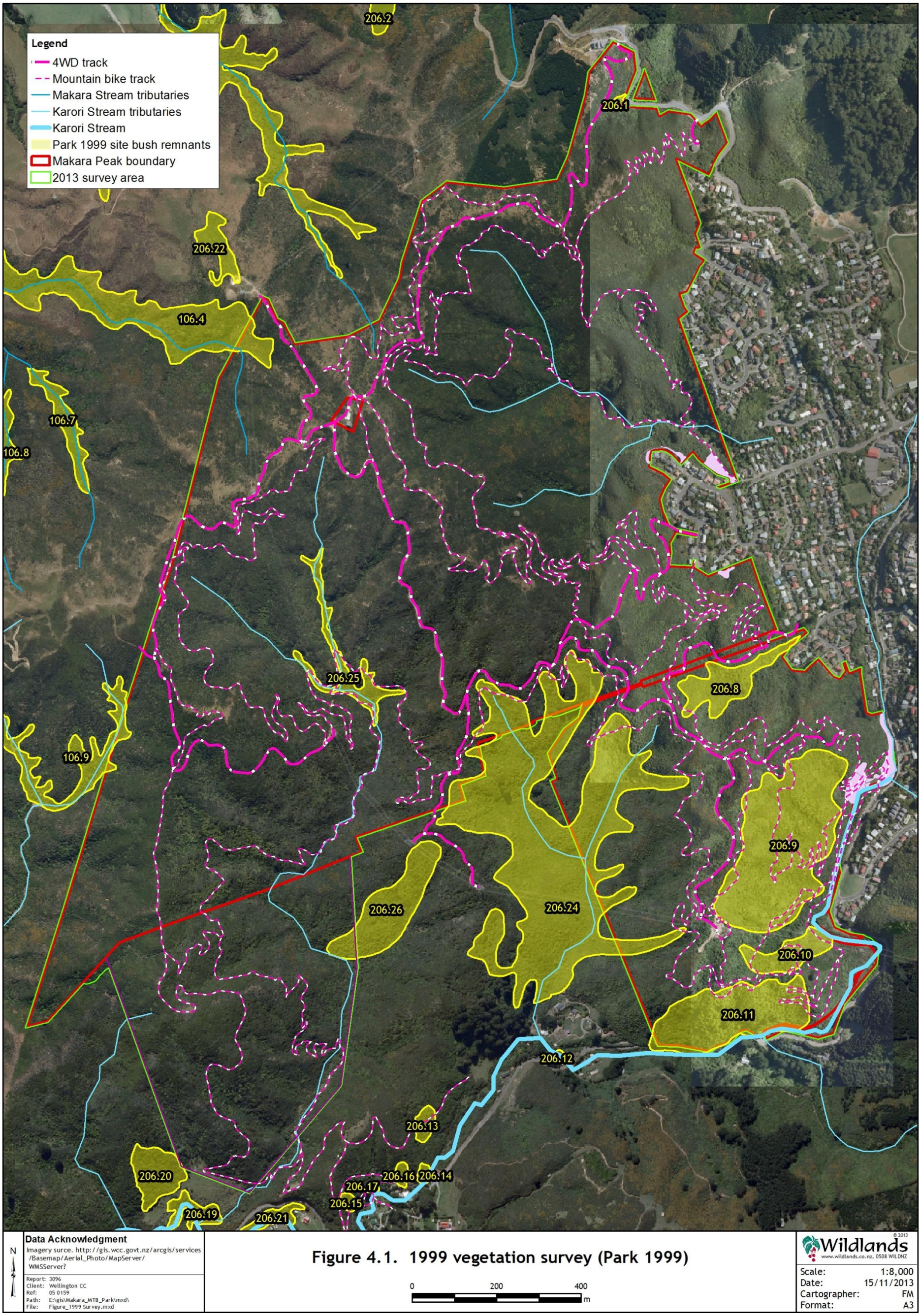

Figure 4.1. 1999 vegetation survey (Park 1999)

4.2 2001/2002 SURVEY

In 2001 the broad vegetation types found within Wellington City Council reserves were identified. This included most of the area within Makara Peak (Froude 2002). Lowland slopes closest to Karori were mapped as "inland" broadleaved indigenous scrub, and this vegetation type also occurred in some of the deeper gully systems at higher elevation. Mixed narrow leaved indigenous scrub occurred on the faces of the elevated area with gorse or barberry dominant scrub or shrubland on most of the ridges throughout the Park. A list of all vegetation types mapped by Froude (2002) is provided in the table below.

Table 4.2: Vegtation types of Makara Peak, from Froude 2002.

Initials	Subclass Level 1	Subclass Level 2	Structural Class	Structural Class Descriptor	% Cover Within Makara Peak
FA	Alien species dominant	Conifers (primarily), eucalyptus and acacias (FA)	Forest	Trees dominant trees and shrubs >80% canopy	0.3%
GA	Alien species dominant		Grassland/ fernland	Grass (fern) cover 20-100%	1.4%
SA	Alien species dominant inland	Gorse or barberry dominant	Scrub	Shrubs >80% canopy	30.4%
SB	Broadleaved indigenous "inland"		Scrub	Shrubs >80% canopy	31.8%
Shg	Shrubland in grassland (exposed upper slopes and ridges)		Shrubland	Shrubs cover in canopy 20-80%	12.0%
SN	Narrow leaved indigenous	Mixed narrow-leaved indigenous	Scrub	Shrubs >80% canopy	18.8%
O	Other (lawns, playing fields, hard surfaces, parking, etc)		Other	Other, non-indigenous	0.1%
	Not mapped - outside WCC land in 2002				5.0%

