Key Native Ecosystem Operational Plan for Parangarahu Lakes Area

2017-2020

Greater Wellington
Te Pane Matua Taiao

Contents

1. Purpose

The purpose of the three-year Key Native Ecosystem (KNE) Operational Plan for Parangarahu Lakes Area KNE site is to:

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

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

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

2. Policy Context

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

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

Greater Wellington 10 Year Plan

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

Proposed Natural Resources Plan

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

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

Parks Network Plan

Management of East Harbour Regional Park as a whole, which contains the Parangarahu Lakes Area KNE site, is guided by the Greater Wellington Parks Network

Plan (PNP)[3]. This plan guides the recreational and amenity uses of East Harbour Regional Park as well as identifying opportunities to protect biodiversity values.

Greater Wellington Biodiversity Strategy

The Greater Wellington Biodiversity Strategy[4] (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 three-year KNE plans prepared by the Greater Wellington's Biodiversity department. Greater Wellington works with the landowners, mana whenua and other operational delivery providers to achieve mutually beneficial goals.

4. Parangarahu Lakes Area Key Native Ecosystem

The Parangarahu Lakes Area KNE (471 ha) is located on the Pencarrow headlands on the eastern side of Wellington Harbour (Appendix 1, Map 1). The KNE site is part of the larger East Harbour Regional Park and contains land protected as Conservation Covenants, Scientific Reserve, Recreation Reserve, Māori Reservation, and Historic Reserve.

Parangarahu Lakes Area KNE site lies within the Tararua Ecological District[5] and contains the nationally recognised Lake Kohangatera and Lake Kohangapiripiri (collectively known as the Pencarrow Lakes), the regionally outstanding Gollans wetland and Cameron's wetland, as well as containing the coastal platform and shingle beaches important for breeding shorebirds and rare cushion plants.

5. Parties involved

Greater Wellington works in collaboration with landowners, management partners and stakeholders where appropriate to achieve shared objectives for the site. Greater Wellington also recognizes that effective working relationships are critical for achieving the management objectives for each KNE site. In preparing this plan Greater Wellington has sought input from landowners, management partners and relevant stakeholders, and will continue to involve them as the plan is implemented.

5.1. Landowners and co-management partners

The KNE site covers land owned by Greater Wellington, Port Nicholson Block Settlement Trust (PNBST) on behalf of Taranaki Whānui ki Te Upoko o Te Ika (Taranaki Whānui) who are mana whenua, DOC, Hutt City Council (HCC) and the Historic Places Trust.

Parangarahu Lakes Area KNE site is part of the larger East Harbour Regional Park which is managed in accordance with the Parangarahu Lakes Area Co-Management Plan[6] and the broader Greater Wellington Parks Network Plan[7]. This KNE plan is consistent with the objectives and policies of the Parks Network Plan and the Parangarahu Lakes Area Co-Management Plan providing further operational detail to specific biodiversity management activities.

The Parangarahu Lakes Area is managed at an operational level by the Roopu Tiaki (Guardianship Group) that comprises representatives of the PNBST, Greater Wellington and the community volunteer group Mainland Island Restoration Operation (MIRO) who have undertaken significant pest control, restoration and monitoring work within the KNE site since 2007.

The primary management partners within Greater Wellington are the Biodiversity department (management advice and overview), the Parks department (overall park planning and site management) and the Biosecurity department (pest control). Greater Wellington supports the work of MIRO.

5.2. Mana whenua partners

Taranaki Whānui are Greater Wellington's mana whenua partners in Parangarahu Lakes Area KNE site. The area is a site of significance for Taranaki Whānui (see Table 1). Greater Wellington is committed to working with Taranaki Whānui in the development of the plan and exploring opportunities where mana whenua may be involved in the operational delivery of the KNE site.

Table 1: Taranaki Whānui sites of significance in Parangarahu Lakes Area KNE site[8]

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

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

- make a small but valuable contribution to the overall expected PNRP outcomes including mahinga kai
- ensure people working in KNE sites understand the requirements of the Accidental Discovery Protocol

- endeavour to ensure that Taranaki Whānui values for the site are protected

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

5.3. Stakeholders

HCC is a key stakeholder as it owns land within the KNE site and manages the controlled-access coastal road[9] from Eastbourne via the locked Burdans Gate and the sewer outfall at Pencarrow Head.

DOC has statutory responsibilities relating to administering the conservation covenants and scientific reserves within the KNE site. DOC also manages the recreational hunting permits for the area.

Both HCC and DOC contribute funds to biodiversity management activities within the KNE site.

Other stakeholders include the Historic Places Trust (which owns the Pencarrow Lighthouse land), the East Harbour Environmental Association, Horokiwi Quarries (who seasonally operate a sand quarry), Fish and Game New Zealand, Wellington Wildfowlers and the Royal Forest and Bird Protection Society.

6. Ecological values

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

A comprehensive account of the ecological values and significance of the Parangarahu Lakes Area KNE site is provided within the Parangarahu Lakes Area Co-Management Plan and Pencarrow Lakes – Conservation values and management report[10].

The KNE site contains a complex assemblage of vegetation (Appendix 1, Map 2) which is habitat for a very high number of threatened species (see Appendix 2).

Of note in recognising the ecological values at the Parangarahu Lakes KNE site are the following:

- ***Naturally Uncommon Ecosystems:*** There is an unusually diverse mix of naturally uncommon ecosystems[11] represented. These are: shingle beaches, active sand dunes and lagoons (all Nationally Endangered[12]), lake margins and estuaries (both Nationally Vulnerable), and coastal rock stacks.
- ***Threatened Ecosystems:*** The Land Environment New Zealand (LENZ) Threatened Environment classification[13] rates many ecosystem types in the KNE site as being threatened (Appendix 1, Map 3). The freshwater/estuarine wetlands and some lake

margins are 'Acutely Threatened'; the degraded freshwater wetlands, coastal escarpments and shingle beaches are 'Chronically Threatened'; and the regenerating forest remnant and regenerating scrub and shrublands are mostly classed as being 'At Risk' or 'Critically Underprotected'.

- ***Threatened species:*** There are eight species classified as 'Threatened' and 30 species classified 'At Risk' within the KNE site. There are also two 'Threatened' species that are only occasional visitors (the Nationally Vulnerable New Zealand falcon and reef heron). The 'At Risk' sand tussock (*Poa billardierei*), recorded prior to 2002, is thought to no longer occur within the KNE site, but still remains in the Baring Head KNE site along the coast to the southeast. An observation of the Nationally Critical purple crassula (*Crassula peduncularis*) from the 1980s has not been confirmed.

  Several additional 'Threatened' or 'At Risk' bird species have been recorded at this KNE site, but are either considered vagrants or irregular visitors (eg, little black shag, reef heron, grey duck, little blue penguin) or are oceanic species that are unlikely to make landfall (eg, fluttering shearwater). Australasian bittern (*Botaurus poiciloptilus*) and spotless crake (*Porzana tabuensis*) are possibly present at this KNE site, but no recent records have been located. See Appendix 2 for a list of 'Threatened' and 'At Risk' species.

There are three main types of ecosystems within the KNE site. As threats and management requirements between them can differ, each has been described as a distinct operational area in this KNE plan (Appendix 1, Map 4).

A brief description of each follows:

6.1. Lakes and wetlands

Lake Kohangapiripiri and Lake Kohangatera[14] (and the shingle beach at Lake Kohangapiripiri)[15] have been described as the best examples of their ecosystem type nationally, while the associated Cameron Creek and Gollans Stream wetlands are some of the best condition wetlands of their type in the country[16].

