Key Native Ecosystem Plan for the Parangarahu Lakes Area

2014-17

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Contents

1. Key Native Ecosystems plan

New Zealand's indigenous biodiversity continues to decline nationally, and in the Wellington region. Major reasons for the decline are that native species are preyed on or outcompeted by invasive species, and ecosystems and habitats are lost or degraded through human resource use and development. Active management to control threats is required to protect indigenous biodiversity. Regional councils have responsibility to maintain indigenous biodiversity, as well as to protect significant vegetation and habitats of threatened species, under the Resource Management Act 1991 (RMA).

Greater Wellington Regional Council's (GWRC's) vision for biodiversity is:

> *"The Wellington region contains a full range of naturally occurring habitats and ecosystems that are in a healthy functioning state and supporting indigenous biodiversity"*

GWRC's Biodiversity Strategy 2011-2021[1] provides a common focus across the council's departments, and guides activities relating to biodiversity. One of its goals is: High value biodiversity areas are protected.

In order to achieve this vision and goal, the Key Native Ecosystem (KNE) programme seeks to protect some of the best examples of ecosystem types in the Wellington region by managing, reducing, or removing threats to their values. Sites with the highest biodiversity values have been identified and then prioritised for management. Active management of KNEs can involve control of ecological weeds and pest animals, fencing to exclude stock, restoration planting and helping landowners to legally protect these areas.

KNEs are managed in accordance with three-year KNE plans, such as this one, prepared for each area by the GWRC's Biodiversity department in collaboration with the landowners and other stakeholders. These plans outline the ecological values and threats specific to each KNE, set out objectives for biodiversity management, and prescribe the operational actions and budget required to work towards achieving the objectives.

Much of the work planned in KNEs will be carried out by GWRC staff or contractors engaged by GWRC. For example, the Biosecurity department carries out ecological weed and pest animal control to achieve the objectives set out in KNE plans.

GWRC also recognizes that working relationships between the management partners are critical for achieving the objectives for the KNE. Under the KNE programme, GWRC staff also work with landowners and volunteer community groups involved in protection or restoration work within KNEs.

KNE plans are reviewed regularly to ensure the activities undertaken to protect and restore the KNE are informed by experience and improved knowledge about the site.

2. Parangarahu Lakes Area Key Native Ecosystem

The Parangarahu Lakes Area KNE is located on the eastern side of the Wellington Harbour heads (Appendix 1, Map 1). The 471 hectare area is protected as Conservation Covenants, Scientific Reserve, Recreation Reserve, Māori Reservation, and Historic Reserve, while some land is held as road reserve or for sewer/drainage purposes as the Hutt City Council's main sewer outfall is adjacent to the area. Parangarahu Lakes Area KNE is within the Tararua Ecological District[2] but the coastal parts share many affinities with the nearby Cook Strait Ecological District.

Landowners and stakeholders

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

Landowners

The KNE covers land owned by GWRC, Port Nicholson Block Settlement Trust, Department of Conservation (DOC), Hutt City Council (HCC) and the Historic Places Trust (Appendix 1, Map 2). Taranaki Whānui ki Te Upoko o Te Ika hold mana whenua for this area. They are represented by the Port Nicholson Block Settlement Trust Board, the iwi authority for this area.

While the Parangarahu Lakes Area KNE is mainly part of the larger East Harbour Regional Park, the area is managed by a Roopu Tiaki (Guardianship Group), which comprises representatives of the Port Nicholson Block Settlement Trust and GWRC senior management. A Parangarahu Lakes Area Co-Management Plan is being prepared and will be released for public consultation in 2014. This plan will inform an amendment to the GWRC Parks Network Plan[3], which notes objectives and policies regarding recreational, heritage and biodiversity values, and rules regarding use of the park. This KNE plan is consistent with the objectives and policies of the Parks Network Plan and the draft Parangarahu Lakes Area Co-Management Plan.

Hutt City Council is an important management partner as it owns land within the KNE and manages the controlled-access coastal road[4] from Eastbourne and the sewer outfall at Pencarrow Head. DOC also has significant statutory responsibilities relating to the lakes as it administers some land, as well as the water column and airspace above the lake bed and the associated esplanade reserve (refer to the draft Parangarahu Lakes Area Co-Management Plan for more detail).

The primary management partners within GWRC are the Biodiversity department (management advice and overview), the Parks department (overall park planning and site management) and the Biosecurity department (pest control). Partnership relationships with landowners, stakeholders and interest groups external to GWRC are also critical to the successful implementation of this KNE plan.

Key stakeholders

The area has a long history of use and occupation by Māori. Restoration of the lakes' ecosystems, including their connection with the sea and the plants and birdlife within and around them, has been identified as being very important to tāngata whenua in restoring Māori biodiversity, cultural and spiritual values. The restoration of the native fish fauna is particularly significant to tāngata whenua.

GWRC supports the work of the Mainland Island Restoration Operation (MIRO) volunteer group which has been actively working with GWRC since 2007 to establish planting plots and trap predators at Parangarahu Lakes Area. It reports the results of its actions to GWRC.

Other stakeholders who have interests in the KNE or may be affected by biodiversity management include the Historic Places Trust, which owns the Pencarrow Lighthouse land, the East Harbour Environmental Association, Horokiwi Quarries who seasonally operate a sand quarry nearby, Fish and Game New Zealand, Wellington Wildfowlers, and the Royal Forest and Bird Protection Society, as well as recreational users of the area and adjacent private landowners.

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.

The lakes[5] and the shingle beaches at Kohangapiripiri[6] have been described as the best examples of their ecosystem type nationally, while the associated swamp wetlands are some of the best condition wetlands of their type in the country[7].

The area contains a complex assemblage of vegetation (Appendix 1, Map 3,) which is habitat for a very high number of threatened species (see Appendix 2). A comprehensive report detailing the ecological significance of the Parangarahu Lakes Area was completed by George Gibbs[8], and a summary of the ecological values will be included in the Parangarahu Lakes Area Co-Management Plan.

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

Regenerating hillslopes

The vegetation on the hills has been highly modified by more than 150 years of burning and grazing – only small native forest remnants remain, mainly in the north-eastern most part of the block. Areas of gorse (*Ulex europaeus*) and mānuka (*Leptospermum scoparium*) as well as tauhinu (*Ozothamnus leptophyllus*) and regenerating native bush are present. Generally, the area is now regenerating to native vegetation after grazing ceased in 2004.

It is expected that gorse and native scrub will initially replace the open grassland but will eventually be succeeded by native canopy tree species. Most of the area has been left to regenerate naturally, except for some trial revegetation planting plots that were established to supplement the current species and include species representative of the original forest.