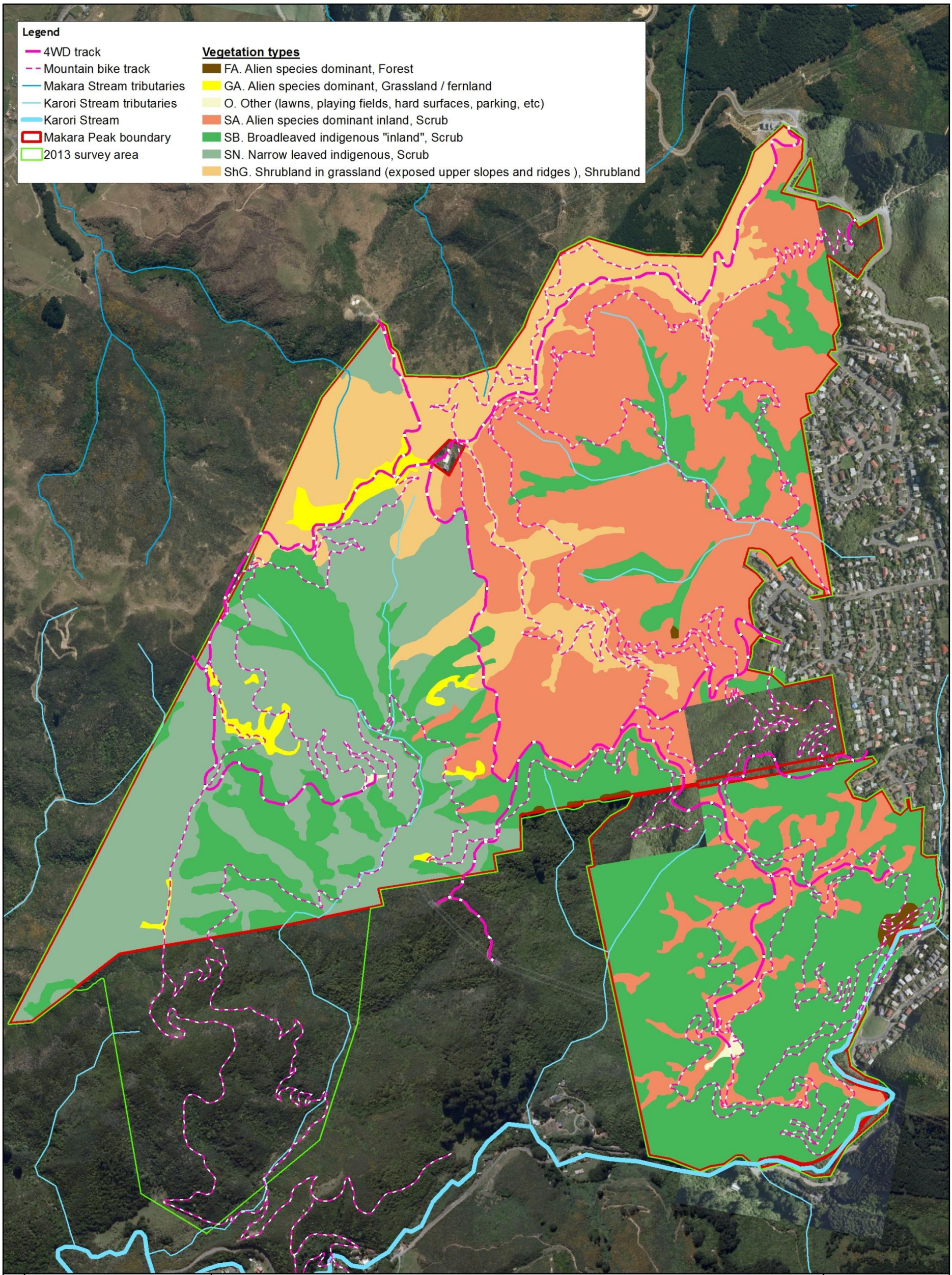

Figure 4.2. Vegetation types of Makara Peak 2001-2002 (Froude 2002)

VASCULAR PLANTS OF MAKARA PEAK

This list was compiled from two site surveys within the Makara Peak Mountain Bike Park undertaken by Astrid van Meeuwen-Dijkgraaf on 21 February 2013 and Sarah Beadel and Astrid van Meeuwen-Dijkgraaf on 12 March 2013. Additional species from earlier surveys by Mitcalfe and Horne (1998, 2000) and Park (1999) have also been incorporated.

Key Species which occur naturally on the Makara Peak and are also not planted have no annotation.
P = Planted; N = Natural; M = Recorded by Mitcalf and Horne (1998 or 2000) as naturally occurring; R = Recorded by Park (1999) as naturally occurring.

INDIGENOUS SPECIES

Gymnosperms

Dacrycarpus dacrydioides (P, N)	kahikatea
Dacrydium cupressinum (P, N)	rimu
Podocarpus totara var. *totara* (P, N)	totara
Prumnopitys ferruginea (P)	miro
Prumnopitys taxifolia (P)	matai

Monocot. trees and shrubs

Cordyline australis (P, N)	tī kōuka, cabbage tree
Cordyline banksii	tī ngahere, forest cabbage tree
Rhopalostylis sapida (P, N)	nīkau

Dicot. trees and shrubs

Alectryon excelsus subsp. *excelsus* (P)	tītoki
Aristotelia serrata (P, N)	makomako, wineberry
Beilschmiedia tawa (P, N)	tawa
Brachyglottis repanda	rangiora
Carmichaelia australis (P, N)	maukoro, tainoka, taunoka
Carpodetus serratus (P, N)	putaputawētā
Coprosma areolata	
Coprosma grandifolia (P, N)	kanono, raurēkau, raurākau, manono
Coprosma ×*cunninghamii* (*Coprosma propinqua* × *C. robusta*) (P,N)	
Coprosma lucida (P, N)	karamū, kāramuramu, glossy karamu
Coprosma propinqua var. *propinqua*	mingimingi
Coprosma rhamnoides (M)	
Coprosma robusta (P, N)	karamū, kāramuramu

Coprosma dumosa	
Clianthus puniceus (P)	kākābeak
Dodonaea viscosa (P)	akeake
Dysoxylum spectabile (P, N)	kohekohe
Elaeocarpus dentatus (P)	hīnau, whīnau
Fuchsia excorticata	kōtukutuku, kōnini
Gaultheria antipoda	tāwiniwini, koropuka, takapo, taupuku
Geniostoma ligustrifolium var. *ligustrifolium*	hangehange
Griselinia littoralis (P, N)	kāpuka
Griselinia lucida (M)	puka
Hebe macrocarpa	kōkōmuka
Hebe parviflora (P, N)	koromiko tāranga, kōkōmuka, tāranga
Hebe stricta var. *atkinsonii* (P, N)	koromiko, kōkōmuka
Hedycarya arborea (P, N)	porokaiwhiri; pigeonwood
Hoheria populnea (P)	houhere, lacebark
Knightia excelsa (P, N)	rewarewa
Kunzea ericoides (P, N)	kānuka
Laurelia novae-zelandiae (P, N)	pukatea
Leptospermum scoparium agg. (P, N)	mānuka
Leucopogon fraseri	pātōtara
Lophomyrtus bullata (M)	ramarama
Macropiper excelsum subsp. *excelsum*	kawakawa
Melicytus ramiflorus subsp. *ramiflorus* (P, N)	māhoe
Metrosideros robusta (P, N)	northern rātā
Myoporum laetum (P, R)	ngaio
Myrsine australis (P, N)	māpou, matipou, māpau
Nestegis lanceolata (P, M, R)	white maire, maire rauriki
Olearia paniculata (P, N)	akiraho
Olearia rani var. *colorata*	heketara
Olearia solandri (P,N)	
Ozothamnus leptophyllus (P, N)	tauhinu
Pennantia corymbosa	kaikōmako
Pittosporum crassifolium (adventive, not natural on the site)	karo
Pittosporum eugenioides (P)	tarata; lemonwood
Pittosporum ralphii (P)	
Pittosporum tenuifolium (P, N)	kōhūhū, rautāhiri, rautāwhiri
Plagianthus regius subsp. *regius* (P)	ribbonwood, mānatu
Pseudopanax arboreus (P, N)	whauwhaupaku, puahou, five finger
Pseudopanax crassifolius (P,N)	horoeka, lancewood
Pseudopanax crassifolius × *P. lessonii* (P)	
Pseudopanax lessonii (P)	houpara
Raukaua anomalus	
Schefflera digitata (P, N)	patē
Solanum aviculare var. *aviculare*	poroporo
Sophora microphylla (P)	kōwhai
Urtica ferox	ongaonga, tree nettle
Weinmannia racemosa (P,N)	kāmahi
Weinmannia silvicola (P)	tōwai

Monocot. lianes

Ripogonum scandens	supplejack, kareao

Dicot. lianes

Calystegia sepium subsp. *roseata*	pōhue
Calystegia tuguriorum	pōwhiwhi, native bindweed
Clematis foetida	akakaikū
Clematis forsteri	poananga, puawānanga
Clematis paniculata	puawānanga
Metrosideros diffusa	rātā
Metrosideros fulgens	rātā
Metrosideros perforata	aka
Muehlenbeckia australis	puka
Muehlenbeckia complexa	pōhuehue
Parsonsia capsularis	akakiore
Parsonsia heterophylla	akakaikiore
Passiflora tetrandra	kohia; native passionfruit
Rubus cissoides agg.	tātarāmoa, tātaraheke , bush lawyer

Lycopods and psilopsids

Huperzia varia	whiri-o-Raukatauri
Lycopodium fastigiatum	mātukutuku
Lycopodium scariosum	mātukutuku
Lycopodium volubile	waewaekoukou
Tmesipteris tannensis	