Blunt pondweed (*Potamogeton ochreatus*) dominates the aquatic vegetation of Lake Kohangatera, but closer to the coast the naturally uncommon sago pondweed (*Stuckenia pectinata*) and horse's mane *(Ruppia polycarpa*) become more abundant. Native milfoil (*Mryiophyllum triphyllum*) and *Lepilaena biloclaris* commonly co-dominate with blunt pond weed.

Beds of emergent lake club rush (*Schoenoplectus tabernaemontani*) are widespread in Lake Kohangapiripiri and turf species dominated by *Glossostigma cleistanthum, Lilaeopsis novae-zelandiae* and *Elatine gratioloides*, are present on the open shore. Native milfoil and blunt pondweed dominate the lake bed vegetation along with small patches of the charophyte *Chara australis*. There are also some areas with low vegetation cover which may be a result of grazing by swans (as other areas at a similar depth support high native plant cover)[17]. New Zealand now has few examples of these dense, tall-growing macrophytic lake communities left, as most other lakes have been significantly altered as a result of exotic aquatic weed invasion[18].

The emergent vegetation within both wetlands is dominated by raupō (*Typha orientalis*), lake club rush, toetoe (*Austroderia toetoe* and *A. fluvida*), harakeke (*Phormium tenax*) and the giant umbrella sedge (*Cyperus usulatus*). Between these large clumps, many small herbs and sedges form a dense grass-like sward. Salt-marsh species, such as the jointed wire rush or oioi (*Apodasmia similis*) and glasswort (*Sarcocornia quinqueflora*), coexist with freshwater species near the coast.

The lakes are significant habitats for many bird species including: New Zealand dabchick (*Poliocephalus rufopectus*), pied stilt (*Himantopus himantopus*), grey duck (*Anas superciliosa*), Australasian shoveler (*Anas rhynchotis*), Australasian bittern (*Botaurus poiciloptilus*) and spotless crake (*Porzana tabuensis*)[19]. Pāteke (*Anas chlorotis*) has also been recorded in the recent past[20].

Lake Kohangapiripiri, Lake Kohangatera and their associated wetlands and streams are considered regionally important for freshwater fish, including migratory species[21]. However, Lake Kohangatera has a wider species diversity compared to Lake Kohangapiripiri[22]. Species present include longfin eel (*Anguilla dieffenbachii*), lamprey (*Geotria australis*), Inanga (*Galaxias maculatus*), giant kōkopu (*Galaxias argentus*), and kōaro (*Galaxias brevipinnis*). Kōura (*Paranephtops planifrons*) and kākahi (*Echyridella menziesi*) are also known to be present in the Lakes[23].

6.2. Coastal escarpments and shingle beaches

The coastal escarpments are typically covered in wind-sheared mingimingi (*Coprosma propinqua*), whaririki (*Phormium cookianum*), pōhuehue (*Muehlenbeckia complexa*), coastal tree daisy (*Olearia solandri*) and tauhinu. Interspersed with these are a number of hardy tree species, including taupata (*Coprosma repens*) and ngaio (*Myoporum laetum*). Notable herbs present include the native New Zealand spinach (*Tetragonia implexicoma*) and taramea/speargrass (*Aciphylla squarrosa var. squarrosa*).

On the shingle beaches, scabweed (*Raoulia australis*) and pinātoro (*Pimelia sp.*) form extensive cushionfields that are considered to be some of the most extensive in the region[24]. Pīngao (*Ficinia spiralis*) and spinifex (*Spinifex sericeus*) are beginning to build low sand dunes at the toe of the escarpments and inland edges of shingle beaches.

Other sand binding plants, such as shore bindweed (*Calystegia soldanella*), sand sedge (*Carex pumila*), Poa cita and the introduced horned poppy (*Glaucum flavum*) occur occasionally.

The dunes and shingle beaches are important breeding habitat for banded dotterels (*Charadrius bicinctus*) and support a number of nationally and regionally threatened species including sea holly (*Eryngium vesiculosum*) and leafless muehlenbeckia (*Muehlenbeckia ephedroides*) which is considered a population at the northern extent of its range[25].

Regenerating hillslopes

The vegetation on the hills has been highly modified by more than 150 years of burning and grazing. Grazing ceased in 2004 and the area is now regenerating primarily with gorse (*Ulex europaeus*), mānuka (*Leptospermum scoparium*) and tauhinu (*Ozothamnus leptophyllus*).

Some small remnants of native forest do remain in the north-eastern part of the KNE site and further natural regeneration of a wider range of broadleaved native species is occurring in the more sheltered gullys throughout the KNE site.

7. Key threats to ecological values at the site

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

There are a number of pest animal species known to exist within the KNE site. The species considered to pose the greatest threat to the ecological values of the KNE site are hedgehogs (*Erinaceus europaeus*), stoats (*Mustela erminea*), possums (*Trichosurus vulpecula*) and feral goats (*Capra hircus*).

Ecological weeds are prevalent and widespread throughout the KNE site. Key species known to have a big impact on the functionality of the ecosystems with the KNE site are marram grass (*Ammophila arenaria*), lupin (*Lupinus arboreus*) and gorse (*Ulex europaeus*) on the beaches and escarpments and Egeria (*Egeria densa*) within the Lakes.

The table below shows the identified threats at the site, which operational areas of the KNE they affect, and how the threats impact on ecological values. The code alongside each threat corresponds to activities listed in the Operational delivery schedule (Table 3) and is used to ensure that actions taken are targeted to specific threats. A map of operational areas is included in Appendix 1 (Map 4).

Table 2: Key threats to ecological values present at Parangarahu Lakes Area KNE

Code	Threats and their impact on biodiversity in the KNE	Operational area/location
Ecological weeds		
EW-1	Ground covering ecological weeds smother and displace native vegetation, inhibit indigenous regeneration and alter vegetation structure and composition. Key weed species for control include marram (*Ammophila arenaria*), pig's ear (*Cotyledon orbiculata* var. *orbiculata*) and horned poppy (*Glaucium flavum*)	Coastal escarpments and shingle beaches
EW-2	Woody weed species displace native vegetation, inhibit indigenous regeneration and alter vegetation structure and composition. Key weed species include boneseed (*Chrysanthemoides monilifera* subsp. *Monilifera*), gorse (*Ulex europaeus*) and lupin (*Lupinus arboreus*)	Coastal escarpments and shingle beaches
EW-3	Climbing weeds smother and displace native vegetation often causing canopy collapse, inhibit indigenous regeneration and alter vegetation structure and composition. Key weed species include old man's beard (*Clematis vitalba*) and cape ivy (*Senecio angulatus*)	Coastal escarpments

Code	Threats and their impact on biodiversity in the KNE	Operational area/location
EW-4	Aquatic weeds out-compete native aquatic species and choke watercourses. Key weed species include Egeria (*Egeria densa*), Canadian pondweed (*Elodea canadensis*), yellow flag iris (*Iris pseudacorus*) and beggar's ticks (*Bidens frondosa*)	Lakes and wetlands
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]	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[29,30]	Entire KNE site
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	Entire KNE site
PA-4	Hedgehogs (*Erinaceus europaeus*) prey on native invertebrates[37], lizards[38] and the eggs[39] and chicks of ground-nesting birds[40]	Entire KNE site
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]	Entire KNE site
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]	Entire KNE site
PA-7*	Feral pigs (*Sus scrofa*) root up the soil and eat roots, invertebrates, seeds and native plants preventing forest regeneration	Entire KNE site
PA-8	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[47]	Entire KNE site
PA-9	Rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*) graze on palatable native vegetation and prevent natural regeneration in some environments. Rabbits are particularly damaging in sand dune environments where they graze native binding plants and restoration plantings. In drier times hares especially, will penetrate into wetland forest areas browsing and reducing regenerating native seedlings	Entire KNE site
Human activities		
HA-1*	Track development for mountain biking and other activities could destroy some native vegetation and cause silt run off into streams, lakes and wetlands	Entire KNE site

