Key Native Ecosystem Operational Plan for Raroa - Pukerua Coast

2022-2027

Contents

1. Purpose

The purpose of the five-year Key Native Ecosystem (KNE) Operational Plan for Raroa - Pukerua Coast KNE site is to:

- Identify the parties involved
- Summarise the ecological values and identify the threats to those values
- Outline the vision and objectives to guide management decision-making
- Describe operational activities to improve ecological condition (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

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

The KNE programme funding is allocated for under The Greater Wellington Long Term Plan (2021-2031)[2] and is managed in accordance with The Greater Wellington Biodiversity Strategy[3] that sets a framework for how Greater Wellington protects and manages biodiversity in the Wellington region. Goal One of the Biodiversity Strategy - *Areas of high biodiversity value are protected or restored* - drives the delivery of the KNE Programme.

Other important drivers for the KNE programme include the Proposed Natural Resources Plan[4] and the Regional Pest Management Plan 2019-2039[5].

3. The Key Native Ecosystem Programme

The KNE Programme is a non-regulatory programme. The programme seeks to protect some of the best examples of original (pre-human) ecosystem types in the Wellington region. Sites with the highest biodiversity values have been identified and prioritised for management.

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.

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

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.

4. Raroa - Pukerua Coast Key Native Ecosystem site

The Raroa - Pukerua Coast KNE site (18.6 ha) is located on the coast of Pukerua Bay township and approximately 11 km north of Porirua City centre (see Appendix 1, Map 1).

The KNE site comprises a narrow coastal platform with a rocky shore, a steep coastal escarpment and two forested gullies, which support several vegetation communities that were once a lot more extensive across Wellington and Kāpiti Coast escarpments. Vegetation communities that are present include coastal saltmarsh; flaxland; scrub and coastal shrubland; and lowland kohekohe-podocarp and kānuka forest.

The KNE site supports a diversity of indigenous flora and fauna species, including several plant, lizard and bird species of conservation concern. Notably the last confirmed mainland sightings of Whitaker's skink (*Oligosoma whitakeri*; Threatened – Endangered) were recorded on the Raroa Escarpment in 2005[6].

The KNE site is surrounded by urban and farmland areas but is located in close proximity to several other important coastal, forest and wetland sites making it an important ecological site for indigenous wildlife within the wider landscape context.

5. Parties involved

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

5.1. Landowner/Land Manager

Porirua City Council (PCC) owns and manages the entire Raroa - Pukerua Coast KNE site. The KNE site is gazetted as a Scenic 'A' Reserve under the Reserves Act 1977. It is managed in accordance with PCC's Porirua City Reserves Management Plan[7] which provides for and ensures the maintenance, protection, preservation and enjoyment of heritage, natural and recreation values.

5.2. Operational delivery

Within Greater Wellington, two departments are responsible for delivering the Raroa - Pukerua Coast KNE operational plan.

- The Biodiversity department is the overarching lead department for Greater Wellington on the longer-term planning and coordination of biodiversity management activities and advice within the KNE site. The Biodiversity department's KNE programme budget funds the Biosecurity department to coordinate and carry out pest control activities.
- The Biosecurity department coordinates and implements ecological weed and pest animal control measures at the KNE site.

PCC funds and delivers biodiversity management activities within the KNE site on PCC owned land in accordance with the Porirua City Reserves Management Plan[8] and the Proposed Porirua District Plan[9]. Activities undertaken by PCC include additional ecological weed control to protect significant natural values and for the provision of pathways for public access.

The Friends of Mana Island (FOMI) service parts of the pest animal control network around the KNE site including the kill-traps in Raroa Bush and along the top and bottom of the Raroa Escarpment. FOMI is a not-for-profit society comprised of members of the local community.

5.3. Stakeholders

The KNE site is recognised by the Department of Conservation (DOC) as a Designated Ecological site (see Appendix 1, Map 2) and it is continuous with the Pukerua Bay Scientific Reserve which DOC owns and manages. Permission has been acquired from DOC for Greater Wellington's Biosecurity department to undertake goat control within the Scientific Reserve as necessary to track and target goats across the escarpment.

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 1, below, lists ecological designations at all or part of the Raroa - Pukerua Coast KNE site.

Table 1: Designations at the Raroa - Pukerua Coast KNE site

Designation level	Type of designation
National	Parts of the Raroa - Pukerua Coast KNE site are designated as a Scenic 'A' Reserve under the Scenic Reserve New Zealand Gazette 1994: • 146169: Raroa Reserve Part of the Raroa - Pukerua Coast KNE site has been identified by DOC as a Designated Ecological Site (see Appendix 1, Map 2): • 406: Raroa Bush (5.16 ha) • 324: Pukerua Bay Scientific Reserve (23.3 ha) • 555: Wairaka Gorge (6.69 ha)
Regional	Parts of the Raroa - Pukerua Coast KNE site are scheduled under Greater Wellington's proposed Natural Resources Plan (PNRP)[10] as: • Indigenous Bird Habitat - Habitats for indigenous birds in the coastal marine area: Pukerua Bay foreshore from Brendan Beach to Wairaka Point (Schedule F2c)
District	Part of the Raroa - Pukerua Coast KNE has been identified by PCC as a Significant Natural Area. It is listed in the Proposed Porirua District Plan[11] as: • SNA018: Pukerua Bay - Wairaka Coastal Fringe (49.85 ha)
Other	Parts of the Raroa - Pukerua Coast KNE site are scheduled under Greater Wellington's proposed Natural Resources Plan (PNRP)[12] as: • Geological Features Coastal - Significant geological features in the coastal marine area: Pukerua Bay (Schedule J)

6.2. Ecological significance

The Raroa - Pukerua Coast 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
- It contains high levels of ecosystem **diversity**, with several ecosystem types represented within the KNE site boundary, including several naturally uncommon ecosystems

- 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.

Representativeness

The Singers and Rogers[13] classification of pre-human forest vegetation indicates the KNE site would likely have been comprised of two dominant ecosystem types. These ecosystem types would have been coprosma, muehlenbeckia shrubland/herbfield/rockland (CL3), previously present across the majority of the Raroa Escarpment (7.15 ha); and kohekohe, tawa forest (MF6) previously present in the Raroa Bush area and the more sheltered Waimapehi gully area (10.64 ha) (see Appendix 1, Map 3).

The Raroa Bush and Waimapehi Gully areas are still representative of the original MF6 ecosystem type, although in a modified and regenerating condition. This forest ecosystem type is considered a regionally threatened ecosystem with only 16% of its original extent remaining in the Wellington region[14].

The Threatened Environment Classification system[15] indicates that different areas across the KNE site have varying classifications:

- Waimapehi Gully is classified as Chronically Threatened (Environments with 10-20% native vegetation cover remaining on these types of land in New Zealand)
- Raroa Bush is classified as At Risk (Environments with 20-30% native vegetation cover remaining on these types of land in New Zealand)
- Raroa Escarpment is classified as Critically Under protected (Environments with greater than 30% native vegetation cover remaining nationally but less than 10% is legally protected)

Rarity/distinctiveness

Two naturally uncommon ecosystem types[16] are present within the KNE site. These include shingle beaches and stony beach ridges which are both classified as Nationally Endangered.

New Zealand's national threat classification system[17] lists many nationally 'Threatened' or 'At Risk' plant, bird and lizard species within the KNE site. Several species have also been listed as regionally threatened. Appendix 2 and 3 contain lists of nationally and regionally threatened species found within the KNE site.

Diversity

The KNE site contains numerous ecosystem types including a narrow coastal platform with a rocky shore; a steep coastal escarpment with vegetated rock and scree slopes; vineland; flaxland; scrubland; and kohekohe and kānuka forest.

Ecological context

The KNE site is continuous with the Pukerua Bay Scientific Reserve, which is owned and managed by DOC to maintain lizard populations which includes, or included until recently, the only known mainland population of Whitaker's skink, (*Oligosoma whitakeri*)[18]. The KNE site is also located within 4 km of several important ecological sites

such as Paekākāriki Escarpment KNE site, Taupō Swamp Complex KNE site, Karehana Bay Bush KNE site and Battle Hill Bush KNE site. Together these sites form an important network of habitat linkages within the wider ecological landscape, enabling native birds to forage, breed and disperse throughout the local area. The site also provides suitable refuges for many invertebrates and lizard species that require rocky scree and low shrubland habitat.

6.3. Ecological features

The Raroa - Pukerua Coast KNE site is located on the fringe of both the Cook Strait and the Foxton Ecological Districts[19]. The Raroa Escarpment area falls within the Cook Strait Ecological District and is characterised by very exposed, steep coastal escarpments and a maritime climate with high winds, frequent gales and an annual rainfall of approximately 1,200 mm[20]. The forested Waimapehi Gully area is situated within the Foxton Ecological District which is characterised by Holocene sand-dune country, a mild climate with west to north-westerly prevailing winds, relatively frequent gales and an annual rainfall of 800-1,000 mm[21].

Vegetation communities and plants

The Raroa - Pukerua Coast KNE site contains several examples of vegetation communities that were once a lot more extensive on Wellington and Kāpiti Coast escarpments. These vegetation communities include coastal saltmarsh, flaxland, scrub and coastal shrubland and lowland kohekohe-podocarp and kānuka forest.

The KNE site has been further described below in three operational areas based on their geographical and ecological features (see Appendix 1, Map 4).

Raroa Bush (Operational Area A)

Raroa bush comprises 2.5 ha of coastal lowland forest with a kohekohe (*Dysoxylum spectabile*), ngaio (*Myoporum laetum*) and kaikōmako (*Pennantia corymbosa*) canopy, situated at the top of the coastal escarpment through a shallow gully on a very rocky substrate.

