Key Native Ecosystem Operational Plan for Western Wellington Forests

2019-2024

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Contents

1. Purpose

The purpose of the five-year Key Native Ecosystem (KNE) Operational Plan for Western Wellington Forests 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 five 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 Long Term Plan

The Long Term Plan (2018-2028)[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)

Greater Wellington Biodiversity Strategy

The Greater Wellington Biodiversity Strategy[3] (the 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 five-year KNE plans prepared by Greater Wellington’s Biodiversity department. Greater Wellington works with the landowners, mana whenua and other operational delivery providers to achieve mutually beneficial goals.

4. Western Wellington Forests Key Native Ecosystem site

The Western Wellington Forests KNE site is located on the eastern slopes of the Skyline Ridgeway, immediately north-west of Wellington City (see Appendix 1, Map 1). The KNE site comprises a number of large regenerating native forest reserves and parks in the city’s outer greenbelt owned or managed by Wellington City Council (WCC). The highest ecological values within the KNE site are found in Johnston Hill Scenic Reserve, Ōtari-Wilton’s Bush, Huntleigh Park, Khandallah Park and Johnsonville Park. The KNE site is an important wildlife corridor in the broader Wellington peninsula landscape, connecting Wellington’s south coast with bush reserves near Porirua City.

5. Parties involved

There are many organisations, groups and individuals that play important roles in the care of the KNE site.

5.1. Landowners

WCC own or administer the majority of lands (as public land) within the KNE site, including the forested reserves that have the highest ecological values (a full list of the WCC reserves contained within the KNE boundary is provided in Appendix 2). WCC manage these reserves in line with the objectives set out within Our Natural Capital – Wellington’s Biodiversity Strategy and Action Plan[4], the Outer Green Belt Management Plan[5], the Botanic Gardens of Wellington Management Plan[6], and the Open Space Access Plan

The Department of Conservation (DoC) own the Ōtari Conservation Area, however this area is controlled and managed by WCC through the Outer Green Belt Management Plan and Botanic Gardens of Wellington Management Plan.

Other landowners include the Girl Guides Association NZ (who own part of Huntleigh Park), Kordia, formally Broadcast Communications Limited (who own lands associated with the summit of Mount Kaukau), and John Hume (who owns and farms a parcel of land adjacent to the summit of Mount Kaukau).

5.2. Operational delivery

Within Greater Wellington, the Biodiversity and Biosecurity departments are responsible for delivering the KNE operational plan. The Biodiversity department is the overarching lead department for Greater Wellington on the coordination of biodiversity management activities and advice within the KNE site. The Biosecurity department coordinates and carries out pest animal control activities.

WCC is responsible for planning, coordinating and delivering most of the biodiversity management activities within the KNE site. WCC is also the primary contact for community groups. A number of active community groups are present within the KNE site and undertake a range of biodiversity management activities including ecological weed control, pest animal control, pest animal monitoring and restoration planting.

5.3. Mana whenua partners

Te Manga o Kaiwharawhara (including Te Mahanga Korimako Streams) is a site of significance for Taranaki Whānui ki te Upoko o te Ika (Taranaki Whānui) (see Table 1) and they are aware that their areas of interest are located on WCC land.

Table 1: Taranaki Whānui sites of significance in the Western Wellington Forest KNE site[7]

Sites of significance	Mana whenua values
Te Manga o Kaiwharawhara (including Te Mahanga Korimako Streams); Schedule B Ngā Taonga Nui a Kiwa	Ngā Mahi a ngā Tūpuna; Te Mahi Kai; Wāhi Whakarite; Te Mana o te Tangata; Te Manawaroa o te Wai; Te Mana o te Wai; Wāhi Mahara

Greater Wellington and WCC are committed to identifying ways in which kaitiakitanga can be strengthened by exploring opportunities on how Taranaki Whānui wish to be involved in the plan development or operational delivery of the KNE site.

5.4. Stakeholders

Transpower New Zealand has the right of access through the KNE site to service electricity pylons located along the Skyline ridgeline. This may require vegetation management within the KNE site that will be managed in accordance with the electricity act. Transpower New Zealand has supported community groups within the KNE site through the provision of grant money that has funded restoration activities.

6. Ecological values

This section describes the various ecological components and attributes that make the KNE site important. These factors determine the site's value at a regional scale and how managing it contributes to the maintenance of regional biodiversity.

6.1. Ecological designations

Table 2 below, lists ecological designations at all or part of the KNE site.

Table 2: Designations at the KNE site

Designation level	Type of designation
Regional	Parts of the KNE site are designated under Greater Wellington's Proposed Natural Resources Plan (PNRP) as Ecosystems and Habitats with Significant Indigenous Biodiversity Values: • Kaiwharawhara stream and tributaries; (Schedule F1) habitat for threatened and at risk species and habitat for six or more migratory fish species
District	Parts of the KNE site are designated as a Reserves under the Reserves Act and managed at District level: • Ōtari Conservation Area scenic and recreation reserves • Johnston Hill scenic reserve • Reserve – Khandallah/Johnsonville • Awarua Street Recreation Reserve • Kilminister block
Other	Parts of the KNE site is designated as: • Karori cemetery • Ōtari Farm Reserve

6.2. Ecological significance

The KNE site is considered to be of regional importance because:

- It contains highly **representative** ecosystems that were once typical or commonplace in the region
- It contains ecological features that are **rare or distinctive** in the region
- Its **ecological context** is valuable at the landscape scale as it contains a variety of inter-connected habitats and, provides core/seasonal habitat for threatened indigenous species within the KNE site

Representativeness

The Threatened Environment Classification system[8] indicates that a small area of this KNE site is classified as Acutely Threatened. However, this is not considered representative of the KNE site which predominately consists of habitat that is either At Risk or Well Protected (see Appendix 1, Map 2).

The Singers and Rogers (2014)[9] classification of pre-human vegetation indicates the KNE site comprised three forest types. These were kohekohe – tawa forest (MF6); tawa - kāmahi - podocarp forest (MF7); kāmahi – broadleaf – podocarp forest (and

MF8). There is 15%, 22% and 85% remaining respectively of the pre-human extent of these forest types in the Wellington region[10]. This makes MF6 and MF7, regionally Threatened and At Risk ecosystem types respectively.

Rarity/distinctiveness

New Zealand's national threat classification system[11] lists a number of threatened species are present within the KNE site including; five At Risk plant species, three Threatened or At Risk bird species, a nationally Threatened land-snail and four At Risk lizard species. Nationally threatened species are listed in Appendix 3 and regionally threatened species in Appendix 4.

Ecological context

The KNE site is the largest continuous area of indigenous vegetation in Wellington City and provides an important connectivity corridor between the Wellington south coast and Porirua harbour.

6.3. Ecological features

Vegetation communities and plants

The KNE site is the largest continuous area of indigenous vegetation in Wellington City. The lower slopes are largely regenerating indigenous broadleaved and podocarp forest, with remnants of primary forest remaining in the gullies[12]. The upper slopes consist of grey scrub (an ecosystem type consisting of small-leaved divaricating indigenous shrubs with climbing plants[13]) developing through the dominant exotic scrub mix. The top of the ridgeline is maintained as an open landscape and is grazed.

The KNE site lies within the Wellington Ecological District[14] on steep, strongly faulted hills. The climate is warm, very windy with frequent gales and an annual rainfall ranging between 900-1,400mm[15].

The KNE site is currently comprised of regenerating native forest dominated by māhoe (*Melicytus ramiflorus*) and rewarewa (*Knightia excelsa*). The site also contains remnants of podocarp-tawa-kohekohe forest, regenerating mataī forest, ngaio forest and mamaku tree fern-land. These forest areas are buffered by exotic scrub, indigenous grey scrub and secondary grey scrub[16] (grey scrub cover is now considered to be reduced nationally from its previous extent[17]).

More than 70 species of indigenous trees and shrubs, nearly 60 species of ferns, and 14 species of orchids have been recorded at the site[18]. Notable tree species present within the KNE site include large-leaved milk tree (*Streblus banksii*), northern rātā (*Metrosideros robusta*), hīnau (*Elaeocarpus dentatus*), rimu (*Dacrydium cupressinum*), tōtara (*Podocarpus totara*), kahikatea (*Dacrycarpus dacrydioides*), miro (*Prumnopitys ferruginea*), mataī (*Prumnopitys taxifolia)*, pukatea (*Laurelia novae-zelandiae*), and large tree fuchsia (*Fuchsia excorticata*).

Species

Birds

The KNE site provides significant habitat for a range of native forest bird species. However, from the latest state and trends in the diversity, abundance and distribution of birds in Wellington City report a number of species are considered of concern[19].

Of 'high concern' is the bellbird (*Anthornis melanura*), although not nationally threatened this species exists in the Wellington city area with only small populations that are threatened by a high risk of predation.