Code	Threats and their impact on biodiversity in the KNE	Operational area/location
HA-2	Recreational use such as tramping, mountain biking and horse riding 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-3	Recreational vehicles such as 4WDs and motorbikes can cause damage and disturbance of the native ecosystems	Entire KNE site
HA-4*	Freshwater activities such as boating, fishing, white baiting and duck shooting can introduce aquatic weed species to waterways	Lakes and wetlands
Other threats		
OT-1	Agricultural practices, particularly stray grazing livestock can result in pugging soils, grazing native vegetation inhibiting regeneration, and wildlife disturbance[48]	Entire KNE site
OT-2*	Impediments to fish passage. Roads and culverts at the outlets of both lakes have altered connections to the sea, limiting the diversity and abundance of most native fish species that naturally occur in the lakes. In particular, the road and perched culvert at the mouth of Lake Kohangapiripiri restricts the passage of migratory species of native fish and the culverts under the road at the mouth of Lake Kohangatera may constrain the passage of fish at high flows	Coastal escarpments and shingle beaches Lakes and wetlands

*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. A map of operational areas can be found in Appendix 1 (see Map 4).

8. Objectives

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

The following objectives will guide the operational activities at Parangarahu Lakes Area KNE.

1. **To improve the structure* and function† of native plant communities**
2. **To improve the habitat for threatened native animals (coastal birds)**

* The living and non-living physical features of an ecosystem. This includes the size, shape, complexity, condition and the diversity of species and habitats within the ecosystem.
† The biological processes that occur in an ecosystem. This includes seed dispersal, natural regeneration and the provision of food and habitat for animals.

9. Operational activities

Operational activities are targeted to work towards the objectives above by responding to the threats outlined in Table 2. The operational activities are described briefly below, and specific actions, with budget figures attached, are set out in the Operational delivery schedule (Table 3).

9.1. Pest animal control

Pest animal control is undertaken by Greater Wellington staff and volunteers within the KNE site. A network of kill-traps is used to target mustelids, rats, hedgehogs and possums (see Appendix 1, Map 5), whilst ground-based shooting targets goats, possums, feral cats, rabbits and hares.

9.2. Ground-based shooting

Greater Wellington undertakes targeted feral goat control and night shooting to target possums, rabbits, hares and feral cats across the escarpments and shingle beaches up to six-times a year using ground-based shooting to reduce all species' population numbers to low levels across the KNE site.

Volunteers also undertake night shooting to target possums, rabbits, hares and feral cats across the escarpments and shingle beaches on an *ad hoc* basis.

9.3. Kill trap network

A network of DOC 200 kill-traps have been installed across the entire KNE site targeting mustelids, rats and hedgehogs. All DOC 200 kill-traps are serviced by MIRO volunteers on a monthly basis, except for the kill-traps on the shingle beaches that are serviced approximately every two weeks by other volunteers between August and February (the main shore bird breeding season). Greater Wellington provides the bait.

The kill-traps installed on the shingle beaches are placed at a higher density to afford greater protection for nesting shore birds. The shingle beaches are also an area where

volunteers supported by Greater Wellington, have trialled installing gas-traps at 30m intervals to monitor their effectiveness in this environment, particularly with regard to targeting hedgehogs.

Possum kill-traps (Timms) have been installed near revegetation planting plots to provide protection for the plants from possum browsing. These traps are checked by MIRO volunteers monthly with bait provided by Greater Wellington.

Over the last three years more than 100 possums per year have been shot during volunteer night-shoots highlighting the need for greater possum control within the KNE site. Whilst the OSPRI operation in the wider landscape (see below) is expected to have some effect on the possum population in the KNE site, Greater Wellington is planning to expand the possum control across the KNE site to maintain numbers at low level by extending the kill-trap network. This activity is highlighted as a pest animal priority in the Parangarahu Lakes Area Co-Management Plan[49].

9.4. Maintenance audit

Greater Wellington Biosecurity staff will undertake an annual audit of the kill-trap network to undertake any maintenance required and to ensure they are able to be operated in a safe and effective manner by MIRO and other volunteers.

9.5. OSPRI's TBfree programme

OSPRI's TBfree programme commenced their control operations targeting possums in the surrounding area in May 2017. Possum control operations involved a combination of aerially-sown 1080 (sodium fluoroacetate) and ground-based trapping and poisoning and are generally carried out at five-yearly intervals. This programme is part of a national strategy aiming to eradicate bovine tuberculosis from New Zealand; possums being the main vector of bovine tuberculosis. Although the objectives of the TBfree programme are somewhat different to the biodiversity objectives of this plan, the possum control carried out under the TBfree programme is expected to deliver positive biodiversity outcomes. This work is wholly funded by OSPRI.

9.6. Ecological weed control

Ecological weed control at the KNE site is aimed at maintaining the overall extent of native cover with particular emphasis on the highest value ecosystems; the lakes and wetlands, the coastal platform and the coastal escarpment.

Past ecological weed control work has focused on the high value areas and has been successful, significantly reducing large infestations of gorse, lupin, marram and boneseed. Control will continue to build on these successes and will be focused on the following operations:

- Ground-based control along coastal platform for marram, horned poppy and lupin
- Aerial follow-up control on coastal escarpments for gorse and lupin
- Aerial follow-up control of aquatic weeds in Lake Kohangatera and Gollans Wetland

- Lake-edge and wetlands survey and control of yellow flag iris and beggar's ticks
- Site-wide surveillance and reactionary control of other high priority weed species

Control of marram grass across the coastal platform has been jointly funded by Greater Wellington, DOC and HCC with the aim of eradicating it from the coastal platform. Progressive control has now vastly reduced the extent of marram across the KNE site; however, small isolated infestations are still present and will continue to be targeted for control annually. In conjunction with the annual marram control operation, other weeds on the shingle beaches will be targeted for control. These include horned poppy, lupin and gorse.

Gorse and lupin will be targeted for control on the coastal escarpments to enable low growing native species to continue regenerating. Follow up control of gorse and lupin via an aerial operation will be conducted in 2017/18. Further follow up control is not expected to be needed until after this timescale of this KNE plan.

Within Lake Kohangatera, the aquatic weeds Canadian pondweed (*Elodea canadensis*) and *Egeria densa* are present and can dominate areas of open water. These aquatic weed species are targeted for control where they are dominant or have a significant impact on ecosystem function via aerial herbicide application. This aims to reduce the density of the target species and prevent both species spreading throughout Lake Kohangatera and Gollans wetland. An annual aerial survey of the lake and wetlands will be conducted by Greater Wellington prior to confirming the operational area for control and need for the operation. It is recognised that both species are unlikely to be eradicated. Should this operation not be required, this funding will be used for other KNE programme pest plant and monitoring operations.

Egeria and Canadian pondweed are controlled under resource consent (WGN140240). An operational plan and monitoring plan are produced each year ahead of the aerial control operation by Greater Wellington.

Around Lake Kohangatera lake-edge and Gollans wetland yellow flag iris and beggar's ticks are targeted for control. This operation will continue annually utilising Greater Wellington's Biosecurity department.

Greater Wellington's Biosecurity department will conduct a survey of Lake Kohangapiripiri and Cameron Creek wetland edges for target species (ie, yellow flag iris and beggar's ticks) and other high priority weeds (eg, willow). Following the completion of the survey in 2018/19, control operations will commence.

