

Key Native Ecosystem Operational Plan for East Harbour Northern Forest

2017-2020



Contents

1. Purpose	1
2. Policy Context	1
3. The Key Native Ecosystem Programme	2
4. East Harbour Northern Forest Key Native Ecosystem	3
5. Parties involved	3
6. Ecological values	6
7. Key threats to ecological values at the site	8
8. Objectives	11
9. Operational activities	11
10. Operational delivery schedule	16
11. Funding contributions	18
Appendix 1: Site maps	19
Appendix 2: Threatened species list	25
Appendix 3: Regionally and locally threatened species list	28
References	30

1. Purpose

The purpose of the three-year Key Native Ecosystem (KNE) Operational Plan for East Harbour Northern Forest KNE site is to:

- Identify the parties involved
- Summarise the ecological values and identify the threats to those values
- Outline the objectives to improve ecological condition
- Describe operational activities (eg, ecological weed control) that will be undertaken, who will undertake the activities and the allocated budget

KNE Operational Plans are reviewed every three years to ensure the activities undertaken to protect and restore the KNE site are informed by experience and improved knowledge about the site.

This KNE Operational Plan is aligned to key policy documents that are outlined below (in Section 2).

2. Policy Context

Regional councils have responsibility for maintaining indigenous biodiversity, as well as protecting significant vegetation and habitats of threatened species, under the Resource Management Act 1991 (RMA)¹.

Plans and Strategies that guide the delivery of the KNE programme are:

Greater Wellington 10 Year Plan

The 10 Year Plan (2015-2025)² outlines the long term direction of the Greater Wellington Regional Council (Greater Wellington) and includes information on all our major projects, activities and programmes for the next 10 years and how they will be paid for. This document outlines that Greater Wellington will actively manage selected high value biodiversity sites. Most of this work is undertaken as part of the KNE programme.

Proposed Natural Resources Plan

The Proposed Natural Resources Plan (PNRP) provides the high level strategic framework which sets out how Greater Wellington, Mana whenua partners and the community work together and includes:

- Guiding Principles that underpin the overall management approach of the plan (eg, Kaitiakitanga)
- Sites with significant indigenous biodiversity values
- Sites of significance to mana whenua (refer Schedules B, C, Schedule D)

Parks Network Plan

Management of East Harbour Northern Forests and the broader East Harbour Regional Park is guided by the Greater Wellington Parks Network Plan (PNP)³. This plan guides

the recreational and amenity uses of East Harbour Regional Park as well as identifying opportunities to protect biodiversity values.

Greater Wellington Biodiversity Strategy

The Greater Wellington Biodiversity Strategy⁴ (Strategy) is an internal document that sets a framework that guides how Greater Wellington protects and manages biodiversity in the Wellington region to work towards the Vision.

Vision
Healthy ecosystems thrive in the Wellington region and provide habitat for native biodiversity

The Strategy provides a common focus across Greater Wellington’s departments and guides activities relating to biodiversity. The Vision is underpinned by four operating principles and three strategic goals. Goal One drives the delivery of the KNE Programme.

Goal One
Areas of high biodiversity value are protected or restored

3. The Key Native Ecosystem Programme

The KNE Programme is a voluntary programme of work. There is no statutory obligation for Greater Wellington to do this work. Greater Wellington invites selected landowners to discuss whether they would like to be involved in the programme. When work is done on private land, it is at the discretion of landowners, and their involvement in the programme is entirely voluntary. Involvement may just mean allowing work to be undertaken on that land.

The programme seeks to protect some of the best examples of original (pre-human) ecosystem types in the Wellington region by managing, reducing, or removing threats to their ecological values. Sites with the highest biodiversity values have been identified and prioritised for management. Sites are identified as of high biodiversity value for the purposes of the KNE Programme by applying the four ecological significance criteria described below.

Representativeness	Rarity/ distinctiveness	Diversity	Ecological context
The extent to which ecosystems and habitats represent those that were once typical in the region but are no longer common place	Whether ecosystems contain Threatened/At Risk species, or species at their geographic limit, or whether rare or uncommon ecosystems are present	The levels of natural ecosystem diversity present, ie, two or more original ecosystem types present	Whether the site provides important core habitat, has high species diversity, or includes an ecosystem identified as a national priority for protection

A site must be identified as ecologically significant using the above criteria and be considered “sustainable” for management in order to be considered for inclusion in the KNE Programme. “Sustainable” for the purposes of the KNE Programme is defined as: a site where the key ecological processes remain intact or continue to influence the site and resilience of the ecosystem is likely under some realistic level of management.

KNE sites can be located on private or publicly owned land. However, land managed by the Department of Conservation (DOC) is generally excluded from this programme.

KNE sites are managed in accordance with three-year KNE plans prepared by the Greater Wellington’s Biodiversity department. Greater Wellington works with the landowners, mana whenua and other operational delivery providers to achieve mutually beneficial goals.

4. East Harbour Northern Forest Key Native Ecosystem

East Harbour Northern Forest KNE site (1,647 ha) is one of the most significant forest ecosystems in the Wellington Region⁵ and is highly representative of the Tararua Ecological District⁶. It is located on the eastern side of Wellington Harbour, in the hills between the eastern bays and the Wainuiomata River valley (see Appendix 1, Map 1). It is large, still relatively intact and home to a number of threatened species.

Most of this KNE site (excluding three small privately owned areas) has been managed by Greater Wellington as part of the East Harbour Regional Park since 2004. East Harbour Northern Forest is one of three KNE sites within this Regional Park. The other two are Baring Head/Ōrua-pouanui and Parangarahu Lakes.

A 400 ha area within the KNE site has been managed intensively by Greater Wellington since 2005 as a Mainland Island. A concept adopted by agencies to focus intensive conservation and pest control efforts at ecosystem restoration sites.

The KNE site is an important area for native forest birds with most also breeding here⁷. The KNE site was the location for a North Island robin / toutouwai (*Petroica longipes*) translocation between 2008 and 2012.

5. Parties involved

Greater Wellington takes a collaborative approach to managing KNE sites. This means we will seek to work with landowners and other interested parties (stakeholders) where appropriate to achieve shared objectives for the KNE site. In preparing this plan Greater Wellington has sought input from landowners and relevant stakeholders, and will continue to involve them as the plan is implemented.

5.1. Landowners

The KNE site includes areas of public and private land. The public landowners are Greater Wellington, Hutt City Council (HCC) and the Crown (Department of Conservation). The private landowners are George and Keena Gibbs, Dion and Liz Ross and the Waitohu Property Trust (see Appendix 1, Map 2). The forest is bounded by urban properties to the north and west, and farmland and a golf course to the south

and east. Most of the KNE site is legally protected as Scenic Reserve or Recreation Reserve and one small area has a Queen Elizabeth II National Trust (QEII) Open Space Covenant on it (see Appendix 1, Map 3).

Greater Wellington is responsible for the ongoing management of East Harbour Regional Park because the Crown has vested its land in Greater Wellington, and HCC has transferred its administering body powers and responsibility for management to Greater Wellington. Greater Wellington Parks Network Plan⁸ (PNP) guides the recreational and amenity uses of the park and identifies opportunities to protect biodiversity. This KNE Plan is consistent with the wider objectives and policies of the PNP. However, the PNP will be reviewed and updated during the life-cycle of this KNE Plan and may result in management changes.

5.2. Operational delivery

Within Greater Wellington, the Biodiversity, Biosecurity, and Parks departments are involved with the delivery of the operational plan. The Biodiversity department is the overarching lead department for Greater Wellington on the coordination of biodiversity operational activities and advice within the KNE site. The Biosecurity department coordinates and carries out pest control activities. The Parks department manages/funds ecological restoration work within the KNE site.

Mainland Island Restoration Operation (MIRO), a local volunteer community group work in partnership with Greater Wellington in East Harbour Regional Park to deliver a large component of the pest control and monitoring in the KNE site. MIRO publish regular articles in social and local print media when opportunities arise regarding their work and KNE site's ecological values. MIRO also led the translocation of North Island robin (*Petroica longipes*) into the KNE site.

MIRO have also recently launched the ERAT – Educating Residents About Trapping project in partnership with HCC and local residents with funding support from the Ministry for the Environment. The ERAT project is about rolling out of a sustainable predator trapping network across Eastbourne and the bays in adjacent land parcels to the Regional Park and KNE site.

5.3. Mana whenua partners

Taranaki Whānui ki Te Upoko o Te Ika a Maui (Taranaki Whānui) are Greater Wellington's mana whenua partners in East Harbour Northern Forest KNE site. Greater Wellington is committed to exploring opportunities on how mana whenua partners wish to be involved in the plan development or operational delivery of the KNE site.