Ferns

Adiantum cunninghamii	huruhuru tapairu, maidenhair fern
Asplenium bulbiferum	mouku, hen and chicken fern
Asplenium flabellifolium	necklace fern
Asplenium flaccidum	makawe, ngā makawe o Raukatauri
Asplenium hookerianum	
Asplenium oblongifolium	huruhuru whenua
Asplenium polyodon	petako
Blechnum chambersii	rereti, nini
Blechnum colensoi	peretao
Blechnum discolor	piupiu, crown fern
Blechnum filiforme	pānako
Blechnum fluviatile	kiwikiwi, kiwakiwa
Blechnum novae-zelandiae	kiokio
Blechnum penna-marina subsp. *alpina*	
Blechnum procerum	
Blechnum vulcanicum	korokio
Ctenopteris heterophylla	
Cyathea dealbata	ponga, silver fern
Cyathea medullaris	mamaku

Cyathea smithii (M)	kātote, soft tree fern
Dicksonia fibrosa	whekī -ponga, kurīpākā
Dicksonia squarrosa	whekī
Diplazium australe	
Grammitis pseudociliata	
Histiopteris incisa	mātātā, water fern
Hymenophyllum demissum	irirangi, piripiri, filmy fern
Hymenophyllum flabellatum (M)	mauku, filmy fern
Hymenophyllum sanguinolentum	piripiri, filmy fern
Hypolepis ambigua	
Hypolepis lactea	
Lastreopsis glabella	
Lastreopsis hispida	tuakura
Leptopteris hymenophylloides	heruheru
Microsorum pustulatum	kōwaowao, pāraharaha, hound's tongue fern
Paesia scaberula	mātātā
Pellaea rotundifolia	tarawera, button fern
Pneumatopteris pennigera	pākau
Polystichum neozelandicum subsp. *zerophyllum*	pikopiko, shield fern
Polystichum vestitum	pūniu, prickly shield fern
Pteridium esculentum	rārahu, bracken
Pteris macilenta	titipo, sweet fern
Pyrrosia eleagnifolia	leather-leaf fern
Rumohra adiantiformis	karuwhai
Trichomanes venosum	

Orchids

Adenochilus gracilis	
Earina mucronata	peka-a-waka
Microtis unifolia agg.	
Orthoceras novae-zeelandiae	māikaika
Pterostylis banksii	tutukiwi
Pterostylis graminea	greenhood
Thelymitra longifolia	

Grasses

Anthosachne multiflorus subsp. *multiflorus*	
Austroderia fulvida (P, N)	toetoe
Deyeuxia avenoides	
Dichelachne crinita	plume grass
Echinopogon ovatus	
Microlaena avenacea	bush rice grass
Microlaena polynoda (M)	
Microlaena stipoides	pātītī, meadow rice grass
Poa cita s.l.	silver tussock
Poa sp.	
Rytidosperma gracile	

Sedges

Carex breviculmis	
Carex dissita	
Carex secta	pūrei, makura, pūreirei, pūrekireki, pūkio
Carex virgata	pūrei
Gahnia procera	
Isolepis sp.	
Schoenus maschalinus	
Uncinia scabra	
Uncinia uncinata	kamu matau a Maui, kamu

Rushes

Juncus planifolius	
Juncus sarophorus	wi, wīwī
Luzula picta var. *picta*	

Monocot. herbs (other than orchids, grasses, sedges, and rushes)

Arthropodium cirratum (P)	rengarenga
Astelia fragrans	kakaha
Astelia solandri	kōwharawhara
Collospermum hastatum	kahakaha
Libertia sp.	mīkoikoi; native iris
Phormium cookianum subsp. *hookeri* (P)	wharariki, mountain flax
Phormium tenax (P)	harakeke, flax

Composite herbs

Euchiton audax	
Euchiton japonicus	
Euchiton ruahinicus	
Helichrysum filicaule	
Lagenifera pumila	papataniwhaniwha
Leptinella squalida	
Pseudognaphalium luteoalbum agg.	pukatea
Raoulia glabra	
Senecio hispidulus	

Dicot. herbs (other than composites)

Acaena anserinifolia	piripiri, hutiwai
Acaena novae-zelandiae	piripiri
Aciphylla squarrosa	karamea, taramea , Spaniard
Cardamine debilis agg.	panapana
Centella uniflora	
Dichondra repens (M)	
Drosera auriculata	sundew, wahu

Epilobium atriplicifolium	
Epilobium nerteroides	
Epilobium pedunculare	
Epilobium pubens	
Epilobium rotundifolium	
Galium propinquum (M)	*mawe*
Geranium brevicaule	
Haloragis erecta subsp. *erecta*	toatoa
Hydrocotyle elongata	
Hydrocotyle heteromeria	
Hydrocotyle moschata	
Leptostigma setulosa	
Lobelia anceps	punakura
Lobelia angulata	pānakenake
Nertera depressa	
Oxalis exilis	
Ranunculus reflexus	maruru
Stellaria parviflora	kohukohu
Wahlenbergia violacea	rimuroa

NATURALISED AND EXOTIC SPECIES

Gymnosperms

Cupressus macrocarpa	macrocarpa
Pinus radiata	radiata pine

Dicot. trees and shrubs

Arbutus unedo	strawberry tree
Berberis darwinii	Darwin's barberry
Buddleja davidii	buddleia
Chamaecytisus palmensis	tree lucerne
Cytisus scoparius	broom
Elaeagnus ×reflexa	elaeagnus
Hypericum androsaemum	tutsan
Prunus sp.	ornamental cherry
Rubus sp. (*R. fruticosus* agg.)	blackberry
Salix fragilis	crack willow
Ulex europaeus	gorse

Dicot. lianes

Calystegia silvatica	greater bindweed
Lonicera japonica	Japanese honeysuckle

Monocot. lianes

Clematis vitalba	Old man's beard
Delairea odorata	German ivy

Lycopods and psilopsids

Selaginella kraussiana	creeping clubmoss, selaginella

Grasses

Agrostis capillaris	browntop
Agrostis stolonifera	creeping bent
Anthoxanthum odoratum	sweet vernal
Avena barbata	slender oat
Avena fatua	wild oat
Bromus willdenowii	prairie grass
Cortaderia selloana	pampas
Dactylis glomerata	cocksfoot
Ehrharta erecta	veldt grass
Eleusine indica	crowfoot grass
Holcus lanatus	Yorkshire fog
Poa annua	annual poa
Schedonorus arundinaceus	tall fescue

Rushes

Juncus articulatus	jointed rush
Juncus bufonius var. *bufonius*	toad rush
Juncus effusus var. *effusus*	soft rush, leafless rush
Juncus tenuis var. *tenuis*	track rush

Monocot. herbs (other than orchids, grasses, sedges, and rushes)

Crocosmia ×crocosmiiflora	montbretia
Lilium lancifolium	tiger lily
Tradescantia fluminensis	tradescantia
Zantedeschia aethiopica	arum lily

Composite herbs

Achillea millefolium	yarrow
Anthemis cotula	stinking mayweed
Arctium minus	burdock
Bellis perennis	lawn daisy
Cirsium arvense	California thistle
Cirsium vulgare	Scotch thistle
Conyza sumatrensis	broad-leaved fleabane
Crepis capillaris	hawksbeard

Gamochaeta calviceps	silky cudweed
Gamochaeta coarctata	purple cudweed
Hypochaeris radicata	catsear
Jacobaea vulgaris	ragwort
Lapsana communis	nipplewort
Leontodon taraxacoides	hawkbit
Leucanthemum vulgare	oxeye daisy
Sonchus asper	prickly puha
Sonchus oleraceus	puha, sow thistle
Taraxacum officinale	dandelion