Coastal escarpments and shingle beaches

South of Pencarrow Head, the coast is exposed to the full force of the southerly winds and heavy swells of Cook Strait.

The escarpments and debris slopes are typically covered in wind-sheared mingimingi (*Coprosma propinqua*), whararikí (*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 NZ 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[9]. The sand binders pīngao (*Ficinia spiralis*) and spinifex (*Spinifex sericeus*) are beginning to build low sand dunes where enough fine sand occurs at the toe of the escarpments and inland edges of shingle beaches. Marram grass (*Ammophila arenaria*) has invaded many of these areas and is dominant in some parts, particularly seaward of the road between the two lakes. 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.

These dunes and shingle beaches support a number of nationally and regionally threatened species such as leafless muehlenbeckia (*Muehlenbeckia ephedroides*) and sea holly (*Eryngium vesiculosum*)[10]. The shingle beaches are important breeding habitat for banded dotterels (*Charadrius bicinctus*) as it is the second largest coastal breeding population in the Wellington region[11].

Lakes and wetlands

The two lakes, Kohangapiripiri and Kohangatera, and their associated swamps contain extensive communities of wetland plants. Although the lakes have not been permanently open to the sea for 5000-7000 years due to tectonic uplift, salinity levels fluctuate as a result of storm and flood events.

The emergent wetland vegetation is dominated by raupō (*Typha orientalis*), lake club rush (*Schoenoplectus tabernaemontani*), 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.

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 are widespread in 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)[12]. 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[13].

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*)[14]. Pāteke (*Anas chlorotis*) has also been recorded in the recent past[15].

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

- ***Naturally Uncommon Ecosystems:*** There is an unusually diverse mix of naturally uncommon ecosystems[16] represented. These are: shingle beaches, active sand dunes and lagoons (all Nationally Endangered[17]), lake margins and estuaries (both Nationally Vulnerable), and coastal rock stacks (not classed as threatened).
- ***Threatened Ecosystems:*** The Land Environment New Zealand (LENZ) Threatened Environment classification[18] rates many ecosystem types in the KNE as being threatened (Appendix 1, Map 5). 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. There are also two 'Threatened' species that are only occasional visitors (the Nationally Vulnerable NZ falcon and reef heron). The 'At Risk' sand tussock (*Poa billardierei*), recorded prior to 2002, is thought to no longer occur within the KNE, but still remains in the Baring Head block 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 site, but are either considered vagrants or irregular visitors (e.g. little black shag, reef heron, grey duck) or are oceanic species that are unlikely to make landfall (e.g. fluttering shearwater). Little penguin, Australasian bittern and spotless crake are possibly present at this site, but no recent records have been located. See Appendix 2 for the complete list of 'Threatened' and 'At Risk' species.

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.

Throughout the area introduced predators and browsers are having an impact on the ecological values of the site. For example, high numbers of hedgehogs are having detrimental effects on the success of ground nesting birds. On the coastal cliffs gorse is well established and has the potential to take over from indigenous vegetation in most areas. On the beaches marram also has the capacity to take over and reduce the natural values. In the lakes and wetlands the aquatic weed Canadian pondweed (*Elodea canadensis*) is present in some areas of the lake at low densities but it does occasionally get up to 25% of cover. Egeria (*Egeria densa*) dominates an open water area upstream in Gollans wetland[19].

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 Plan (Table 2) 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 1: 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	Marram grass will dominate and displace coastal plant species.	Coastal escarpments and shingle beaches
EW-2	Gorse changes natural ecological succession, preventing native colonising species (mānuka/kānuka/tauhinu) from establishing. It will permanently displace native plants on coastal escarpments.	Regenerating hillslopes, coastal escarpments and shingle beaches
EW-3	Horned poppy and lupin quickly invade and displace native coastal plant species.	Coastal escarpments and shingle beaches
EW-4	Boneseed will displace native plants on coastal escarpments and also change the succession process in a similar manner to gorse.	Whole KNE
EW-5	Beggars' ticks and yellow flag iris, if left to spread, will dominate quickly (particularly along lakeshore margins) and displace threatened native plant species.	Lakes and wetlands
EW-6	Aquatic weeds (especially *Egeria densa* and to a lesser extent *Elodea canadensis*)[20] are displacing native plants and changing the structure and function of the native aquatic ecosystem[21].	Lakes and wetlands
EW-7	Karaka, spread by kererū into forest, scrub and shrublands, can prevent natural regeneration of the understorey.	Regenerating hillslopes

Code	Threats and their impact on biodiversity in the KNE	Operational area/location
EW-8	Ecological weeds, including wilding pines, may reinvade from land outside the KNE.	Whole KNE
EW-9	Dense exotic grass swards are dominating *Muehlenbeckia ephedrioides.*	Coastal escarpments and shingle beaches
Pest animals		
PA-1	Possums and rats browse native flora and their seeds, inhibiting natural regeneration and altering the structure and diversity of vegetation communities.	Whole KNE
PA-2	Goats browse native vegetation inhibiting natural regeneration and altering vegetation structure and diversity.	Whole KNE
PA-3	Pigs root up the ground, destroying vegetation, eating invertebrates and disturbing soil allowing weeds to invade.	Whole KNE
PA-4	Possums, rats, hedgehogs and cats prey on native birds (including young chicks and eggs), lizards and invertebrates. Banded dotterels and variable oystercatchers use the shingle beaches as breeding habitat and are particularly vulnerable to these predators.	Whole KNE
PA-5	Pest animal species may reinvade from land outside the KNE.	Whole KNE
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.	Whole KNE
HA-2	Off-road vehicles damage and can destroy sensitive plant communities, especially on shingle beaches and lake shore vegetation.	Whole KNE
HA-3	Off-road vehicles disturb nesting birds and destroy ground-level nests.	Whole KNE
HA-4	Recreational users accessing lakes and wetlands may inadvertently introduce or spread aquatic weeds. This includes (but is not limited to) duck hunting, fishing and boating.	Lakes and wetlands
Other threats		
OT-1	Stock trespass. Stock browsing and trampling inhibits natural regeneration of native vegetation and alters vegetation composition and diversity. Stock can damage restoration plantings. Stock movement pugs soil, causing siltation in waterways. Grazing stock add nutrients to land and waterways, reducing water quality and degrading changing freshwater habitats. Stock can spread plant pests within the KNE (through seed in faeces or on their coats) and introduce plant pest species if moved or given feed from outside the KNE.	Whole KNE

Code	Threats and their impact on biodiversity in the KNE	Operational area/location
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
OT-3*	Protection of some cultural heritage sites (see Appendix 8) may be at odds with restoring ecological values e.g. regenerating vegetation or restoration planting might damage or obscure archaeological sites and/or cultural values.	Whole KNE
OT-4	Planting of new karaka trees into existing karaka groves could introduce pathogens to the old trees and could undermine historic values.	Regenerating hillslopes
OT-5*	Local extinctions. Natural species diversity within the KNE is reduced by the historic local loss of some native plant and animal species.	Whole KNE

***Threats marked with an asterisk are not addressed by actions in the Operational Plan. Not all threats can be adequately addressed. Threats might not be managed for a number of reasons including financial, legal, or capacity restrictions. However, in order to manage the KNE as a whole, it is important to be aware of all threats to ecological values.**

3. Objectives and management activities

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

To be consistent with the Parangarahu Lakes Area Co-Management Plan, the KNE will be managed to protect and restore the values of the ecosystems present and the habitats of threatened species it contains. Management activities will also enhance its potential as habitat for populations of freshwater fish species that are crucial to the healthy functioning of the lakes' ecosystems.