Table 1: Taranaki Whānui sites of significance in East Harbour Northern Forest KNE site⁹

Sites of significance	Mana whenua values
Parangārahu Lakes (Kohangatera, Kohangapiripiri including catchments)	<p>Ngā Mahi a ngā Tūpuna:</p> <p>The lakes are significant to Te Ātiawa/Taranaki Whānui and they were received back by the iwi through the treaty settlement process because of their significance for the iwi identity. The lakes were in the ownership of the hapū from Te Tatau o Te Po along with the surrounding whenua. A small area is still in whanau ownership adjacent to the lakes today</p>
	<p>Te Mahi Kai:</p> <p>The lakes were a superior fishery for Te Ātiawa/Taranaki Whānui and used extensively for the hapū of Te Tatau o Te Po. Fish included eel, mullet, kahawai and whitebait. Karaka groves were planted alongside the lakes as a food source and the tributaries contain watercress. The raupō beds were used and summer camps were used by whanau as they fished not only the lakes but the sea</p>
	<p>Wāhi Whakarite:</p> <p>This is a place of ritual related especially to the mahinga kai activities. The presence of the dendroglyphs require rituals specific to them and provide a place of wānanga. Rituals are still undertaken by whanau today</p>
	<p>Te Mana o te Tangata:</p> <p>The fishery of the lakes enabled Te Ātiawa/Taranaki Whānui to manaaki manuhiri who came in peace to Te Whānganui a Tara and supported the early growing of wheat in Fitzroy Bay</p>
	<p>Te Manawaroa o Te Wai:</p> <p>The water quality of the lakes is already very high and the iwi along with the co-management partner Wellington Regional Council have drafted a management plan jointly to support the ecology</p>
	<p>Te Mana o te Wai:</p> <p>Parangārahu lakes support the identity of Te Ātiawa ki Te Whānganui a Tara/Taranaki Whānui as a place that enables the protection of the iwi in times of attack working closely with Oruaiti, Te Mahanga and Whetu Kairangi Pā across the harbour entrance on the Miramar Peninsula</p>
	<p>Wāhi Mahara:</p> <p>The lakes are crucial to iwi story of ahikaa in Te Whānganui a Tara and are used for oral traditional knowledge both of history and environmental matters</p>

Greater Wellington recognises the value and importance of working with mana whenua in their roles as kaitiaki in areas within the KNE site. The KNE operational plan activities will:

- make a small but valuable contribution to the overall expected PNRP outcomes including protecting vegetation in the catchment
- ensure people working in KNE sites understand the requirements of the Accidental Discovery Protocol
- endeavour to ensure that Taranaki Whānui values for the site are protected

In addition, Greater Wellington will work on initiatives to achieve mutual benefit including the internship monitoring programme of the cultural health and wellbeing of KNE sites.

5.4. Stakeholders

Other key stakeholders are:

- East Harbour Environmental Association (EHEA), who have undertaken pest control within the KNE site and now promote education, action, and advocacy in and around the East Harbour Regional Park
- Eastbourne Forest Rangers, who have a long history associated with the Northern Forest
- QEII

6. Ecological values

Ecological values are a way to describe indigenous biodiversity found at a site, and what makes it special. These ecological values can be various components or attributes of ecosystems that determine an area's importance for the maintenance of regional biodiversity. Examples of values are the provision of important habitat for a threatened species, or particularly intact remnant vegetation typical of the ecosystem type. The ecological values of a site are used to prioritise allocation of resources to manage KNE sites within the region.

6.1. Site description

The East Harbour Northern Forest KNE site covers hilly topography from close to sea level near Eastbourne to the top of Mt Lowry (372m). It includes several ridgelines and deep incised valleys with clean streams running through them.

The Singers and Rogers (2014) classification of original (pre-human) vegetation¹⁰ indicates the KNE site would have been classified as the ecosystem type MF20 – hard beech forest: a forest type comprising beech forest and beech, podocarp, broadleaved forest. The dominant species of this forest type would have included hard beech (*Fuscospora truncata*), black beech (*Fuscospora solandri*), kamahi (*Weinmannia racemosa*), rimu (*Dacrydium cupressinum*), northern rātā (*Metrosideros robusta*), hīnau (*Elaeocarpus dentatus* var. *dentatus*) and rewarewa (*Knightia excelsa*).

Although the forest currently present is modified having experienced selective logging, hunting and clearances, much of the KNE site is still representative of this original ecosystem type, a type with only 26% remaining of the original regional extent in the Wellington Region¹¹.

The dry and less fertile ridges and hill faces are covered in open forest dominated by kāmahi, black beech and hard beech with patches of northern rātā and an understory of mingimingi (*Leucopogon fasciculatus*) and prickly mingimingi (*Leptecophylla juniperina*). The northern rātā growing in this area are unique because most of the trees have a terrestrial form in contrast to the more common epiphytic growth form.

Northern rātā would have once been a more abundant and widespread component of this forest but its range has been reduced by possum browsing and selective logging¹².

The wetter and more fertile valleys contain lush lowland podocarp/broadleaf forest dominated by large miro (*Prumnopitys ferrunginea*), mataī (*Prumnopitys taxifolia*), kahikatea (*Dacrycarpus dacrydioides*), pukatea (*Laurelia novae-zelandiae*) and rimu. In the past some of the edges of this KNE site were cleared by burning¹³ and are now covered in regenerating kāmahī, mānuka (*Leptospermum scoparium* var. *scoparium*) and gorse (*Ulex europaeus*).

The Gollans Stream and Butterfly Creek watercourses are healthy lowland streams in the southern end of the KNE site. These areas are classified as “Chronically Threatened” by the LENZ Threatened Environment Classification¹⁴ because there is only 10-20% native vegetation remaining on these types of land in New Zealand (see Appendix 1, Map 4). These watercourses run along the valley floors and are well shaded, have cobbled bottoms and contain a number of native freshwater species. Populations of giant kōkopu (*Galaxias argenteus*), longfin eel (*Anguilla dieffenbachia*), shortfin eel (*Anguilla australis*), common bully (*Gobiomorphus cotidianus*), banded kōkopu (*Galaxias fasciatus*) and kōura (*Paranephrops planifrons*) have been found here¹⁵.

6.2. Significant species

East Harbour Northern Forest is ecologically important not only because it has a large and relatively intact forest ecosystem, but also because of the diversity of native plant and animal species that live here. Some of the species of note include:

- 46 nationally, regionally or locally rare or threatened plants and animals (see Appendices 2 and 3 for threatened species lists)
- 33 species of native orchid and one of the richest orchid floras (terrestrial and epiphytic) for any area of an equivalent size in the region¹⁶
- All of the native forest bird species that have survived naturally on the mainland in the lower North Island (with most also breeding here)¹⁷
- Most of the region’s terrestrial northern rātā population¹⁸
- North Island robin, translocated into the KNE site between 2008 -2012

7. Key threats to ecological values at the site

Ecological values can be threatened by human activities, and by introduced animals and plants, that change the natural balance of native ecosystems. The key to protecting and restoring biodiversity as part of the KNE programme is to manage the threats to the ecological values at the site.

The main threats to the ecological values of the East Harbour Northern Forest KNE site are ecological weeds, and a suite of introduced mammalian browsers and predators typical of many sites in New Zealand.

Ecological weeds are prevalent and widespread throughout the northern half of the KNE site, with the densest known infestations concentrated in discrete locations. Climbing asparagus (*Asparagus scandens*) is arguably the most ecologically damaging weed in the KNE site as it smothers native vegetation affecting both the forest floor and the understorey up to a height of about four metres. Once established it can prevent the growth and regeneration of native species and can also strangle and kill some tree species.

There are a number of pest animal species known to exist within the KNE site. The species considered to pose the greatest threat to the ecological values of the KNE site are rats (*Rattus* spp.), stoats (*Mustela erminea*), possums (*Trichosurus vulpecula*), feral goats (*Capra hircus*) and red deer (*Cervus elaphus*).

Possums are generally present in very low numbers due to ongoing control regimes. If possum control is not ongoing it is likely that they will increase in numbers over time to levels that will significantly impact on forest health and regeneration.

Feral goats and deer also affect the natural regeneration of the forest by browsing on palatable plant species. Both goats and deer are thought to be present in low to moderate numbers as a result of control programmes that have been ongoing since 2005. However, reinvasion of goats and deer from adjacent Crown and private land where they are currently uncontrolled is ongoing.

Some park management and recreational activities have the potential to impact the ecological values of the KNE site if not undertaken in environmentally sensitive ways. Vehicle and walking tracks within the site require maintenance from time to time which could impact native plant and animal communities if not carried out in an appropriate manner.

Table 2 below shows all identified threats at this KNE site, the operational areas of the KNE they affect, and how they impact on ecological values. The codes alongside each threat correspond to activities listed in the Operational delivery schedule (Table 3), and are used to ensure that actions taken are targeted to specific threats. Map 5 in Appendix 1 shows the operational areas within the KNE site.

Table 2: Summary of all threats to ecological values present at the East Harbour Northern Forest KNE site

Code	Impact on biodiversity in the KNE	Operational area/location
Ecological weeds		
EW-1	Ground covering ecological weeds smother and displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key weed species for control include: tradescantia (<i>Tradescantia fluminensis</i>), wild ginger (<i>Hedychium gardnerianum</i>) and mile-a-minute (<i>Dipogon lignosus</i>)	Historic control sites & Mainland Island
EW-2	Woody weed species displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key weed species include Elaeagnus (<i>Elaeagnus x reflxa</i>), boneseed (<i>Chrysanthemoides monilifera</i>)	Historic control sites & Mainland Island
EW-3	Climbing weeds smother and displace native vegetation often causing canopy collapse, inhibit indigenous regeneration, and alter vegetation structure and composition. Key weed species include climbing asparagus (<i>Asparagus scandens</i>), bomarea (<i>Bomarea caldasii</i>), Japanese honeysuckle (<i>Lonicera japonica</i>), old man's beard (<i>Clematis vitalba</i>), banana passionfruit (<i>Passiflora</i> spp.) and English ivy (<i>Hedera helix</i>)	Historic control sites & Mainland Island
Pest animals		
PA-1	Possums (<i>Trichosurus vulpecula</i>) browse palatable canopy vegetation until it can no longer recover ^{19,20} . This destroys the forest's structure, diversity and function. Possums may also prey on native birds ²¹ and invertebrates	Whole KNE
PA-2	Red deer (<i>Cervus elaphus</i>) and fallow deer (<i>Dama dama</i>) browse the forest understory and can significantly change vegetation composition by preferential browsing and preventing regeneration ^{22,23,24}	Whole KNE
PA-3*	Feral pigs (<i>Sus scrofa</i>) root up the soil and eat roots, invertebrates, seeds and native plants preventing forest regeneration ²⁵	Whole KNE
PA-4*	Goats (<i>Capra hircus</i>) browsing affects the composition and biomass of native vegetation in the understory tiers of forest habitats, preventing regeneration of the most palatable understory species and reducing species diversity ²⁶	Whole KNE
PA-5	Feral, stray and domestic* cats (<i>Felis catus</i>) prey on native birds ²⁷ , lizards ²⁸ and invertebrates ²⁹ , reducing native fauna breeding success and potentially causing local extinctions ³⁰	Whole KNE
PA-6	Mustelids (stoats ^{31,32} (<i>Mustela erminea</i>), ferrets ^{33,34} (<i>M. furo</i>) and weasels ^{35,36} (<i>M. nivalis</i>)) prey on native birds, lizards and invertebrates, reducing their breeding success and potentially causing local extinctions	Whole KNE
PA-7*	Hedgehogs (<i>Erinaceus europaeus</i>) prey on native invertebrates ³⁷ , lizards ³⁸ and the eggs ³⁹ and chicks of ground-nesting birds ⁴⁰	Whole KNE
PA-8	Rats (<i>Rattus</i> spp.) browse native fruit, seeds and vegetation. They compete with native fauna for food and can reduce forest regeneration. They also prey on invertebrates, lizards and native birds ^{41,42}	Whole KNE
PA-9*	Wasps (<i>Vespa</i> spp.) adversely impact native invertebrates (including the forest ringlet butterfly) and birds through predation and competition for food resources. They also affect nutrient cycles in beech forests ⁴³	Whole KNE