Site-wide surveillance for high priority weed species will be undertaken by Greater Wellington's Biosecurity Officers, Park Ranger, Biodiversity Advisor and MIRO/other volunteers during the course of existing operations within the KNE site. Should any high priority weed species be reported, Greater Wellington's Biosecurity department may control them during the course of their other operations (see above). High priority species for surveillance and control include boneseed, wilding pine species, karo, karaka, willow and boxthorn.

9.7. Revegetation

Most of the KNE site has been left to regenerate naturally, except for some revegetation planting plots within the open hillslopes that were established to supplement the current species and include species representative of the original forest.

Revegetation is undertaken within the KNE site to assist natural regeneration by planting these plots of native plant species to provide a native seed sources. These sites are predominately fenced for protection from browsing animals and some have Timms kill-traps targeting possums present for protection. New sites for planting are agreed in collaboration with Greater Wellington Parks.

Revegetation is undertaken in the KNE site by MIRO using locally eco-sourced plants with support provided by Greater Wellington Parks department, who assist with site preparation, logistics and materials for planting days. Species and numbers planted are determined annually by MIRO.

The hillslopes are dominated by gorse and pasture grasses. These areas have not been targeted for management and can be used to facilitate forest restoration by providing shelter for native colonising scrub species such as mānuka, kānuka and tauhinu. It is expected that gorse and native scrub will initially replace the open grassland but will eventually be succeeded by native canopy tree species.

Planting is also not recommended on the immediate edge of the lakes or on the shingle beach/dune communities due to the risk of importing invasive species, the sensitive nature of these systems and their intact condition.

The cultural significance of the area must be taken into account when planning restoration plantings and planting in known archaeological or cultural sites must be avoided (see co-management plan for archaeological/cultural site locations).

9.8. Banded dotterel nest protection and monitoring

The shingle beaches within the KNE site are an important habitat for the Threatened – National Vulnerable banded dotterel. The banded dotterel colony is one of a number of breeding colonies along the south coast.

Volunteers from Taranaki Whānui and MIRO have been working with Greater Wellington to monitor and protect banded dotterel. Furthermore, Taranaki Whānui kaitiaki (guardians) place a temporary rāhui (access restriction) on these beaches during the birds' nesting season. Greater Wellington and MIRO place temporary fencing and signage around the rāhui areas to prevent access and disturbance of the nests, and MIRO undertakes monitoring during the nesting period between July – February with the Ornithological Society of New Zealand (OSNZ). OSNZ also help train MIRO volunteers to band birds for identification.

9.9. Regional Park management

Environmental Enhancement Fund

The Greater Wellington Parks department has an annual Environmental Enhancement Fund (EEF) available to enable local community groups to undertake environmental enhancement projects within the Regional Park. This fund and how it is allocated is determined three yearly in conjunction with the Biodiversity department and the detail annually with MIRO. Examples of how this fund has been spent previously includes fencing revegetation plots, nursery materials support and fixing boundary fencing to prevent stock incursion.

Environmental care of Greater Wellington's operations

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

Other regular Park maintenance operations also have the potential to impact biodiversity within the KNE site. Regular operations undertaken within the Parks should take into account the biodiversity values before commencing the operation to ensure that damage is avoided.

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

Collection of native plants and animals

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

Community engagement

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

10. Operational delivery schedule

The operational plan shows the actions planned to achieve the stated objectives for Parangarahu Lakes Area KNE site, and their timing and cost over the three-year period from 1 July 2017 to 30 June 2020. The budget for the 2018/19 and 2019/20 years are indicative only and subject to change. Operational areas are shown in Appendix 1, Map 4.

Table 3: Three year operational plan for Parangarahu Lakes Area KNE

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable and resourcing		
							2017/18	2018/19	2019/20
1	EW 1 EW 2	Ecological weed control	Coastal platform and shingle beaches	GWRC Biosecurity department	Weed sweep to control marram grass, horned poppy, gorse and lupin - Need to avoid Rāhui timing	Marram eradication, other species suppressed to maintain native dominance	$6,000	$3,000	$3,000
1	EW 2	Ecological weed control	Coastal escarpments	GWRC Biosecurity department	Follow up control of gorse and lupin (Aerial operation)	Broad scale control to facilitate regeneration and prevent entrenchment	$6,000	Nil	Nil
1	EW 4	Ecological weed control	Lake Kohangatera	GWRC Biosecurity department	On-going weed control of flag iris and beggars' ticks	Suppression of weeds to maintain native dominance	$10,000	$14,000	$14,000
1	EW 4	Ecological weed control	Lake Kohangapiripiri	GWRC Biosecurity department	Weed survey and control	Suppression of weeds to maintain native dominance	Nil	$3,000	$3,000
1	EW 1-4	Ecological weed control	Entire KNE site	GWRC Biosecurity department	Park-wide surveillance and control of priority weeds during other operations	Broad scale control to facilitate regeneration and prevent entrenchment	Nil	$2,000	$2,000

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable and resourcing		
							2017/18	2018/19	2019/20
1	EW 4	Ecological weed control	Lakes and wetlands	GWRC Biosecurity department	Aquatic weed control to control *Egeria* and *Elodea* Aerial operation as per resource consent WGN140240	Suppression of weeds to maintain native dominance. Prevent incursion into main lakes area.	$6,000	$6,000**	$6,000**
1	EW 4	Resource consent Monitoring	Lakes and wetlands	GWRC Environmental Science	Monitoring of aquatic weed control as per resource consent WGN140240	Suppression of weeds to maintain native dominance	$6,000	$6,000**	$6,000**
1, 2	PA 1-4	Pest animal control	Entire KNE site	MIRO and other volunteers	Service pest animal kill-traps monthly and kill-traps on shingle beaches fortnightly during the breeding season (August – February)	Mustelids <5% TTI** Possums <5%RTCI* Rats <10% TTI* Reduction in number and impact of hedgehogs	Nil	Nil	Nil
1, 2	N/A	Pest animal control	Entire KNE site	GWRC Biosecurity department	Annual maintenance service and safety audit of bait station and trap network to ensure safe and effective operation	No accidents caused by defective infrastructure 90% of pest animal network effective at all times	$1,000	$1,000	$1,000
1, 2	N/A	Pest animal control	Entire KNE site	GWRC Biosecurity department	Bait provision to support MIRO/volunteers		$500	$500	$500

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable and resourcing		
							2017/18	2018/19	2019/20
1	PA 1, PA 6, PA 8, PA 9	Pest animal control	Entire KNE site	GWRC Biosecurity department	Six visits per year to control either feral goats or undertake night shooting for possums, rabbits, hares and feral cats across the escarpments and shingle beaches	Reduction in distribution and abundance of target species.	$8,500	$8,500	$8,500
1, 2	PA 1	Pest animal control	Entire KNE site	GWRC Biosecurity department	Expansion of pest animal network to include installation of possum kill-traps across whole KNE site	Possums <5%RTCI*	$3,500	Nil	Nil
1	N/A	Fencing	Entire KNE site	GWRC Biodiversity	Biodiv. fencing budget available for new revegetation plots	N/A	Nil	$3,500	$3,500
1	OT 1	Revegetation	Regenerating hillslopes	MIRO	Ongoing revegetation as resources allow using locally sourced plants	Survival rate of >80%	Parks funded	Parks funded	Parks funded
2	HA 2, HA 3	Banded dotterel nest protection and monitoring	Coastal platform	PNBST	Rāhui placed over banded dotterel nesting sites annually between August – February	Rāhui placed and observed	Parks funded	Parks funded	Parks funded
2	HA 2, HA 3	Banded dotterel nest protection and monitoring	Coastal platform	GWRC Parks department and MIRO	Temporary fencing of rāhui areas annually between August – February - Using existing fencing supplies	Fencing completed annually	Nil	Nil	Nil