Of 'moderate concern', because of their small, localized or sparse populations and risk of predation are the New Zealand falcon (*Falco novaeseelandiae*), North Island kākā (*Nestor meridionalis septentrionalis*), red-crowned kākāriki (*Cyanoramphus novaezelandiae*), kererū (*Hemiphaga novaeseelandiae*), and whitehead (*Mohoua albicilla*).

Other species are considered of 'low concern' include fantail (*Rhipidura fuliginosa*), tūī (*Prosthemadera novaeseelandiae*), and grey warbler (*Gerygone igata*). These species tend to have larger, more stable or increasing populations and are of lower risk to predation.

Reptiles

Between 2016 and 2018, WCC conducted lizard surveys in four sites within or adjacent to the KNE site; Awarua Street Recreation Reserve, Khandallah Park - Johnsonville Park, Huntleigh Park and Ōtari-Wilton's Bush.

Ngahere gecko (*Mokopirirakau* 'southern North Island') were found in three of the four survey sites. Copper Skink (*Oligosoma aeneum*), ornate skink (*Oligosoma ornatum*) and Northern grass skink (*Oligosoma polychroma*) were also found in Huntleigh Park, which had the highest reptile diversity. Large numbers of Northern grass skink were found in Awarua Street Reserve[20].

Previously, barking gecko (*Naultinus punctatus*) and glossy brown skink (*Oligosoma zelandicum*) have also been recoded within Khandallah Park and Ōtari-Wilton's Bush respectively[21].

Fish and kōura

The KNE site contains the headwaters of several streams, including Kaiwharawhara Stream, Koromako Stream and Tyers Stream. These streams support a variety of native fish[22]. Recent surveys undertaken as part of the WCC's city-wide urban streams monitoring programme found longfin eel (*Anguilla dieffenbachii*), shortfin eel (*Anguilla australis*), giant kōkopu (*Galaxias argenteus*), kōaro (*Galaxias brevipinnis*), Redfin bully (*Gobiomorphus huttoni*), banded kōkopu (*Galaxias fasciatus*) and kōura (*Paranephrops planifrons*) present in the catchment[23].

Invertebrates

The KNE site has a high diversity of invertebrates with over 600 species recorded during the Bioblitz (2007) within Ōtari-Wilton's Bush reserve alone[24].

Khandallah Park was the location for a translocation of a population of native land-snail, the *Powelliphanta traversi latizona* in 1944. This population is still thought to be present[25].

7. Threats to ecological values at the KNE site

Ecological values can be threatened by human activities, and by introduced animals and plants that change ecosystem dynamics. The key to protecting and restoring biodiversity as part of the KNE Programme is to manage threats to the ecological values at each KNE site.

7.1. Key threats

The primary threats to the biodiversity values of the KNE site are from the impacts of ecological weeds and pest animals.

Ecological weeds are widespread throughout the KNE site ranging from mature pine trees to ground-covering plant species (see Table 3). The largest infestations are known to be present on the urban-edge of the KNE site and along tracks where the canopy is open. The presence of ecological weeds can affect the biodiversity values of a habitat by out-competing native plants to such an extent that the weeds become infestations. This hinders the natural regeneration of forest understory and reduces species diversity and the availability of food resources for native animals. Ecological weed control is undertaken to allow native plants to regenerate without the competition provided by ecological weed species. This enables native species to become more dominant which in itself becomes a natural suppressor of weeds.

Pest animals affect the forest habitat by over-browsing native foliage, out-competing native species for food and resources, and through direct predation. Possums (*Trichosurus vulpecula*), rats (*Rattus* spp.) and mustelids (*Mustela* spp.) are the biggest threat to the identified ecological values. These species are known to compete for food resources, consume large quantities of canopy foliage, and to eat birds, bird's eggs and invertebrates.

While the key threats discussed in this section are recognised as the most significant, a number of other threats to the KNE site's values have also been identified. Table 3 presents a summary of all known threats to the KNE site (including those discussed above), detailing which operational areas they affect, how each threat impacts on ecological values, and whether they will be addressed by operational activities.

Table 3: Summary of all threats to ecological values present at the KNE site

Threat code	Threat and impact on biodiversity in the KNE site
Ecological weeds	
EW-1	Ground covering ecological weeds smother and displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition (see full list in Appendix 4)
EW-2	Woody weed species displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition (see full list in Appendix 4)
EW-3	Climbing weeds smother and displace native vegetation often causing canopy collapse, inhibit indigenous regeneration, and alter vegetation structure and composition (see full list in Appendix 4)
Pest animals	
PA-1	Possums (*Trichosurus vulpecula*) browse palatable canopy vegetation until it can no longer recover[26,27]. This destroys the forest's structure, diversity and function. Possums may also prey on native birds and invertebrates[28]
PA-2	Rats (*Rattus* 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[29,30]
PA-3	Mustelids (stoats[31,32] (*Mustela erminea*), ferrets[33,34] (*M. furo*) and weasels[35,36] (*M. nivalis*)) prey on native birds, lizards and invertebrates, reducing their breeding success and potentially causing local extinctions
PA-4	Hedgehogs (*Erinaceus europaeus*) prey on native invertebrates[37], lizards[38] and the eggs[39] and chicks of ground-nesting birds[40]
PA-5*	House mice (*Mus musculus)* 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[41,42]
PA-6	Feral, stray and domestic cats (*Felis catus*) prey on native birds[43], lizards[44] and invertebrates[45], reducing native fauna breeding success and potentially causing local extinctions[46]
PA-7	Rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*) graze on palatable native vegetation and prevent natural regeneration in some environments[47]
PA-8	Wasps (*Vespula* spp.) adversely impact native invertebrates and birds through predation and competition for food resources. They also affect nutrient cycles in beech forests[48]
PA-9	Red deer (*Cervus elaphus*) and fallow deer (*Dama dama*) browse the forest understory and can significantly change vegetation composition by preferential browsing and preventing regeneration[49,50,51]
PA-10	Feral pigs (*Sus scrofa*) root up the soil and eat roots, invertebrates, seeds and native plants preventing forest regeneration[52]
PA-11	Goats (*Capra hircus*) 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[53]

Threat code	Threat and impact on biodiversity in the KNE site
Human activities	
HA-1*	Garden waste dumping often leads to ecological weed invasions into natural areas
HA-2	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[54]
HA-3*	Recreational use and an increased visitor numbers monitored in recent times to undertake activities such as tramping, mountain biking (including illegal track building) and horse riding can cause damage and disturbance of the native ecosystem. It is also likely to disturb native fauna and introduce ecological weeds
HA-4	Encroachment of residential gardens into the KNE site from urban areas causes habitat loss and introduces ecological weeds
HA-5*	Companion animals such as dogs off lead can pose a serious threat to many bird and lizard species in the KNE
HA-5*	Barriers to native fish passage are present within and downstream of the KNE site preventing migrating fish from completing their life-cycle
Other threats	
OT- 1*	Myrtle rust attacks new shoots, fruits and flowers, and can destroy the food relied on by some species of native birds, lizards and insects. There is the possibility that some of these species could become regionally extinct, and their loss could have serious flow-on effects to ecosystem services like erosion control and nutrient cycling[55]

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

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.

8. Vision and objectives

8.1. Vision

Create a resilient and self-sustaining forest ecosystem supporting native species that plays a full part in connecting species and their habitats along the wildlife corridor from the Wellington South Coast to Porirua Harbour.

8.2. Objectives

Objectives help to ensure that operational activities carried out are actually contributing to improvements in the ecological condition of the site.

The following objectives will guide the operational activities at the KNE site:

1. **To improve the KNE site for native vulnerable birds**
2. **The resilience of the core forest blocks is maintained and enhanced**
3. **To maintain the KNE site's freshwater habitat**
4. **To support the community in management of the KNE site**

9. Operational activities

Operational activities are targeted to work towards the objectives and vision 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 4).

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.

9.1. Ecological weed control

Ecological weed control is undertaken within the KNE site aimed at maintaining the integrity and resilience of the high value core forested areas. This is achieved through annual targeted weed control through the core forested blocks in Johnston Hill, Ōtari, Huntleigh, Khandallah and Johnsonville Reserve areas (see map 3 and 4).

Annually, the weed control operational areas will be set out by WCC identifying target species for control. Priority weeds for control are identified within Appendix 4; however, the general approach affords climbing species the highest priority to manage in this KNE site. Woody species and subsequently ground cover species are the lowest priority.

Biocontrol (controlling one living thing using another), of Darwin's Barberry (*Berberis darwinii*) and Buddleia (*Buddleja davidii*) could occur within the life-cycle of this KNE plan. WCC, Greater Wellington and the National Biocontrol Collective work collectively to trial biocontrol organisms that are approved for release in the wild.

9.2. Pest animal control

A large-scale network of pest animal control has been developed across the KNE site and buffer zone areas since 1998 to prevent over-browsing of the native forest cover and protect native fauna. This activity also encourages natural regeneration of the native forest and improves food supply and nesting opportunities available for vulnerable bird species.