Dicot. herbs (other than composites)

Anagallis arvensis	scarlet pimpernel
Centaurium erythraea	centaury
Cerastium fontanum subsp. *vulgare*	mouse-ear chickweed
Cymbalaria muralis	ivy-leaved toad flax
Daucus carota	wild carrot
Digitalis purpurea	foxglove
Echium plantagineum	Paterson's curse
Foeniculum vulgare	fennel
Fumaria muralis	scrambling fumitory
Galeobdolon luteum	aluminium plant
Geranium molle	dovesfoot cranesbill
Linaria purpurea	purple linaria
Linum catharticum	purging flax
Lotus pedunculatus	lotus
Lotus suaveolens	hairy birdsfoot trefoil
Malva sp.	mallow
Medicago lupulina	black medick
Mimulus moschatus	musk
Modiola caroliniana	creeping mallow
Nasturtium officinale	watercress
Petroselinum crispum	parsley
Plantago lanceolata	narrow-leaved plantain
Plantago major	broad-leaved plantain
Prunella vulgaris	selfheal
Ranunculus repens	creeping buttercup
Raphanus raphanistrum subsp. *raphanistrum*	wild raddish
Rumex acetosella	sheep’s sorrel
Rumex obtusifolius	broad-leaved dock
Sagina procumbens	pearlwort
Silene gallica	catchfly
Sison amomum	stone parsley
Solanum chenopodioides	velvety nightshade
Solanum nigrum	black nightshade
Solanum tuberosum	potato
Stachys arvensis	staggerweed
Stachys sylvatica	hedge woundwort
Stellaria media	chickweed

Trifolium pratense	red clover
Trifolium repens	white clover
Verbascum thapsus	woolly mullein
Verbascum virgatum	moth mullein
Veronica serpyllifolia	turf speedwell
Vicia sativa	vetch

LIST OF SPECIES SUITABLE FOR PLANTING

Whilst species listed in Table 6.1 are the main species for planting, any species that occur naturally in the Park (see Appendix 5) or nearby are also suitable for planting.

Key S = Sheltered, with existing forest or shrubby vegetation.
O = Open sites, unvegetated or grassy.

Planting frequency

1. Use mostly these species.
2. Plantings should aim to have a total of at least 600 plants/ha of these species when the planting is completed.
3. Only plant in sheltered sites.
4. Plant in lower numbers.

Table 6.1: Species recommended for planting within Makara Peak.

Scientific Name	Common Name	Planting frequency	Lower Slopes						Upper Slopes					
			Ridges		Hillslopes		Gullies		Ridges		Hillslopes		Gullies	
			S	O	S	O	S	O	S	O	S	O	S	O
GYMNOSPERMS														
Dacrycarpus dacrydioides	kahikatea	4			✓		✓							
Dacrydium cupressinum	rimu	4	✓		✓									
Podocarpus totara var. *totara*	totara	4	✓		✓									
Prumnopitys ferruginea	miro	4	✓		✓									
Prumnopitys taxifolia	matai	4	✓		✓									
MONOCOT. TREES AND SHRUBS														
Cordyline australis	tī kōuka, cabbage tree	3			✓	✓	✓	✓						
Cordyline banksii	tī ngahere, forest cabbage tree	3			✓									
Rhopalostylis sapida	nīkau	3					✓							
DICOT. TREES AND SHRUBS														
Alectryon excelsus subsp. *excelsus*	tītoki	3, 4			✓									

Scientific Name	Common Name	Planting frequency	Lower Slopes						Upper Slopes					
			Ridges		Hillslopes		Gullies		Ridges		Hillslopes		Gullies	
			S	O	S	O	S	O	S	O	S	O	S	O
Beilschmiedia tawa	tawa	3, 4			✓		✓							
Carpodetus serratus	putaputawētā	1			✓						✓			
Coprosma grandifolia	kanono, raurēkau, raurākau, manono	1			✓		✓							
Coprosma propinqua var. *propinqua*	mingimingi	1							✓		✓			
Coprosma robusta	karamū, kāramuramu	1	✓		✓						✓			
Coprosma dumosa		1							✓	✓	✓			
Dysoxylum spectabile	kohekohe	3			✓		✓							
Elaeocarpus dentatus	hīnau, whīnau	3			✓						✓			
Fuchsia excorticata	kōtukutuku, kōnini	3					✓						✓	
Griselinia littoralis	kāpuka	1							✓	✓	✓			
Hebe stricta var. *atkinsonii*		1		✓		✓						✓		
Hedycarya arborea	porokaiwhiri; pigeonwood	3			✓									
Knightia excelsa	rewarewa	3	✓		✓									
Kunzea ericoides	kānuka	2	✓	✓	✓						✓			
Laurelia novae-zelandiae	pukatea	4					✓							
Leptospermum scoparium agg.	mānuka	2		✓		✓				✓		✓		
Melicytus ramiflorus subsp. *ramiflorus*	māhoe	2			✓		✓							
Metrosideros robusta	northern rātā	4	✓		✓									
Myrsine australis	māpou, matipou, māpau	1	✓		✓									
Myrsine salicina	toro	1							✓	✓				
Nestegis lanceolata	white maire, maire rauriki	4	✓		✓									
Pennantia corymbosa	kaikōmako	1			✓		✓							
Pittosporum eugenioides	tarata; lemonwood	3			✓									
Pittosporum tenuifolium	kōhūhū, rautāhiri, rautāwhiri	3			✓									

Scientific Name	Common Name	Planting frequency	Lower Slopes						Upper Slopes					
			Ridges		Hillslopes		Gullies		Ridges		Hillslopes		Gullies	
			S	O	S	O	S	O	S	O	S	O	S	O
Plagianthus regius subsp. *regius*	ribbonwood, mānatu	3					✓							
Pseudopanax arboreus	whauwhaupaku, puahou, five finger	1	✓		✓									
Pseudopanax crassifolius	horoeka, lancewood	1	✓		✓									
Raukaua anomalus		1									✓			
Schefflera digitata	patē	3					✓							
Solanum aviculare var. *aviculare*	poroporo	3	✓		✓		✓							
Weinmannia racemosa	kāmahi	1							✓		✓			
GRASSES														
Austroderia fulvida	toetoe	2		✓		✓		✓		✓		✓		✓
MONOCOT. HERBS (other than orchids, grasses, sedges, and rushes)														
Phormium cookianum subsp. *hookeri*	whaririki, mountain flax	2		✓		✓				✓		✓		
Phormium tenax	harakeke, flax	2						✓						✓

WEED SURVEYS, CONTROL PRIORITIES, AND RISK CLASSES

WEED SURVEY PRIORITIES

Weed surveys are vital for the assessment of which weeds are present, and where these weeds occur. They are required to help the prioritisation of species control and infestations, monitoring the success of weed control operations, and to ascertain if new species and infestations have become established. Ongoing, preferably annual (or maximum of three yearly intervals), weed surveys are an important management activity, especially to assess the success of weed control operations, and to pick up new species. Surveys also enable the regular review of weed control priorities.

Shade-tolerant weed species, such as tradescantia and Darwin's barberry, may be present and unrecorded in higher value habitats, such as areas of remnant tall forests (see Vegetation Types 1a and 1g in Figure 2). It is therefore important to undertake a more detailed weed survey of these areas, to ensure the ongoing health of these valuable habitats. This could be prioritised by habitat type, as outlined in Table 6.2.

If possible map the locations of weeds on a topographical map, or use GPS to record accurate distribution information. Additional survey effort will be required, prior to undertaking control of pest plants in Classes One to Three, to accurately assess the extent and density of each weed infestation.