Objectives

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

1. **To increase native plant dominance**
2. **To increase native plant regeneration**
3. **To increase abundance of threatened plants**
4. **To reintroduce plant species to the site**
5. **To increase populations of threatened animal species**
6. **To engage the community in management of the KNE**
7. **To engage the landowners in the management of the KNE**

Management activities

Management of biodiversity is achieved most effectively when coordinated across landscapes. The management activities set out in this Plan have been developed in the context of other biodiversity management activities being carried out in the wider ecological landscape. Relevant management is referred to under the individual sections below. In implementing this Plan, GWRC will integrate activities that contribute to the objectives of other management plans where possible.

Management activities are targeted to work towards the objectives above by responding to the threats outlined in Table 1. The management activities are described briefly below, and specific actions, with budget figures attached, are set out in the Operational Plan (Table 2).

Whole catchment management

Where possible, a whole-of-catchment approach will be taken in managing the KNE (ie, putting effort into managing all the geographic area that drains into the lakes). Much of the catchment is forested and/or legally protected, with the exception of the large area of private property which makes up about half of the Gollans Stream/Lake Kohangatera catchment (Appendix 1, Map 6). Where possible, GWRC will work with landowners to protect and manage all influences on the health and integrity of the wetlands and streams in the catchment (see also 'Cross-boundary issues').

Pest animal control

Intensive pest animal control is critical to protecting the values present within the KNE. Multiple pest animal species are targeted using different management methods. Predator control will target mustelids throughout the KNE and hedgehogs on the shingle beaches. Some rats are controlled as by-kill using the current methods. Possum kill traps are located near planting plots to provide control additional to the ongoing Bovine TB Vector Control operation that targets possums and ferrets throughout the area. Map 7 in Appendix 1 shows the locations of existing integrated pest animal control equipment.

Ecological weed control

A relatively small number of ecological weeds are present in the Parangarahu Lakes Area KNE. As a general principle, outlying areas of ecological weeds should be controlled first and then more entrenched infestations controlled over time. Regular follow-up of areas previously controlled is also important to avoid reinvasion from any untreated plants.

This principle will be applied to the control of: marram grass (starting with the shingle beaches and associated sand dunes at Lake Kohangapiripiri followed by progressive control along the coast toward Lake Kohangatera) which is supported by HCC and DOC; boneseed (suppression to low levels on coastal escarpments in a buffer zone that extends north to a small gully just south of Burdans Gate) supported by HCC; and minor infestations of species such as beggars' ticks, yellow flag iris, lupin, sweet briar, and broom at the southern end of both lakes.

Leafless pōhuehue (*Muehlenbeckia ephedroides*) is being outcompeted by pasture grasses. A small trial of grass selective spray is planned to investigate whether leafless pōhuehue can survive and spread when competition is controlled.

Eradication of the aquatic weeds, *Elodea canadensis* and *Egeria densa,* is thought to be impossible using management methods that are currently available. However, actively controlling the existing infestations and managing recreational use of the lakes will reduce the risk of both species spreading. *Egeria* and *Elodea* will be controlled where they dominate or are having a significant impact on the aquatic ecosystems. The *Elodea* infestation in the lakes and wetlands is thought to be limited due to the brackish nature of the lakes (naturally raised salinity). Managing recreational access and increasing the awareness of lake users will also reduce the risk of new aquatic pest plants being introduced.

Gorse is entrenched on the hills, so widespread control is not practical. However, gorse can be used to facilitate forest restoration in the regenerating hillslopes (see restoration planting below). On the coastal escarpment, where forest will never grow, gorse is likely to become dominant over indigenous vegetation if not controlled. Vegetation plot monitoring on coastal cliffs along Wellington's south coast by Wellington City Council has shown that gorse slowly becomes dominant where present on coastal cliffs and will probably dominate eventually if not managed[22]. Fortunately, it is not yet well established on the coastal escarpment between the lakes so control is possible there. There is potential to expand the control to other coastal escarpment areas (where it does not yet dominate) in the future, with the support of HCC. Horned poppy and lupin are also being targeted where they occur on the coast as they quickly spread and overcome native plants.

Regular sweeps/surveys of the entire area will enable new invasions of ecological weeds and outliers of existing infestations to be detected and controlled before they become a significant problem.

Restoration planting

Restoration planting is undertaken in the area by MIRO with the support of the GWRC Parks department. Parks supports MIRO's native plant nursery and assists with logistics and materials for planting days.

A review of the outcomes of planting trials on recommended sites[23] carried out since 2007 by MIRO has enabled the identification of four potential approaches to planting to optimise ecological and cultural outcomes:

1. ***Beech forest planting*****:** Trial planting into fenced plots of hard and black beech (these species would have dominated the forest on ridges and hillslopes in the KNE) is recommended away from exposed ridge tops, to build on and diversify the completed planting plot trials, which focused on podocarp/broadleaf planting in sheltered gully or valley sites.
2. ***Enrichment planting into existing scrub***: Planting trials (one plant every 5m along appropriately located transects) are recommended for planting forest climax canopy species into existing mānuka and gorse scrub communities, to better understand site conditions, methods and costs before implementing planting amongst scrub communities on a larger scale.

3. ***Wetland and lake edge planting:*** Planting of climax species such as harakeke, kahikatea, pukatea, tōtara, mataī and lowland ribbonwood into the existing early successional plants (typically cutty grass/rautahi- *Carex geminata*) will help to restore large areas of wetland and lake margins degraded by former stock grazing. This will also improve eel habitat and may allow the opportunity for harakeke fibre to be harvested for cultural use when it is being transplanted. Map 8 in Appendix 1 shows degraded wetland areas suitable for planting. The total area shown in the map is approximately 5.4 ha. It would take approximately 700 'climax trees' planted at 5m spacing to plant 25% of this area. The remaining 75% of the area could be planted with approximately 12,000 harakeke and toetoe at 2m spacing. Some of the harakeke could be transplanted to reduce costs.
4. ***Karaka grove enhancement*:** Karaka planting into existing karaka groves will support the wish of tāngata whenua to perpetuate the groves and protect the dendroglyphs in them. This species is not local to the area and can be invasive, so, while the cultural value of the groves is sufficient reason to protect and enhance them, karaka will be confined to these areas so that it does not threaten native forest and shrublands.