Vegetation near the escarpment edge features wind-sculpted mingimingi (*Coprosma propinqua* var. *propinqua*) and akiraho (*Olearia paniculata*), whilst mature trees, such as kohekohe, kānuka (*Kunzea robusta*) and tītoki (*Alectryon excelsus* subsp. *excelsus*) reach only 5 m in height due to extreme wind shear and salt burden. Further inland, the bush is dominated by a much taller kohekohe canopy with several large māhoe (*Melicytus ramiflorus*) and frequent ngaio, kānuka and the non-native karaka (*Corynocarpus laevigatus*).

The understorey comprises emerging ngaio, kaikōmako and kohekohe, however some areas are largely dominated by karaka seedlings. Hangehange *(Geniostoma ligustrifolium* var. *ligustrifolium*) and a diversity of *Asplenium* fern species are also present throughout.

Raroa Escarpment (Operational Area B)

The Raroa Escarpment comprises steep coastal cliffs, several rocky spurs and partly stabilised or loose scree, supporting a complex mosaic of low stature scrubland, and areas of grassland reverting to shrubland.

Pōhuehue (*Muehlenbeckia complexa*) and mingimingi shrubland dominate areas on stable or semi stable scree with frequent patches of meadow rice grass (*Microlaena stipoides*) and exotic grassland also present. Shrubland species such as mountain flax (*Phormium cookianum* subsp. *cookianum*), ngaio, native spinach (*Tetragonia trigyna*), kawakawa (*Piper excelsum* subsp. *excelsum*), taupata (*Coprosma repens*), māhoe and karaka are also common across the escarpment.

Vegetation on the rocky spurs is predominantly comprised of exotic succulent species such as pinwheel aeonium (*Aeonium haworthii*), pig's ear *(Cotyledon orbiculata*), fairy crassula (*Crassula multicava* subsp. *multicava*), blue echeveria (*Echeveria secunda)*, century plant (*Agave americana*) and red hot poker (*Kniphofia uvaria*).

Toward the western-most edge of the KNE boundary on the lower escarpment are some small remnants of low stature coastal lowland forest comprising of kohekohe, māhoe, kaikōmako, pigeonwood (*Hedycarya arborea*) and karaka with scattered ngaio and puka (*Griselinia lucida*) also present.

Oioi (*Apodasmia similis*), half-star (*Selliera radicans*), and slender clubrush (*Isolepis cernua* var. *cernua*) are present within the salt marsh on the rock and shingle shore.

Waimapehi Gully (Operational Area C)

The Waimapehi Gully rises to 60 m above sea level and comprises a steep, narrow gorge formed by the Pukerua Fault Line with the Waimapehi Stream traversing the length of it. The vegetation within the gully largely comprises tall secondary growth kānuka forest with a dense and diverse understory of coastal broadleaf forest species and ferns. Other canopy and subcanopy species present include tree fuchsia (*Fuchsia excorticata*), five-finger (*Pseudopanax arborea*), māpou (*Myrsine australis*), mamaku (*Cyathea medullaris*) and kaikōmako. Whau (*Entelea arborescens*), which is known from a few sites in the eastern Wairarapa, near Paekākāriki and Wellington, is also present. The understorey and most vegetation in the lower reaches of Waimapehi Gully comprises a diversity of *Asplenium* and *Parablechnum* fern species with numerous sedge species present, including frequent coastal forest sedge (*Carex raoulii*). Orchid species such as the greenhood orchid (*Pterostylis alobula*), spider orchid (*Corybas trilobus*) and white sun orchid (*Thelymitra longifolia*) have also been recorded[22].

Toward the sea on the north and lower west facing slopes, kānuka forest becomes progressively more stunted and sparse giving way to mountain flax dominated flax-shrublands and herbaceous plant communities.

Several Threatened species are known to occur through Waimapehi Gully. Some notable species include: akatea (*Metrosideros perforata*; Threatened – Nationally Vulnerable), New Zealand sow thistle (*Sonchus kirkii*; At Risk – Declining), speargrass (*Aciphylla squarrosa* var. *squarrosa*; At Risk – Declining), woollyhead (*Craspedia uniflora* var. *maritima;* At Risk – Declining) and *Linum monogynum* var. *monogynum* (At Risk – Declining). Regionally threatened species that have been recorded include *Schoenus concinnus* (Regionally Endangered) and scabweed (*Raoulia hookeri* var. *hookeri*; Regionally Declining)[23].

Species

Birds

The KNE site provides important habitat for a variety of native bird species, with the coastal platform supporting a high diversity of nesting shorebirds whilst Raroa Bush and Waimapehi Gully supports several forest species.

The coastal platform is known to provide habitat for 7% of the regional breeding population of reef heron (*Egretta sacra*; Threatened – Nationally Endangered)[24,25], whilst small colonies of northern (little) blue penguin (*Eudyptula minor iredalei*; At Risk – Declining) are known to nest along the beach[26].

A number of other Nationally Threatened or At Risk species are also known to be resident or regular visitors to the site, including: Caspian tern (*Hydroprogne caspia*; Threatened – Nationally Vulnerable), black shag (*Phalacrocorax carbo*; At Risk – Naturally Uncommon), New Zealand pipit (*Anthus novaeseelandiae*; At Risk – Declining), pied shag (*Phalacrocorax varius*; At Risk – Recovering), red-billed gull (*Larus novaehollandiae scopulinus*; At Risk – Declining), black-billed gull (*Larus bulleri*; At Risk – Declining), variable oystercatcher (*Haematopus unicolor*; At Risk – Recovering) and white-fronted tern (*Sterna striata*; At Risk – Declining)[27,28,29,30]. Fluttering shearwater (*Puffinus gavia*; At Risk – Relict) have recently been observed by residents in large numbers just off the coast[31]. The Regionally Threatened little shag (*Phalacrocorax melanoleucos*; Regionally Vulnerable) is also known to be present.

The forested areas of the KNE site provides habitat for the Nationally Threatened New Zealand falcon (*Falco novaeseelandiae*; Threatened – Nationally Vulnerable)[32] and North Island kākā (*Nestor meridionalis* septentrionalis; At Risk – Recovering)[33]. The Regionally threatened kererū (*Hemiphaga novaeseelandiae*; Regionally Recovering) has also been observed.

Other more common bird species known to be present across the site include[34,35]:

- paradise shelduck (*Tadorna variegata*),
- grey warbler (*Gerygone igata*),
- bellbird (*Anthornis melanura*),
- tūī (*Prosthemadera novaeseelandiae*),
- fantail (*Rhipidura fuliginosa*),
- silvereye (*Zosterops lateralis*),
- welcome swallow (*Hirundo neoxena*),
- Australasian harrier (*Circus approximans*),
- Black backed gull (*Larus dominicanus*),
- New Zealand kingfisher (*Todiramphus sanctus*)

A comprehensive list of nationally and regionally threatened native bird species recorded within the KNE site are listed in Appendix 2 and Appendix 3.

Reptiles

The Raroa Escarpment has historically been known to provide habitat for the only mainland population of Whitaker's skink (*Oligosoma whitakeri*; Threatened –

Endangered), with the last confirmed observation reported in 2005[36]. Monitoring for Whitaker's skink was previously undertaken by DOC within the adjacent Scientific Reserve (see Appendix 1, Map 1). However, this was ceased due to the population having declined to such low densities that it is considered to be non-detectable or locally extinct[37,38].

The Nationally Threatened copper skink (*Oligosoma aeneum*; At Risk – Declining), glossy brown skink (*Oligosoma zelandicum*; At Risk – Declining) and barking gecko (*Naultinus punctatus*; At Risk – Declining) have all been recorded either on the escarpment or within Waimapehi Gully[39,40,41]. The more common northern grass skink (*Oligosoma polychroma*) and Raukawa gecko (*Woodworthia maculata*) are also known to be present[42,43,44].

A comprehensive list of nationally and regionally threatened native lizard species recorded within the KNE site are listed in Appendix 2 and Appendix 3.

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 key threats to the ecological values at each KNE site. Appendix 4 presents a summary of all known threats to the Raroa - Pukerua Coast KNE site.

7.1. Key threats

The primary threats to the ecological values of the Raroa - Pukerua Coast KNE site are ecological weed species, pest animals and adverse impacts from human activities such as green waste and rubbish dumping.

Ecological weeds are widespread throughout the KNE site. Weed species that have the highest ecological impact within the site and include species such as old man's beard (*Clematis vitalba*), banana passionfruit (*Passiflora* spp.), boneseed (*Chrysanthemoides monilifera*), everlasting pea (*Lathyrus latifolius*) and several succulent species. These weed species can smoother native vegetation and inhibit native regeneration, resulting in altered vegetation structure and composition and reduced species diversity. The non-local native species karaka is considered an ecological weed at the site as it is known to outcompete and displace local native species.

Pest animals such as cats (*Felis catus*), rats (*Rattus* spp.), mustelids (*Mustela* spp.), possums (*Trichosurus vulpecula*) and feral goats (*Capra hircus*) pose the greatest threats to the identified ecological values of the KNE site. Cats, rats, possums and mustelids impact the forest and escarpment habitat by over-browsing native vegetation, reducing food resource availability and through direct predation on lizards and birds. Feral goats inhibit regeneration of native forest understory by over-browsing palatable native plant species. Reinvasion of pest animals from the surrounding landscape is common and is likely to be an enduring threat to the biodiversity values within the KNE site.

Illegal rubbish dumping has occurred around the urban edges of the KNE site and has the potential to contaminate watercourses that flow through the site. Green waste dumping of weed species present in adjacent gardens can lead to the introduction of new weed species and weed infestations within the KNE site.

8. Vision and objectives

8.1. Vision

The KNE site comprises dynamic and interconnected coastal escarpment and coastal, lowland forest ecosystems dominated by native vegetation communities that support thriving native fauna populations.