Code	Impact on biodiversity in the KNE	Operational area/location
PA-10*	Brown trout (<i>Salmo trutta</i>) prey on native fish and compete with them for food resources ⁴⁴	Gollans Stream and Butterfly Creek
PA-11*	House mice (<i>Mus musculus</i>) browse native fruit, seeds and vegetation, and prey on invertebrates. They compete with native fauna for food and can reduce forest regeneration. They also prey on invertebrates, lizards and small eggs and nestlings ^{45,46}	Whole KNE
Human activities		
HA-1*	Illegal collection of orchids can cause local extinctions and reduce biodiversity in the KNE site	Whole KNE
HA-2*	Garden waste dumping often leads to ecological weed invasions into natural areas	KNE boundary (urban section)
HA-3	Recreational use such as tramping, mountain biking, dog walking and horse riding can cause damage and disturbance of the native ecosystem. It is also likely to disturb native fauna and introduce ecological weeds	Whole KNE
HA-4*	Agricultural practices, particularly grazing livestock can result in pugging soils, grazing native vegetation inhibiting regeneration, wildlife disturbance and increasing nutrient content of soils and watercourses ⁴⁷	KNE boundary (rural section)
HA-5	Park management activities such as track development, pest control and ecological monitoring can damage and destroy vegetation, and cause the accidental introduction of weed species through the carriage of seeds and plant fragments on machinery, equipment and clothing	Entire KNE site
HA-6	Fire can be destructive to native flora and fauna and create conditions for pest plant invasion	Entire KNE site
HA-7*	Barriers to native fish passage are present in streams within the KNE site preventing migrating fish from completing their life-cycle A survey conducted in 2002 ⁴⁸ showed that most of the native fish found in East Harbour Northern Forest were large adults. This may suggest that structures further downstream are blocking juvenile fish migration from the sea ⁴⁹ . The barriers affecting fish migration in this KNE are outside the KNE boundary	n/a
Other threats		
OT-1*	Beech mast years can lead to a significant increase in rodent and predator populations that have a negative impact on native animal populations in the KNE site	Whole KNE
OT-2*	Pathogens, such as myrtle rust (<i>Austropuccinia psidii</i>) could have a devastating effect on native myrtaceae species including mānuka, northern rātā, and ramarama	Whole KNE

*Threats marked with an asterisk are not addressed by actions in the Operational delivery schedule

8. Objectives

Objectives help to ensure that management activities carried out are actually contributing to improving the ecological condition of the site.

Objectives

The objectives guiding management activities at East Harbour Northern Forest KNE site are:

1. **To improve the structure* and function† of native plant communities**
2. **To improve the habitat for native birds**
3. **To improve the habitat for native lizards**

9. Operational activities

Operational activities are targeted to work towards the objectives above (Section 8) by responding to the threats outlined in Section 7.

The broad approach to operational activities is described briefly below, and specific actions, with budget figures attached, are set out in the operational delivery schedule (Table 3). It is important to note that not all threats identified in Section 7 can be adequately addressed. This can be for a number of reasons including financial, legal, or capacity restrictions.

The operational activities in the KNE site focus predominantly on controlling and maintaining the gains made from ecological weed and pest animal control where significance investment has been made by Greater Wellington since 2004. This followed on from programmes initiated by HCC and EHRA in the 1990's.

9.1. Ecological weed control

The aim of ecological weed control at the KNE site is to protect the Mainland Island from weed incursions and reduce the density and spread of ecological weeds into the remainder of the KNE site.

Ecological weed control has been undertaken in a coordinated approach since 2005 when a pest plant control plan was developed⁵⁰ to guide ecological weed control efforts in the KNE site. Since this time, good progress has been made in reducing the density of weed infestations; however, follow up control is required at all historic control sites to ensure that ecological weeds do not regenerate.

Ecological weeds will be targeted for control by Greater Wellington annually in two main operations (see Appendix 1, Map 5 for operational area locations):

- Control climbing asparagus in the south-western corner of the KNE site to prevent its spread further into the Mainland Island and reduce its overall density. Control is undertaken annually within the larger operational area; however, the area is currently sub-divided into 8 small sections that may not receive control every year. During the course of controlling climbing asparagus the weed team may encounter other invasive weed species, if so these will be

controlled if possible. This control operation will be reviewed after year 1 of this KNE plan

- Control of a wide variety of ecological weeds at historic control sites to prevent further incursion into the wider-KNE site. See 2005 pest plant control plan⁵¹ for historic weed control species

Greater Wellington Biosecurity will be responsible for the delivery of most of this work but, contractors may be engaged where necessary.

During the life-cycle of this KNE plan the strategy and resources used for controlling ecological weeds will be reviewed by the management partners to ensure that maximum value and biodiversity benefit is still being achieved. This will be undertaken in parallel with the PNP review process.

9.2. Pest animal control

Pest animal control occurs across the whole KNE site utilising a variety of control methods including aerially-sown 1080 (sodium fluoroacetate), ground-based trapping/baiting, and targeted hunting. The primary aim of the pest animal control regime across the KNE site is to maintain ecosystem functionality and flora diversity whilst, enabling native forest dwelling animals such as birds, lizards and invertebrates to thrive.

The 400 ha Mainland Island was created in 2006 around the Butterfly Creek / Gollans Stream area where more intensive pest control is undertaken primarily, to improve bird breeding success. Within the Mainland Island; possums, rats, and mustelids are targeted for control. Within the Mainland Island rats are controlled using bait stations, the southern half on a 100m x 150m grid and the northern half on a 50m x 150m grid. Bait stations are serviced six times a year by Greater Wellington. Mustelids and possums are controlled within the Mainland Island using a combination of DOC200 and Possum Master kill-traps. Traps spaced at 300m intervals around the boundary of the Mainland Island and on the main internal ridgeline. MIRO Volunteers service the traps monthly. During mast year events (when climatic conditions trigger an abundance of fruit-fall), rat populations numbers can spike significantly. During these events Greater Wellington will continue to monitor the rat population and further action may be required to bring the numbers down. This may be attained by servicing the bait stations more frequently or changing toxin used.

Possums are controlled throughout the remainder of the KNE site using Possum Master kill-traps spaced at 150m intervals along main ridges and gullies and by utilising official and unofficial walking tracks. Poison bait stations are positioned at each trap site to reduce the consumption of kill-trap bait by rodents ensuring maximum engagement with traps by possums. The possum traps and associated bait stations are serviced monthly by MIRO volunteers.

OSPRI's TBfree programme commenced their control operations targeting possums in the KNE site and surrounding area in May 2017. Possum control operations involved a combination of aerially-sown 1080 and ground-based trapping and poisoning and are generally carried out at five-yearly intervals. This programme is part of a national strategy aiming to eradicate bovine tuberculosis from New Zealand, possums being the

main vector of bovine tuberculosis. Although the objectives of the TBfree programme are somewhat different to the biodiversity objectives of this plan, the possum control carried out under the TBfree programme is expected to deliver positive biodiversity outcomes. This work is wholly funded by OSPRI.

Mustelids are increasingly being targeted throughout the remainder of the KNE site. MIRO is undertaking a rolling programme of infrastructure installation throughout the KNE site which will be completed during the life-cycle of this KNE plan. DOC 200 kill traps are being installed at every-other existing traps/bait-station location and are serviced by MIRO volunteers monthly. The Greater Wellington Parks' Environmental Enhancement Fund has been used for the purchase of kill-traps in support of extending this network.

Red deer are controlled in the KNE site to minimise their impact on the ecological values of the forest, as heavy browsing of favoured plant species by deer can eliminate individual native species from an area resulting in the loss of diversity and functionality of the original native forest ecosystem. Deer control operations (undertaken in spring and autumn to maximize the potential for detecting deer), focus on the northern and western parts of the KNE site where tracking and browsing of native plants has been observed.

Professional hunters are used by Greater Wellington to hunt the operational areas and shoot all wild deer observed, if safe to do so. The hunters are required to remove carcasses of shot deer from water courses but, they do not recover venison for consumption. The control operations are focused in higher risk areas, often closer to residential properties and the most popular walking tracks and picnic areas. These areas are different to the designated recreational hunting area.

9.3. Monitoring

Small mammal monitoring

Greater Wellington, assisted by MIRO, undertake small mammal monitoring (quarterly for rodents and six-monthly for mustelids/hedgehogs) in the KNE site. Tracking Tunnel Index (TTI) method is used to monitor the presence of small mammal species. The results of this monitoring provide an indication of the effectiveness of the pest animal control network and are reported on following each survey in the KNE programme's Small Mammal Monitoring report.

Bird monitoring

MIRO undertake five-minute bird counts annually in spring. Five-minute bird counts are undertaken to assess trends in abundance, diversity and distribution of native birds across the KNE site and provide an indication of the effectiveness of the pest animal control network.