Planting is 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. Planting in known archaeological or cultural sites must be avoided (see Appendix 1, Map 9), unless appropriate consultation with tāngata whenua is undertaken and approval is granted by the Historic Places Trust. GWRC's Accidental Discovery protocol[24] must be followed if anything that may be culturally significant is found when disturbing the ground for planting.

Improving fish passage

The freshwater fish fauna of both lakes has been impacted by barriers to migration[25]. Due to recent culvert improvements and local topography, Lake Kohangatera is not as affected as Lake Kohangapiripiri by the road and culvert barriers at the lake outlets[26]. The topography of the beach combined with the location of the road and culvert at Lake Kohangapiripiri is preventing fish passage and natural breaching of the lakes to the sea. A number of options are being explored to improve the fish passage at the mouth of Lake Kohangapiripiri. These include realignment of the road, new culverts, improvements to existing culverts and cutting the mouth at appropriate times[27].

Species reintroduction opportunities

Due to the very high habitat values of the KNE, considerable potential exists for reintroduction of species that would have naturally occurred in the area and are now locally extinct. These include:

- ***Birds:*** The nationally endangered pāteke (brown teal *Anas chlorotis*) and possibly the New Zealand dotterel (*Charadrius obscurus*) and shore plover

(*Thinornis novaeseelandiae*) but these species are known to be difficult to translocate due to strong homing tendencies.

- ***Plants:*** Shrubby tororaro (*Muehlenbeckia astonii*), sand tussock (*Poa billardierei*), native sow thistle (*Sonchus kirkii*), grey salt bush (*Atriplex cinerea*), shore spurge (*Euphorbia glauca*), nau/Cook's scurvy grass (*Lepidium oleracium*), scandia (*Scandia geniculata*), Beddies tussock (*Chionochloa beddiei*), *Brachyglottis greyii*, matagouri (*Discaria toumatou*), sand pimelea (*Pimelea arenaria*), kōkihi (*Tetragonia teragonioides*), shore spleenwort (*Asplenium obtusatum*), sea sedge (*Carex litorosa*), curly sedge (*Carex cirrhosa*), mīkoikoi (*Libertia peregrinans*), shore dock (*Rumex neglectus*) and Cook Strait kōwhai (*Sophora molloyii*).
- ***Lizards***: Lizard densities are relatively high but diversity is low[28] and could benefit from the reintroduction of spotted skinks (*Oligosoma lineoocellatum*). Further survey work should be undertaken to confirm that they are no longer present and rodents would need to be at very low densities before reintroduction could be considered.
- ***Invertebrates***: The endemic speargrass weevil (*Lyperobius huttoni*) could be reintroduced, subject to surveys to confirm its absence. If this species is translocated, supplementary plantings of taramea will be needed.

The process of reintroducing some of these species is likely to be led by MIRO as they have expressed interest in leading this work. GWRC may play a supporting role if any reintroduction is attempted, subject to budget provisions. No budgetary provision has been made by GWRC in the period covered by this plan for species reintroductions.

Management approach

Partnerships

In implementing this Plan, GWRC seeks to work collaboratively with stakeholders, interest groups and landowners. In particular, GWRC will work through Roopu Tiaki in implementing this Plan and in supporting implementation of the Parangarahu Lakes Area Co-Management Plan.

Within GWRC, there are likely to be synergies and cost efficiencies between different departments' work programmes and budget allocations; for example, fencing to meet both biodiversity and overall park management objectives. Coordination of pest control programmes across the East Harbour Regional Park and the local area also holds potential for cost efficiencies and enhanced outcomes for all three KNEs in the park.

There is also potential to align with other landowners and stakeholders in securing support and resources for managing the Parangarahu Lakes Area KNE. HCC funds a significant amount of management work, particularly on land it owns and manages. DOC is also contributing some funding to the marram control on the coast.

DOC will continue to manage the recreational hunting permits for the area while HCC manages access to the area via the locked Burdans Gate. GWRC will work with HCC and private landowners to reduce the incidence of illegal vehicle access to Fitzroy Bay

and off-road driving in the area. The Roopu Tiaki will provide approval for tāngata whenua activities and will consider applications for activities that require concessions and permits.

MIRO volunteers are also active partners. As well as assisting with restoration planting trials, the group runs a native plant nursery to supply the plants and undertakes some predator control, particularly along the coast to Burdans Gate. They are also keen to be involved with species reintroductions where appropriate. MIRO is partly funded through GWRC Parks and also raises external funds to support their work. They have indicated their interest in seeking funding for other types of ecological restoration work including species translocations. Volunteer involvement from the local community and local iwi in will be encouraged and supported.

Cross-boundary issues

Over time, it would be desirable to extend biodiversity management to as much of the high ecological value areas in the locality as possible, to strengthen protection from pest incursions and reduce adverse effects on the lakes. The recommended whole-of-catchment management approach requires working with private landowners adjacent to the Parangarahu Lakes Area KNE to both reduce downstream adverse impacts on the KNE and improve the ecological condition of the upper catchment. GWRC will work with landowners where possible to reduce stock access to streams, restore shading riparian vegetation on all waterways, enable appropriate fish passage throughout the catchment, and co-ordinate pest control.

Other work in the area contributes to protection of this area. Established predator control and significant ecological weed control in the area north to Burdans Gate (and potentially east to Baring Head) is similar to the work being done in the KNE and buffers the KNE from reinvasion by pest animals and ecological weeds.

This plan is one of three that will guide biodiversity management in East Harbour Regional Park; the other KNE plans relate to Baring Head Ōrua-pouanui (to the east) and East Harbour Northern Forest (to the north and upstream of Lake Kohangatera; see Appendix 1, Map 9). The potential for improving the relationship between these areas, particularly ecological connections, and the potential for synergies in management (such as in pest control programmes) should be investigated.

4. Operational plan

The operational plan shows the actions planned to achieve the stated objectives for Parangarahu Lakes Area KNE, and their timing and cost over the three-year period from 1 July 2014 to 30 June 2017. The budget for the 2015/16 and 2016/17 years are indicative only and subject to change as a result of the 2015-25 Long Term Plan process. Operational areas are shown in Appendix 1, Map 4.

Table 2: Three year operational plan for Parangarahu Lakes Area KNE.