The primary focus of the pest animal control network is on protecting native ecosystems and species from the effects of possums, rats and mustelids. A combination of Pelifeed poison bait-stations, DOC 200 kill-traps, and Timms kill-traps have been installed across the entire KNE site (see Appendix 1; map 5).

This work is jointly funded and delivered by Greater Wellington, WCC and community groups. A brief outline of each control method is provided below:

- A large network of poison bait-stations using anticoagulant bait has been installed across the whole KNE site and buffer zone areas that control possums to low levels and reduce the risk of re-invasion into the KNE site of this species. Rats have access to bait stations and thus bait stations provide some level of control. The bait stations are serviced every three months by Greater Wellington

- DOC 200 kill-traps are used in a network sufficient to control small mammals such as mustelids, rats and hedgehogs. These traps have been installed in all operational areas and are serviced monthly by community group volunteers everywhere except Johnston's Hill where they are serviced every three months by Greater Wellington

  Note: not all DOC 200 kill-traps are shown in Appendix 1, Map 5 given the ongoing expansion of community group networks (see below).

- Timms kill-traps have been installed on the skyline ridge to reduce the risk of possum re-invasion into the KNE site from the Ohariu Valley. The traps are currently not being serviced, but WCC is in discussions with another volunteer group to re-start this servicing. The traps would ideally be serviced on a monthly basis.

Johnsonville Park has, up until recently been maintained as a trial site testing the effectiveness of Goodnature A24 gas-traps. However, this approach has not proven effective to date in maintaining rat low numbers. Therefore, it is proposed that this area will revert to an anticoagulant baiting regime to reduce the rat population in line with the KNE site's objectives. The Johnsonville Park area will remain an operational area where new pest control tools are tested for effectiveness against current methods. This area is monitored as part of the small mammal monitoring programme (see monitoring section below).

Many Community groups originally have self-funded the expansion of the DOC 200 kill-trap network across the KNE site (see Appendix 1; Map 6). WCC is the key support for

community groups trapping in the area, providing traps, training and support. The traps primarily target mustelids and rats across a greater area of the KNE site, providing benefits to native birds and lizards. WCC and Greater Wellington and DOC are working collaboratively to share best practice and training advice with community groups trapping in the area. Expansion of the pest animal kill-trap network will be assessed in collaboration with community as opportunities arise in the KNE site.

Greater Wellington has installed a large bait-station network throughout the Ohariu Valley, which is immediately adjacent to the KNE site. This work was funded by Greater Wellington's Regional Pest and Predator Control Programme (RPPCP) that aims to control possums across the greater Wellington landscape to low levels[56]. This activity will benefit the KNE site by controlling possums in the wider landscape and reducing the risk of re-invasion into the KNE site.

Feral goats, pigs and deer are present in the Wellington peninsula and are occasional visitors to the KNE site via the Skyline ridge. WCC undertake regular control using contracted hunters.

WCC fund regular control of stray and feral cats in the KNE site especially in Chartwell/Crofton Downs and continue with their engagement program with communities about the impact and management of stray and feral cats.

WCC fund the control of rabbits in the pasture lands along the Skyline ridge from Karori to Mount Kaukau in collaboration with adjacent private land owners.

WCC are also aiming undertake wasp control in the KNE site from 2020 onwards.

9.3. Restoration planting

WCC coordinates all restoration planting activities within the KNE site with assistance from community groups. These activities are undertaken in line with the objectives set out in this KNE Operational Plan and with Our Natural Capital – Biodiversity Strategy and Action Plan [57] and the proposed draft Outer Green Belt Management Plan[58].

Restoration planting is an important part of the management of the KNE site, supporting the regeneration and resilience of the forest and providing additional food resources for native animals.

Only locally sourced (eco-sourced) native plant species, grown at WCC's nursery and community nurseries, are used in restoration planting.

The principles guiding restoration planting in the KNE are to:

- Increase species diversity
- Plant key 'missing' species (ie, podocarp species and epiphytes)
- In-fill canopy gaps with native species, and
- Restore areas following ecological weed control work

WCC will continue to monitor and record the condition of the restoration plantings.

9.4. Monitoring

Small mammal monitoring

Greater Wellington fund small mammal monitoring undertaken bi-annually in Ōtari-Wilton's Bush and Johnsonville Park. Tracking tunnels are used to monitor the presence of small mammal species, primarily mustelids, mice, rats and hedgehogs to provide an indication of the effectiveness of the pest animal control network. Monitoring in Johnsonville Park is undertaken in to assess the effectiveness of the non-toxin approaches to forest pest control.

Small mammal monitoring reports can be found at: http://www.gw.govt.nz/terrestrial-ecology/

Bird monitoring

WCC funds bird monitoring within the KNE site as part of their City-wide bird monitoring programme. Five-minute bird counts are undertaken annually to assess trends in abundance, diversity and distribution of native birds across Wellington City parks and reserves. Citizen science data is also analysed as part of the data set.

This data is utilised to assess the effectiveness and inform the future management undertaken within the KNE site.

Bird monitoring reports can be found at: http://www.gw.govt.nz/terrestrial-ecology/

Urban streams monitoring

Surveys of fish and fish passage barriers in the catchment were undertaken during the last three years. This data is being collected to establish a baseline from which a city-wide freshwater monitoring programme will be developed. This city-wide programme will continue during the course of this plan, and will include further investigations within the KNE site.

9.5. Supporting the Community

The purpose of community engagement is to support and build the capacity of existing and new community groups engaging in biodiversity projects. WCC support these groups and direct their work plans where required. Greater Wellington provide support and advice as required. This work has become increasingly important with the emergence of community-led projects such as the development of Predator-free communities and Capital Kiwi.

WCC supports community groups undertaking biodiversity management activities to develop robust monitoring frameworks bed on their activities and desired outcomes if they are willing to do this work.

The current community groups supported by WCC within the KNE are:

- The Friends of Khandallah Park
- Khandallah Predator Free community
- Otari-Wilton's Bush Trust

- Rodent and Mustelid Blitzing at Otari (RAMBO)
- Bells Track Working Group
- Royal Forest & Bird Protection Society – Wellington Branch Chartwell Group
- Crofton Downs Predator Free Community
- Katch 22 (Makara Peak Supporters)
- Silversky Track
- Ngaio and Crofton Downs Residents Association
- The Green Belters
- Makererua Reserve Group*

*This group works outside the KNE area but within the pest animal buffer zone

9.6. Other management activities

KNE site boundary expansion

WCC and Greater Wellington have recently agreed to review the potential for adding land parcels to the immediate west of the existing KNE site boundary to the KNE site itself following WWC's draft Significant Natural Area identification. The management requirements of these land parcels will be reviewed and programmed for action in 2020/21.

Fencing and grazing

WCC has prioritised fencing along the grazed margins adjacent to Otari-Wilton's Bush and Khandallah Park[59]. Fencing is an effective tool for excluding some feral animals and livestock from sites with high biodiversity values or where natural regeneration of native vegetation is the management objective. Fencing along the grazed margins of the Wellington Western Forests Key Native Ecosystem (KNE) is prioritized.

Grazing in general as a management tool is being reviewed as per the Outer Green Belt Management Plan – Policy 4.3.2.2. Until now grazing has been used to maintain pasture cover on the ridgetops and hilltops. WCC has reviewed the effectiveness, suitability and sustainability of grazing regimes in the light of recreational use, environmental impact and farm consultant advice about the land's grazing capacity and value. It is proposed to gradually phase out grazing.

Private land encroachments

The cumulative effect of encroachments into open space is a significant issue for the management of reserve land. Encroachments are a prohibited activity and WCC has a programme to identify and resolve existing encroachments and protect the KNE site from new encroachment.

Veteranisation

Veteranisation is a term used to describe the pruning methods used as a management tool to accelerate the ageing process of trees. Veteranisation of trees creates habitat for birds, lizards and insects. This work is carried out by WCC, and will be continued within the KNE site on exotic species where appropriate.

10. Future opportunities

We endeavour to take the management activities that we believe best protect the biodiversity values of this land.

We welcome interest from community and organization who may want to expand on the activities we currently undertake or take on some of the other challenges left.

Below is a list of some of the further worth that has been identified as having the potential to improve biodiversity values in the KNE or further our understanding of the present values and how to protect them:

- Extend weed management
- Extend predator trapping
- Increase frequency of trap checks
- Species monitoring (eg, lizards, snails)
- Reporting of wildlife sightings through citizen science platforms such as I naturalist

Community groups and researchers should approach WCC in the first instance to pursue any of the above or other opportunities within the KNE site.

11. Operational delivery schedule

The operational delivery schedule shows the actions planned to achieve the stated objectives for the Western Wellington Forests KNE site, and their timing and cost over the five-year period from 1 July 2019 to 30 June 2024. The budget for years 2020/21 to 2023/24 are indicative only and subject to change.