9.4. Regional Park management

Environmental Enhancement Fund

The Greater Wellington Parks department has an annual Environmental Enhancement Fund (EEF) available to enable local community groups to undertake environmental enhancement projects within the Regional Park. This fund and how it is allocated is determined three-yearly in collaboration with the Biodiversity department and the detail finalized annually in conjunction with MIRO.

Environmental care of Greater Wellington's operations

Assessments of Environmental Effects will be used to assess Greater Wellington's planned works, to identify and avoid damage to biodiversity values such as plant and animal communities. This will limit risks to these values that could occur while planning and carrying out the construction and maintenance of assets (eg, culvert maintenance in appropriate weather conditions).

Other regular maintenance operations undertaken with the Regional Park also have the potential to impact biodiversity within the KNE site. For example, track maintenance can damage native botanical values such as the rich native orchids and sedges that prefer these more open environments. Greater Wellington Parks will ensure that regular maintenance operations undertaken within the Regional Park take into account the biodiversity values before commencing any operations and ensure damage is minimised.

Greater Wellington Parks biosecurity protocol will be used by all Greater Wellington and other personnel entering and working in the KNE site. Instructional information on how to avoid introducing ecological weeds and damage to ecological values will be included in the conditions contained in permits issued to private hunters, possum trappers and researchers entering the KNE site.

Collection of native plants and animals

The collection of natural materials and research activities in the KNE site is managed by a permit system administered by the Greater Wellington Environmental Science department. The Park Ranger and KNE Biodiversity Advisor will be informed of any new permits issued within the Regional Park.

Illegal collection of native plants and animals has occurred occasionally in the Regional Park. This has included some species of native tree, which are valued for domestic uses such as fence building and for firewood, some species of orchid, which are sought after by collectors and traders, and may have also included lizards and invertebrates.

Recreational hunting

Recreational hunting is permitted within the Regional Park and is managed by the Parks department.

Recreational deer hunting is only permitted with the designated area and permits are allocated by an annual ballot. Recreational deer hunting may have a positive effect on the biodiversity values in the KNE site.

Recreational pig hunting does not have a ballot system, but runs on a permit system available for six months of the year.

Community engagement

The purpose of community engagement is to raise awareness of the Regional Park's ecological values and involve the community in management activities to protect those values. Information about the KNE site's ecological values will be conveyed to the public during any Greater Wellington summer events held at the KNE site.

10. Operational delivery schedule

The operational delivery schedule below shows the activities planned to achieve the stated objectives for East Harbour Northern Forest KNE site. Their timing and cost are shown over three year period from 1 July 2017 to 30 June 2020. The budget for the 2018/19 and 2019/20 years are indicative only and subject to change. See Appendix 1, Map 5 for operational areas.

Table 3: Three-year operational plan for East Harbour Northern Forest KNE

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable and resourcing		
							2017/18	2018/19	2019/20
1	EW-1, 2, 3	Ecological weed control	See Map 5	GWRC Biosecurity department	Search for and control ecological weeds at historic control sites	Reduce distribution and density of target species	\$33,000	\$33,000	\$33,000
1	EW-3	Ecological weed control	See Map 5	GWRC Biosecurity department	Targeted control of climbing asparagus Operation to be reviewed by Biosecurity/ Biodiversity after year 1	Reduce distribution and density of target species	\$50,000	\$50,000	\$50,000
1, 2, 3	PA-1, 5, 6	Pest animal control	Entire KNE site	MIRO	Service kill-traps to control possums and mustelids on a monthly basis	Mustelids <5% TTI** Possums <5%RTCI*	Nil	Nil	Nil
1, 2, 3	PA-1, 5, 6	Pest animal control	Entire KNE site	GWRC Biosecurity department	GWRC provide bait to MIRO for possum and mustelid control		\$3,700	\$3,700	\$3,700
1	PA-2	Pest animal control	Determined annually	GWRC Biosecurity department	Control deer twice a year by shooting. Up to 20 hunter days allocated	Contract completed to required standard	\$8,500	\$8,500	\$8,500
1, 2, 3	PA-1, 8	Pest animal control	Mainland Island	GWRC Biosecurity department	Service bait stations (six times a year) to control rats	Rats <5% TTI*	\$36,000	\$36,000	\$36,000

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable and resourcing		
							2017/18	2018/19	2019/20
1,2,3	PA-6, 7, 8, 11	Monitoring	Entire KNE site	GWRC Environmental Science	Small mammal monitoring Rodent monitoring: February, May, August & November Mustelid monitoring: February & November	Rats <5% TTI* in the Mainland Island Mustelids <5% TTI**	\$14,300	\$14,300	\$14,300
2		Monitoring	Entire KNE site	MIRO	Complete and report on annual SMBC monitoring		Nil	Nil	Nil
							\$145,500	\$145,500	\$145,500

*RTCI = Residual Trap Catch Index. The control regime has been designed to control possums to this level. Experience in the use of this control method indicates this target will be met

**TTI = Tracking Tunnel Index. The control regime has been designed to control rats and mustelids to this level. Experience in the use of this control method indicates this target will be met

11. Funding contributions

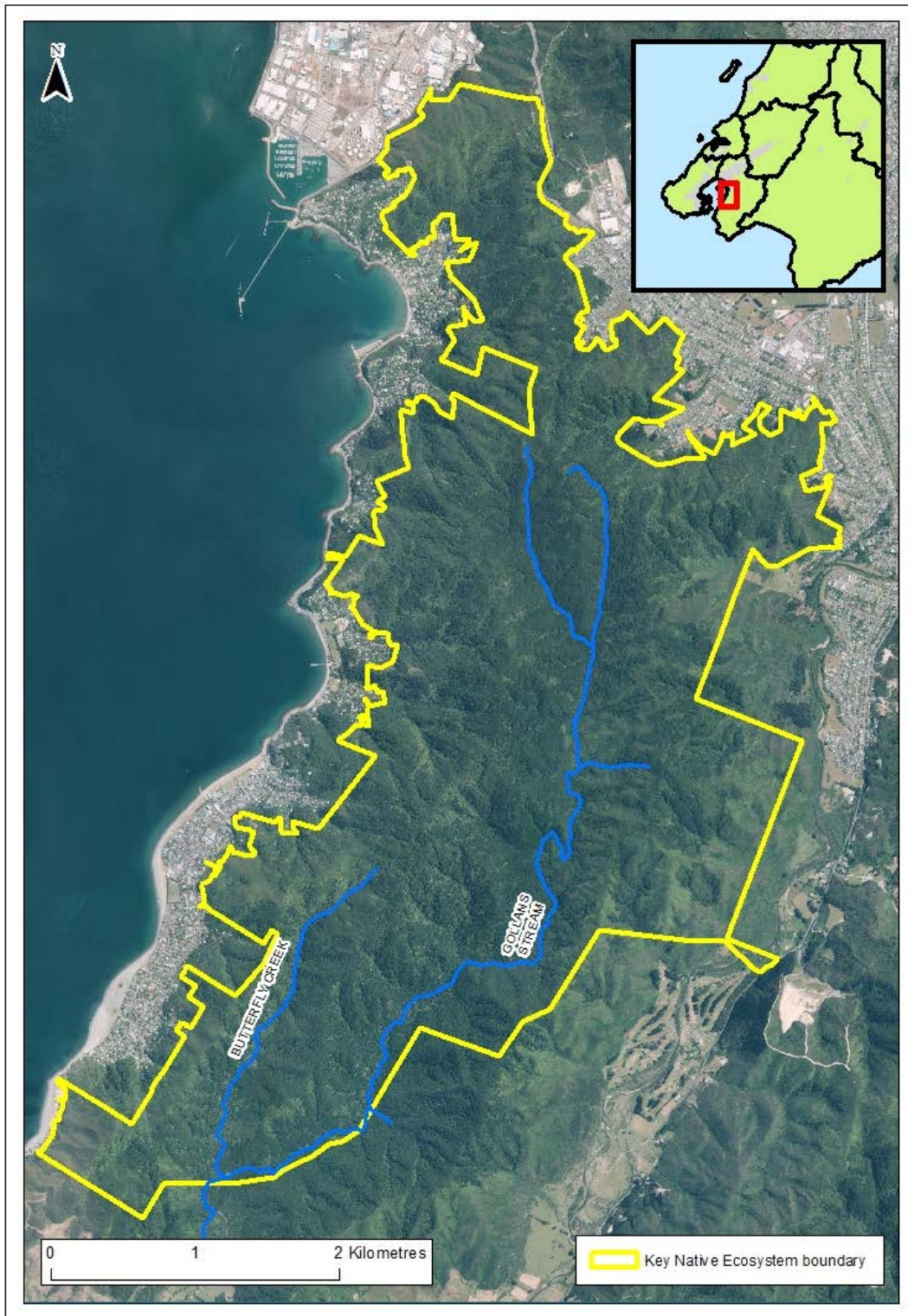
11.1. Greater Wellington contribution

The budget for the 2018/19 and 2019/20 years are indicative only and are subject to change.