Garden Refuse Informal "Dumping Areas"

Garden refuse "dumping areas" provide an ongoing source of new weeds. It is important to know where these sites are and to monitor them, in order to minimise the threat they pose to Makara Peak. A survey is required to assess the location and extent of garden refuse "dumping areas", and to record weedy species in these areas. The entire boundary should be walked to accurately locate, map and assess all these areas, which should then be prioritised in terms of: risk class, weediness, accessibility for control, and potential for enhancement through community restoration programmes. To reduce the risk of additional garden dumping sites becoming established, an advocacy programme should be undertaken with residents adjacent to the Park.

WEED CONTROL PRIORITIES

This section briefly describes the rationale for assigning weed species to particular risk classes, using six categories (adapted from Wildland Consultants Ltd 2000). Table 6.1 lists the weed species present in Makara Peak. Control efforts should concentrate on Class One to Class Three environmental pest plants. However, budget limitations, the size the infestations and range of species involved, will likely mean that weeds will need to be prioritised over a multi-year work programme. Hence the weeds within each Class (Table 6.1) can be further prioritised by infestation type (Table 6.2). For instance, a small patch of a newly-arrived weed is a high priority for control, to stop it from becoming established, and because the cost

of eradication in the early stages is much cheaper then when a species is more established and widespread.

Assessment of the infestation type is determined by the habitat the weeds are distributed in, size and shape of the infestation area; the growth form of the weed, how the weed spreads, and reducing the risk of other weed species establishing where weeds have been controlled. Table 6.2 provides a matrix for setting these priorities, and examples are given in italics in the table. Timeframes for the various weed control operations will be dependent on the budget available.

1. Class One

   Class One species are Suppression Pests identified in the Wellington City Council Pest Management Strategy (2004). All species listed under Class One should be eliminated.

2. Class Two

   Class Two species are generally present in low numbers or are restricted to smaller infestations. These should all be controlled before they spread. Control should be prioritised by infestation type (refer to Table 6.2).

3. Class Three

   Class Three species threaten the ecological integrity of the study area and the long-term viability of the ecologically valuable vegetation. Infestations of these species are generally sizeable and would require substantial effort to control, and should, therefore, be prioritised by infestation type.

4. Class Four

   These are environmental pest plant species that are present in moderate to large infestations, but pose a lesser threat to ecological processes or values in Makara Peak. These should be controlled as resources allow, or if they begin to threaten the indigenous vegetation of Makara Peak.

5. Class Five

   These are small infestations of pest plants which do not threaten ecological processes, and control is not advocated at present.

6. Class Six

   Species listed under Class Six are not recommended for control, because they either pose little threat to ecological values, or seem unlikely to spread significantly. Gorse (*Ulex europaeus*) may need to be controlled to fulfil RPMS and fire requirements; however it poses little ecological threat. Broom (*Cytisus scoparius*) will need to be monitored to ensure that it doesn't spread or halt succession to indigenous vegetation.

Table 7.1: Pest plants known from Makara Peak.

Scientific Name	Common Name	Recorded in 2013 Survey	Risk Class	Weed Management Recommendations	Unwanted Organism[1]	NPPA[2]	GW RPMS[3]	WCC PMS[4]	Notes
Clematis vitalba	old man's beard	Yes	1	Ongoing control, following infestation priorities (Table 6.2).	yes	yes	Site lead	Boundary control	RPMS short term goal: prevent flowering and seed set of all plants on Wellington City Council, covenant, or buffer zone properties.
Galeobdolon luteum	aluminium plant (artillery plant)	Yes	1	Control to eradicate.	yes		KNE	KNE	
Elaeagnus ×reflexa	elaeagnus	yes	1	Control trees near St Albans entrance to prevent furhter spread.			KNE		Birds spread the seed and it invades all types of shrublands. Wear gloves and eye protection when working with Elaeagnus as its spines can cause injury.
Cortaderia selloana	Pampas	Yes	2	Control to eradicate.	yes	yes	KNE	KNE	
Lonicera japonica	Japanese honeysuckle	Yes	2	Control to eradicate.	yes	yes	KNE	KNE	Present near skills area, also in stream valley.
Salix fragilis	crack willow	Yes	2	Control to eradicate.	yes	yes	KNE		
Selaginella kraussiana	creeping clubmoss, selaginella	Yes	2	Ongoing control, following infestation priorities. Control to reduce spread.	yes	yes	KNE	KNE	
Zantedeschia aethiopica	arum lily	Yes	2	Control to eradicate.	yes		KNE		

[1] Listed on Ministry for Primary Industries Unwanted Organisms Register accessed on 16 September 2013 http://www.biosecurity.govt.nz/pests/registers/uor

[2] Listed on Ministry for Primary Industries National Pest Plant Accord accessed on 16 September 2013 http://www.biosecurity.govt.nz/nppa

[3] Greater Wellington (2009). Indicates level of control outlined in the Regional Pest Management Strategy (RPMS). Site-led and KNE (Key Native Ecosystem)-species are widespread pest plants that can, and have, spread rapidly over long distances and adverse impacts of species is considered to be severe, but total control or containment is not achievable. The focus is for control of pest species by the land-owner of these sites, and KNE sites may receive funding to support such pest control. Containment species are those species that have established in the Greater Wellington area, but have not yet achieved maximum distribution, and may be able to be prevented from infesting additional sites.

[4] Wellington City Council (2004). Indicates levels of control outlined in Wellington City Council Pest Management Plan (PMP).

Scientific Name	Common Name	Recorded in 2013 Survey	Risk Class	Weed Management Recommendations	Unwanted Organism[1]	NPPA[2]	GW RPMS[3]	WCC PMS[4]	Notes
Buddleja davidii	buddleia	Yes	2	Control to eradicate.			KNE	KNE	Provides food for butterflies, but forms dense impenetrable stands and hard to eradicate. Recommend introducing biocontrol; very effective where introduced in Bay of Plenty.
Berberis darwinii	Darwin's barberry	Yes	3	Survey high value habitats, and control there. Where more wide spread create and/or plant clearings with indigenous species to encourage eventual overtopping.	yes	yes	KNE	KNE	RPMS short term goal: prevent Darwin's barberry from establishing in open sites.
Tradescantia fluminensis	tradescantia	Yes	3	Control to minimise increases in coverage following infestation priorities. Survey high value habitats for this shade tolerant species. Long term aim to eradicate.	yes	yes	KNE	KNE	Including areas of controlled weeds.
Calystegia silvatica	greater bindweed	yes	3	Control around revegetation areas and forest margins			KNE	KNE	Easily confused with indigenous bindweed species.
Crocosmia ×crocosmiiflora	montbretia	yes	3	Control around revegetation areas, and where plants are stored prior to planting to prevent further spread.			KNE		
Delairea odorata	German ivy	yes	3	Control to minimise increases in coverage following infestation priorities. Survey high value habitats for this partially shade tolerant species. Long term aim is to eradicate.			KNE		
Rubus sp. (*R. fruticosus* agg.)	blackberry	Yes	3	Control to minimise increases in coverage and in replanted areas.			Site lead	KNE	
Arbutus unedo	strawberry tree	yes	3	Control to stop further spread					Spread by birds