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 Raroa - Pukerua Coast KNE site.

1. **Protect the integrity of mature native plant communities across the KNE site from weed incursions**
2. **Enhance the potential for natural regeneration of native understorey vegetation and scrubland across the KNE site**
3. **Protect and enhance habitat for native bird, invertebrate and lizard populations**

9. Operational activities

Operational activities are targeted to work towards the objectives above (Section 8). 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 2).

The primary management activities undertaken at this KNE site are ecological weed control, pest animal control and revegetation.

For practicality of management, the KNE site has been divided into three operational areas based on their geographical and ecological features (See Appendix 1, Map 4). These are:

A: Raroa Bush (2.47 ha)

B: Raroa Escarpment (9.43 ha)

C: Waimapehi Gully (6.26 ha)

9.1. Ecological weed control

The aim of weed control at the Raroa - Pukerua Coast KNE site is to reduce the distribution and density of high impact weed species in order to increase native plant dominance and facilitate natural regeneration of native plant species in line with objectives 1, 2 and 3 of this operational plan.

Ecological weed control has been undertaken at the site since 2006. However, ongoing work is required to further reduce priority weed infestations and ensure ecological weeds do not regenerate and spread. Greater Wellington's Biosecurity department and independent contractors undertake weed control throughout the KNE site on an annual basis targeting species that are prioritised as having a 'severe or 'high' ecological impact as indicated in Appendix 5.

Targeted weed control

Targeted control of boneseed and succulent species such as pinwheel aeonium, pig's ear and fairy crassula is undertaken on an annual basis across the three rocky spurs that jut out from the Raroa Escarpment (Operational Area B). To achieve good coverage and effective control, one rocky spur will be programmed for weed control each year. Once weed control has been undertaken across all three rocky spurs, the cycle will begin again with follow-up control undertaken as required. This work is be undertaken by contracted abseilers due to the difficult access.

Ongoing surveillance for tradescantia (*Tradescantia fluminensis*) is undertaken throughout Raroa Bush (Operational Area A) and Waimapehi Gully (Operational Area C). Raroa Bush is predominantly clear of tradescantia with only a small infestation present around the stream near the Raroa Pl entrance. Follow-up control will continue to be undertaken at this known site as required and any new infestations discovered will be targeted for control in the subsequent spring/summer. As resources are freed up from priority weed control in other areas, consideration will be made for targeting tradescantia infestations present within the stream corridor of Waimapehi Gully. Tradescantia is widespread through this stream corridor and is also found upstream of the KNE site, so control outside of the KNE will also need to be considered.

Multi-species weed control

Multi-species weed control is undertaken across the Raroa Escarpment (Operational Area B) and within Waimapehi Gully (Operational Area C) prioritising climbing species that are known to dominate native shrubs as well as woody and groundcover species that are rapid colonisers and prevent native regeneration. Priority weed species include, but are not limited to: everlasting pea, Japanese honeysuckle, banana passionfruit, (*Lonicera japonica*), German ivy (*Delairea odorata*), Cape ivy (*Senecio angulatus*), karo (*Pittosporum crassifolium*) and boneseed.

9.2. Pest animal control

The aim of pest animal control at the KNE site is to increase native plant regeneration through the control of mammalian browsers; and protect populations of native birds and lizards through the control of mammalian predators, in line with objectives 2 and 3 of this plan.

Pest animal control targeting possums and rats has been undertaken at the site by Greater Wellington since 1999. A network of 21 toxin bait stations are positioned throughout the KNE site (see Appendix 1, Map 5) and are maintained and serviced by Greater Wellington on a quarterly basis.

A network of 36 DOC200 kill traps are also positioned at 50 m intervals along the top and bottom of Raroa Escarpment (Operational Area B) within the KNE site and adjacent DOC Scientific Reserve targeting mustelids (see Appendix 1, Map 5). This network was established by DOC and is serviced by the Friends of Mana Island on a fortnightly basis during summer and on a monthly basis in winter. DOC maintains these traps and is the primary contact for the volunteers who service them.

Control of goats is undertaken on an annual basis as circumstances allow. Small mobs of goats occasionally move in to the KNE site but are very transient which can make control very difficult. Therefore, permission has been acquired from DOC to also undertake goat control within the adjacent Scientific Reserve as necessary so that goats may be tracked and targeted across a greater land area. One day of ground-based hunting is planned to be undertaken each year with the potential for additional follow-up control if further sightings are made during the year. Greater Wellington's Biosecurity department will undertake this work.

Greater Wellington keep possums to relatively low numbers within the local area beyond the KNE site boundary with a poison bait-station network as part of the Regional Possum Predator Control Programme (RPPCP). This programme benefits the KNE site by reducing possums in the wider landscape, thereby decreasing the risk of reinvasion into the KNE site.

9.3. Monitoring/surveys

Drone Survey

An annual drone survey will be undertaken at the Raroa-Pukerua Coast KNE site to collect imagery from the upper escarpment and rocky spurs (Operational Area B) where boneseed and succulent species are being targeted for control by contracted abseilers. These areas are unable to be accessed on foot for assessment and complete views are

not possible from the top or bottom of the escarpment. Therefore, detailed imagery collected via drone will help to provide a visual record of changes in native and exotic vegetation composition in response to weed control across these areas. Over time, this visual record can be used to monitor weed control effectiveness and will help guide requirements for follow-up control work.

10. Future opportunities

Below is a list of further management activities that have been identified as having the potential to improve the biodiversity values of the KNE site or would provide information to further our understanding of the ecological values and how to protect them. Current funding within the KNE programme doesn't allow for any of these activities to be undertaken but they will be considered in the future if/when resources become available. This activities could also be undertaken/funded other parties.

- Control of adult karaka trees and seedlings within lowland forested areas of the KNE site to suppress their spread and prevent the replacement of existing native plant communities over time
- Undertake regular rabbit control to further reduce the pressure of over-browsing on native vegetation
- Undertake some revegetation planting of native shrubland and threatened plant species on bare rock screes and in areas where exotic grassland has been controlled to enhance lizard habitat and assist regeneration of declining plant species within the region
- Undertake a survey for threatened plant species previously recorded within the KNE site to better understand what species are still present and their extent, as well as determine if additional management measures might be required to protect them
- Undertake a baseline lizard survey within the KNE site to better understand what species exist and what management measures might be required to protect them.
- Undertaken a survey of northern little (blue) penguin in autumn using penguin detection dogs to better understand how many penguins are regularly using the site and determine if additional management and protection measures are necessary
- Providing artificial burrows for northern little (blue) penguins along the gravel beach to provide more safe places for them to nest
- Greater reporting of wildlife sightings through citizen science platforms such as iNaturalist and eBird

11. Operational delivery schedule

The operational delivery schedule shows the actions planned to achieve the stated objectives for the Raroa - Pukerua Coast KNE site, and their timing and cost over the five-year period from 1 July 2022 to 30 June 2027. The budget for years 2023/24 to 2026/27 are indicative only and subject to change. A map of operational areas can be found in Appendix 1 (see Map 4 and 5).

Table 2: Five-year operational plan for the Raroa - Pukerua Coast KNE site

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
						2022/23	2023/24	2024/25	2025/26	2026/27
1, 2, 3	Ecological weed control	B	Targeted control of boneseed and succulent species on rocky spurs across the escarpment	Priority weed species are supressed to very low numbers and follow-up control is only required periodically to target new growth	Greater Wellington Biosecurity department	✓ $5,250	✓ $5,250	✓ $5,000	✓ $5,000	✓ $5,000
1, 2, 3	Ecological weed control	A, C	Targeted surveillance for tradescantia infestations and control as required	Small tradescantia infestations are eradicated, and control of widespread infestations has commenced and working towards suppression	Greater Wellington Biosecurity department	✓† $112	✓† $130	✓ $652	✓ $930	✓ $964
1, 2, 3	Ecological weed control	B, C	Multispecies control of priority weed species around the KNE boundary	The integrity of native vegetation communities is maintained, and priority weed species are eradicated or suppressed to a level that prevents further spread and allows for native regeneration	Greater Wellington Biosecurity department	✓ $8,000	✓ $8,250	✓ $8,250	✓ $8,250	✓ $8,500

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
						2022/23	2023/24	2024/25	2025/26	2026/27
1, 2, 3	Ecological weed control	Entire KNE site	Multispecies weed control to protect significant natural values and for the provision of pathways for public access	The integrity of native vegetation communities is maintained, and designated pathways for public access are maintained	PCC	✓^	✓^	✓^	✓^	✓^
2, 3	Pest animal control	Entire KNE site	Traps and bait stations serviced on a quarterly basis and annual audit	Browsing pest animal populations are maintained to: possums <5% RTC*; rats <10% TTI**; mustelids <2% TTI** to facilitate native vegetation growth and protect native bird, lizard and invertebrate species	Greater Wellington Biosecurity department	✓ $3,622	✓ $3,694	✓ $3,768	✓ $3,844	✓ $3,920
2, 3	Pest animal control	A, B	Traps serviced on a fortnightly (summer) and monthly (winter) basis and annual audit	Browsing pest animal populations are maintained to: possums <5% RTC*; rats <10% TTI**; mustelids <2% TTI** to facilitate native vegetation growth and protect native bird, lizard and invertebrate species	DOC, Friends of Mana Island	✓^	✓^	✓^	✓^	✓^
2, 3	Pest animal control	Entire KNE site	Ground-based control of goats (1 day of hunting allocated per year)	Maintain goat population to low levels to allow forest understorey to regenerate naturally	Greater Wellington Biosecurity department	✓ $2,000	✓ $2,000	✓ $2,000	✓ $2,000	✓ $2,000

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
						2022/23	2023/24	2024/25	2025/26	2026/27
1, 3	Monitoring	B	Drone survey across the upper escarpment and rocky spurs where boneseed and succulent species are targeted for control	A visual record of changes in native and exotic vegetation composition overtime is obtained and is used to inform weed control operations in this area	Greater Wellington Biodiversity department	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)

*RTC = Residual Trap Catch. The control regime has been designed to control possums to this level but monitoring will not be undertaken. 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/mustelids to this level but monitoring will not be undertaken. Experience in the use of this control method indicates this target will be met

[†]= Budget allocated for this work will be reviewed annually and may be reallocated to other areas of the KNE site if work is not required in that given financial year

[^] = Budget for this activity is not known at this time and is subject to change annually at the discretion of DOC

12. Funding contributions

12.1. Budget allocated by Greater Wellington

The budget for the years 2023/24 to 2026/27 are indicative only and subject to change.