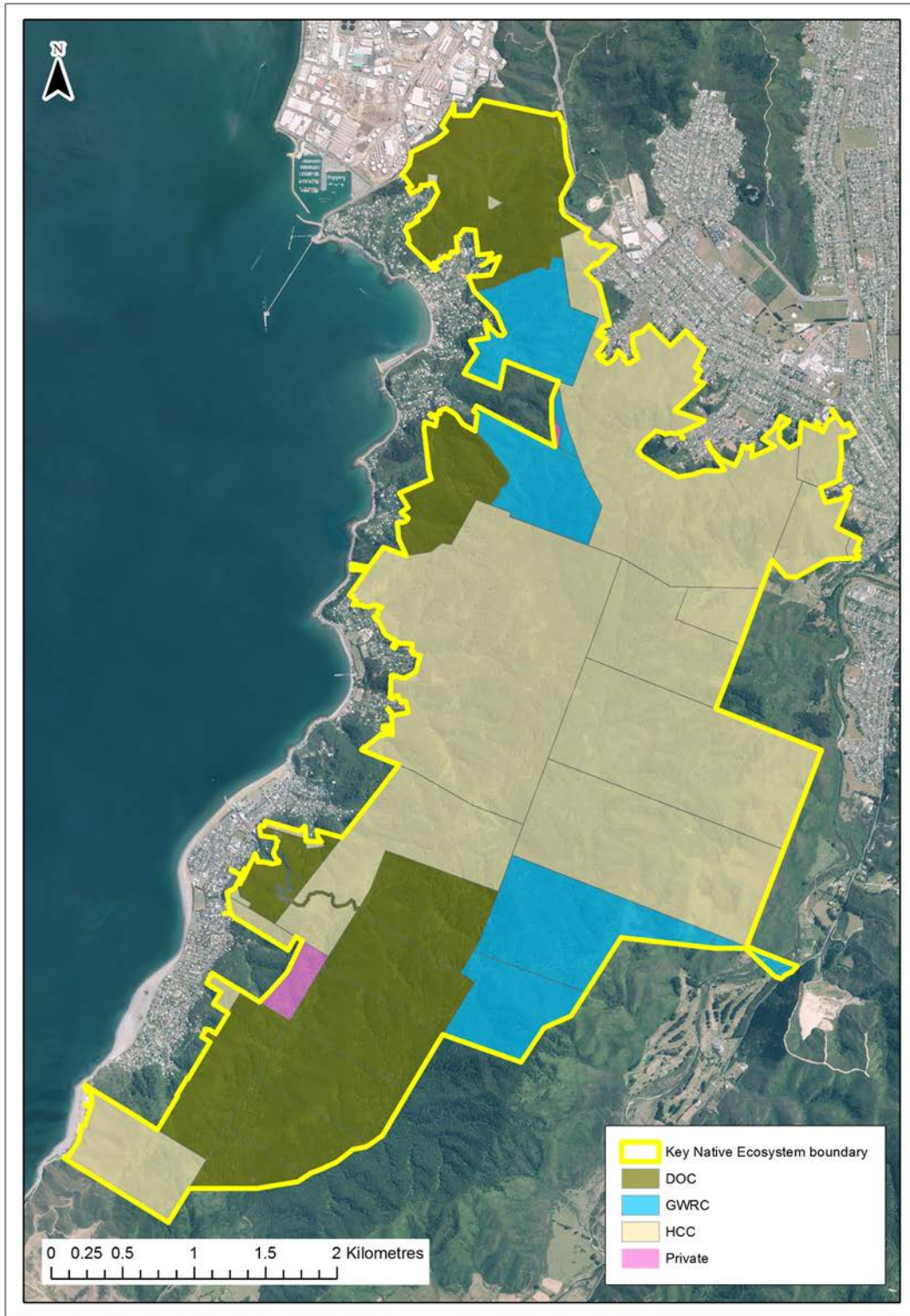
Table 4: Greater Wellington allocated budget for East Harbour Northern Forest KNE

Management activity	Timetable and resourcing		
	2017/2018	2018/2019	2019/2020
Pest plant control	\$83,000	\$83,000	\$83,000
Pest animal control	\$48,200	\$48,200	\$48,200
Monitoring	\$14,300	\$14,300	\$14,300
Environment Enhancement Fund [administered by Parks]	\$6,000	\$6,000	\$6,000
Total	\$151,500	\$151,500	\$151,500

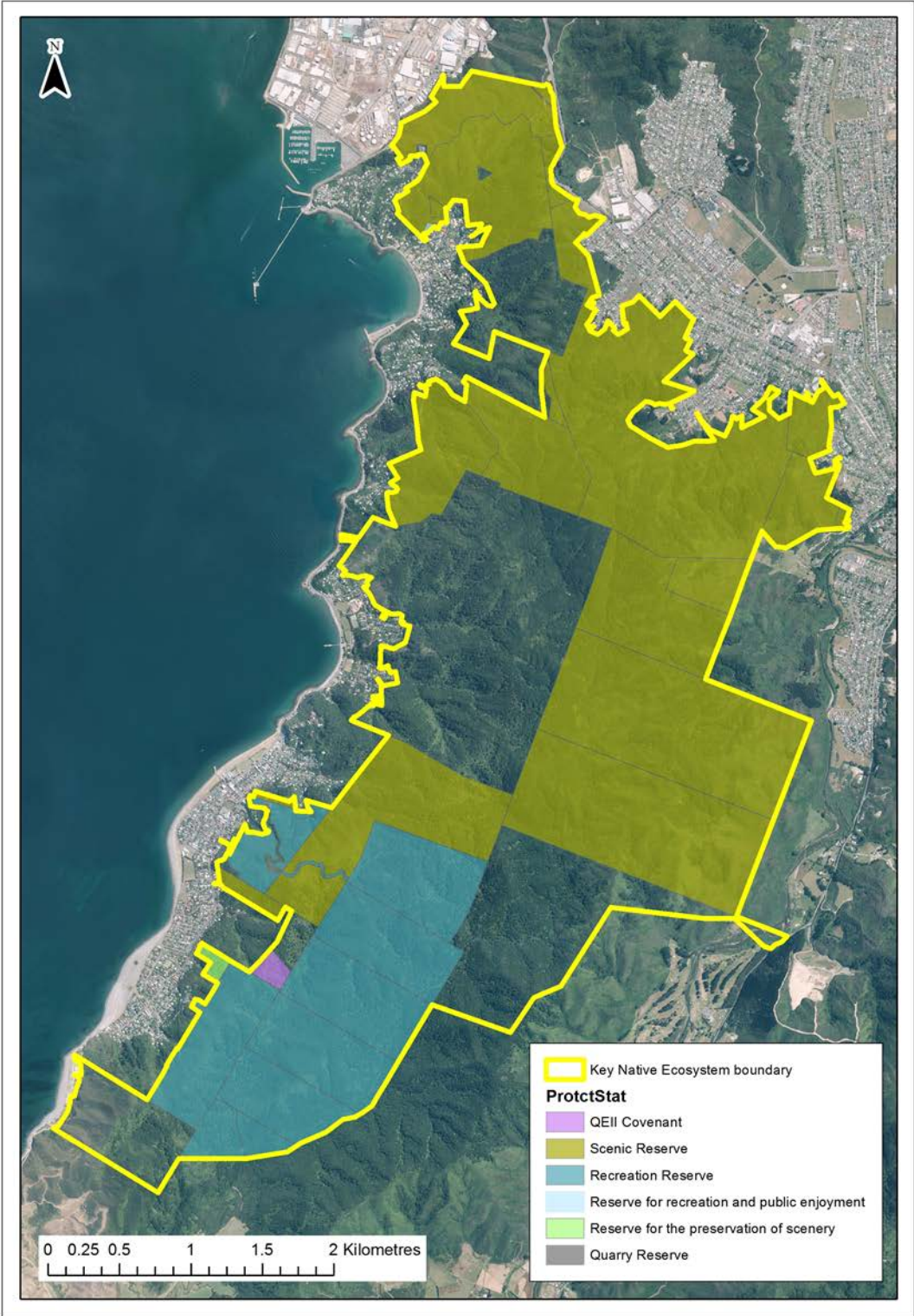
Appendix 1: Site maps



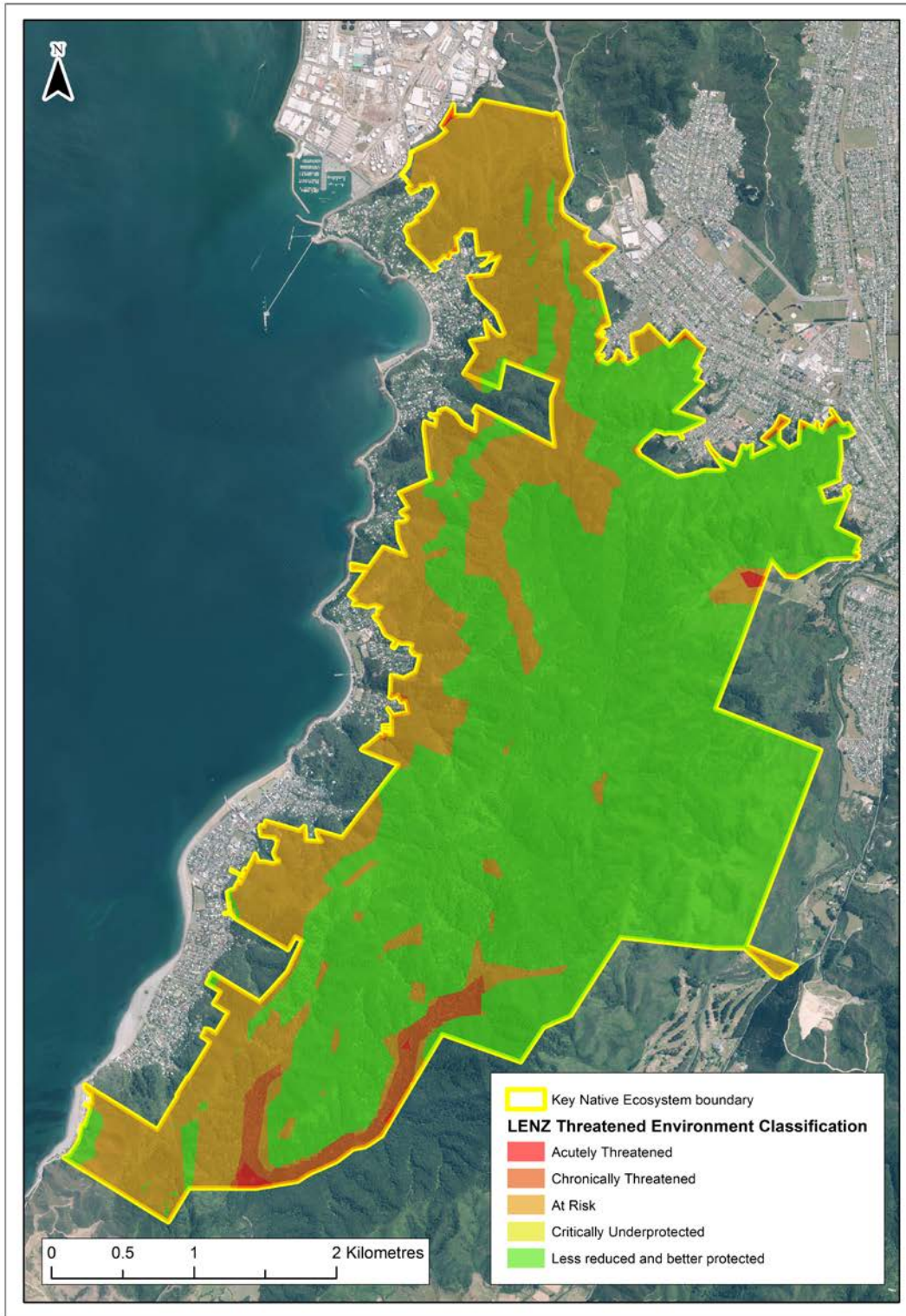
Map 1: East Harbour Northern Forest KNE site location and boundary