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable and resourcing		
							2017/18	2018/19	2019/20
2	PA 3, PA 4, PA 6, HA 2, HA 3	Banded dotterel nest protection and monitoring	Coastal platform	MIRO	Banded dotterel nest monitoring annually between August – February 1-2 per week	Monitoring completed and reported	Nil	Nil	Nil
						Total	**$47,500**	**$47,500**	**$47,500**

*** TTI = Tracking tunnel index. The control regime has been created to control mustelids to this level but monitoring will not be undertaken. Experience in the use of this control method indicates this target will be met**

**** When Egeria operations are not required, this funding will be used for other KNE programme pest plant and monitoring operations**

11. Funding contributions

11.1. Greater Wellington contribution

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

Table 4: Greater Wellington Allocated budget for Parangarahu Lakes Area KNE

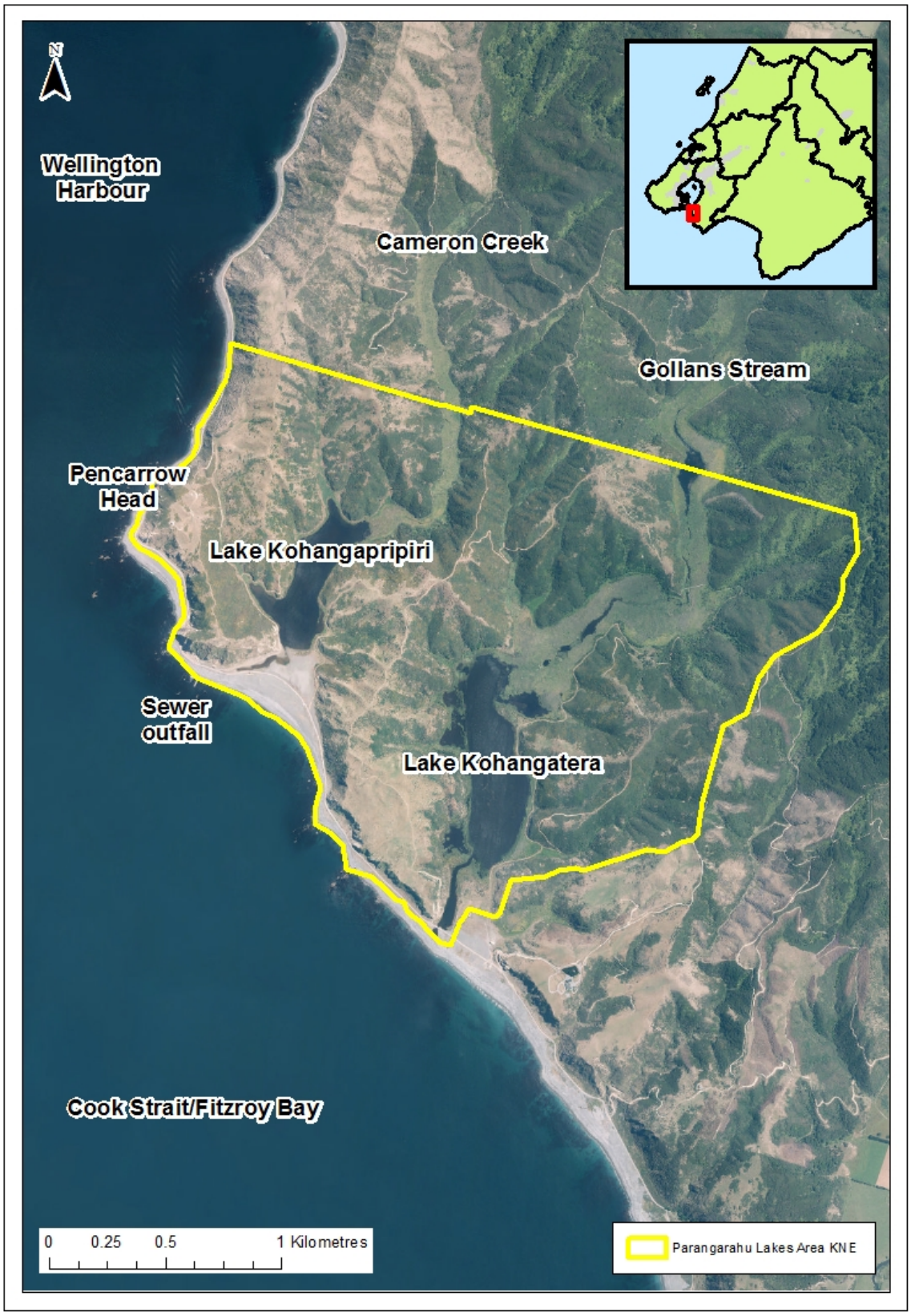
Management activity	Timetable and resourcing		
	2017/18	2018/19	2019/20
Ecological weed control	$26,000	$26,000	$26,000
Resource Consent monitoring	$6,000	$6,000	$6,000
Pest animal control	$9,500	$9,500	9,500
Revegetation/Fencing	$3,500	$3,500	$3,500
Environment Enhancement Fund [administered by Parks]	$4,000	$4,000	$4,000
Total	**$49,000**	**$49,000**	**$49,000**

11.2. Other contributions

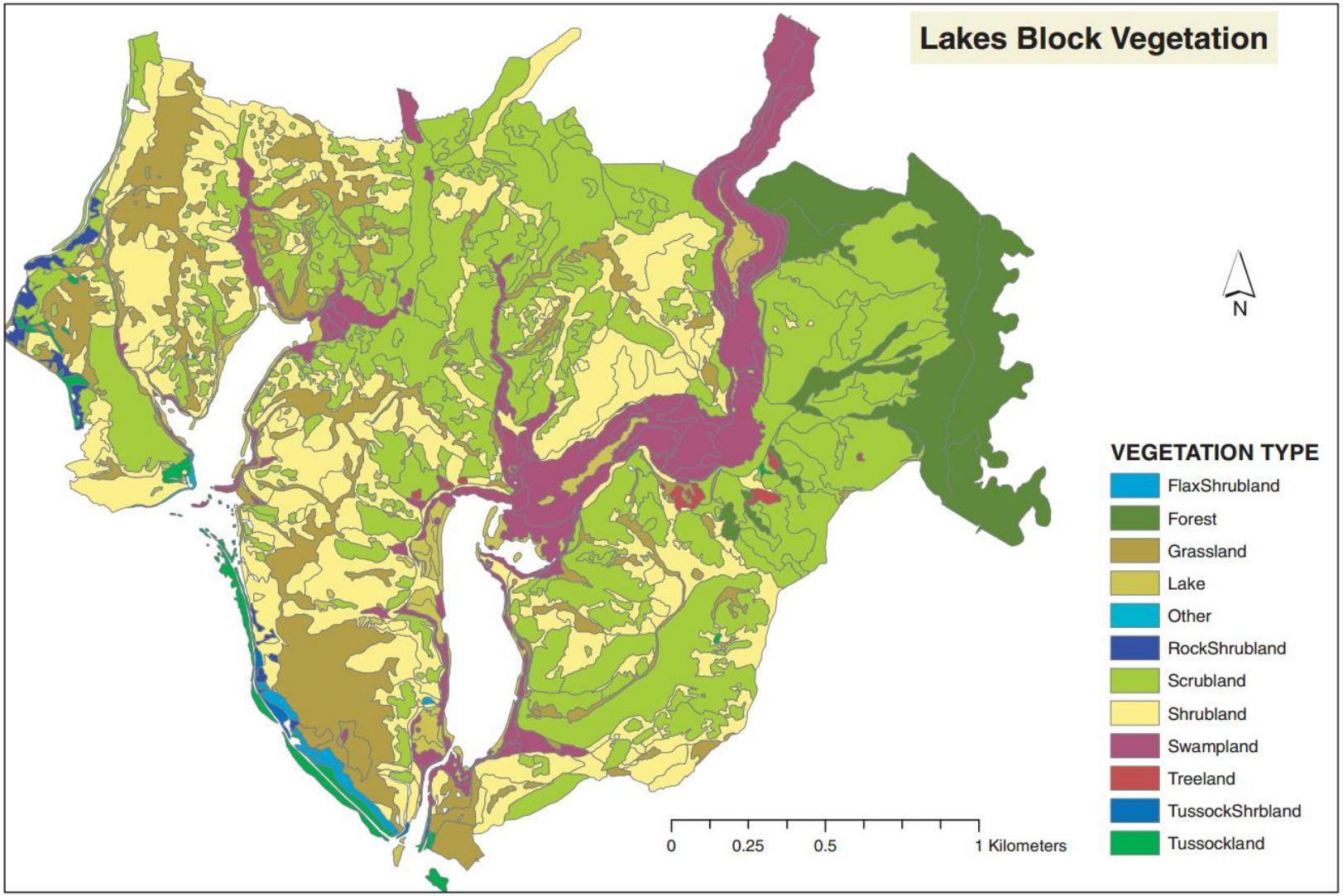
Table 5: Additional allocated budget for Parangarahu Lakes Area KNE from other management partners