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable & resourcing		
							2014/15	2015/16	2016/17
1-5	EW-1, 9	Ecological weed control	Coastal escarpments and shingle beaches	GWRC Biosecurity department	Marram grass and pasture grass control	Reduction in distribution and density of targeted species.	$4,500	$4,500	$4,500
1-5	EW-2,3,4	Ecological weed control	Coastal escarpments and shingle beaches	GWRC Biosecurity department	Broadleaf weed control on coast (Gorse, boneseed, lupin, horned poppy)	Reduction in distribution and density of targeted species	$5,000	$5,000	$5,000
1-3	EW-5	Ecological weed control	Lakes and wetlands	GWRC Biosecurity department	Lake edge weed control (Beggars' tick, broom, sweet briar)	Reduction in distribution and density of targeted species	$5,000	$5,000	$5,000
1-3	EW-6	Ecological weed control	Lakes and wetlands	GWRC Biosecurity department	Aquatic weed control (application of diquat herbicide to control the species *Egeria* and *Elodea*)	Reduction in distribution and density of targeted species	$6,000	$6,000	$6,000
1-3	EW (all) HA-4	Ecological weed control	All	GWRC Biosecurity department	Sweep of entire block on foot to control any new infestations and follow up any previous control	Reduction in distribution and density of targeted species	$5,500	$5,500	$5,500
1-6	PA (all)	Pest animal control	All	GWRC Biosecurity department supported by community	Predator control (servicing network of predator traps while also doing opportunistic goat and pig shooting)	TTI* of <1% for mustelids	$8,500	$8,500	$8,500
1-7	EW-2	Revegetation	Regenerating hillslopes Lakes and wetlands	MIRO and PNBST supported by GWRC Parks department	Ongoing revegetation as resources allow using locally sourced plants	Survival rate of >80%	Parks	Parks	Parks

Objectives	Threat	Activity	Operational areas	Delivery	Description/detail	Target	Timetable & resourcing		
							2014/15	2015/16	2016/17
1-5	OT-3	Stock removal	All	GWRC Parks department and neighbours	Boundary fence repair and replacement plus stock relocation	No resident stock in area	Parks	Parks	Parks
5-7	OT-2	Fish passage restoration	Lakes and wetlands Coastal escarpments and shingle beaches	HCC supported by GRWC biodiversity and tangata whenua	Investigation and implementation of options to restore fish passage at Lake Kohangapiripiri	Native fish passage restored at Lake Kohangapiripiri	TBA	TBA	TBA
							$34,500	**$34,500**	**$34,500**

*** 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.**

5. Funding summary

GWRC budget

The budgets for 2015/16 and 2016/17 years are indicative only and are subject to change as a result of GWRC's 2015-2025 Long Term Plan process.

Table 3: GWRC Allocated budget for Parangarahu Lakes Area KNE.

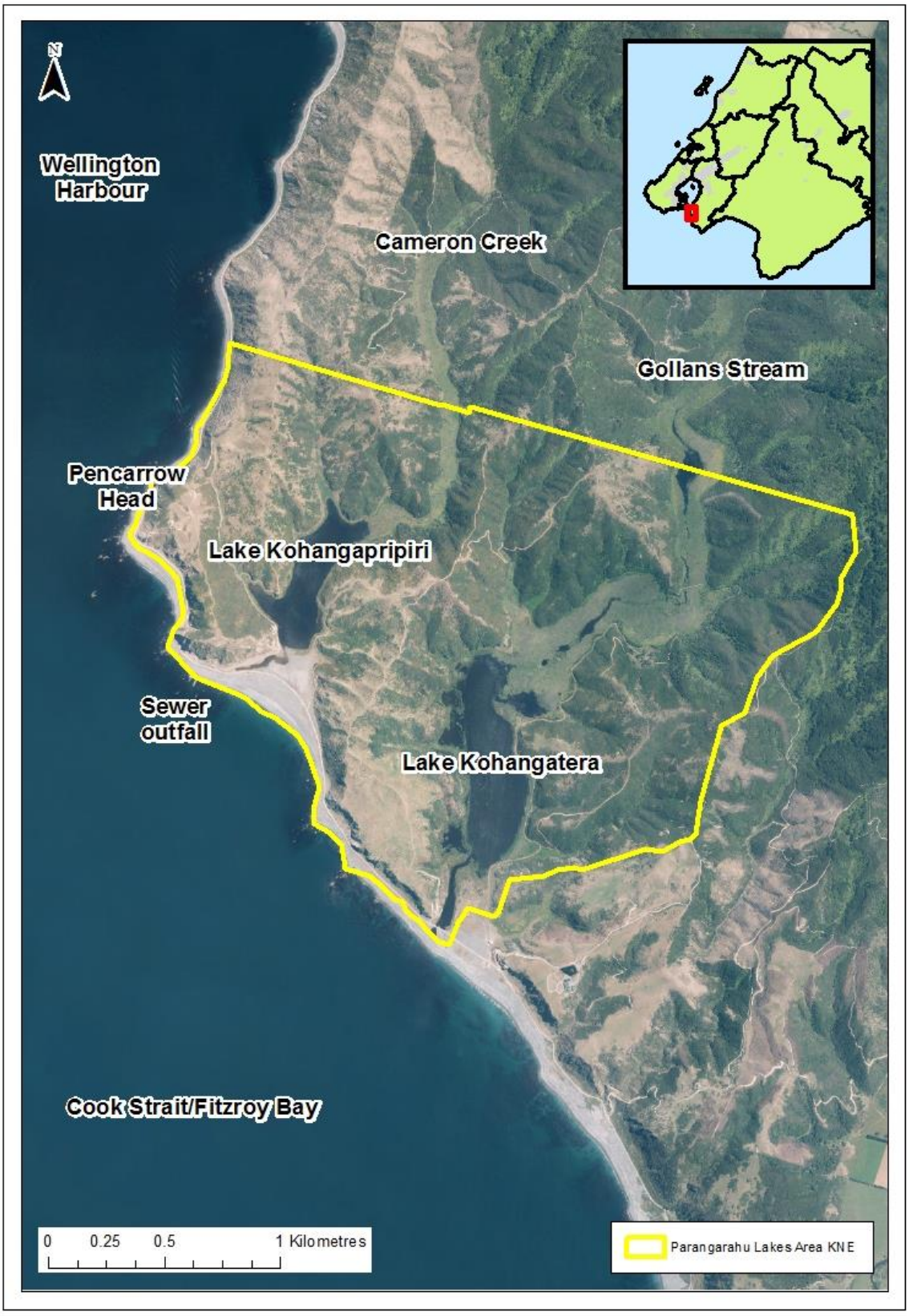
Management activity	Timetable & resourcing		
	2014/15	2015/16	2016/17
Ecological weed control	$26,000	$26,000	$26,000
Pest animal control	$8,500	$8,500	$8,500
Total	**$34,500**	**$34,500**	**$34,500**