Table 4: Five-year operational plan for the Western Wellington Forests KNE site

Objective	Management Activity	Implementing party	The actions: Description/detail	Intended 5 year outcomes	Frequency and/or indicative funding available*				
					2019/20	2020/21	2021/22	2022/23	2023/24
2	Pest plant control	WCC	Annual programme of surveillance and control of priority weeds in core forest areas. Operational areas targeted determined annually by WCC	Priority weeds identified and controlled. Integrity of core forested areas maintained	✓ $50,000*	✓ $45,000*	✓ $45,000*	✓ $45,000*	✓ $45,000*
1,2	Pest animal control	Greater Wellington	Sustained control of possums and rats by servicing all Pelifeed bait-stations every three months with anticoagulant bait DOC200 kill-traps at Johnston Hill serviced every three months	Maintain target species at low densities to low numbers	✓ $46,850	✓ $47,788	✓ $48,742	✓ $49,716	✓ $50,711
1,2,4	Pest animal control	WCC supported Volunteer groups	Sustained control of mustelids rats and hedgehogs by servicing all DOC 200 kill-traps on a monthly basis (exc. Johnston Hill)	Maintain target species at low densities	✓ $5,000	✓ $5,000	✓ $5,000	✓ $5,000	✓ $5,000

Objective	Management Activity	Implementing party	The actions: Description/detail	Intended 5 year outcomes	Frequency and/or indicative funding available*				
					2019/20	2020/21	2021/22	2022/23	2023/24
1,2,4	Pest animal control	WCC supported Volunteer groups	Service Timms kill-traps on skyline ridgeline on monthly basis	Possum reinvasion prevented	✓ $1,000	✓ $1,000	✓ $1,000	✓ $1,000	✓ $1,000
1,2	Pest animal control	WCC	Coordinate the sustained control of pest species including rabbits, goats, deer, pigs, and stray cats throughout and immediately adjacent to the KNE site	Maintain target species at low densities	✓ $20,000	✓ $20,000	✓ $20,000	✓ $20,000	✓ $20,000
1,2,4	Restoration planting	WCC	Coordination of annual restoration planting programme. Restoration planting priorities to be determined annually by WCC	Increased diversity and connectivity of forest blocks. Maintained suppression of weeds.	✓ $14,000	✓ $14,000	✓ $14,000	✓ $14,000	✓ $14,000
1,2,4	Monitoring effectiveness	Greater Wellington	Coordinate small mammal monitoring programme and reporting on effectiveness of KNE programme	Monitoring completed and reported to inform future management	✓ $6,800	✓ $6,800	✓ $6,800	✓ $6,800	✓ $6,800
1	Monitoring effectiveness	WCC	Coordinate bird monitoring programme and reporting as part of WCC's reserve wide bird monitoring programme	Monitoring completed and reported to inform future management	✓ $2,500*	✓ $2,500*	✓ $2,500*	✓ $2,500*	✓ $2,500*
3	Monitoring effectiveness	WCC	Coordinate and report on urban streams habitat assessments for WCC's city-wide programme	Baseline established and reported to inform future management	✓ $**	-	-	-	-

Objective	Management Activity	Implementing party	The actions: Description/detail	Intended 5 year outcomes	Frequency and/or indicative funding available*				
					2019/20	2020/21	2021/22	2022/23	2023/24
1,2	Fencing	WCC	Monitor and repair boundary stock-proof fencing to prevent incursions into high value biodiversity areas	No damage to high value areas recorded as a result of stock damage	✓ $1,000*	✓ $1,000*	✓ $1,000*	✓ $1,000*	✓ $1,000*
2	Private land encroachments	WCC	Review/audit of private land boundaries to assess encroachment	No loss of reserve land	✓ $ **	-	-	-	-
1,2	Veteranisation	WCC	Annual veteranisation programme completed	Improved habitat availability for a range of species	✓ $ **	✓ $ **	✓ $ **	✓ $ **	✓ $ **
1,2	Grazing review	WCC	Grazing review in line with OGBMP policy 4.3.2.2	Gradual phasing out of grazing implemented	✓ $ **	✓ $ **	✓ $ **	✓ $ **	✓ $ **
1,4	KNE site boundary expansion	WCC/ Greater Wellington	Review potential for inclusion and programme in biodiversity management requirements for recently added land parcels to KNE site boundary	KNE site management area expanded	-	✓ $ **	-	-	-
4	Future opportunities	WCC/ Greater Wellington	Work with communities to identify and enable further management activities that support the vision and objectives of this KNE plan as they arise see section 12 for ideas	Communities supported to achieve their goals. Actions add value to the management of the KNE site	✓ $ **	✓ $ **	✓ $ **	✓ $ **	✓ $ **

*Variable costs determined annually by WCC. Figures given are based on 2018-19 expenditure or averaged out expenditure across multiple sites/years.
**Costs cannot be detailed at this time

12. Funding contributions

12.1. Budget allocated by Greater Wellington

The budget for the years 2020/21 and 2023/24 are indicative only and subject to change.

Table 5: Greater Wellington allocated budget for the Western Wellington Forests KNE site

Management activity	Timetable and resourcing				
	2019/20	2020/21	2021/2022	2022/23	2023/24
Ecological weed control	$5,000	-	-	-	-
Pest animal control	$23,425	$23,894	$24,371	$24,858	$25,356
Small mammal Monitoring	$6,800	$6,800	$6,800	$6,800	$6,800
Total	$35,225	$30,694	$31,171	$31,658	$32,156

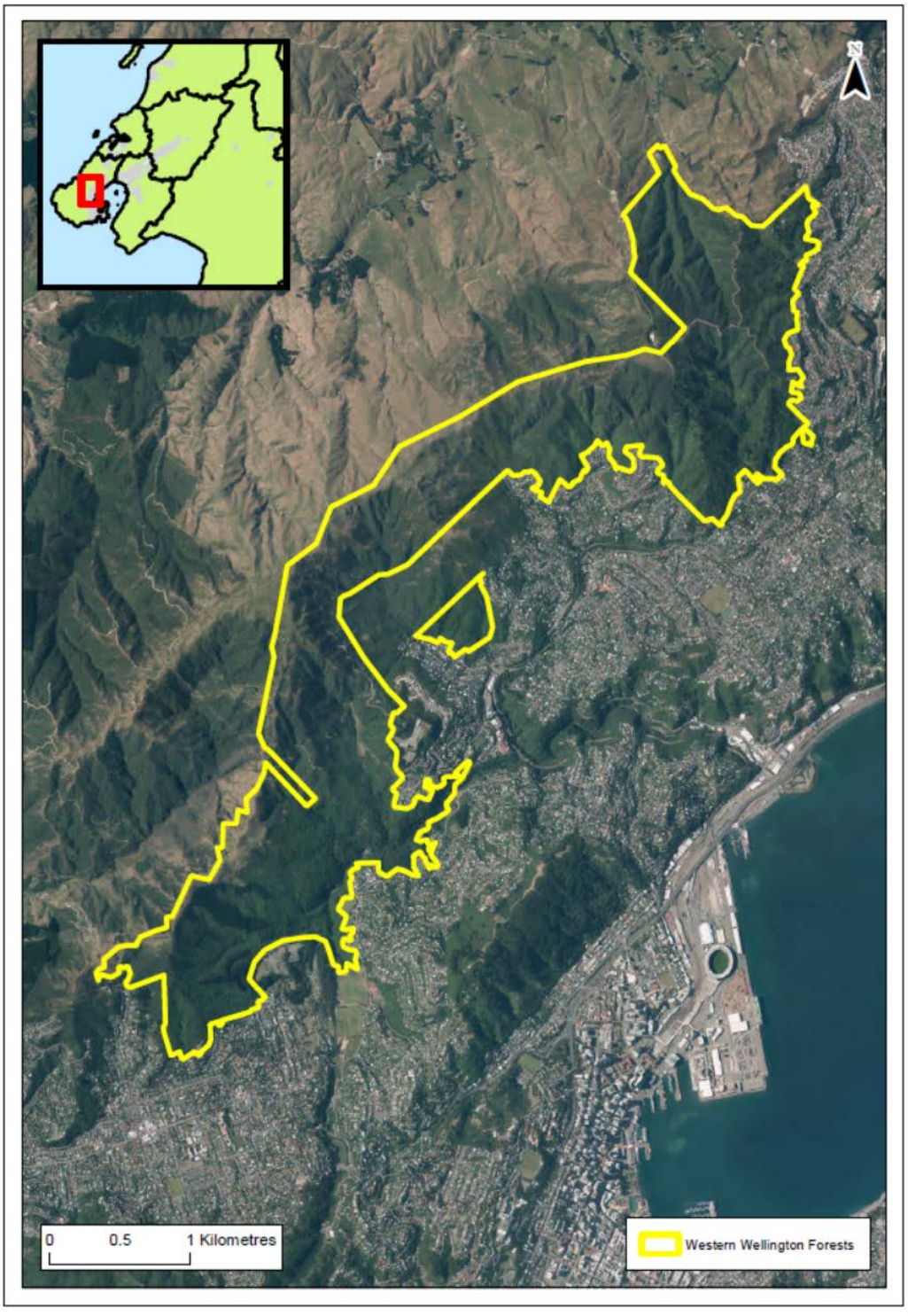
12.2. Budget allocated by WCC

The budget is subject to confirmation through the long term planning process.