Scientific Name	Common Name	Recorded in 2013 Survey	Risk Class	Weed Management Recommendations	Unwanted Organism[1]	NPPA[2]	GW RPMS[3]	WCC PMS[4]	Notes
Prunus sp.	ornamental cherry	yes	3	Remove to prevent spread of seeds					Bird dispersed fruits
Erigeron karvinskianus	Mexican daisy	Yes	4	Control to limit spread.	yes	yes	KNE	KNE	Hard to eradicate, profuse wind dispersed seed.
Lilium lancifolium	tiger lily	yes	4	Keep areas where plants are stored clear to prevent spread					
Pinus radiata	radiata pine	Yes	5	Monitor to assess distribution changes. Reassess priority at a later date if required.			KNE	KNE	May provide perching or roosting for birds, dying trees may provide food for kākā.
Chamaecytisus palmensis	tree lucerne	Yes	5	Control not recommended at present. Monitor to assess distribution changes. Reassess priority at a later date if required.					
Foeniculum vulgare	Fennel	Yes	5	Control not recommended at present. Undertake control if becoming dominant or preveting regeneration.					
Cytisus scoparius	Broom	Yes	6	Not recommended for control. Monitor to prevent spread, assess if hindering indigenous succession.			KNE	KNE	
Jacobaea vulgaris	ragwort	yes	6	Not recommended for control except for PMS boundary requirements.			Site lead	Boundary control	
Ulex europaeus	gorse	Yes	6	Not recommended for control except for PMS boundary requirements.			Site lead	Boundary control	PMS short term goal: meet RPMS requirements for boundary control.
Cupressus macrocarpa	macrocarpa	Yes	6	Not recommended for control.					Control in primary forest remnants first.

Table 7.2: Priorities for weed control by infestation type.

Priority	Infestation Type	Highest Priority	Medium Priority	Lowest Priority
1	Habitat type.	High value, least disturbed habitats: *Park 1999 forest remnant.*	Medium value, moderately disturbed, habitats: *Mahoe forest, Riparian, Ridgelines.*	Low value, highly disturbed habitats:
2	Size, shape, and extent of infestation.	Prevention, keep uninfested areas free of weeds: *Forest remnant with good indigenous buffers. Small infestations of environmental weeds which threaten the ecological values of forest or replanted areas.*	Satellite infestations, reduce spread: *Tiger lily, montbretia.*	Move towards core of infestation, dealing with the core last:
3	Weed growth form.	Vines: *control old man's beard and banana passionfruit.*	Shade tolerant species: *control Darwin's barberry, tradescantia.*	Woody weeds: *Pinus radiata.*
4	How the weed spreads:			
	Resprouting riparian weeds.	Control upstream infestations first: *Start tradescantia control up stream and around boundary.*	Work downstream.	
	Edge weeds.	Start at edges: *Dimorphotheca.*	Move towards centre of Reserve.	
	Fruiting/seed-setting weeds.	Control prior to seed set: *Elaeagnus,* wild cherry.	Remove flowers/seed, try to avoid spreading of propagules.	
5	Reduce risk of replacement weeds becoming established.	Undertake restoration planting as soon as possible after weed control	.	

The following weed species are present near Makara Peak. If they are found to occur in the Park in the future, then they are of high priority for control.

Table 7.3: Weed species currently not known from Makara Peak, but present nearby.

Chrysanthemoides monilifera	boneseed
Cobaea scandens	cathedral bells
Hedychium gardnerianum	kahili ginger
Passiflora tripartita var. *mollissima*	banana passionfruit
Asparagus scandens	climbing asparagus
Euonymus japonicus	Japanese spindleberry
Gunnera tinctoria	gunnera (Chilean rhubarb)
Plectranthus ciliatus	plectranthus, blue spur flower
Syzygium smithii	lillypilly, monkey apple
Ipomoea indica	blue morning glory
Pinus contorta	lodgepole pine
Acer pseudoplatanus	sycamore
Erica lusitanica	Spanish heath
Leycesteria formosa	Himalayan honeysuckle
Senecio angulatus	cape ivy
Senecio mikanioides	German ivy
Vinca major	periwinkle
Actinidia deliciosa	kiwifruit
Agapanthus praecox	agapanthus
Apium nodiflorum	water celery
Hedera helix subsp. helix	Ivy
Impatiens spp.	impatiens
Jasminum polyanthum	jasmine
Prunus campanulata	Taiwan cherry
Watsonia bulbillifera	watsonia
Acer pseudoplatanus	sycamore
Senecio glastifolius	purple ragwort
Ilex aquifolium	holly
Allium triquetrum	wild onion
Cedronella canariensis	balm of Gilead
Cotoneaster glaucophylla	cotoneaster
Lathyrus latifolius	everlasting pea
Osteospermum fruticosum	rain daisy, dimorphotheca
Tropaeolum majus	nasturtium
Paraserianthes lophantha	brush wattle
Rumex sagittatus	climbing dock
Acacia longifolia	Sydney golden wattle
Escallonia rubra var. *micrantha*	red escallonia
Laurus nobilis	bay tree, sweet bay
Populus alba	white poplar
Pseudotsuga menziesii	Douglas fir

PEST AND WEED CONTROL HISTORY

Goats

In 1998 a remnant population, estimated to be fewer than 30 goats, destroyed about half of 1300 recently-planted indigenous seedlings. After that incident, any reported goat sightings were usually quickly followed up by a Makara Peak supporter. This resulted in significantly decreased damage to planted seedlings and increased numbers of self-sown seedlings. A bounty system was trialed during 2003-2004, which resulted in dozens of kills in the buffer zone just outside the Park and a reduction of goat sightings and kills in the Park to less than five goats. Goat shooting lapsed for a while as WCC indicated that they were not comfortable with goat shooting taking place. Unfortunately cessation of hunting has subsequently allowed the goat population within Makara Peak to increase.

In the last two years Wellington City Council, as part of the South Peninsula goat control project, have shot just under 100 goats within, or close to, Makara Peak. A Judas goat is also being used in the area to help pinpoint goats (Illona Keenan, WCC, pers. comm. 21 August 2013). Makara Peak Supporters notify Wellington City Council of any goat sightings or damage, and this is followed up by a Council hunter. Not all Makara Peak neighbours allow goat control on their properties, thus reinvasion is likely to be ongoing.

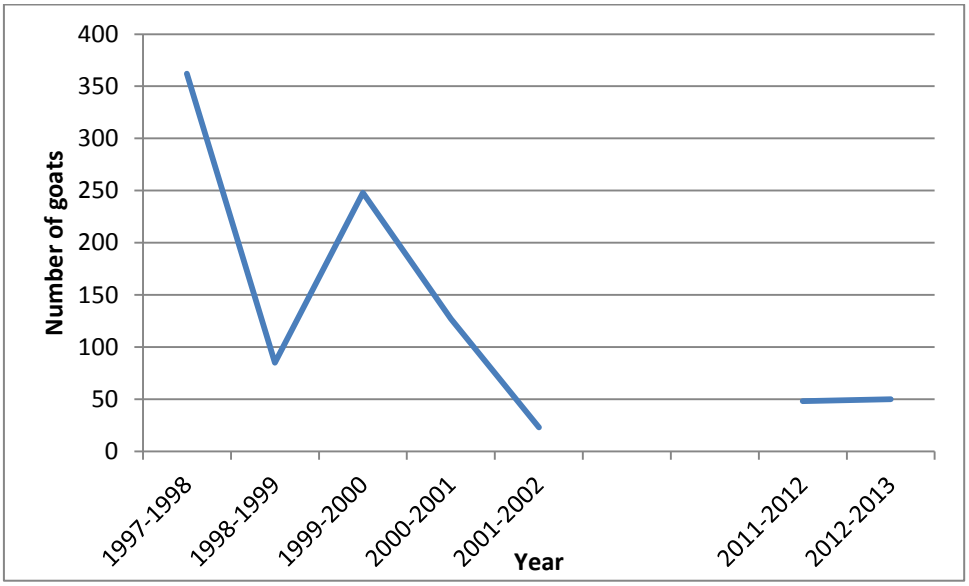

Figure 8.1: History of goat kills at Makara Peak.