Management activity	Timetable and resourcing		
	2017/18	2018/19	2019/20
HCC: - Bait for pest animal control	$500	$500	$500
HCC: - Ecological weed control for marram control	$1,000	$1,000	$1,000
DOC: - Ecological weed control for marram control	$1,000	$1,000	$1,000
Total	**$2,500**	**$2,500**	**$2,500**

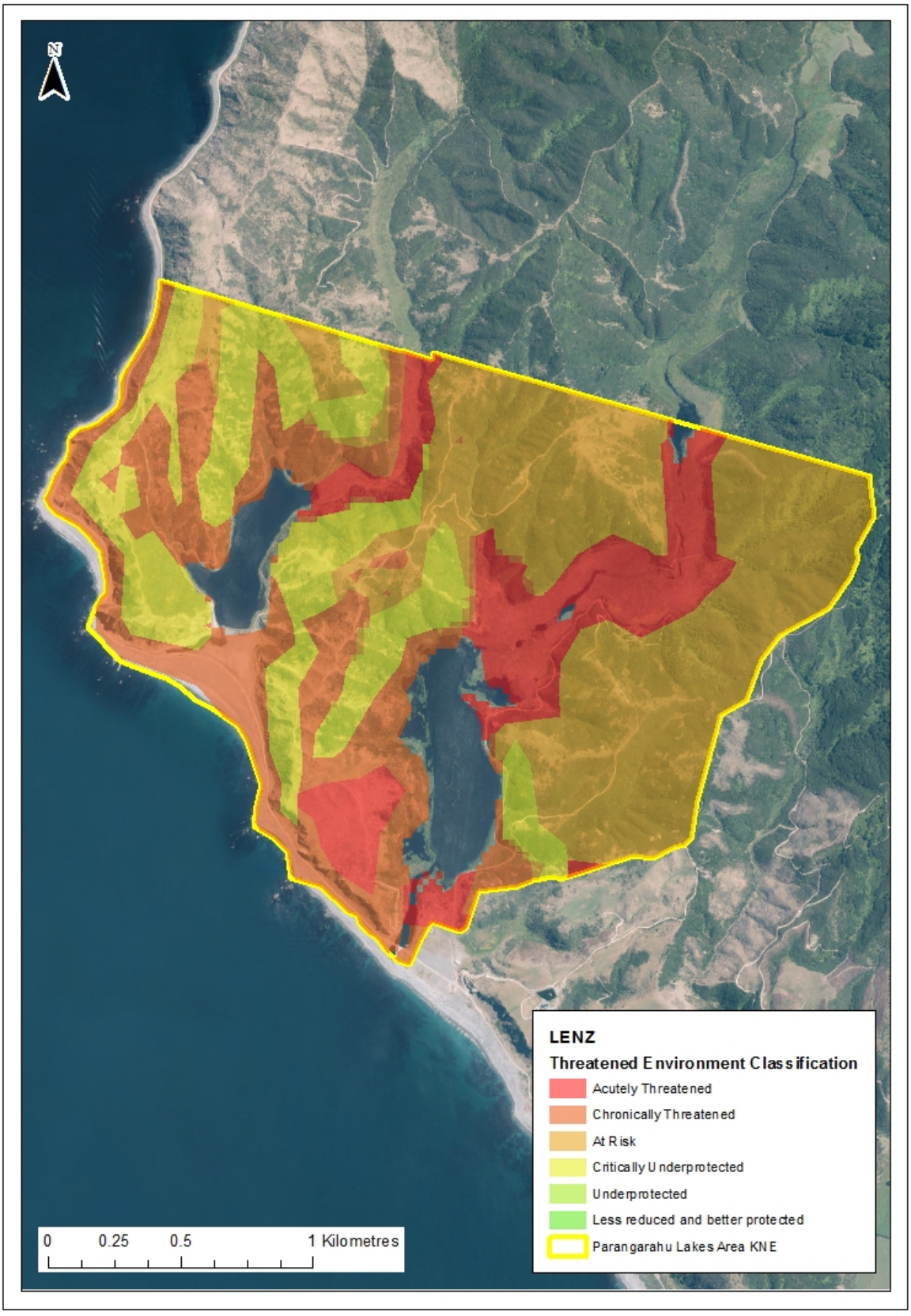
Appendix 1: Site maps



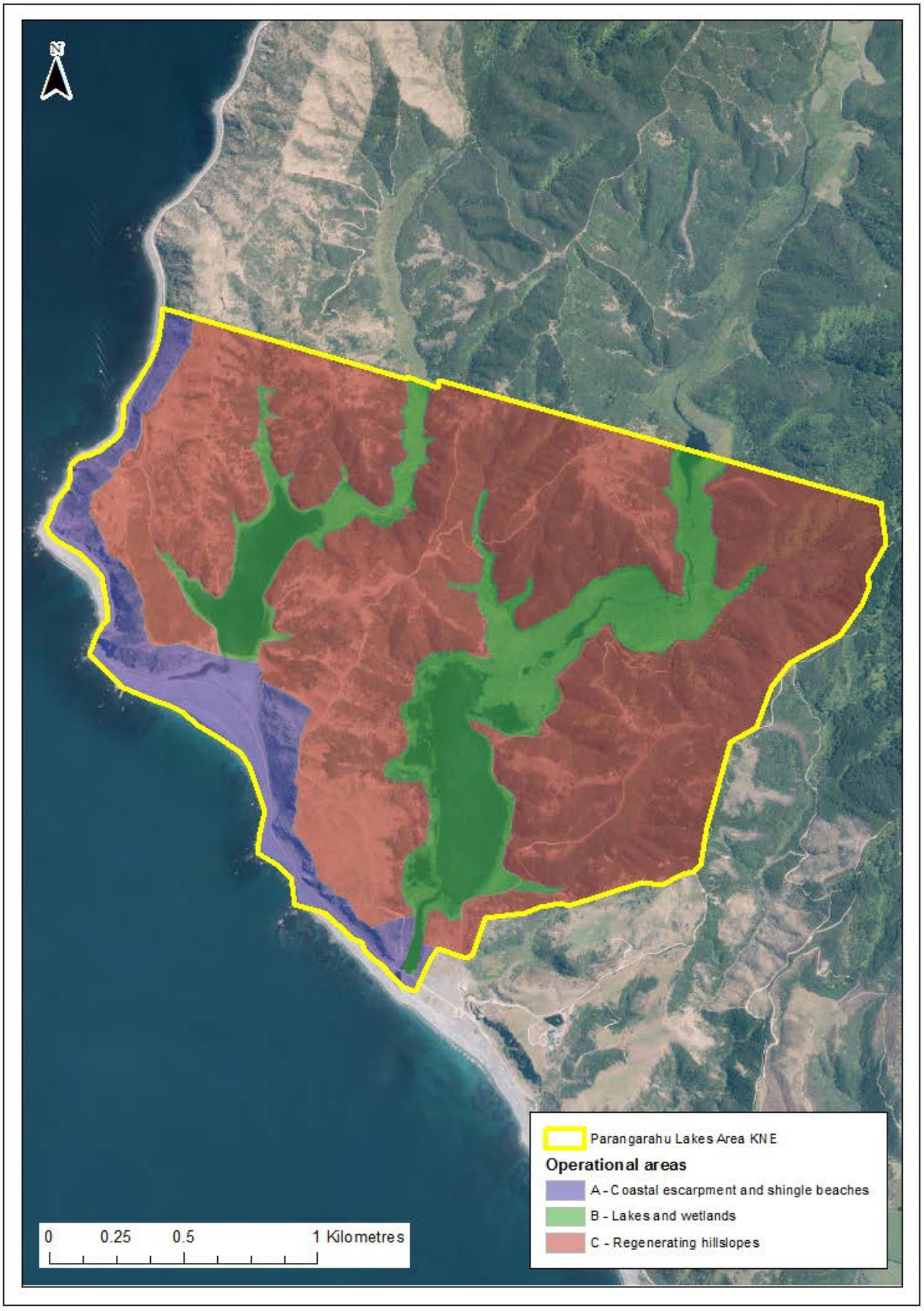
Map 1: Parangarahu Lakes Area KNE site boundary