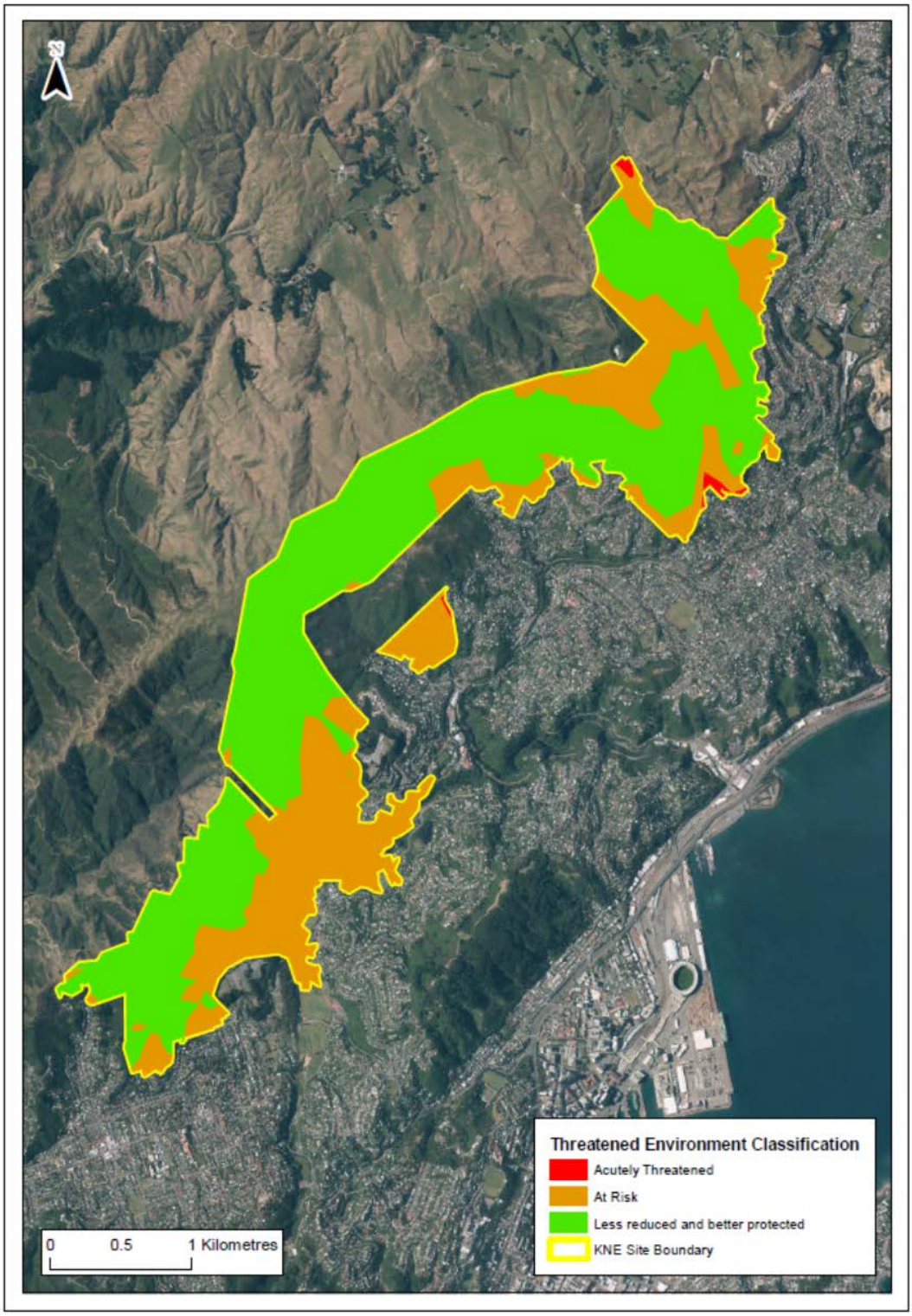
Table 6: WCC allocated budget for the Western Wellington Forests KNE site

Management activity	Timetable and resourcing				
	2019/20	2020/21	2021/2022	2022/23	2023/24
Ecological weed control	At least $45,000	At least $45,000	At least $45,000	At least $45,000	At least $45,000
Pest animal control	$45,000	$45,000	$45,000	$45,000	$45,000
Restoration	$14,000	$14,000	$14,000	$14,000	$14,000
Bird monitoring	$2,500	$2,500	$2,500	$2,500	$2,500
Fencing	$1,000	$1,000	$1,000	$1,000	$1,000
Total	$107,500	$107,500	$107,500	$107,500	$107,500