Table 3: Greater Wellington allocated budget for the Raroa - Pukerua Coast KNE site

Management activity	Timetable and resourcing				
	2022/23	2023/24	2024/25	2025/26	2026/27
Ecological weed control	$6,681	6,815	$6,951	$7,090	$7,232
Pest animal control	$3,811	$3,847	$3,884	$3,922	$3,960
Total	**$10,492**	**$10,662**	**$10,835**	**$11,012**	**$11,192**

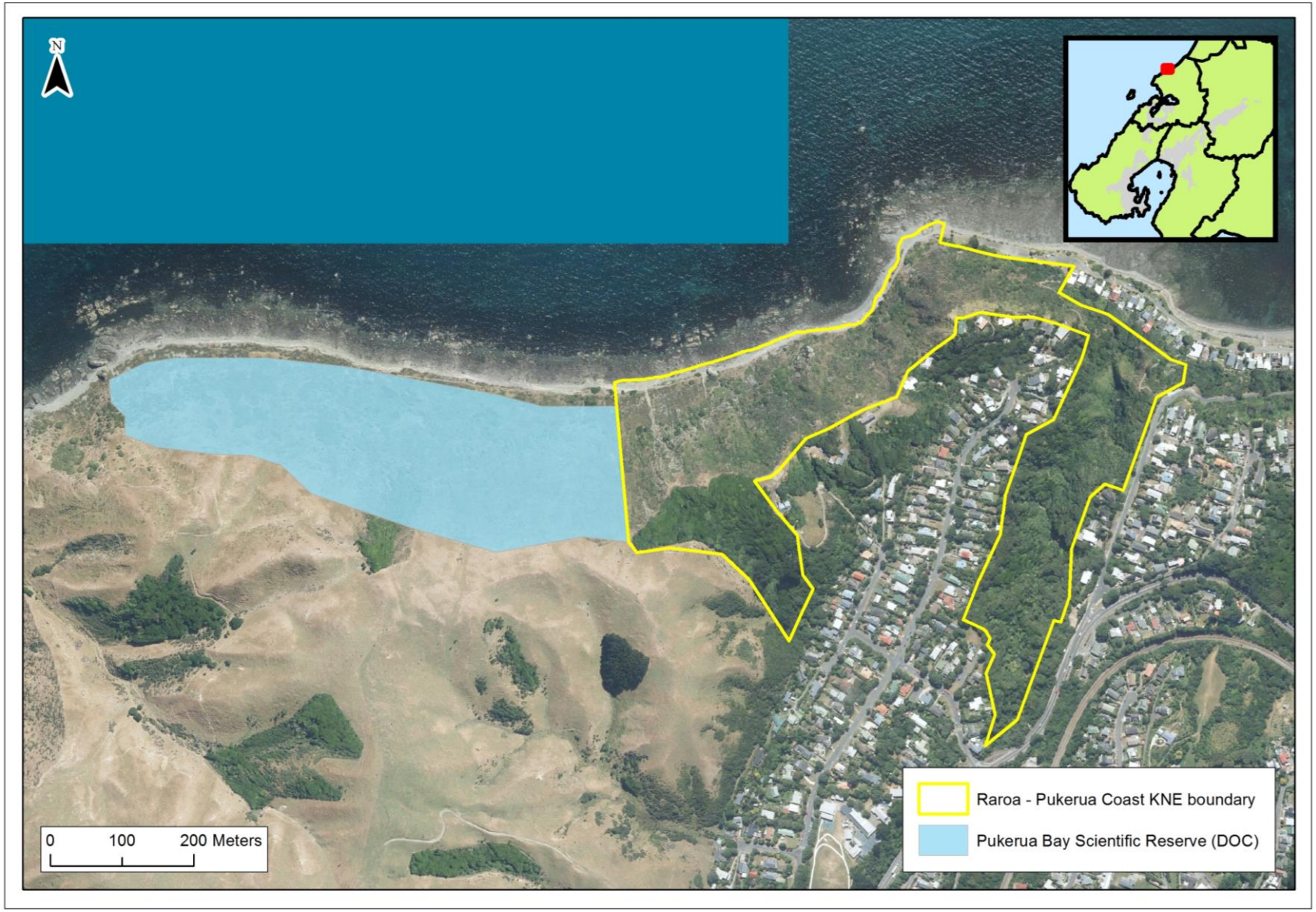
12.2. Budget allocated by PCC

The budget is subject to confirmation through PCC's ten-year planning process.

Table 4: PCC allocated budget for the Raroa - Pukerua Coast KNE site

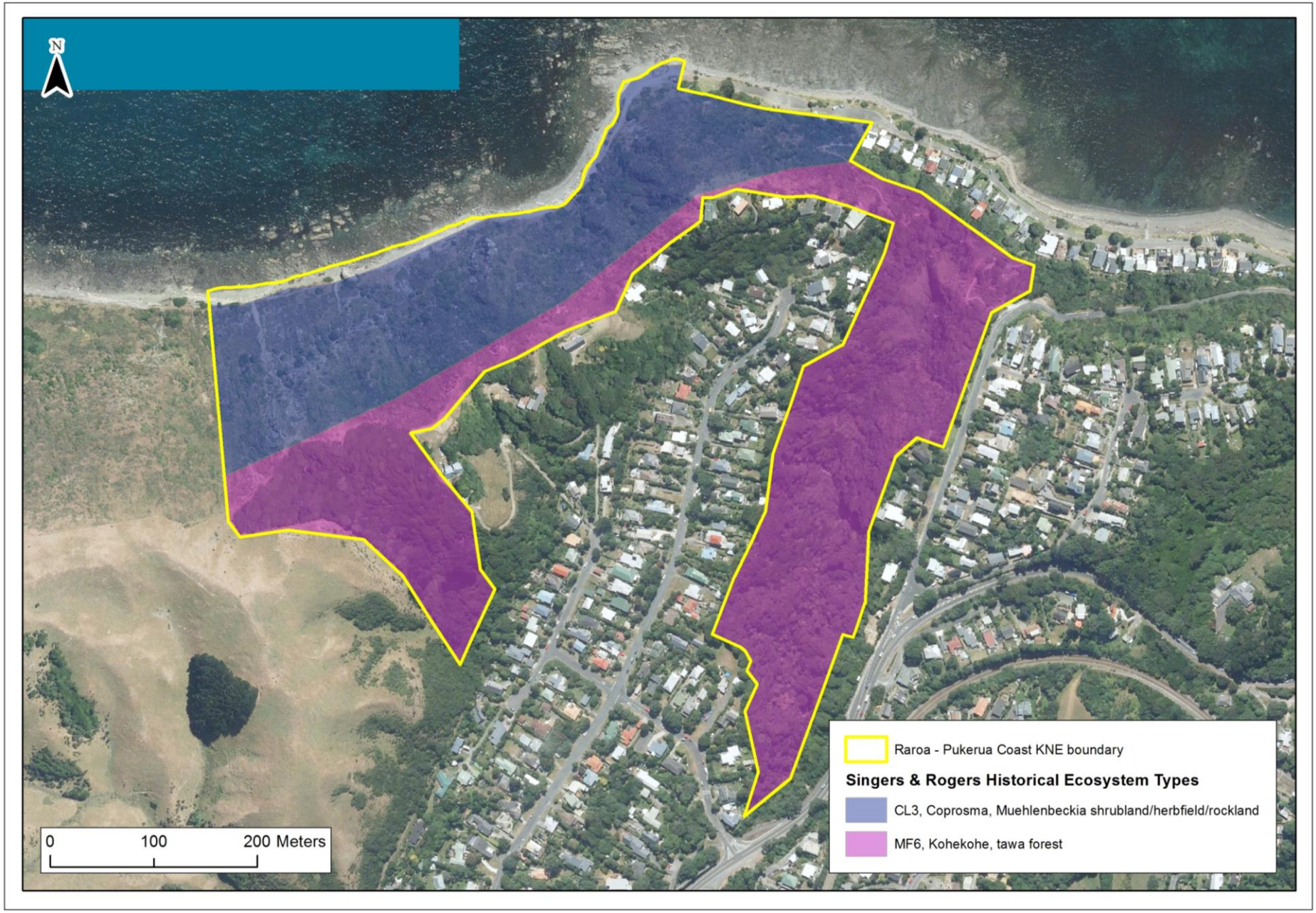
Management activity	Timetable and resourcing				
	2022/23	2023/24	2024/25	2025/26	2026/27
Ecological weed control	$6,681	6,815	$6,951	$7,090	$7,232
Pest animal control	$1,811	$1,847	$1,884	$1,922	$1,960
Total	**$8,492**	**$8,662**	**$8,835**	**$9,012**	**$9,192**