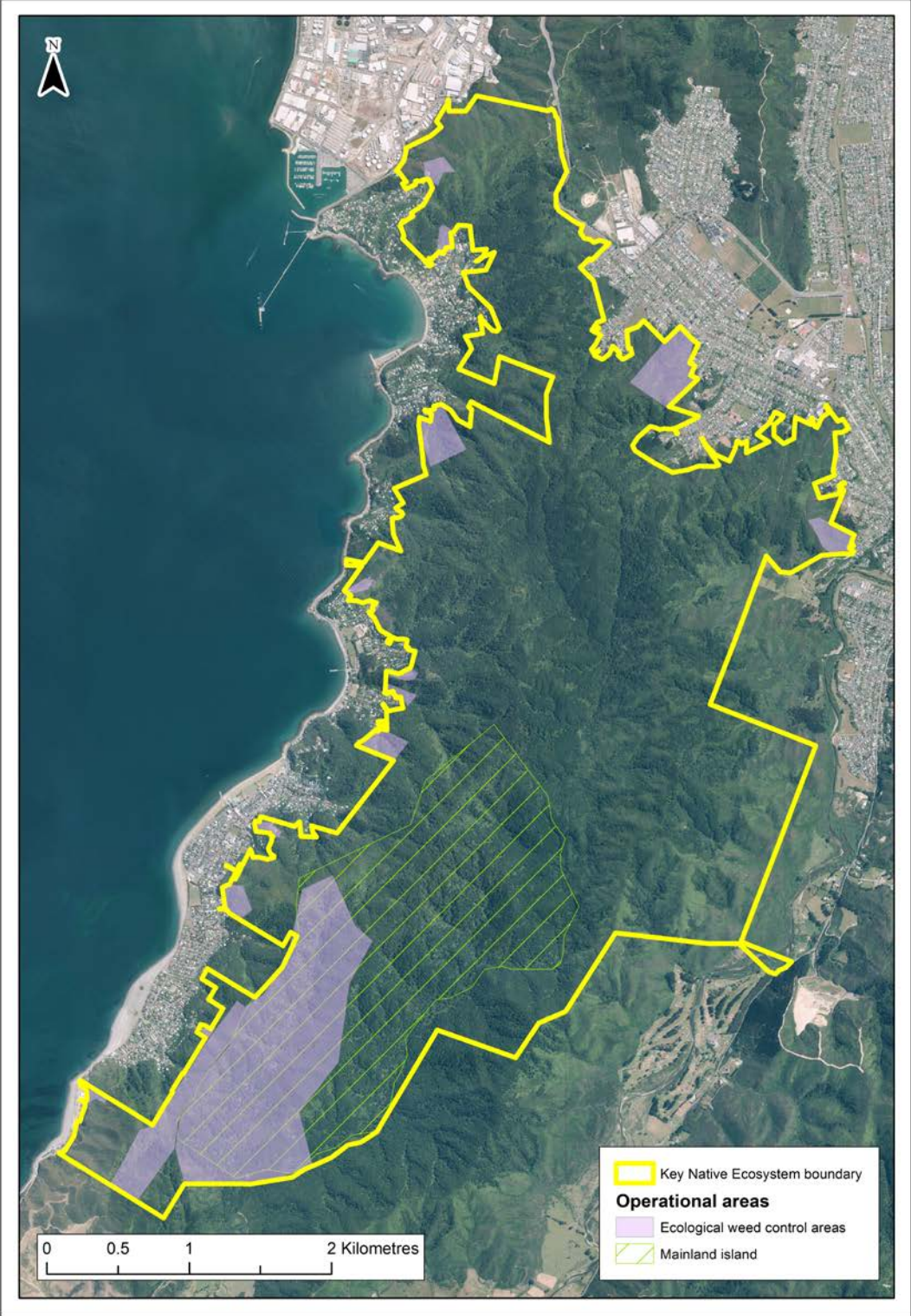
Map 2: East Harbour Northern Forest KNE site land tenure



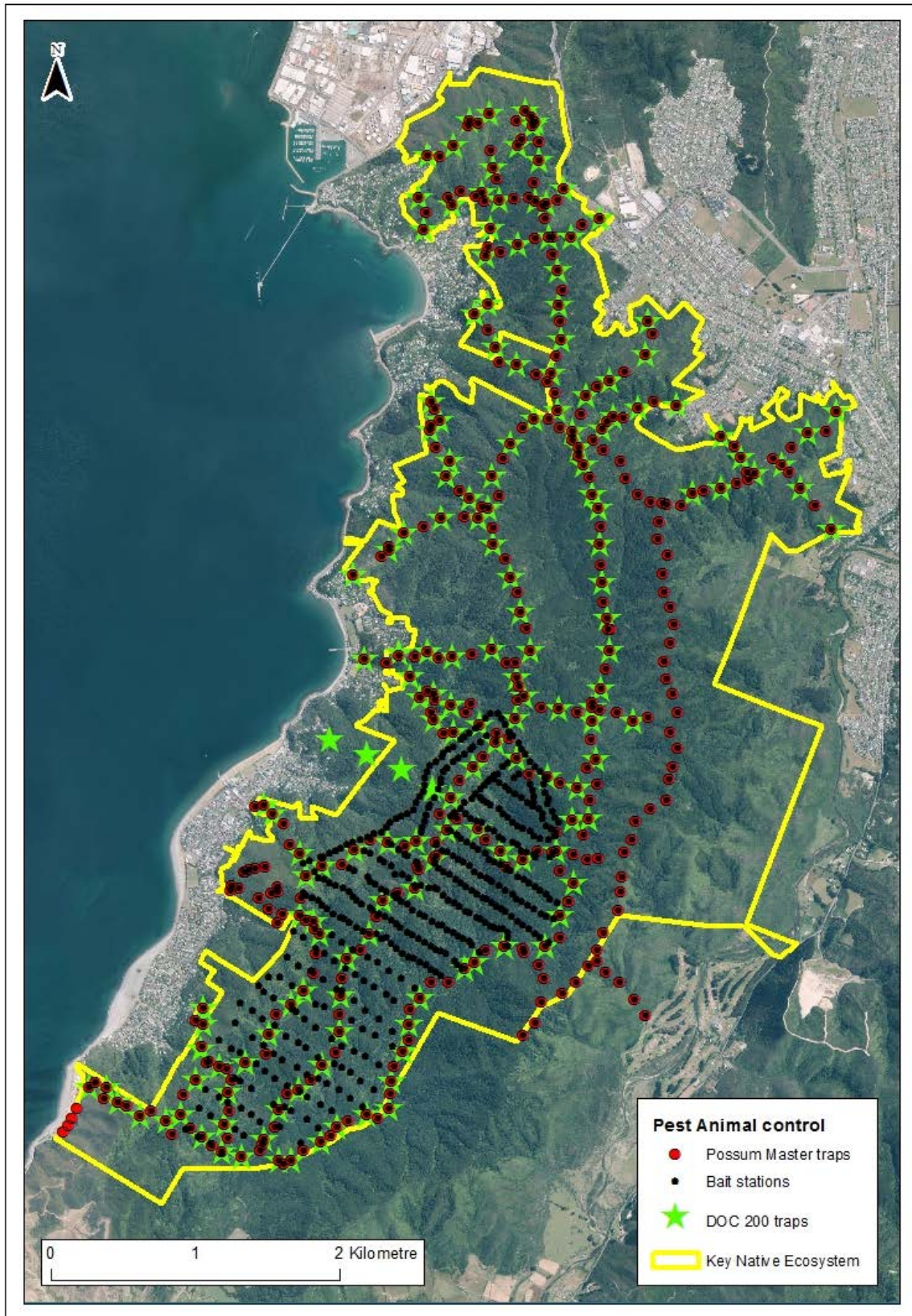
Map 3: Legally protected areas within the East Harbour Northern Forest KNE site



Map 4: Land Environments of New Zealand Threatened Ecosystems for East Harbour Northern Forest KNE site



Map 5: Operational areas within the East Harbour Northern Forest KNE site



Map 6: Pest animal control network in the KNE site

Appendix 2: Threatened species list

The New Zealand Threat Classification System lists species according to their threat of extinction. The status of each species group (plants, reptiles, etc) is assessed over a five-year cycle⁵². Species are regarded as Threatened if they are classified as Nationally Critical, Nationally Endangered or Nationally Vulnerable. They are regarded as At Risk if they are classified as Declining, Recovering, Relict or Naturally Uncommon. The following table lists Threatened and At Risk species that are resident in, or regular visitors to, the KNE site.

The following table lists threatened species that are known to live within the KNE.