There are two 15 m × 15 m goat control exclosures within Makara Peak; one near the Lower Leaping Lizard Track and the other near the Koru Track. Both exclosures were established in canopy gaps and have been planted with a range of indigenous species, including podocarps such as rimu and kahikatea (Appendix 6, Plate 17).

Possums

Makara Peak Supporters have deployed 19 Timms traps, mostly along the western boundary of Makara Peak (Figure 10). These are set and checked weekly to fortnightly and usually a total of two or three possums are caught overall per check. In addition, hedgehogs are caught at certain times of the year. Nearly every year an additional line of possum bait stations is added. In 2011 the possum stations were reviewed in conjuction with Greater Wellington Regional Council and this resulted in stations being moved and new lines being created. However, it can be difficult to get the spacing right due to the type of vegetation or ease of access. Another issue is that it can be difficult to ensure that volunteers are visiting their stations. Making sure that the work is done is the responsibility of the pest animal control coordinators.

One hundred and twenty-five 'Kilmore' bait stations have been set up at approximately 100 m intervals along most tracks. The bait in these is checked seven or eight times per year, with a focus on the lead up to and during the bird breeding season. Bait is replaced when necessary, i.e. station empty or bait mouldy. All Timms traps and bait stations are numbered individually and the locations have been mapped using GPS.

Wellington City Council surveyed possum numbers in 1999 and 2001 using the Residual Trap Catch (RTC) method, but this hasn't been repeated recently. Mahoe in the valley to the west of Sally Alley appeared (Appendix 6, Plate 5) to be affected by possum browse during February and March 2013, indicating that this area may need additional possum control, or that the existing possum control is insufficient, or that volunteers designated to manage that area are finding the task onerous (some areas can be difficult to access).

There are also 30 automated GoodNature A12 possum traps in the Park. They've been relatively successful, although they were modified to stop the traps being damaged by possums and rats. These still result in surprising numbers of dead possums under traps near where there are Timms traps and bait stations. The GoodNature traps are along the Leaping Lizard, Possum Bait Line and Nikau Valley Tracks.

Three large northern rata (*Metrosideros robusta*) were banded in the forest remnant near the Koro Track in 2002.

Mustelids

Sixty-one DOC200 traps, in single-trap sets, have been set up along most of the Makara Peak perimeter to catch stoats (Figure 11). No stoat traps have been placed near the boundary with Karori township to avoid trapping pet cats. All traps are individually numbered and the locations have been mapped by GPS. The traps are checked twice monthly from October to May, and monthly during the colder months. Eggs are replaced about four or five times a year. Seventy stoats have been killed thus far. Data from the last few year are summarised in Figure 9. In addition the stoat traps have also caught one mouse and one cat.

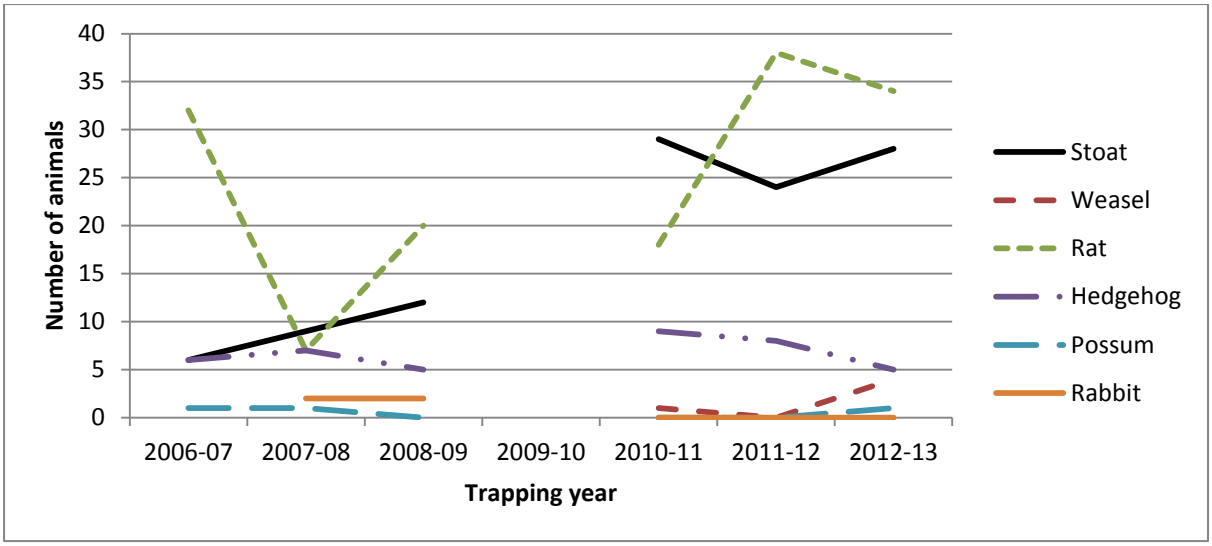

Figure 8.2: Species caught in stoat traps per trapping year (2006-2013).

Feral Sheep

Makara Peak Supporters are continuing to work with the Wellington City Council to improve the quality and effectiveness of the fencing around Makara Peak. However there remain significant areas of the Park on the South Karori Road side that have no fencing at all. Also, occasionally fences with adjoining properties fail. Thus stock such as sheep may stray into Makara Peak. If the location of the fence failure, or stock incursion, is known then the landowner is contacted to remove the stock. Otherwise they are killed by a Wellington City Council hunter and removed.

Rabbits

Rabbits can damage seedlings planted along road and track verges, and in the grasslands on the ridges. To prevent rabbit damage, corflute plant guards are used around seedlings until they are well established. Rabbit repellent was occasionally used and found to be not effective as it washes away. No rabbit control or poisoning is undertaken in Makara Peak. The rabbit population is expected to decrease as the amount of grassland reduces.

Pigs

Pigs are occasionally released for hunting. Pig rooting and faeces is often seen within Makara Peak, mostly during the winter and spring months. Wellington City Council is notified when fresh pig sign is seen, and this is followed up by a Council hunter. Three pigs have been shot in the last year (Illona Keenan, WCC pers. comm. 21 August 2013).

Rats

No targeted control or monitoring of rats is undertaken within Makara Peak.

There were tentative plans to monitor rat densities using chew-sticks as part of a school/university project, jointly funded by GWRC and the Makara Peak Supporters. However this has not eventuated yet. Similarly, rat poisoning with Feracol BioBags was

proposed for the 2012-2013 season but hasn't been undertaken yet. The intention was to focus on the area around the Koru and Lazy Fern Tracks as there is good bush there and it is relatively close to Zealandia.