Other contributions

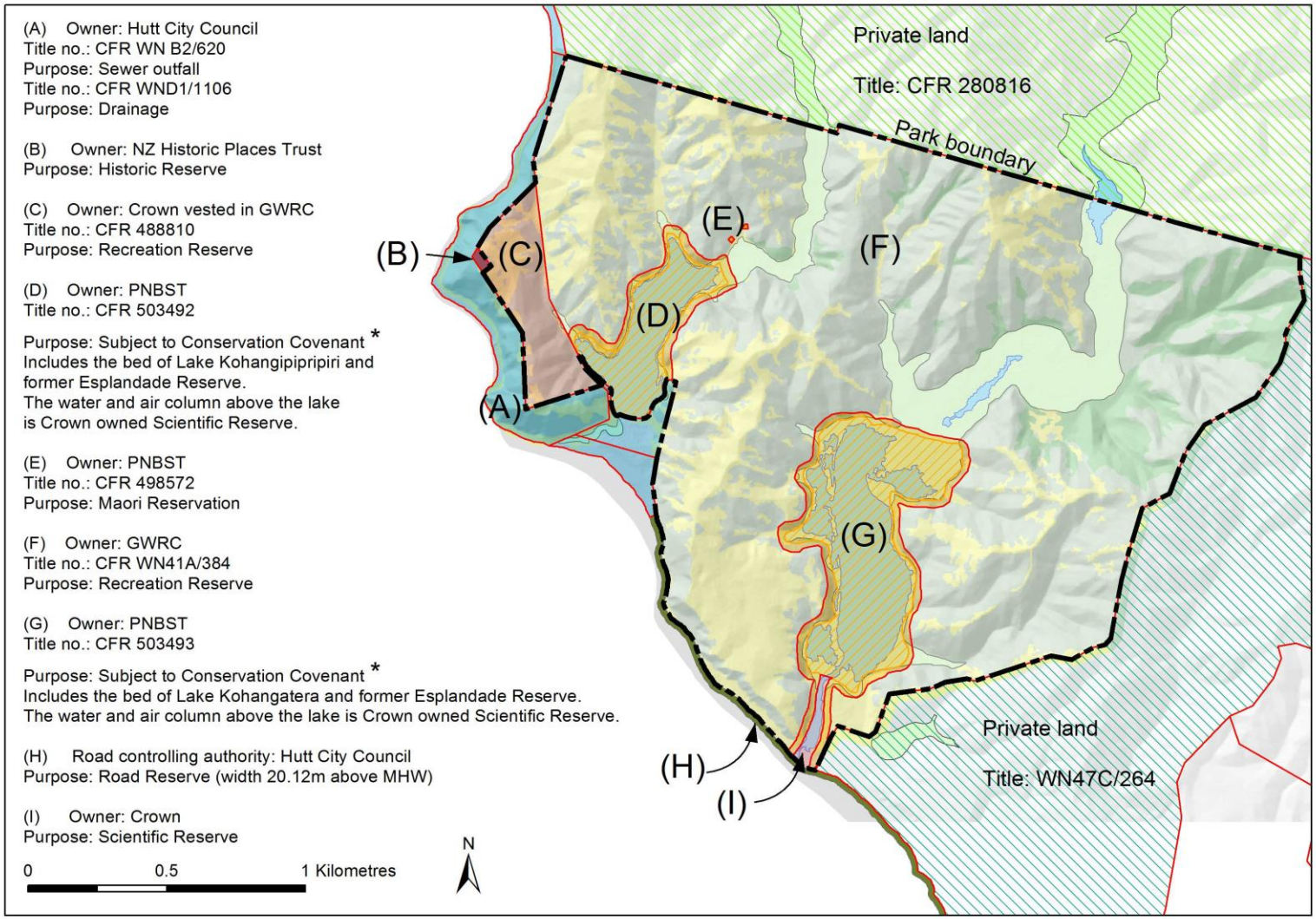
Table 4: Additional allocated budget for Parangarahu Lakes Area KNE from other management partners.

Management activity	Timetable & resourcing		
	2014/15	2015/16	2016/17
Ecological weed control (HCC broadleaf in buffer)	$5,000	$5,000	$5,000
Ecological weed control (HCC Marram)	$1,000	$1,000	$1,000
Ecological weed control (DOC Marram)	$1,000	$1,000	$1,000
Total	**$7,000**	**$7,000**	**$7,000**