Table 5: Threatened species at East Harbour Northern Forest KNE

Scientific name	Common name	Threat status	Source
Plants(vascular) ⁵³			
<i>Adelopetalum (Bulbophyllum) tuberculatum</i>	Bulb leaf orchid	At Risk – Naturally Uncommon	Sawyer 2005 ⁵⁴ (Butterfly Creek)
<i>Botrychium australe</i>	Parsley fern	At Risk – Naturally Uncommon	Sawyer 2005 (Mt Hawtrey Bush and Butterfly Creek)
<i>Brachyglottis kirkii</i>	Kirk's tree daisy	At Risk – Declining	Sawyer 2005 (Lowry Bay and Mt Hawtrey Bush)
<i>Chenopodium allanii</i>		At Risk – Naturally Uncommon	Sawyer 2005 (Days Bay)
<i>Corunostylis nuda</i>	Red leek orchid	At Risk – Naturally Uncommon	Sawyer 2005 (Days Bay and Muritai Park)
<i>Drymoanthus flavus</i>	Little spotted moa	At Risk – Naturally Uncommon	Sawyer 2005 (Days Bay, Point Webb and Rona Bay)
<i>Hypolepis dicksonioides</i>	Giant hypolepis	At Risk – Naturally Uncommon	Sawyer 2005 (Mt Hawtrey Bush and Butterfly Creek to Gollans)
<i>Liguella puberula</i>	Dwarf greenhood orchid	Threatened – Nationally Vulnerable	Sawyer 2005 (Days Bay)
<i>Melicytus obovatus</i>		At Risk – Naturally Uncommon	Sawyer 2005 (Point Howard)
<i>Peraxilla tetrapetala</i>	Red mistletoe	At Risk – Declining	Sawyer 2005 (Muritai, Eastbourne, Mackenzie track and Butterfly Creek)
<i>Plumatochilus tasmanica</i>	Plumed greenhood orchid	Threatened – Nationally Vulnerable	Sawyer 2005 (Days Bay – very old record)
<i>Ranunculus macropus</i>	Swamp buttercup	At Risk – Data Deficient	Sawyer 2005 (Mt Hawtrey Bush and Butterfly Creek)

Scientific name	Common name	Threat status	Source
<i>Rorippa divaricate</i>	New Zealand water cress	Threatened – Nationally Vulnerable	Enright pers comm 2014 (specimen from EHNH held in Allan Herbarium, Lincoln)
<i>Streblus banksii</i>	Large leaved milktree / tūrepo	At Risk – Relict	Sawyer 2005 (Lowry Bay)
Birds⁵⁵			
<i>Acanthisitta chloris granti</i>	North Island rifleman / titipounamu	At Risk – Declining	www.ebird.org (March 2017)
<i>Cyanoramphus novaezelandiae novaezelandiae</i>	Red crowned parakeet / Kākāriki	At Risk – Relict	www.ebird.org (March 2017)
<i>Endynamys taitensis</i>	Long-tailed cuckoo / koekoeā	At Risk – Naturally Uncommon	GWRC 2007 ⁵⁶
<i>Falco novaeseelandiae</i>	New Zealand falcon / kārearea	At Risk – Recovering	GWRC 2007
<i>Mohoua albicilla</i>	Whitehead / pōpokatea	At Risk – Declining	GWRC 2007
<i>Nestor meridionalis</i>	North Island kākā	At Risk – Recovering	GWRC 2007
Reptiles⁵⁷			
<i>Oligosoma ornatum</i>	Ornate skink	At Risk – Declining	Herpetofauna database (June 2010)
<i>Naultinus punctatus</i>	Barking gecko	At Risk – Declining	Herpetofauna database (June 2010)
Freshwater fish⁵⁸			
<i>Anguilla dieffenbachii</i>	Longfin eel	At Risk – Declining	NIWA National Freshwater Fish Database (December 2012)
<i>Galaxias argenteus</i>	Giant kōkopu	At Risk – Declining	NIWA National Freshwater Fish Database (December 2012)
<i>Galaxias maculatus</i>	Inanga	At Risk – Declining	NIWA National Freshwater Fish Database (December 2012)
<i>Geotria australis</i>	Lamprey	Threatened – National Vulnerable	NIWA National Freshwater Fish Database (December 2012)
<i>Gobiomorphus huttoni</i>	Redfin bully	At Risk – Declining	NIWA National Freshwater Fish Database (December 2012)

Scientific name	Common name	Threat status	Source
Invertebrates (lepidoptera – butterflies and moths) ⁵⁹			
<i>Dodonidia helmsii</i>	Forest ringlet butterfly	At Risk – Relict	Owen Spearpoint, GWRC, pers comm 2009.

Appendix 3: Regionally and locally threatened species list

The following table lists regionally and locally threatened species that have been recorded in the KNE site.

Regionally threatened native plant species are identified in the Plant Conservation Strategy, Wellington Conservancy 2004-2010⁶⁰.

Table 6: Regionally Threatened species at East Harbour Northern Forest KNE

Scientific name	Common name	Threat status	Source
Plants ⁶¹			
<i>Adelopetalum (Bulbophyllum) tuberculatum</i>	Bulb leaf orchid	Regionally Data Deficient	Sawyer 2005 (Butterfly Creek)
<i>Adiantum diaphanum</i>	Small maidenhair	Locally Rare in Wellington	Sawyer 2005 (Days Bay)
<i>Botrychium australe</i>	Parsley fern	Regionally Critical	Sawyer 2005 (Mt Hawtrey Bush and Butterfly Creek)
<i>Botrychium biforme</i>	Fine-leaved parsley fern	Regionally Susceptible	Sawyer 2005 (Butterfly Creek)
<i>Brachyglottis kirkii</i>	Kirk's tree daisy	Regionally Critical	Sawyer 2005 (Lowry Bay and Mt Hawtrey Bush)
<i>Carex diandra</i>	Sedge	Regionally Data Deficient	Sawyer 2005 (Eastbourne)
<i>Drymoanthus adversus</i>	Drymoanthus	Uncommon in Wellington and the Hutt	Sawyer, 2005 (Eastbourne hills)
<i>Gonocarpus incanus</i>		Regionally Sparse	Sawyer 2005 (Mt Hawtrey and between Days Bay and Eastbourne)
<i>Ichthyostomum pygmaeum</i>	Bulb leaf orchid	Rarely recorded in Wellington region	Sawyer 2005 (Days Bay, Butterfly Creek to Gollans Valley)
<i>Libertia edgariae</i>	Edgars Iris, Edgars Mikoikoi	Regionally Range Restricted	Sawyer 2005 (Eastbourne hills)
<i>Lindsaea linearis</i>	Fern	Locally Rare in Wellington and in decline	Sawyer 2005 (Butterfly Creek, Kowhai St track, Lowry Bay Scenic reserve)
<i>Melicytus obovatus</i>		Regionally Critical	Sawyer 2005 (Point Howard)
<i>Metrosideros robusta</i>	Northern rātā	One of the region's most significant populations of this species	Sawyer 2005 (Eastbourne hills)

Scientific name	Common name	Threat status	Source
<i>Morelotia affinis</i>	Morelotia	Regionally Sparse	Sawyer 2005 (Days Bay and Butterfly Creek)
<i>Nestegis montana</i>	Narrow leaved maire	Very rare in Wellington, one of three known sites	Sawyer 2005 (Muritai)
<i>Pittosporum divaricatum</i>		Widespread throughout the region but never found in abundance	Sawyer 2005 (Eastbourne hills)
<i>Pterostylis cardiostigma</i>	Greenhood orchid	Regionally Sparse	Sawyer 2005 (Lowry Bay, Days Bay and Mt Hawtrey Bush)
<i>Schizaea bifida</i>	Forked comb fern	Regionally Critical	Sawyer 2005 (Days Bay and Eastbourne)
<i>Syzygium maire</i>	Swamp maire, waiwaka	Locally Rare due to destruction and modification of much of the region's wetlands	Sawyer 2005 (Lowry Bay Scenic Reserve, Mt Hawtrey Bush, Butterfly Creek)
<i>Teleoschistes flavicans</i>	Lichen	A rare lichen often found in association with rare native grasses	Sawyer 2005 (York Bay)
Birds ⁶²			
<i>Petroica longipes</i>	North Island robin (translocated)	Regionally Rare	www.ebird.org (December 2012)