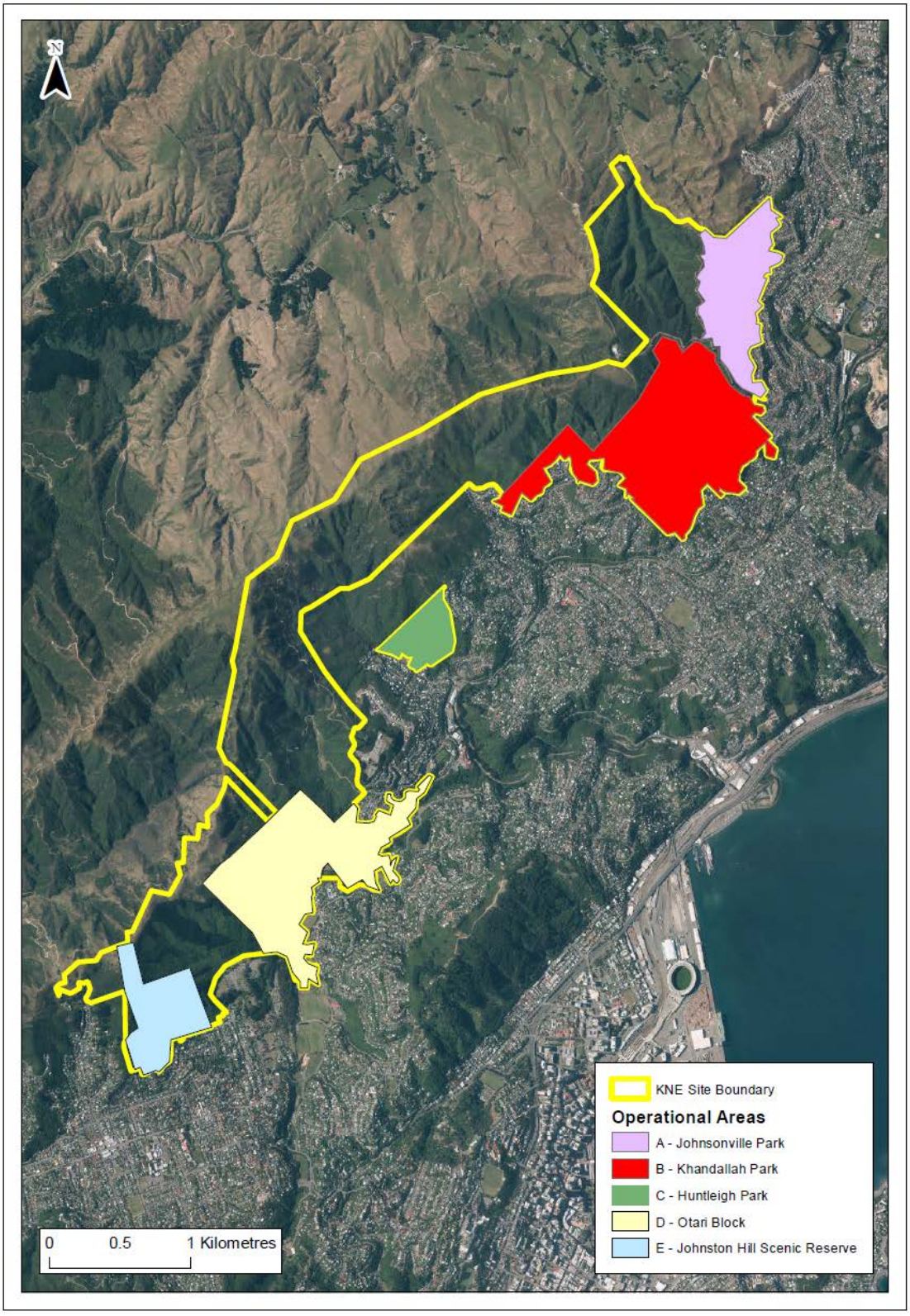
Appendix 1: Site maps



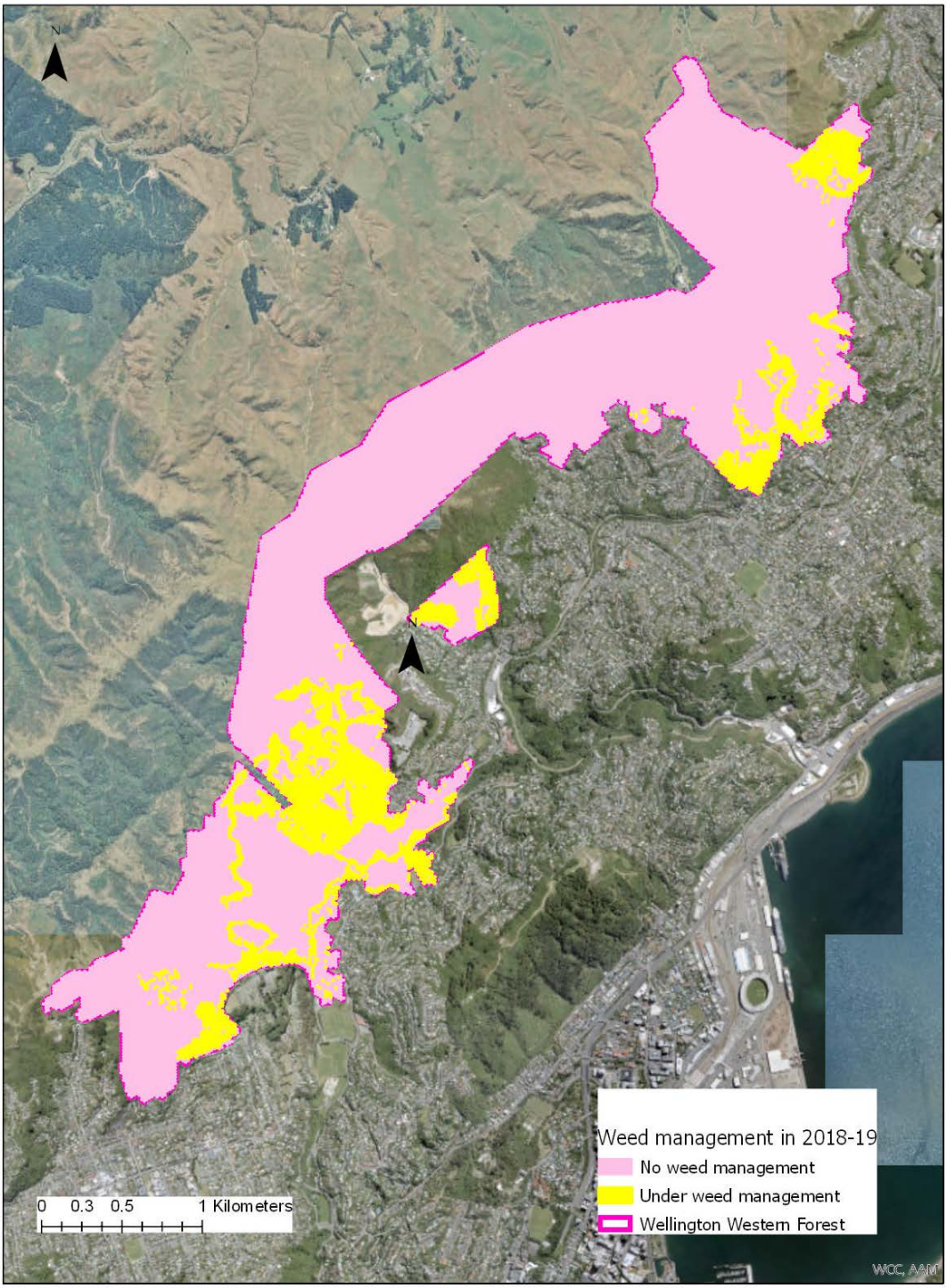
Map 1: The Western Wellington Forests KNE site boundary



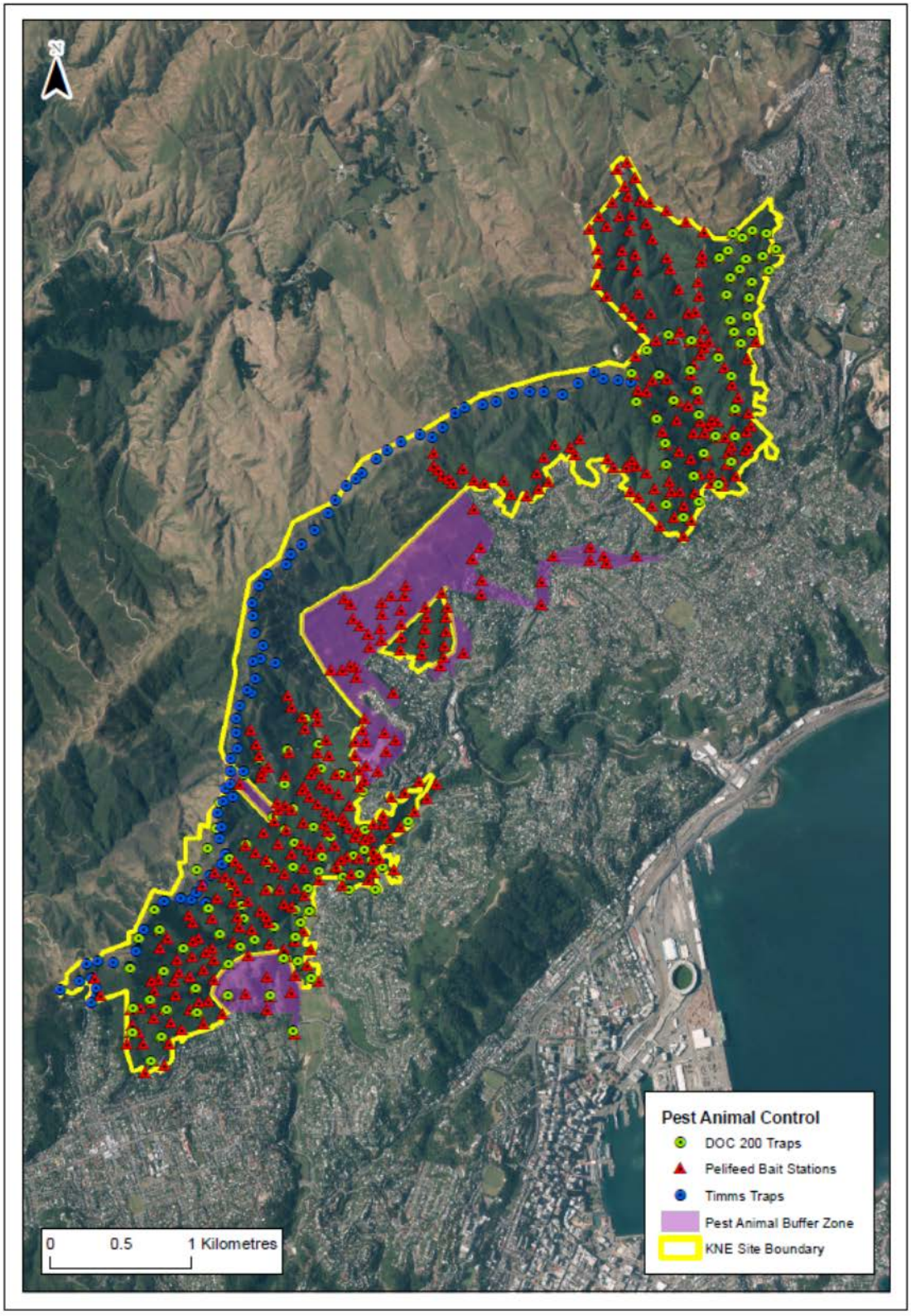
Map 2: Land Environment New Zealand threat classifications for the Western Wellington Forests KNE site