Appendix 1: Raroa - Pukerua Coast KNE site maps

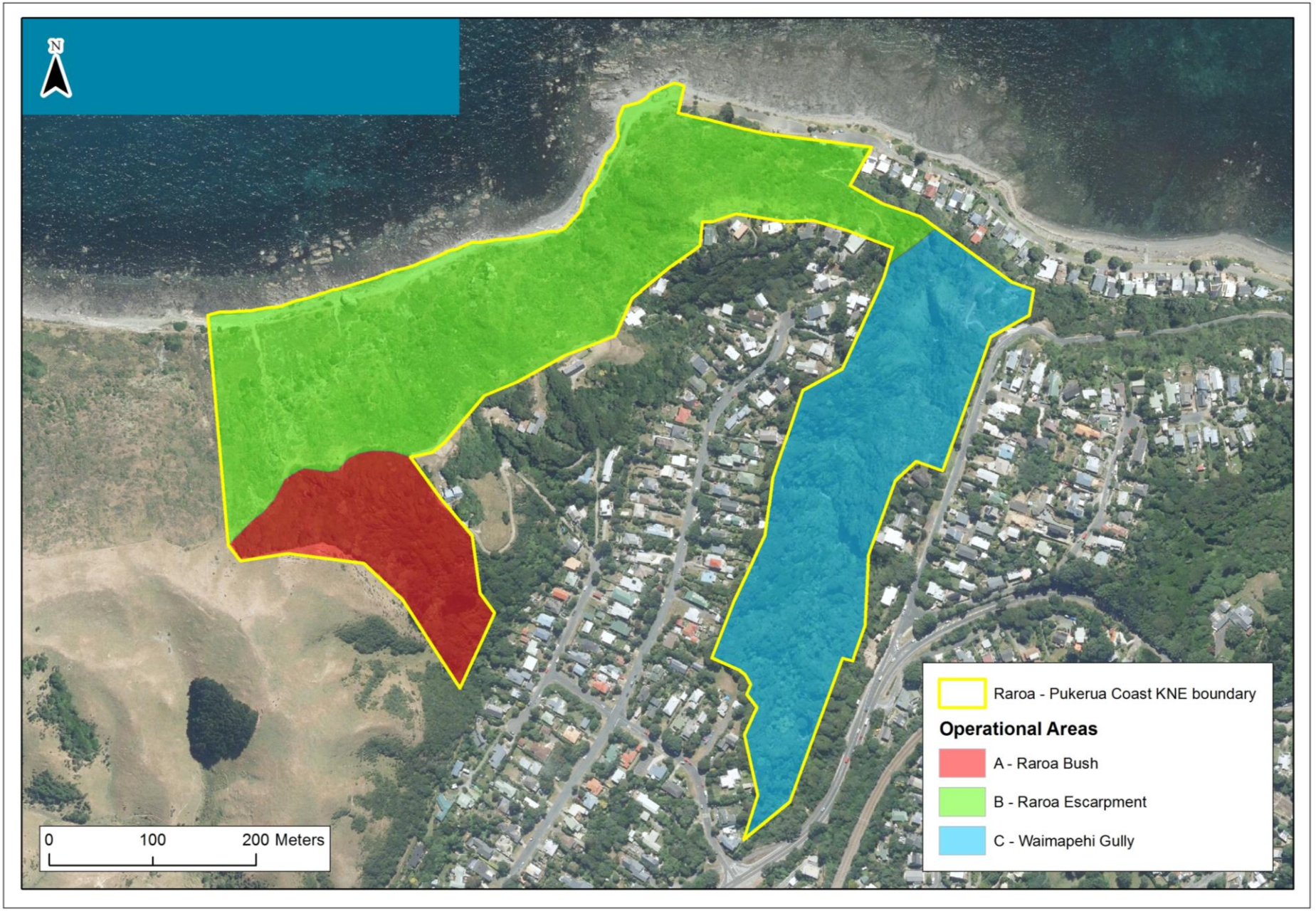


Map 1: The Raroa - Pukerua Coast KNE site boundary with adjacent Pukerua Bay Scientific Reserve

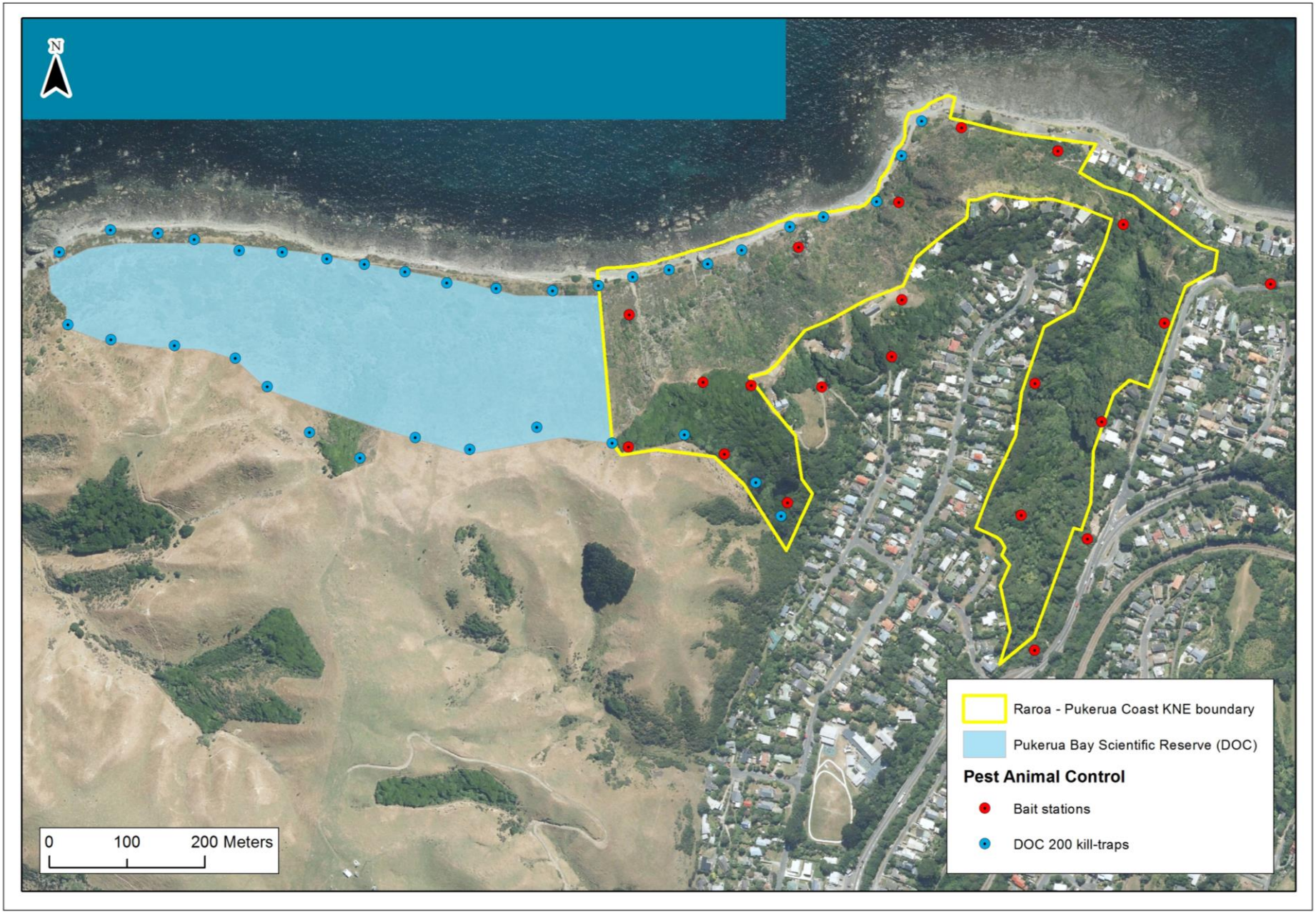
Map 2: DOC Designated Ecological Sites within the Raroa - Pukerua Coast KNE site



Map 3: Singers and Rogers classification of pre-human vegetation types for the Raroa - Pukerua Coast KNE site



Map 4: Operational areas in the Raroa - Pukerua Coast KNE site



Map 5: Pest animal control in the Raroa - Pukerua Coast 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[45,46,47]. 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 Raroa - Pukerua Coast KNE site.

Table 5: Threatened and At Risk species at the Raroa - Pukerua Coast KNE site

Scientific name	Common name	Threat status	Observation
Plants (vascular)[48]			
Aciphylla squarrosa var. *squarrosa*	Speargrass	At Risk – Declining	Ogle, 1980a[49]; Ogle, 1980b[50]
Craspedia uniflora var. *maritima*	Woollyhead	At Risk – Declining	Ogle, 1974[51]; Ogle, 1980a; 1980b
Drymoanthus flavus	Spotted fleshy tree orchid	At risk – Declining	Ogle, 1974
Kunzea amathicola	Rawiritoa, kānuka	Threatened – Nationally Vulnerable	van Meeuwen-Dijkgraaf, 2019[52]
Kunzea ericoides	Kānuka	Threatened – Nationally Vulnerable	Ogle, 1980a; Ogle, 1980b
Leptospermum scoparium	Manuka	At Risk – Declining	Ogle, 1974; Ogle, 1980b; Clelland, 1984[53]
Linum monogynum var. *monogynum*	*Linum monogynum* var. *monogynum*	At Risk – Declining	Ogle, 1980a
Lophomyrtus bullata	Ramarama	Threatened – Nationally Critical	Ogle, 1980b
Melicytus crassifolius	Thick-leaved māhoe	At Risk – Declining	Ogle, 1985[54] (planted);
Metrosideros diffusa	White rātā	Threatened – Nationally Vulnerable	Ogle, 1980b
Metrosideros fulgens	Climbing rātā	Threatened – Nationally Vulnerable	Ogle, 1974; Ogle, 1980b
Metrosideros perforata	Akatea	Threatened – Nationally Vulnerable	Ogle, 1974; Ogle, 1980b; Ogle, 1985
Solanum aviculare var. *aviculare*	Poroporo	Threatened – Nationally Vulnerable	Ogle, 1980b; Clelland, 1984; Ogle, 1985
Sonchus kirkii	Shore pūhā, New Zealand sow thistle	At Risk – Declining	Ogle, 1974
Streblus banksii	Large-leaved milk tree, tūrepo	At Risk – Relict	Ogle, 1980a; Ogle, 1980b
Trisetum antarcticum	Coastal grass species	At Risk – Declining	Ogle, 1980b; Ogle, 1985