MAKARA PEAK MOUNTAIN BIKE PARK TRACK NETWORK

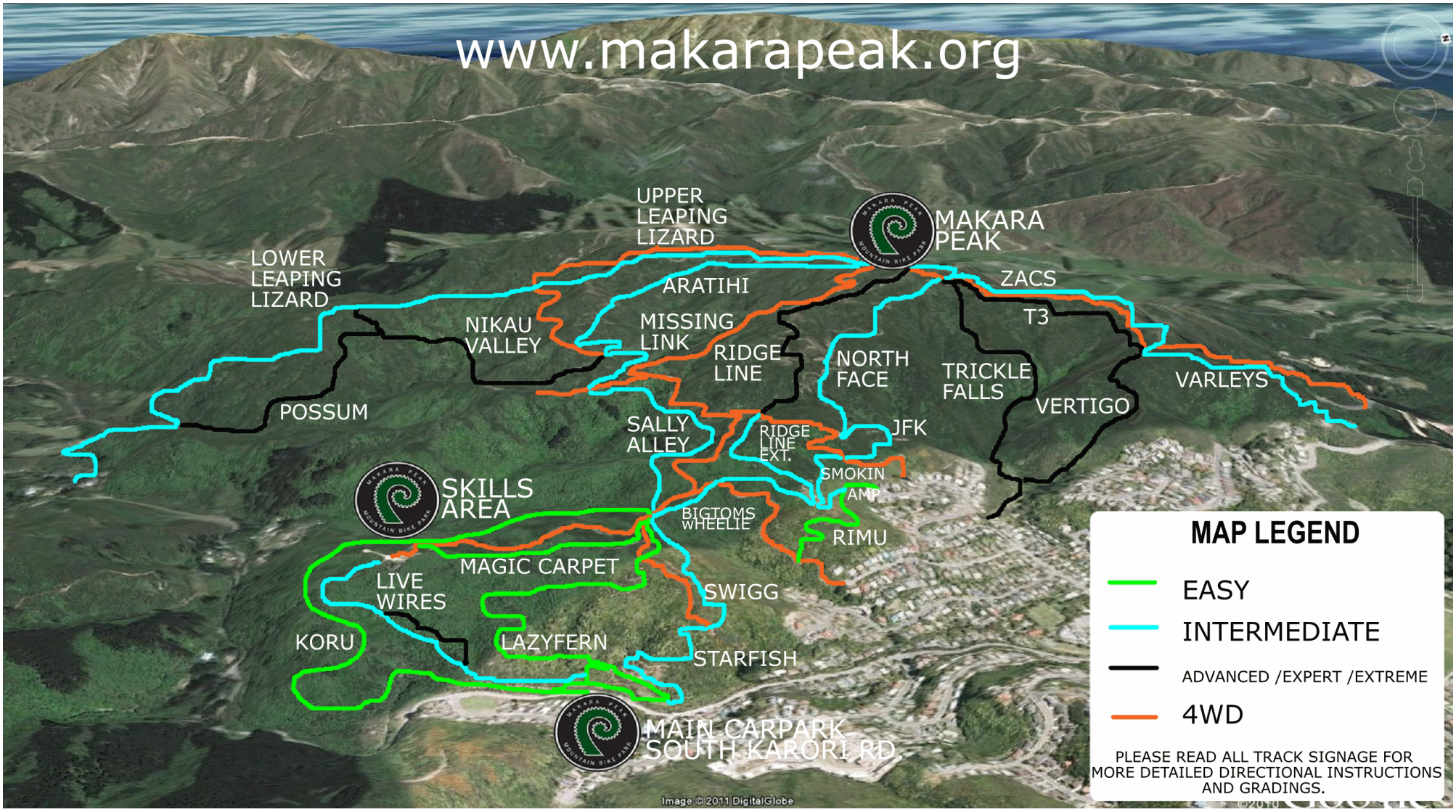

Figure 9.1. Mountain bike track network within Makara Peak - October 2011 (source Makara Peak website)

SITE PHOTOGRAPHS

Plate 1: Exotic shrubland with occasional indigenous species.

Plate 2: Darwin's barberry and tauhinu along road margins.
Koromiko tāranga and mahoe forest on the face, with patches of gorse.

Plate 3: Mixed indigenous exotic scrub, with tree ferns in gullies and manuka on spurs.

Plate 4: Indigenous species are starting to overtop Darwin's barberry in places.

Plate 5: Parts of the extensive track network are clearly visible along ridges.

Plate 6: Most tracks are clearly signposted. Planting of flax (harakeke or whaririki), along tracks can prove to be somewhat problematical as the leaves are slippery and can get caught in bikes.

Plate 7: Spaniard with seed head. This regionally sparse species is common along upper ridges and open faces within Makara Peak.

Plate 8: A clearing in Darwin's barberry planted with indigenous seedlings, protected from browsing by corflute covers.

Plate 9: An extensive area of planted whahariki has formed in closed canopy.

Plate 10: Plantings at the Makara Road entrance grades into gorse and Darwin's barberry on the ridge.

Plate 11: The Karori Stream has benefited from considerable weed control and extensive planting.

Plate 12: In places tracks are very close to or cross streams, which can cause localised erosion and sedimentation.

Plate 13: Seeding trays used where a wide range of weed species are present, if moved to other sites, could contribute to spreading of weeds.

Plate 14: *Elaeagnus* (reddish foliage) starting to overtop the canopy near the St Albans entrance.

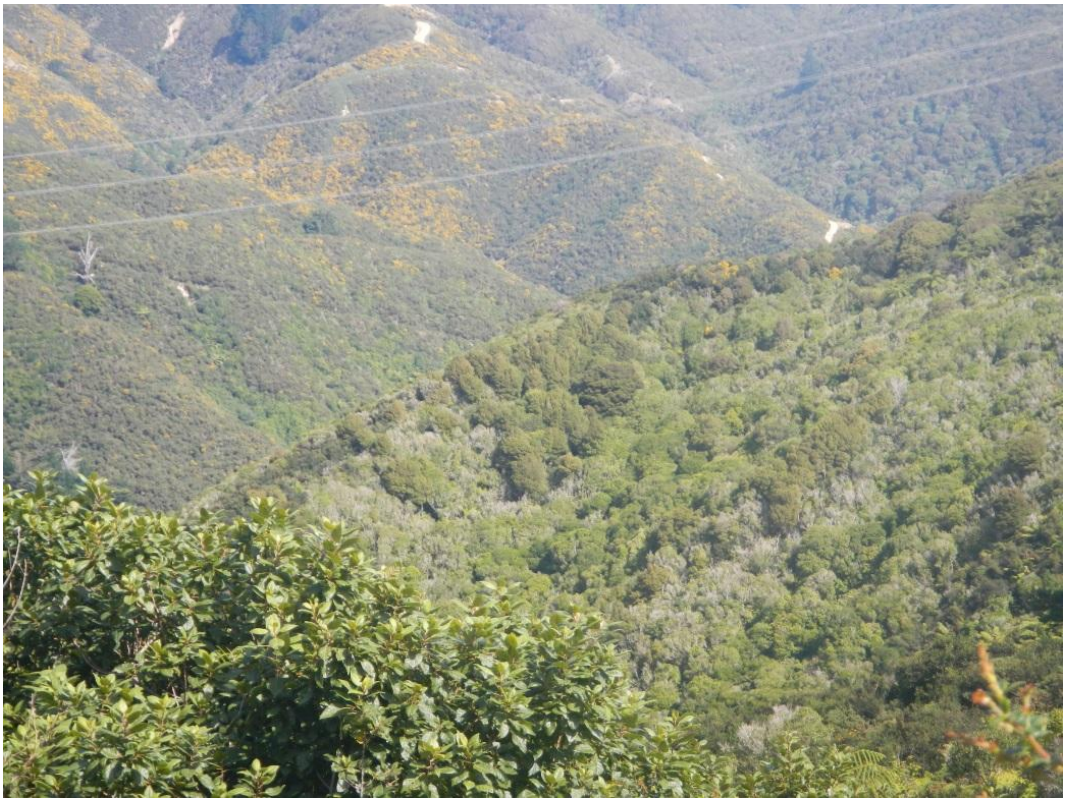

Plate 15: Mahoe in this valley is showing signs of possum damage.

Plate 16: Goats, and pig sign is regularly seen within the Park.
However, numbers are currently low and they are not causing much damage.

Plate 17: Simon Kennett outside the Lower Leaping goat exclosure.
Photo supplied by Makara Peak Supporters.

Plate 18: There are multiple users of the park and this can lead to potentially conflicting requirements. Vehicle accessways to infrastructure need to be maintained, and issues such as spread of weeds and fire-prone vegetation also require management.

Plate 19: All tracks lead to Makara Peak summit.

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