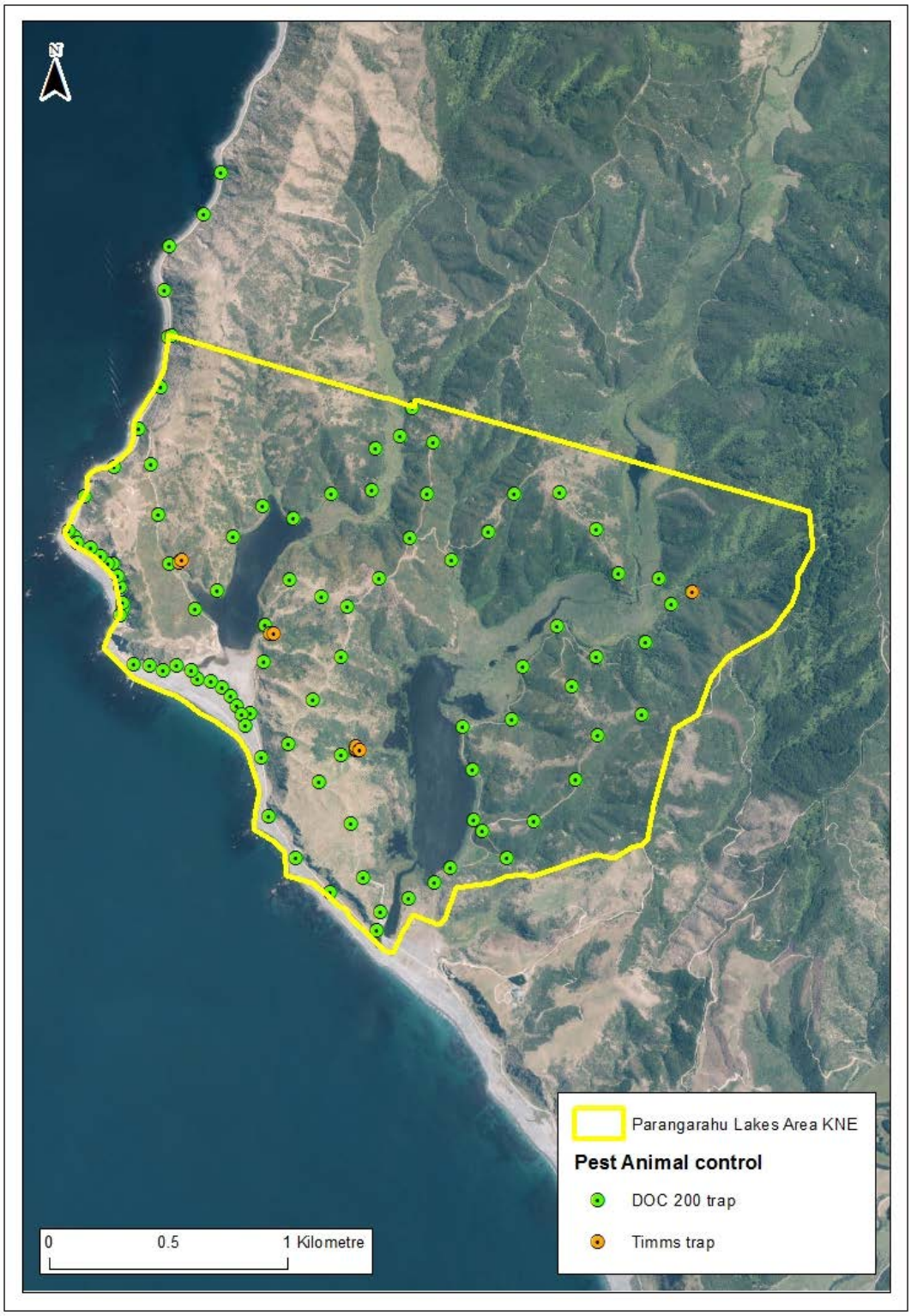
Map 2: Vegetation structural classes at Parangarahu Lakes Area KNE site[50]



Map 3: Land Environments of New Zealand Threatened Ecosystems for Parangarahu Lakes Area KNE site



Map 4: Operational areas in Parangarahu Lakes Area KNE site



Map 5: Pest animal control in Parangarahu Lakes Area KNE site

Appendix 2: Threatened species list

The New Zealand Threat Classification System lists extant species according to their threat of extinction. The status of each species group (birds, plants, reptiles, etc) is assessed over a five-year cycle. 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 species that have been recorded within the KNE.

Table 6: Threatened species at Parangarahu Lakes Area KNE

Scientific name	Common name	Threat status	Source/Comments
Plants (vascular)[51]			
Centipeda aotearoana	Sneezeweed	At Risk – Naturally Uncommon	Gibbs (2002)[52]
Craspedia uniflora var. *maritima*		At Risk – Naturally Uncommon	Gibbs (2002)
Crassula kirkii	Kirk's crassula	At Risk – Naturally Uncommon	Gibbs (2002)
Crassula sinclairii		At Risk – Naturally Uncommon	Gibbs (2002)
Chenopodium allanii		At Risk – Naturally Uncommon	Gibbs (2002)
Eryngium vesiculosum	Sea holly	At Risk – Declining	Gibbs (2002)
Ficinica spiralis	Pīngao	At Risk – Declining	Gibbs (2002)
Geranium aff. *microphyllum*		At Risk – Naturally Uncommon	Gibbs (2002)
Geranium retrorsum		Threatened – Nationally Vulnerable	Gibbs (2002)
Lepilaena bilocularis		Threatened – Nationally Vulnerable	de Winton (2013a)[53]
Leptinella dispersa subsp. *dispersa*		At Risk – Naturally Uncommon	Gibbs (2002)
Melicytus aff. *obovatus* (Cook Strait)		At Risk – Naturally Uncommon	Gibbs (2002)
Melicytus crassifolius	Thick-leaved māhoe	At Risk – Declining	Gibbs (2002)
Muehlenbeckia ephedroides	Leafless pōhuehue, dead stick plant	At Risk – Declining	Gibbs (2002)
Nematoceras macranthum	Spider orchid	At Risk – Naturally Uncommon	Gibbs (2002)
Nematoceras trilobum agg. (Rimutaka)	Spider orchid	Data Deficient (Taxonomically uncertain entity)	Gibbs (2002)