Scientific name	Common name	Threat status	Observation
Birds[55]			
Anthus novaeseelandiae	New Zealand pipit	At Risk – Declining	McArthur, 2020[56]; ebird database[57]
Egretta sacra	Reef heron	Threatened – Nationally Endangered	McArthur et al, 2019[58]; McArthur, 2020; McArthur, 2021[59]; ebird database
Eudyptula minor iredalei	Northern (little) blue penguin	At Risk – Declining	Sim, 2015[60]
Falco novaeseelandiae ferox	New Zealand bush falcon, kārearea	Threatened – Nationally Increasing	Bell, 2014[61]; ebird database
Haematopus unicolor	Variable oystercatcher	At Risk – Recovering	McArthur et al, 2015[62]; McArthur, 2020; McArthur, 2021; ebird database
Hydroprogne caspia	Caspian tern	Threatened – Nationally Vulnerable	ebird database
Larus bulleri	Black-billed gull	At Risk – Declining	McArthur, 2021; ebird database
Larus novaehollandiae scopulinus	Red-billed gull	At Risk – Declining	McArthur et al, 2015; McArthur, 2020; McArthur, 2021; ebird database
Nestor meridionalis septentrionalis	North Island kākā	At Risk – Recovering	Dovey, 2018[63]
Phalacrocorax carbo novaehollandiae	Black shag	At Risk – Relict	McArthur et al, 2015; McArthur, 2020
Phalacrocorax varius	Pied shag	At Risk – Recovering	McArthur et al, 2015; McArthur et al, 2019; McArthur, 2020; ebird database
Puffinus gavia	Fluttering shearwater	At Risk – Relict	ebird database
Sterna striata	White-fronted tern	At Risk – Declining	McArthur et al, 2015; McArthur et al, 2019; McArthur, 2020; McArthur, 2021; ebird database
Reptiles[64]			
Oligosoma whitakeri	Whitaker's skink	Threatened – Nationally Endangered	Towns & Elliott, 1996[65]; Hoare, 2007[66]
Oligosoma aeneum	Copper skink	At Risk – Declining	Hoare, 2007; Newman, 2018[67]
Oligosoma zelandicum	Glossy brown skink	At Risk – Declining	Hoare, 2007; Newman, 2018

Appendix 3: Regionally threatened plant species list

A methodology to create regional threat lists was developed by a collaborative group comprising representatives from DOC, regional councils and a local authority. The resulting regional threat listing methodology leverages off the NZTCS, but applies a species population threshold adjusted to the regional land area under consideration (relative to the national land area) for species that are not nationally threatened. The assigned regional threat status cannot be lower than that of the national threat status, but can be higher, (eg, a Nationally Vulnerable species could be assessed as being Regionally Critical). Other assessments made in the regional threat listing process include identifying populations that are national strongholds and the use of regional qualifiers, such as natural or historic range limits.

The following table lists regionally threatened species that have been recorded in the Raroa - Pukerua Coast KNE site.

Table 6: Regionally threatened species recorded in the Raroa - Pukerua Coast KNE site

Scientific name	Common name	Threat status	Observation
Plants[68]			
Aciphylla squarrosa var. *squarrosa*	Speargrass	Regionally Vulnerable	Ogle, 1980a[69]; Ogle, 1980b[70]
Craspedia uniflora var. *maritima*	Woollyhead	Regionally Endangered	Ogle, 1974[71]; Ogle, 1980a; 1980b
Kunzea amathicola	Rawiritoa, kānuka	Regionally Data Deficient	van Meeuwen-Dijkgraaf, 2019[72]
Melicytus crassifolius	Thick-leaved māhoe	Regionally Declining	Ogle, 1985[73] (planted);
Raoulia hookeri var. *hookeri*	Scabweed	Regionally Declining	Ogle, 1980a
Solanum aviculare var. *aviculare*	Poroporo	Regionally Vulnerable	Ogle, 1980b; Clelland, 1984; Ogle, 1985
Schoenus concinnus	*Schoenus concinnus*	Regionally Endangered	Ogle, 1980a
Sonchus kirkii	Shore pūhā, New Zealand sow thistle	Regionally Declining	Ogle, 1974
Streblus banksii	Large-leaved milk tree, tūrepo	Regionally Relict	Ogle, 1980a; Ogle, 1980b
Trisetum antarcticum	Coastal grass species	At Risk – Declining	Ogle, 1980b; Ogle, 1985
Birds[74]			
Anthus novaeseelandiae	New Zealand pipit	Regionally Vulnerable	McArthur, 2020[75]; ebird database[76]
Egretta sacra	Reef heron	Regionally Critical	McArthur et al, 2019[77]; McArthur, 2020; McArthur, 2021[78]; ebird database
Eudyptula minor iredalei	Northern (little) blue penguin	Regionally Vulnerable	Sim, 2015[79]

Scientific name	Common name	Threat status	Observation
Falco novaeseelandiae	Bush falcon / kārearea	Regionally Critical	Bell, 2014[80]; ebird database
Haematopus unicolor	Variable oystercatcher	Regionally Vulnerable	McArthur et al, 2015[81]; McArthur, 2020; McArthur, 2021; ebird database
Hemiphaga novaeseelandiae	Kereru, New Zealand pigeon	Regionally Recovering	McArthur, 2021; ebird database
Hydroprogne caspia	Caspian tern	Regionally Critical	ebird database
Larus bulleri	Black-billed gull	Regionally Critical	McArthur, 2021; ebird database
Larus novaehollandiae scopulinus	Red-billed gull	Regionally Vulnerable	McArthur et al, 2015; McArthur, 2020; McArthur, 2021; ebird database
Nestor meridionalis	North Island kākā	Regionally Recovering	Dovey, 2018[82]
Phalacrocorax carbo	Black shag	Regionally Critical	McArthur et al, 2015; McArthur, 2020
Phalacrocorax melanoleucos	Little shag	Regionally Vulnerable	McArthur, 2021; ebird database
Phalacrocorax varius	Pied shag	Regionally Vulnerable	McArthur et al, 2015; McArthur et al, 2019; McArthur, 2020; ebird database
Sterna striata	White-fronted tern	Regionally Endangered	McArthur et al, 2015; McArthur et al, 2019; McArthur, 2020; McArthur, 2021; ebird database
Reptiles[83]			
Oligosoma whitakeri	Whitaker's skink	Regionally Critical	Towns & Elliott, 1996[84]; Hoare, 2007[85]
Oligosoma aeneum	Copper skink	Regionally Critical	Hoare, 2007; Newman, 2018[86]
Oligosoma zelandicum	Glossy brown skink	Regionally Declining	Hoare, 2007; Newman, 2018

Appendix 4: Threat table

Appendix 4 presents a summary of all known threats to the Raroa - Pukerua Coast KNE site including those discussed in section 7.

Table 7: Threats to the Raroa - Pukerua Coast KNE site

Threat code	Threat and impact on biodiversity in the KNE site	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 ground covering ecological weed species for control include pinwheel aeonium, pig's ear and tradescantia (see full list in Appendix 5).	Entire KNE site
EW-2	Woody weed species displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key woody ecological weed species include boneseed, karaka and Montpellier broom (see full list in Appendix 5).	Entire KNE site
EW-3	Climbing weeds smother and displace native vegetation often causing canopy collapse, inhibit indigenous regeneration, and alter vegetation structure and composition. Key climbing ecological weed species include everlasting pea, Japanese honeysuckle and banana passionfruit (see full list in Appendix 5).	Entire KNE site
Pest animals		
PA-1	Possums (*Trichosurus vulpecula*) browse palatable canopy vegetation until it can no longer recover[87,88]. This destroys the forest's structure, diversity and function. Possums may also prey on native birds and invertebrates[89].	Entire KNE site
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[90,91] .	Entire KNE site
PA-3	Mustelids (stoats[92,93] (*Mustela erminea*), ferrets[94,95] (*M. furo*) and weasels[96,97] (*M. nivalis*)) prey on native birds, lizards and invertebrates, reducing their breeding success and potentially causing local extinctions.	Entire KNE site
PA-4	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[98].	A, B
PA-5	Hedgehogs (*Erinaceus europaeus*) prey on native invertebrates[99], lizards[100] and the eggs[101] and chicks of ground-nesting birds[102] .	Entire KNE site
PA-6*	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[103,104].	Entire KNE site

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
PA-7*	Pest and domestic cats (*Felis catus*) prey on native birds[105], lizards[106] and invertebrates[107], reducing native fauna breeding success and potentially causing local extinctions[108].	Entire KNE site
PA-8*	Rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*) graze on palatable native vegetation and prevent natural regeneration in some environments[109].	B
Human activities		
HA-1*	Garden waste dumping often leads to ecological weed invasions into natural areas. Common weed species introduced at this KNE site include: Agapanthus and hydrangeas.	Entire KNE site
HA-2*	Encroachment of residential gardens into the KNE site from urban areas causes habitat loss and introduces ecological weeds.	Urban boundaries across entire KNE site
HA-3*	Recreational use such as bush walking and mountain biking can cause damage and disturbance of the native ecosystem. It is also likely to disturb native fauna and introduce ecological weeds.	Entire KNE site
HA-4*	Dogs (*Canis lupus familiaris*), if uncontrolled/unleashed can disturb or kill nesting birds and chicks, and lizards within the KNE site, particularly in close proximity to walking tracks[110].	A, B
Other threats		
OT-1*	Small forest remnants are effected by environmental impacts on their edges such as changing environmental conditions (eg, soil moisture or temperature levels), changing physical environment (eg, different plant assemblages compared to the interior) and changing species interactions (eg, increased predation by invasive species)[111,112].	A, C
OT-2*	Erosion, slips and scouring caused by storm events and natural processes can cause damage to established native plant communities and habitats.	B

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

Appendix 5: Ecological weed species

The following table lists key ecological weed species that have been recorded in the Raroa - Pukerua Coast KNE site.