References

- ¹ New Zealand legislation. 1991. Resource Management Act 1991.
- ² Greater Wellington Regional Council. Greater Wellington Regional Council 10 Year Plan: 2015 – 2025.
- ³ Greater Wellington Regional Council. 2011. Parks Network Plan. GW/CP-G-11/101.
- ⁴ Greater Wellington Regional Council. 2016. Greater Wellington Regional Council Biodiversity Strategy. <http://www.gw.govt.nz/assets/council-publications/Biodiversity-Strategy-2016.pdf>
- ⁵ Crisp P. 2011. Unpublished report: Regionally significant ecosystems: ecological criteria of representativeness, diversity, rarity and ecological context used in the GWRC Regional Policy Statement (2012) to define regionally significant ecosystems.
- ⁶ McEwen WM (Editor). 1987. Ecological regions and districts of New Zealand. Third revised edition. Department of Conservation, Wellington, New Zealand.
- ⁷ Nikki McArthur, Greater Wellington Regional Council, pers comm 2012.
- ⁸ Greater Wellington Regional Council. 2010. Parks Network Plan.
- ⁹ Greater Wellington Regional Council. 2015. Proposed Natural Resources Plan. P. 288-289.
- ¹⁰ Singers NJD, Rogers GM. 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation No. 325. Department of Conservation, Wellington. 87 p.
- ¹¹ Greater Wellington Regional Council. 2017. Identification and prioritisation of high value terrestrial biodiversity sites for selection within the Key Native Ecosystem Programme in the wellington region.
- ¹² Greater Wellington Regional Council. 2007. East Harbour Regional Park Resource Statement.
- ¹³ Hunt S. 1994. Butterfly Creek. A visitor's guide to the forests between Eastbourne and Wainuiomata. Eastbourne Forest Rangers, Eastbourne, New Zealand.
- ¹⁴ Walker S, Cieraad E, Grove P, Lloyd K, Myers S, Park T, Porteous T. 2007. Guide for the users of Land Environments Classification. Landcare Research Manaaki Whenua.
- ¹⁵ Joy M, Hewitt A. 2002. Freshwater fish survey of selected sites for Wellington Regional Council. Institute of Natural Resources-Ecology, Massey University.
- ¹⁶ Sawyer J. 2005. Native Plants of the Eastbourne Hills, status and conservation management. Department of Conservation, Wellington, New Zealand.
- ¹⁷ Nikki McArthur, Greater Wellington Regional Council, pers comm 2012.
- ¹⁸ Owen Spearpoint, Greater Wellington Regional Council, pers comm 2012.
- ¹⁹ Pekelharing CJ, Parkes JP, Barker RJ. 1998. Possum (*Trichosurus vulpecula*) densities and impacts on fuchsia (*Fuchsia excorticata*) in South Westland, New Zealand. New Zealand Journal of Ecology 22(2): 197–203.
- ²⁰ Nugent G, Sweetapple P, Coleman J, Suisted P. 2000. Possum feeding patterns. Dietary tactics of a reluctant folivore. In: Montague TL ed. The brushtail possum: Biology, impact and management of an introduced marsupial. Lincoln, Manaaki Whenua Press. Pp. 10–19.
- ²¹ Sweetapple PJ, Fraser KW, Knightbridge PI. 2004. Diet and impacts of brushtail possum populations across the invasion front in South Westland, New Zealand. New Zealand Journal of Ecology 28(1): 19–33.
- ²² Stewart GH, Wardle JA and Burrows LE. 1987. Forest understory changes after reduction in deer numbers, Northern Fiordland, New Zealand. New Zealand Journal of Ecology 10: 35–42.
- ²³ Nugent G, Fraser W. 2005. Red deer. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 401–419.
- ²⁴ Nugent G, Asher G. 2005. Fallow deer. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 447–459.
- ²⁵ McIlroy JC. 2005. Feral pigs. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 334–345.
- ²⁶ Parkes. JP. 2005. Feral goat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 374–391.
- ²⁷ King CM, Flux M, Innes JG, Fitzgerald BM. 1996. Population biology of small mammals in Pureora Forest Park: 1. Carnivores (*Mustela erminea*, *M. furo*, *M. nivalis* and *Felis catus*). New Zealand Journal of Ecology 20(2): 241–251.

- ²⁸ Reardon JT, Whitmore N, Holmes KM, Judd LM, Hutcheon AD, Norbury G, Mackenzie DI. 2012. Predator control allows critically endangered lizards to recover on mainland New Zealand. *New Zealand Journal of Ecology* 36(2): 141–150.
- ²⁹ King CM, Flux M, Innes JG, Fitzgerald BM. 1996. Population biology of small mammals in Pureora Forest Park: 1. Carnivores (*Mustela erminea*, *M. furo*, *M. nivalis* and *Felis catus*). *New Zealand Journal of Ecology* 20(2): 241–251.
- ³⁰ Gillies C, Fitzgerald BM. 2005. Feral cat. In: King CM ed. *The handbook of New Zealand mammals*. Oxford University Press. Pp. 308–326.
- ³¹ Murphy E, Maddigan F, Edwards B, Clapperton K. 2008. Diet of stoats at Okarito Kiwi Sanctuary, South Westland, New Zealand. *New Zealand Journal of Ecology* 32(1): 41–45.
- ³² King CM, Murphy EC. 2005. Stoat. In: King CM ed. *The handbook of New Zealand mammals*. Oxford University Press. Pp. 261–287.
- ³³ Ragg JR. 1998. Intraspecific and seasonal differences in the diet of feral ferrets (*Mustela furo*) in a pastoral habitat, east Otago, New Zealand. *New Zealand Journal of Ecology* 22(2): 113–119.
- ³⁴ Clapperton BK, Byron A. 2005. Feral ferret. In: King CM ed. *The handbook of New Zealand mammals*. Oxford University Press. Pp. 294–307.
- ³⁵ King CM. 2005. Weasel. In: King CM ed. *The handbook of New Zealand mammals*. Oxford University Press. Pp. 287–294.
- ³⁶ King CM, Flux M, Innes JG, Fitzgerald BM. 1996. Population biology of small mammals in Pureora Forest Park: 1. Carnivores (*Mustela erminea*, *M. furo*, *M. nivalis* and *Felis catus*). *New Zealand Journal of Ecology* 20(2): 241–251.
- ³⁷ Jones C, Sanders MD. 2005. European hedgehog. In: King CM ed. *The handbook of New Zealand mammals*. 2nd edition. Melbourne, Oxford University Press. Pp. 81–94.
- ³⁸ Spitzen-van der Sluijs AM, Spitzen J, Houston D, Stumpel AHP. 2009. Skink predation by hedgehogs at Macraes Flat, Otago, New Zealand. *New Zealand Journal of Ecology* 33(2): 205–207.
- ³⁹ Jones C, Moss K, Sanders M. 2005. Diet of hedgehogs (*Erinaceus europaeus*) in the upper Waitaki Basin, New Zealand. Implications for conservation. *New Zealand Journal of Ecology* 29(1): 29–35.
- ⁴⁰ Jones C, Sanders MD. 2005. European hedgehog. In: King CM ed. *The handbook of New Zealand mammals*. 2nd edition. Melbourne, Oxford University Press. Pp. 81–94.
- ⁴¹ Daniel MJ. 1973. Seasonal diet of the ship rat (*Rattus r. rattus*) in lowland forest in New Zealand. *Proceedings of the New Zealand Ecological Society* 20: 21–30.
- ⁴² Innes JG. 2005. Ship rat. In: King CM ed. *The handbook of New Zealand mammals*. Oxford University Press. Pp. 187–203.
- ⁴³ Beggs JR. 2001. The ecological consequences of social wasps (*Vespula* spp.) invading an ecosystem that has an abundant carbohydrate resource. *Biological Conservation* 99: 17–28.
- ⁴⁴ McIntosh AR, McHugh PA, Dunn NR, Goodman JM, Howard SW, Jellyman PG, O'Brien LK, Nystrom P, Woodford DJ. 2010. The impact of trout on galaxiid fishes in New Zealand. *New Zealand Journal of Ecology* 34(1): 195–206.
- ⁴⁵ Ruscoe WA, Murphy EC. 2005. House mouse. In: King CM ed. *The handbook of New Zealand mammals*. Oxford University Press. Pp. 204–221.
- ⁴⁶ Newman DG. 1994. Effect of a mouse *Mus musculus* eradication programme and habitat change on lizard populations on Mana Island, New Zealand, with special reference to McGregor's skink, *Cyclodina macgregori*. *New Zealand Journal of Ecology* 21: 443–456.
- ⁴⁷ Smale MC, Dodd MB, Burns BR, Power IL. 2008. Long-term impacts of grazing on indigenous forest remnants on North Island hill country, New Zealand. *New Zealand Journal of Ecology* 32(1): 57–66.
- ⁴⁸ Joy M, Hewitt A. 2002. Freshwater fish survey of selected sites for Wellington Regional Council. Institute of Natural Resources-Ecology, Massey University.
- ⁴⁹ Joy M, Hewitt A. 2002. Freshwater fish survey of selected sites for Wellington Regional Council. Institute of Natural Resources-Ecology, Massey University.
- ⁵⁰ Greater Wellington Regional Council. 2005. Pest plant control plan 2005-2009.
- ⁵¹ Greater Wellington Regional Council. 2005. Pest plant control plan 2005-2009.
- ⁵² Department of Conservation. 2008. *New Zealand Threat Classification System manual*.

- ⁵³ de Lange PJ, Rolfe JR, Champion PD, Courtney SP, Heenan PB, Barkla JW, Cameron EK, Norton DA, Hitchmough RA. 2013. Conservation status of New Zealand indigenous vascular plants, 2012. New Zealand Threat Classification Series 3. 70 p.
- ⁵⁴ Sawyer J. 2005. Native Plants of the Eastbourne Hills, status and conservation management. Department of Conservation, Wellington, New Zealand.
- ⁵⁵ Robertson HA, Baird K, Dowding JE, Elliot GP, Hitchmough RA, Miskelly CM, McArthur N, O'Donnell CFJ, Sagar PM, Scofield P, Taylor GA. 2017. Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. 27p.
- ⁵⁶ Greater Wellington Regional Council. 2007. East Harbour Regional Park – Resource Statement.
- ⁵⁷ Hitchmough R, Barr B, Lettink M, Monks J, Reardon J, Tocher M, Van Winkel D, Rolfe J. 2016. Conservation status of New Zealand reptiles, 2015. New Zealand Threat Classification Series 17. 14 p.
- ⁵⁸ Goodman JM, Dunn NR, Ravenscroft PJ, Allibone RM, Boubée JAT, David BO, Griffiths M, Ling N, Hitchmough RA, Rolfe JR. 2014. Conservation status of New Zealand freshwater fish, 2013. New Zealand Threat Classification Series 7. 12 p.
- ⁵⁹ Stringer IAN, Hitchmough RA, Dugdale JS, Edwards E, Hoare RJB, Patrick BH. 2012b. The conservation status of New Zealand Lepidoptera. *New Zealand Entomologist* 35: 120–127.
- ⁶⁰ Sawyer JWD. 2004. Plant conservation strategy, Wellington Conservancy (excluding Chatham Islands), 2004–2010. Department of Conservation, Wellington. 91 p.
- ⁶¹ Sawyer J. 2005. Native plants of the Eastbourne hills, status and conservation management. Department of Conservation, Wellington, New Zealand.
- ⁶² Nikki McArthur, Greater Wellington Regional Council, pers comm 2012.

Greater Wellington Regional Council:

Wellington office
PO Box 11646
Manners Street
Wellington 6142

T 04 384 5708
F 04 385 6960

Upper Hutt office
PO Box 40847
Upper Hutt 5018

T 04 526 4133
F 04 526 4171

Masterton office
PO Box 41
Masterton 5840

T 06 378 2484
F 06 378 2146

Follow the Wellington
Regional Council



info@gw.govt.nz
www.gw.govt.nz

August 2020
GW/BD-G-20/7



Please recycle
Produced sustainably