Scientific name	Common name	Threat status	Source/Comments
Pimelea spp.	New Zealand daphne	Data Deficient (undescribed species/hybrid swarm)	Gibbs (2002)
Ranunculus limosella		At Risk – Declining	Gibbs (2002)
Ranunculus macropus	Swamp buttercup	Data Deficient	Gibbs (2002)
Stuckenia pectinata	Sago pondweed	At Risk – Naturally Uncommon	de Winton (2013a)
Zannichellia palustris	Horned pondweed	At Risk – Naturally Uncommon	de Winton (2013a)
Birds[54]			
Anthus novaeseelandiae	NZ pipit	At Risk – Declining	Gibbs (2002)
Charadrius bicinctus	Banded dotterel	Threatened – Nationally Vulnerable	Gibbs (2002)
Hydroprogne caspia	Taranui, Caspian tern	Threatened – Nationally Vulnerable	Gibbs (2002)
Larus novaehollandiae scropulinus	Tarāpunga, red billed gull	At Risk – Declining	Gibbs (2002)
Phalacrocorax carbo	Large black shag	At Risk – Naturally Uncommon	Gibbs (2002)
Phalacrocorax varius varius	Pied shag	At Risk – Recovering	Gibbs (2002)
Poliocephalus rufopectus	NZ dabchick	At Risk – Recovering	Gibbs (2002)
Sterna striata striata	Tara, white fronted tern	At Risk – Declining	Gibbs (2002)
Freshwater fish[55]			
Anguilla dieffenbachii	Longfin eel	At Risk – Declining	Gibbs (2002)
Galaxias argenteus	Giant kōkopu	At Risk – Declining	Gibbs (2002)
Galaxias brevipinnis	Kōaro	At Risk – Declining	Gibbs (2002)
Galaxias maculatus	Inanga, whitebait	At Risk – Declining	Gibbs (2002)
Geotria australis	Lamprey	Threatened – Nationally Vulnerable	Gibbs (2002)
Gobiomorphus huttoni	Redfin bully	At Risk – Declining	Gibbs (2002)
Invertebrates (less well known terrestrial invertebrates)[56](butterflies and moths)[57]			
Ericodesma aerodana	Moth	Threatened – Nationally Endangered	Gibbs (2002)
Hyridella menziesi	Kākahi, freshwater mussel	At Risk – Declining	McEwan (2013)[58]
Notoreas perornata (Wellington)	Coastal moth	Threatened – Nationally Critical	Gibbs (2002)

References

[1] New Zealand legislation. 1991. Resource Management Act 1991.
[2] Greater Wellington Regional Council. Greater Wellington Regional Council 10 Year Plan: 2015 – 2025.
[3] Greater Wellington Regional Council. 2011. Parks Network Plan. GW/CP-G-11/101.
[4] Greater Wellington Regional Council. 2016. Greater Wellington Regional Council Biodiversity Strategy. http://www.gw.govt.nz/assets/council-publications/Biodiversity-Strategy-2016.pdf
[5] Department of Conservation, 1987. Ecological Regions and Districts of New Zealand.
[6] Greater Wellington Regional Council. 2014. Parangarahu Lakes Area Co-Management Plan – and amendment to the GWRC Parks Network Plan. GW/CC-G-14/77.
[7] Greater Wellington Regional Council. 2010. Parks Network Plan.
[8] Greater Wellington Regional Council. 2015. Proposed Natural Resources Plan. P. 288-289.
[9] Hutt City Council. 2012. Pencarrow Coast Road Policy for Vehicle Use 2012-2017.
[10] Gibbs G. 2002. Pencarrow Lakes – Conservation values and management. Department of Conservation.
[11] Williams PA, Wiser S, Clarkson B, Stanley MC. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Ecology 31(2): 119-128.
[12] Holdaway RJ, Wiser S, Williams PA. 2012. Status Assessment of New Zealand's Naturally Uncommon Ecosystems. Conservation Biology 26 (4): 619-629.
[13] Walker S, Cieraad E, Grove P, Lloyd K, Myers S, Park T, Porteous T. 2007. Guide for users of the Threatened Environment Classification. Landcare Research Manaaki Whenua.
[14] de Winton M, Champion P, Wells R. 2011. LakeSPI assessment of the Parangarahu Lakes and Lake Pounui: with reference to management of ecological values. Prepared for Greater Wellington Regional Council. NIWA Client Report No. HAM2011-038
[15] Susan Wiser, Landcare Research, pers comm 2011.
[16] Bev Clarkson, Landcare Research, pers comm 2012.
[17] de Winton M, Champion P, Wells R. 2011. LakeSPI assessment of the Parangarahu Lakes and Lake Pounui: with reference to management of ecological values. Prepared for Greater Wellington Regional Council. NIWA Client Report No. HAM2011-038.
[18] Wells R, Champion P. 2004. Lakes Kohangapiripiri and Kohangatera (Pencarrow Lakes): Survey of submerged flora. Prepared for Greater Wellington Regional Council. NIWA Client Report No. HAM2004-065.
[19]Gibbs G. 2002. Pencarrow Lakes – Conservation values and management. Department of Conservation
[20] Ian Armitage, OSNZ, pers comm 2013.
[21] Greater Wellington Regional Council. 2015. Proposed Natural Resources Plan.
[22] McEwan A. 2013. Considerations for restoration of native freshwater fish populations in the Parangarahu Lakes. Prepared for Roopu Tiaki. Riverscapes Freshwater Ecology.
[23] McEwan A. 2013. Considerations for restoration of native freshwater fish populations in the Parangarahu Lakes. Prepared for Roopu Tiaki. Riverscapes Freshwater Ecology.
[24] Milne R, Sawyer J. 2002. Coastal foredune vegetation in Wellington Conservancy. Current status and future management. Department of Conservation.
[25] Gibbs G. 2002. Pencarrow Lakes – Conservation values and management. Department of Conservation
[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, 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] Parkes JP. 2005. Feral goat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 374–391.
[48] 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.
[49] Greater Wellington Regional Council. 2014. Parangarahu Lakes Area Co-Management Plan – and amendment to the GWRC Parks Network Plan. GW/CC-G-14/77.
[50] Greater Wellington Regional Council. 2009. East Harbour Resource Statement.

[51] 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. Department of Conservation.
[52] Gibbs G. 2002. Pencarrow Lakes – Conservation values and management. Department of Conservation.

[53] de Winton M. 2013a. LakeSPI survey of Lake Kohangatera : 2013. Prepared for Greater Wellington Regional Council. NIWA Client Report No. HAM2013-052.
[54] 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
[55] 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.
[56] Buckley TR, Palma RL, Johns PM, Gleeson DM, Heath ACG, Hitchmough RA, Stringer IAN. 2012. The conservation status of small or less well known groups of New Zealand terrestrial invertebrates. New Zealand Entomologist 35: 137-143.
[57] Stringer IAN, Hitchmough RA, Dugdale JS, Edwards E, Hoare RJB, Patrick BH. 2012b. The conservation status of New Zealand Lepidoptera. New Zealand Entomologist 35: 120–127.
[58] McEwan A. 2013. Considerations for restoration of native freshwater fish populations in the Parangarahu Lakes. Prepared for Roopu Tiaki. Riverscapes Freshwater Ecology.

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

June 2020
GW/BD-G-20/10

Please recycle
Produced sustainably