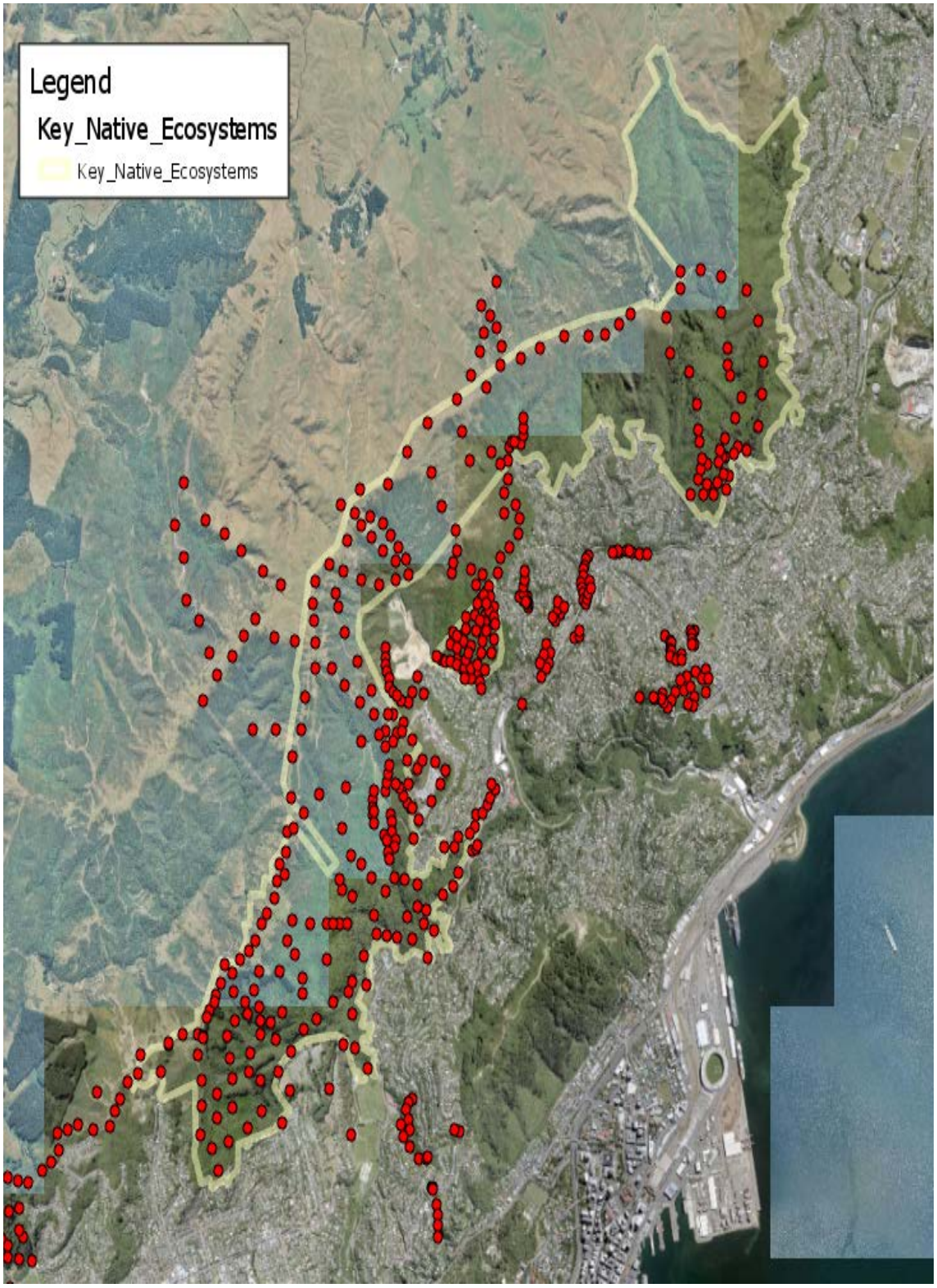
Map 3: Core forest weed control operational Areas in Wellington Western Forest KNE site



Map 4: 2018/19 weed control operational areas in the Western Wellington Forests KNE site



Map 5: Pest animal control in the Western Wellington Forests KNE site



Map 6: Community group pest animal control in the Western Wellington Forests KNE site

Appendix 2: Nationally 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 cycle[60]. 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.

Table 7: Threatened and At Risk species at the KNE site

Scientific name	Common name	Threat status	Observation
Plants(vascular)[61]			
Anemanthele lessoniana	Hunangāmoho	Threatened – Nationally Vulnerable	Garden escapee Wellington Botanical Society 2007[62]
Kunzea robusta	Kanuka	Threatened – Nationally Vulnerable	A. Benbrook *pers comm.*
Lophomyrtus bullata	Ramarama	Threatened – Nationally Critical	A. Benbrook *pers comm.*
Lophomyrtus obcordata	Rohutu	Threatened – Nationally Critical	A. Benbrook *pers comm.*
Melicytus crassifolius	Thick-leaved mahoe	At Risk – Declining	A. Benbrook *pers comm.*
Metrosideros colensoi	Rata	Threatened – Nationally Vulnerable	A. Benbrook *pers comm.*
Metrosideros diffusa	White rata	Threatened – Nationally Vulnerable	A. Benbrook *pers comm.*
Metrosideros fulgens	Climbing rata	Threatened – Nationally Vulnerable	A. Benbrook *pers comm.*
Metrosideros perforata	Akatea	Threatened – Nationally Vulnerable	A. Benbrook *pers comm.*
Metrosideros robusta	Northern rata	Threatened – Nationally Vulnerable	A. Benbrook *pers comm.*
Streblus banksii	Large-leaved milk tree	At Risk – Relict	Greater Wellington site inventory Wilton House
Syzygium maire	Swamp maire	Threatened – Nationally Critical	A. Benbrook *pers comm.*
Teucridium parvifolium	Teucridium	At Risk – Declining	Garden escapee Wellington Botanical Society 2007
Birds[63]			
Cyanoramphus novaezelandiae	Red-crowned parakeet; kākāriki	At Risk – Relict	MacArthur *et al.* 2018[64]

Scientific name	Common name	Threat status	Observation
Falco novaeseelandiae	New Zealand falcon; kārearea	At Risk – Recovering	MacArthur *et al*. 2018
Nestor meridionalis septentrionalis	North Island kākā	At Risk – Recovering	MacArthur *et al*. 2018
Notiomystis cincta	Hihi; stichbird	Threatened – Nationally Vulnerable	MacArthur *et al*. 2018
Reptiles[65]			
Mokopirirakau 'southern North Island'	Ngahere gecko	At Risk – Declining	Department of Conservation 2014
Naultinus punctatus	Barking gecko	At Risk – Declining	Department of Conservation 2014[66]
Oligosoma ornatum	Ornate skink	At Risk – Declining	Department of Conservation 2014
Oligosoma zelandicum	Glossy brown skink	At Risk – Declining	Department of Conservation 2014
Freshwater fish[67]			
Anguilla dieffenbachii	Longfin eel	At Risk – Declining	NIWA 2015[68]
Galaxias argenteus	Giant kōkopu	At Risk – Declining	NIWA 2015
Galaxias brevipinnis	Kōaro	At Risk – Declining	NIWA 2015
Invertebrates[69]			
Powelliphanta traversi latizona	None known	Threatened – Nationally Endangered	Walker 2003[70]

Appendix 3: Regionally threatened plant species list

The following table lists regionally threatened species that have been recorded in the KNE site. Native plant species have been identified in the Plant Conservation Strategy, Wellington Conservancy 2004-2010[71].

Table 8: Regionally threatened plant species at the KNE site

Scientific name	Common name	Threat status	Observation
Plants[72]			
Botrychium biforme	Fine-leaved parsley fern	Regionally Naturally uncommon	Khandallah Park
Cyathea cunninghamii	Slender tree fern	Regionally Sparse	Wellington Botanical Society 2007

Appendix 4: Ecological weed species

The following table lists key ecological weed species that have been recorded in the KNE site and prioritised by WCC for control.

Table 9: Ecological weed species recorded in the Wellington Western Forest KNE site

Scientific name	Common name	Priority	Weed type	Notes
Acanthus mollis	Bear's breeches	Low	Ground cover	
Acer pseudoplatanus	Sycamore	Medium	Woody	
Agapanthus praecox	Agapanthus	Low	Ground cover	
Allium triquetrum	Onion weed	Low	Ground cover	
Alocasia brisbanensis	Giant taro	Low	Ground cover	
Asparagus scandens	Climbing asparagus	High	Climber	
Berberis darwinii	Darwin's barberry	Low	Woody	Given the widespread distribution of this weed, there is insufficient resources to start tackling this weed
Buddleja davidii	Buddleia	Medium	Woody	Hopefully biocontrol agent will reduce its dominance
Cedronella canariensis	Balm of Gilead	Low	Woody	
Chrysanthemoides monilifera subsp. monilifera	Boneseed	Low	Woody	
Clematis vitalba	Old man's beard	High	Climber	
Cobaea scandens	Cathedral bells	High	Climber	
Cotoneaster spp.	Cotoneaster	Low	Woody	
Crateagus monogyna	Hawthorn	Medium	Woody	
Crocosmai x crocosmiiflora	Montbretia	Low	Ground cover	
Cytisus scoparius	Broom	Low	Woody	
Elaeagnus x reflexa	Elaeagnus	Low	Woody	
Erigeron karvinskianus	Mexican daisy	Low	Ground cover	
Foeniculum vulgare	Fennel	Low	Woody	
Galeobdolon luteum	Aluminium weed	Low	Ground cover	
Hedera helix	English Ivy	High	Climber	Not enough resources to control to adequate levels
Hedychium gardnerianum	Kahili Ginger	High	Woody	