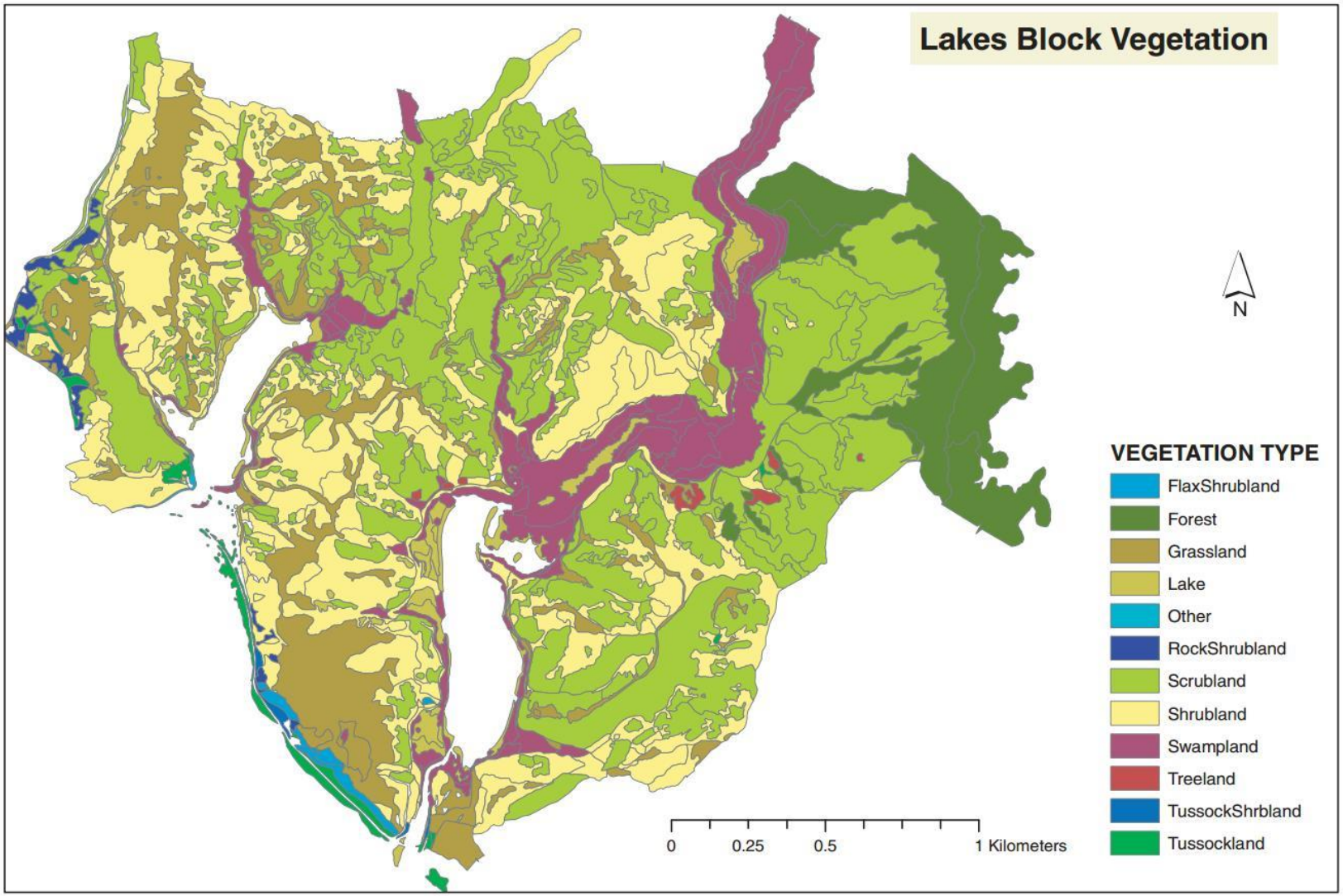
Appendix 1: Site maps



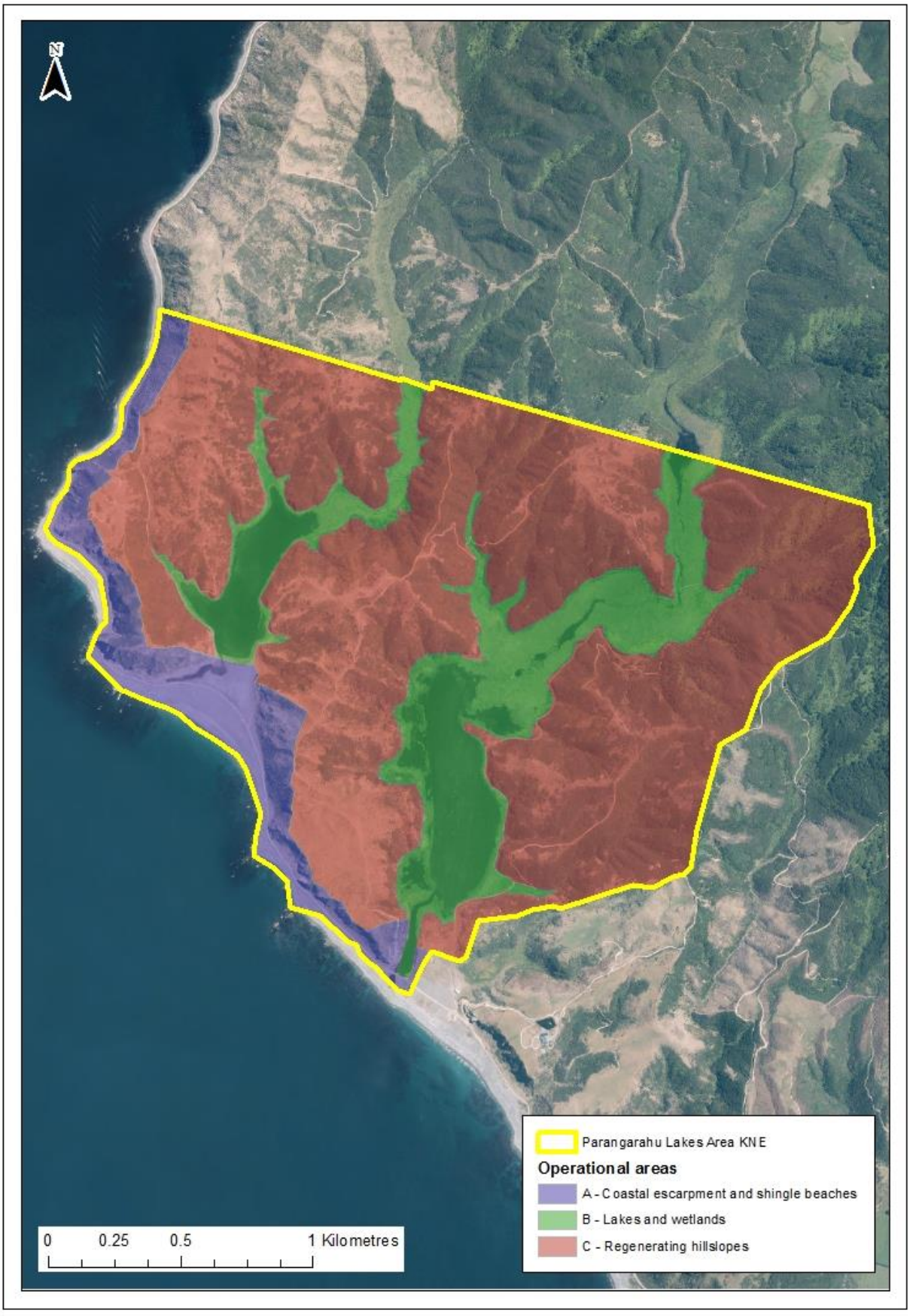
Map 1: Parangarahu Lakes Area KNE boundary.