The distribution and density of individual species is recorded. Three levels of distribution (localised, patchy and widespread) and density (sparse, abundant and dense) are used to describe these aspects of infestations of each species.

Table 8: Ecological weed species recorded in the Raroa - Pukerua Coast KNE site

Scientific name	Common name	Priority	Level of distribution	Management aim
Chrysanthemoides monilifera	Boneseed	Severe	Patchy and sparse	Eradication
Delairea odorata	German ivy	Severe	Patchy and sparse	Eradication
Dipogon lignosus	Mile a minute vine	Severe	Localised and sparse	Eradication
Helichrysum petiolare	Licorice plant	Severe	Not present	Surveillance and eradication if found
Lathyrus latifolius	Everlasting pea	Severe	Widespread and patchy	Eradication
Lonicera japonica	Japanese honeysuckle	Severe	Localised and sparse	Eradication
Passiflora tripartite var. *mollissima*	Banana passionfruit	Severe	Patchy and sparse	Eradication
Rumex sagittatus	Climbing dock	Severe	Patchy and abundant	Suppression
Senecio angulatus	Cape ivy	Severe	Patchy and abundant	Eradication
Aeonium haworthii	Pinwheel aeonium	High	Localised and abundant	Eradication
Asparagus scandens	Climbing asparagus	High	Patchy and sparse	Eradication
Agave americana	Century plant	High	Localised and sparse	Eradication
Clematis vitalba	Old man's beard	High	Localised and sparse	Eradication
*Corynocarpus laevigatus**	Karaka	High	Widespread and abundant	Surveillance
Cotyledon orbiculata var. *orbiculata*	Pig's ear	High	Localised and abundant	Eradication
Crassula multicava subsp. *Multicava*	Fairy crassula	High	Localised and abundant	Eradication
Echeveria secunda	Blue echeveria	High	Localised and abundant	Eradication
Genista monspessulana	Montpellier broom	High	Patchy and abundant	Suppression
Kniphofia uvaria	Red hot poker	High	Localised and sparse	Eradication

Scientific name	Common name	Priority	Level of distribution	Management aim
Myoporum aff. *insulare*	Tasmanian ngaio	High	Patchy and sparse	Surveillance
Paraserianthes lophantha	Brush wattle	High	Patchy and abundant	Suppression
Parietaria judaica	Pellitory of the wall	High	Patchy and abundant	Suppression
*Pittosporum crassifolium**	Karo	High	Widespread and abundant	Surveillance
Plectranthus ciliatus	Blue spur flower	High	Patchy and abundant	Suppression
Polygala myrtifolia	Sweet pea shrub	High	Localised and sparse	Eradication
Senecio glastifolius	Purple ragwort	High	Patchy and sparse	Suppression
Acanthus mollis	Bear's breaches	Moderate	Localised and sparse	No management
Agapanthus praecox	Agapanthus	Moderate	Localised and sparse	Suppression
Carpobrotus edulis	Ice plant	Moderate	Localised and sparse	No management
Cortaderia selloana	Pampas	Moderate	Patchy and sparse	Suppression
Crocosmia x crocosmooflora	Montbretia	Moderate	Localised and sparse	No management
Cytisus scoparius	Broom	Moderate	Localised and sparse	No management
Ehrharta erecta	Veldt grass	Moderate	Patchy and abundant	No management
Fumaria muralis subsp. *muralis*	Scrambling fumitory	Moderate	Patchy and sparse	No management
Gazania rigens	Gazania	Moderate	Localised and sparse	No management
Hedera helix	Ivy	Moderate	Patchy and sparse	Suppression
Hydrangea macrophylla	Hydrangea	Moderate	Localised and sparse	Suppression
*Metrosideros excelsa**	Pohutukawa	Moderate	Patchy and sparse	No management
Pennisetum clandestinum	Kikuyu grass	Moderate	Patchy and abundant	No management
Phytolacca octandra	Ink weed	Moderate	Patchy and abundant	Suppression
Rubus sp. (*R. Fruticosus* agg.)	Blackberry	Moderate	Patchy and abundant	Suppression
Sambucus nigra	Elderberry	Moderate	Patchy and abundant	No management
Selaginella kraussiana	Creeping clubmoss	Moderate	Patchy and sparse	Surveillance
Tecoma capensis	Cape honey flower	Moderate	Localised and sparse	No management
Tradescantia fluminensis	Tradescantia	Moderate	Localised and abundant	Suppression
Tropaeolum majus	Nasturtium	Moderate	Localised and abundant	No management

Scientific name	Common name	Priority	Level of distribution	Management aim
Zantedeschia aethiopica	Arum lily	Moderate	Localised and sparse	Suppression
Allium triquetrum	Onion weed	Low	Patchy and abundant	No management
Artemisia absinthium	Wormwood	Low	Patchy and abundant	No management
Bambusa spp.	Bamboo	Low	Localised and sparse	No management
Brassica rapa sylvestris	Wild turnip	Low	Patchy and abundant	No management
Calystegia silvatica	Greater bindweed	Low	Patchy and abundant	No management
Foeniculum vulgare	Fennel	Low	Patchy and abundant	No management
Opuntia monacantha	Drooping prickly pear	Low	Localised and sparse	No management
Rhaphiolepis umbellata	Sexton's bride	Low	Localised and abundant	No management
Solanum nigrum	Black nightshade	Low	Patchy and abundant	No management
Ulex europaeus	Gorse	Low	Patchy and sparse	No management

* 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 Long Term Plan Ko Te Pae Tawhiti: 2021 – 2031.
[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] Greater Wellington Regional Council. Proposed Natural Resources Plan for the Wellington Region. 2019.
[5] Greater Wellington Regional Council. 2019. Greater Wellington Regional Pest Management Plan 2019–2039. GW/BIO-G-2019/74
[6] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[7] Porirua City Council. 2013. Porirua City Reserves Management Plan. https://storage.googleapis.com/pcc-wagtail-media/documents/Porirua_City_Reserve_Management_Plan_Volume_1_-_General_Policies.pdf
[8] Porirua City Council. 2013. Porirua City Reserves Management Plan. https://storage.googleapis.com/pcc-wagtail-media/documents/Porirua_City_Reserve_Management_Plan_Volume_1_-_General_Policies.pdf
[9] Porirua City Council. 2020. Proposed Porirua District Plan. https://eplan.poriruacity.govt.nz/districtplan/default.html
[10] Greater Wellington Regional Council. 2019. Proposed Natural Resources Plan. P. 608.
[11] Porirua City Council. 2020. Proposed Porirua District Plan. https://eplan.poriruacity.govt.nz/districtplan/default.html
[12] Greater Wellington Regional Council. 2019. Proposed Natural Resources Plan. P. 608.
[13] Singers NJD, Rogers GM. 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation No. 325. Department of Conservation, Wellington. 87 p.
[14] Singers N, Crisp P, Spearpoint O. 2018. Forest ecosystems of the Wellington Region.
[15] 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.
[16] Holdaway RJ, Wiser SK, Williams PA. 2012. Status assessment of New Zealand's naturally uncommon ecosystems. Conservation Biology 26: 619–629.
[17] DOC. New Zealand Threat Classification System (NZTCS). http://www.doc.govt.nz/nztcs
[18] Newman DG. 2015. Lizard Monitoring at Pukerua Bay: January - March 2015 Report.
[19] McEwen M (compiler). 1987. Ecological Regions and Districts of New Zealand. New Zealand Biological Resources Centre Publication No. 5. Department of Conservation, Wellington.
[20] McEwen WM (Ed.). 1987. Booklet to accompany SHEET 3. Descriptions of Districts in central New Zealand, from Eastern Wairarapa to Akaroa. Ecological Regions and Districts of New Zealand. Wellington, Department of Conservation. 104 p.
[21] McEwen WM (Ed.). 1987. Booklet to accompany SHEET 2. Descriptions of Districts in central New Zealand, from Meremere to Eastern Hawkes Bay. Ecological Regions and Districts of New Zealand. Wellington, Department of Conservation. 92 p.
[22] Ogle CC. 1980. Plant Checklist for Raroa and Wairaka Reserves, Pukerua Bay (with reference to the 1979 Porirua City Council Management Plan).
[23] Ogle CC. 1980. Plant Checklist for Raroa and Wairaka Reserves, Pukerua Bay (with reference to the 1979 Porirua City Council Management Plan).
[24] McArthur N. 2020. A review of significant coastal and freshwater habitats for indigenous birds in the Wellington region. Client report prepared for Greater Wellington Regional Council, Wellington.
[25] McArthur N. 2021. Threatened bird species in the KNE programme. Unpublished report for Greater Wellington Regional Council.