Hydrangea macrophylla	Hydrangea	Low	Woody	
Hypericum androsaemum	Tutsan	Low	Ground cover	
Ilex aquifolium	Holly	High	Woody	
Impatiens glandulifera	Himalayan balsam	Medium	Woody	
Jasmine polyanthum	Jasmine	High	Climber	
Laurus nobilis	Bay laurel	High	Woody	
Lonicera japonica	Japanese Honeysuckle	High	Climber	
Lupinus arboreus	Tree lupin	Low	Woody	
Melanoselinum decipiens	Parsnip palm	Low	Ground cover	
Passiflora 'Tacsonia' subgroup	Banana passionfruit	High	Climber	
Pinus spp.	Wilding pines and conifers	Low	Woody	
*Pittosporum crassifolium**	Karo	Low	Woody	
*Pittosporum ralphii**	Pittosporum ralphii	Low	Woody	
Prunus laurocerasus	Cherry laurel	High	Woody	
Prunus spp.	Cherry	Medium	Woody	Given widespread nature, not enough resources to target in entire area
Pseudosasa japonica	Bamboo	Low	Woody	
Rhaphiolepsis indica	Indian hawthorn	Medium	Woody	
Rubus fruticosus agg.	Blackberry	Medium	Climber	
Sambrucus nigra	Elderberry	Low	Woody	
Selaginella kraussiana	African club moss	Low	Ground cover	Not enough resources to control at present, but spreading along tracks and bait lines
Senecio angulatus	Cape ivy	Medium	Climber	
Senecio mikanioides	German ivy	Low	Climber	
Stachys sylvatica	Hedge woundwort	Low	Ground cover	
Syzgium smithi	Monkey apple	Medium	Woody	
Taxus baccata	Yew	Low	Woody	
Tradescantia fluminensis	Tradescantia	Low	Ground cover	Only selective areas controlled

Tropaeolum majus	Nasturtium	Low	Ground cover	
Vinca major	Periwinkle	Low	Ground cover	
Zantedeschia aethiopica	Arum lily	Low	Ground cover	

* Denotes a New Zealand native plant that is not local to the KNE site

References

[1] New Zealand legislation. 1991. Resource Management Act 1991.
[2] Greater Wellington Regional Council. Greater Wellington Regional Council 10 Year Plan: 2018 – 2028.
[3] Greater Wellington Regional Council. 2016. Greater Wellington Regional Council Biodiversity Strategy. http://www.gw.govt.nz/assets/council-publications/Biodiversity-Strategy-2016.pdf
[4] Wellington City Council 2015. Our Natural Capital – Wellington's Biodiversity Strategy and Action Plan. Wellington City Council, Wellington.
[5] Wellington City Council 2013. Wellington Town Belt Management Plan. Wellington City Council, Wellington. 260 pp.
[6] Wellington City Council 2014. Botanic Gardens of Wellington Management Plan. Wellington City Council, Wellington.
[7] Greater Wellington Regional Council. 2015. Proposed Natural Resources Plan. P. 299.
[8] Walker S, Cieraad E, Grove P, Lloyd K, Myers S, Park T, Porteous T. 2007. Guide for users of the threatened environment classification, Version 11, August 2007. Landcare Research New Zealand. 34p plus appendix.
[9] Singers NJD, Rogers GM. 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation No. 325. Department of Conservation, Wellington. 87p.
[10] Singers N, Crisp P, Spearpoint O. 2018. Forest ecosystems of the Wellington Region. Publication no. GW/ESCI-G-18-164. Greater Wellington Regional Council.
[11]New Zealand Threat Classification System (NZTCS) http://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/
[12] Park G. 1999. An inventory of the surviving traces of the primary forest of Wellington city. Wellington City Council, Wellington. 11 plus appendices pp.
[13] Brabyn L. New Zealand Landscape Classification version 2 – A Classification of visual Landscape Character.
[14] Department of Conservation. 1987. Ecological Regions and Districts of New Zealand.
[15] McEwen WM. (Ed.) 1987. Booklet to accompany SHEET 3. Descriptions of Districts in central New Zealand, from Eastern Wairarapa to Akaroa; also Chathams, not shown on map. Ecological Regions and Districts of New Zealand. Wellington, Department of Conservation. 139 pp.
[16] Wardle P. 1991. Vegetation of New Zealand. Cambridge, Cambridge University Press. 672 pp.
[17] Walker S, Price R, Rutledge D. 2005. New Zealand's indigenous cover. Recent changes and biodiversity protection needs. Landcare Research Contract Report No. LC0405/038. Landcare Research, Dunedin. 81 pp.
[18] Wellington Botanical Society 2007. Results of the BioBlitz up to 16 May 2007 for the forested areas of Otari Wilton's bush.
[19] McArthur N, Flux I, Harvey A, Ray S. 2018. State and trends in the diversity, abundance and distribution of birds in Wellington City. Client report prepared for Greater Wellington Regional Council. Wildlife Management International Ltd, Blenheim.
[20] Bell T. 2019. Wellington City Council lizard surveys: 2016-2018. Technical report prepared for Wellington City Council by EcoGecko Consultants Limited, February 2019.
[21] Department of Conservation. Bioweb Herpatofauna database. Accessed 2018.
[22] Joy M, Hewitt A. 2002. Freshwater fish survey of selected sites for Wellington Regional Council. Institute of Natural Resources-Ecology, Massey University.
[23] Harrison, E. 2019. Ecosystem health in Wellington City urban streams. Greater Wellington Regional Council, Publication No. GW/ESCI-T-19/123, Wellington.
[24]http://wellington.govt.nz/~/media/recreation/gardens/files/2007bioblitz-organisms.pdf.
[25] Walker K. 2003. Recovery plans for *Powelliphanta* land snails 2003–2013 Department of Conservation, Wellington. 203 pp.
[26] 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.

[27] 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.
[28] 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.
[29] 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.
[30] Innes JG. 2005. Ship rat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 187–203.
[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 and 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] Ruscoe WA, Murphy EC. 2005. House mouse. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 204–221.
[42] 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.
[43] 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.
[44] 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.
[45] 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.
[46] Gillies C, Fitzgerald BM. 2005. Feral cat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 308–326.
[47] Norbury G, Flux JEC. 2005. Brown hare. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 151–158.
[48] 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.
[49] 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.
[50] Nugent G, Fraser W. 2005. Red deer. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 401–419.

[51] Nugent G, Asher G. 2005. Fallow deer. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 447–459.
[52] McIlroy JC. 2005. Feral pigs. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 334–345.
[53] Parkes JP. 2005. Feral goat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 374–391.
[54] Smale MC, Dodd MB, Burns BR, Power IL. 2008. Long-term impacts of grazing on indigenous forest remnants on North Island hill county, New Zealand. New Zealand Journal of Ecology 32(1): 57–66.
[55] https://www.myrtlerust.org.nz/about-myrtle-rust/new-landing-page/
[56] Greater Wellington Regional Council 2009. Greater Wellington – Regional Pest Management Strategy. 2002 – 2022 Five Year Review 2007. *Regional Pest Management Strategy No. GW/BIO-G-08/188*. Greater Wellington Regional Council, Wellington. 168 pp.
[57] Wellington City Council (2014) Our Natural Capital - Biodiversity Strategy and Action Plan. Wellington City Council, Wellington.
[58] Wellington City Council. 2019. Draft Outer Green Belt Management Plan January 2019. Wellington City Council, Wellington.
[59] Wellington City Council 2014. Our Natural Capital – Biodiversity Strategy and Action Plan. Wellington City Council, Wellington.
[60] Department of Conservation. 2008. New Zealand Threat Classification System manual.
[61] Lange P, Rolfe J, Champion P, Courtney S, Heenan P, Barkla J, Cameron E, Norton D, Hitchmough R 2013. Conservation status of New Zealand indigenous vascular plants, 2012. New Zealand Threat Classification Series 3. 70p.
[62] Wellington Botanical Society 2007. Results of the BioBlitz up to 16 May 2007 for the forested areas of Otari Wilton's bush.
[63] 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.
[64] McArthur N, Flux I, Harvey A, Ray S. 2018. State and trends in the diversity, abundance and distribution of birds in Wellington City. Client report prepared for Greater Wellington Regional Council. Wildlife Management International Ltd, Blenheim.
[65] Hitchmough R, Barr B, Lettink M, Monks J, Reardon J, Tocher M, Rolfe J. 2016. Conservation status of New Zealand reptiles, 2015. Department of Conservation, Wellington.
[66] Department of Conservation 2014. Bioweb Herpatofauna database. Accessed March 2014.
[67] Goodman JM, Dunn NR, Ravenscroft PJ, Allibone RM, Boubee 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.
[68] NIWA 2015. New Zealand Freshwater Fish Database. Accessed July 2014.
[69] Hitchmough R, Bull L, Cromarty P (Comps.). 2007. New Zealand Threat Classification System lists 2005. Department of Conservation, Wellington.
[70] Walker K. 2003. Recovery plans for *Powelliphanta* land snails 2003–2013 Department of Conservation, Wellington. 203 pp.
[71] Sawyer JWD. 2004. Plant conservation strategy, Wellington Conservancy (excluding Chatham Islands), 2004–2010. Department of Conservation, Wellington. 91 p.
[72] Sawyer J.W.D. 2004. Plant conservation strategy, Wellington Conservancy (excluding Chatham Islands), 2004–2010. Department of Conservation, Wellington. 91 pp.

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