[26]Joanna Sim. 2015. Preliminary Penguin Survey For Kapiti Coast Biodiversity Project: Ames Street Reserve. DabChickNZ. 3 p.
[27] McArthur N, Robertson H, Adams L and Small D. 2015. A review of coastal and freshwater habitats of significance for indigenous birds in the Wellington Region. Greater Wellington Regional Council, Publication No. GW/ESCI-T-14/68, Wellington.
[28] McArthur N. 2020. A review of significant coastal and freshwater habitats for indigenous birds in the Wellington region. Client report prepared for Greater Wellington Regional Council, Wellington.
[29] McArthur N, Ray S, Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[30] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: February 2022).
[31] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: February 2022).
[32] Bell D. 2014. NZ Falcon Survey - Wellington Region data extract. Accessed 30 November 2014.
[33] Olivia Dovey, Porirua City Council, pers obs 2018.
[34] McArthur N. 2021. Threatened bird species in the KNE programme. Unpublished report for Greater Wellington Regional Council.
[35] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: February 2022).
[36] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[37] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[38] Brent Tandy, Department of Conservation, pers comms 2021.
[39] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[40] Newman D. 2018. Lizard Monitoring at Pukerua Bay: January - March 2018: Summary of Results. 3p.
[41] Romijn R. 2021. Lizards in the Key Native Ecosystem Programme. Greater Wellington Regional Council. Unpublished report.
[42] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[43] Newman D. 2018. Lizard Monitoring at Pukerua Bay: January - March 2018: Summary of Results. 3p.
[44] Romijn R. 2021. Lizards in the Key Native Ecosystem Programme. Greater Wellington Regional Council. Unpublished report.
[45] Townsend AJ, de Lange PJ, Duffy CAJ, Miskelly CM, Molloy J, Norton DA. 2008. New Zealand Threat Classification System manual. Department of Conservation, Wellington. 36 p.
[46] Rolfe J, Makan T, Tait A. 2021. Supplement to the New Zealand Threat Classification System manual 2008: new qualifiers and amendments to qualifier definitions, 2021. Department of Conservation, Wellington. 7 p
[47] Michel P. 2021. Amendment to the New Zealand Threat Classification System manual 2008: revised categories 2021. Department of Conservation, Wellington. 5 p.
[48] de Lange PJ, Rolfe JR, Barkla JW, Courtney SP, Champion PD, Perrie LR, Beadel SM, Ford KA, Breitwieser I, Schonberger, I, Hindmarsh-Walls R, Heenan PB, Ladley K. 2018. Conservation status of New Zealand indigenous vascular plants, 2017. New Zealand Threat Classification Series 22. Department of Conservation, Wellington. 82 p.
[49] Ogle CC. 1980. Plant Checklist for Raroa and Wairaka Reserves, Pukerua Bay (with reference to the 1979 Porirua City Council Management Plan).
[50] Ogle CC. 1980: Native Plants of Pukerua Bay Reserves: Wairaka Road Gully, Coastal section of Wairaka and Raroa Reserves and Raroa Reserve. Appendix.

[51] Ogle CC. 1974. Plant Checklist of Species for Pukerua Bay Recreation Reserve (including "Fault Gorge"), and other hills and coast immediately west of Pukerua Bay residential area.
[52] van Meeuwen-Dijkgraaf A. 2019. Regional and District Plans, nomenclature, and Kunzea. In Trilepidea – Newsletter of the New Zealand Plant Conservation Network. No. 188, July 2019.
[53] Clelland D. 1984: Pukerua Bay to Wairaka Point. Unprotected Natural areas of the Wellington Region: A survey of eleven areas of biological significance. Unpublished report prepared for the Wellington District Office, Dept. Lands & Survey.
[54] Ogle CC. 1987. Vascular plants of Pukerua Bay Wildlife Management Reserve. Plant list Wellington. 6 p.
[55] Robertson HA, Baird KA, Elliot GP, Hitchmough RA, McArthur NJ, Makan TD, Miskelly CM, O'Donnell CFJ, Sagar PM, Scofield RP, Taylor GA, Michel P. 2021. Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 p.
[56] McArthur N. 2020. A review of significant coastal and freshwater habitats for indigenous birds in the Wellington region. Client report prepared for Greater Wellington Regional Council, Wellington.
[57] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: February 2022).
[58] McArthur N, Ray S, Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[59] McArthur N. 2021. Threatened bird species in the KNE programme. Unpublished report for Greater Wellington Regional Council.
[60] Joanna Sim. 2015. Preliminary Penguin Survey For Kapiti Coast Biodiversity Project: Ames Street Reserve. DabChickNZ. 3 p.
[61] Bell D. 2014. NZ Falcon Survey - Wellington Region data extract. Accessed 30 November 2014.
[62] McArthur N, Robertson H, Adams L and Small D. 2015. A review of coastal and freshwater habitats of significance for indigenous birds in the Wellington Region. Greater Wellington Regional Council, Publication No. GW/ESCI-T-14/68, Wellington.
[63] Olivia Dovey, Porirua City Council, pers obs 2018.
[64] Hitchmough R, Barr B, Knox C, Lettink M, Monks JM, Patterson GB, Reardon JT, Tocher M, Van Winkel D, Rolfe J, Michel P. 2021. Conservation status of New Zealand reptiles, 2021. New Zealand Threat Classification Series 35. Department of Conservation, Wellington. 15 p.
[65] Towns DR, Elliott GP. 1996. Effects of habitat structure on distribution and abundance of lizards at Pukerua Bay, Wellington, New Zealand. New Zealand Journal of Ecology 20:191–206.
[66] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[67] Newman DG. 2018. Lizard Monitoring at Pukerua Bay: January - March 2018 - Summary of Results. Unpublished report. 3p.
[68] Crisp, P. 2020. Conservation status of indigenous vascular plant species in the Wellington region. Greater Wellington Region Council. GW/ESCI-G-20/20.
[69] Ogle CC. 1980. Plant Checklist for Raroa and Wairaka Reserves, Pukerua Bay (with reference to the 1979 Porirua City Council Management Plan).
[70] Ogle CC. 1980: Native Plants of Pukerua Bay Reserves: Wairaka Road Gully, Coastal section of Wairaka and Raroa Reserves and Raroa Reserve. Appendix.
[71] Ogle CC. 1974. Plant Checklist of Species for Pukerua Bay Recreation Reserve (including "Fault Gorge"), and other hills and coast immediately west of Pukerua Bay residential area.
[72] van Meeuwen-Dijkgraaf A. 2019. Regional and District Plans, nomenclature, and Kunzea. In Trilepidea – Newsletter of the New Zealand Plant Conservation Network. No. 188, July 2019.
[73] Ogle CC. 1987. Vascular plants of Pukerua Bay Wildlife Management Reserve. Plant list Wellington. 6 p.
[74] Crisp P. 2020. Conservation status of native bird species in the Wellington region. Greater Wellington Regional Council, Publication No. GW/ESCI-G-20/75, Wellington.
[75] McArthur N. 2020. A review of significant coastal and freshwater habitats for indigenous birds in the Wellington region. Client report prepared for Greater Wellington Regional Council, Wellington.
[76] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: February 2022).

[77] McArthur N, Ray S, Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[78] McArthur N. 2021. Threatened bird species in the KNE programme. Unpublished report for Greater Wellington Regional Council.
[79] Joanna Sim. 2015. Preliminary Penguin Survey For Kapiti Coast Biodiversity Project: Ames Street Reserve. DabChickNZ. 3 p.
[80] Bell D. 2014. NZ Falcon Survey - Wellington Region data extract. Accessed 30 November 2014.
[81] McArthur N, Robertson H, Adams L and Small D. 2015. A review of coastal and freshwater habitats of significance for indigenous birds in the Wellington Region. Greater Wellington Regional Council, Publication No. GW/ESCI-T-14/68, Wellington.
[82] Olivia Dovey, Porirua City Council, pers obs 2018.
[83] Crisp P. 2020. Conservation status of lizard species in the Wellington region. Greater Wellington Regional Council, Publication No. WRC/ESCI-G-20/2, Wellington.
[84] Towns DR, Elliott GP. 1996. Effects of habitat structure on distribution and abundance of lizards at Pukerua Bay, Wellington, New Zealand. New Zealand Journal of Ecology 20:191–206.
[85] Hoare JM, Adams LK, Bull LS, Towns DR. 2007. Attempting to manage complex predator-prey interactions fails to avert imminent extinction of a Threatened New Zealand skink population. The Journal of Wildlife Management 71(5): 1576–1584.
[86] Newman DG. 2018. Lizard Monitoring at Pukerua Bay: January - March 2018 - Summary of Results. Unpublished report. 3p.
[87] 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.
[88] 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.
[89] 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.
[90] 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.
[91] Innes JG. 2005. Ship rat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 187–203.
[92] 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.
[93] King CM and Murphy EC. 2005. Stoat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 261–287.
[94] 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.
[95] Clapperton BK, Byron A. 2005. Feral ferret. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 294–307.
[96] King CM. 2005. Weasel. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 287–294.
[97] 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.
[98] Parkes. JP. 2005. Feral goat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 374–391.
[99] 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.
[100] 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.
[101] 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.

[102] 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.
[103] Ruscoe WA, Murphy EC. 2005. House mouse. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 204–221.
[104] 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.
[105] 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.
[106] 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.
[107] 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.
[108] Gillies C, Fitzgerald BM. 2005. Feral cat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 308–326.
[109] Norbury G, Flux JEC. 2005. Brown hare. in: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 151–158.
[110] Holderness-Roddam B. 2011. The effects of domestic dogs (Canis familiaris) as a disturbance agent on the natural environment. Thesis submitted at University of Tasmania, Hobart.
[111] Young A, Mitchell N. 1994. Microclimate and vegetation edge effects in a fragmented podocarp-broadleaf forest in New Zealand. Biological Conservation 67: 63–72.
[112] Norton DA. 2002. Edge effects in a lowland temperate New Zealand rainforest. DOC Science Internal Series 27. Department of Conservation, Wellington.

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 2022
GW/BD-G-22/13