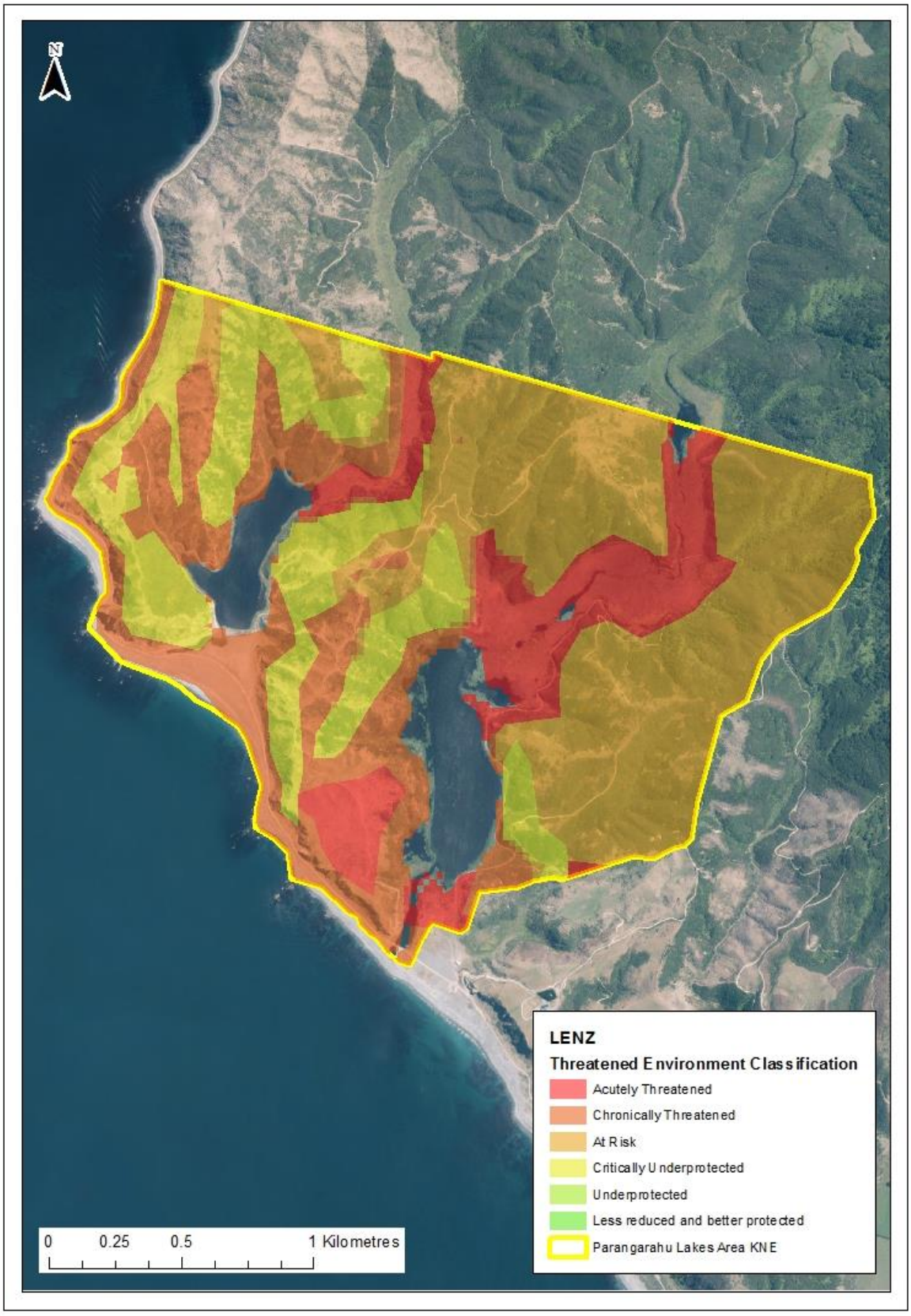
Map 2: Property boundaries and tenure for Parangarahu Lakes Area KNE.



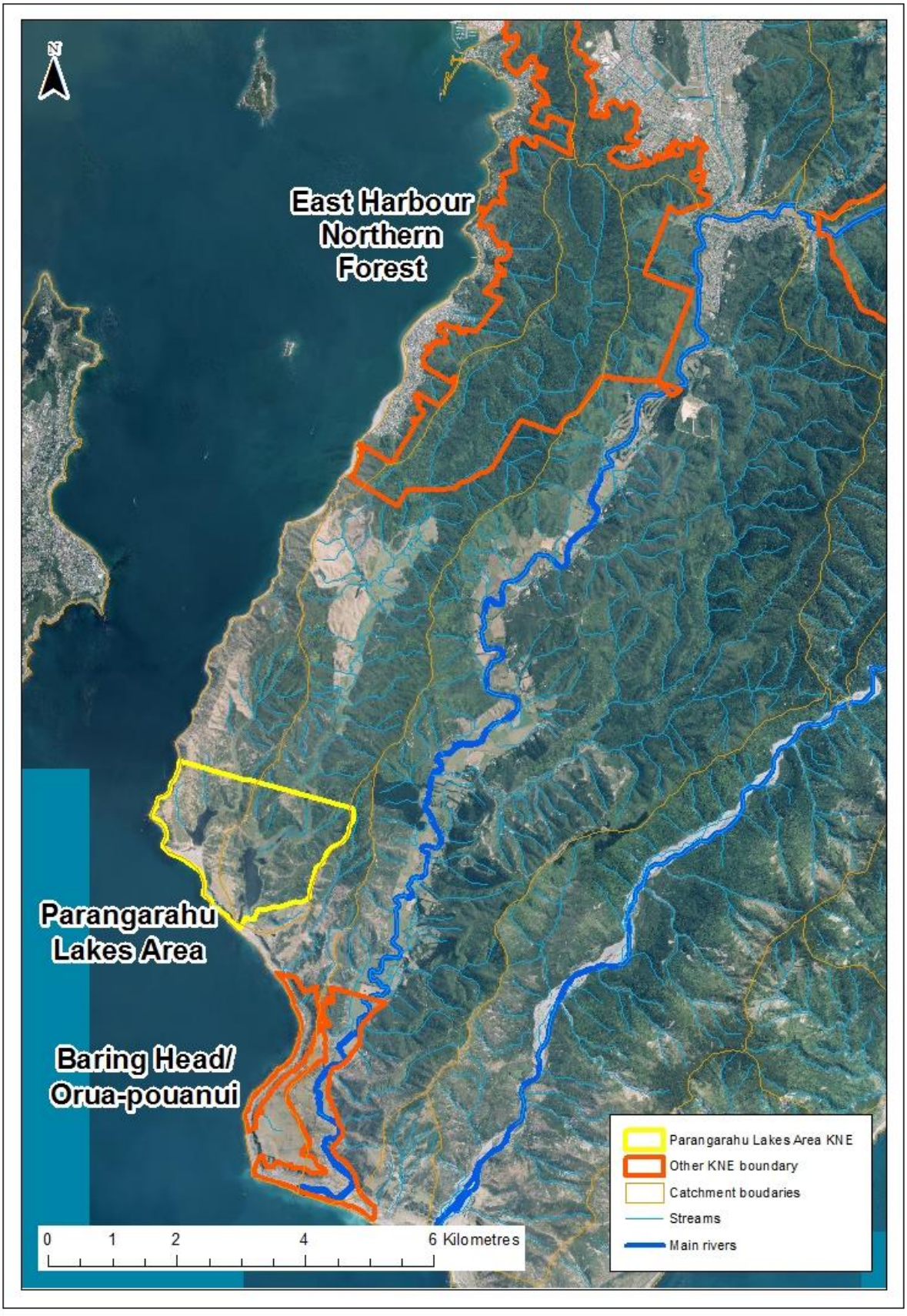
Map 3: Vegetation structural classes at Parangarahu Lakes Area KNE[29].



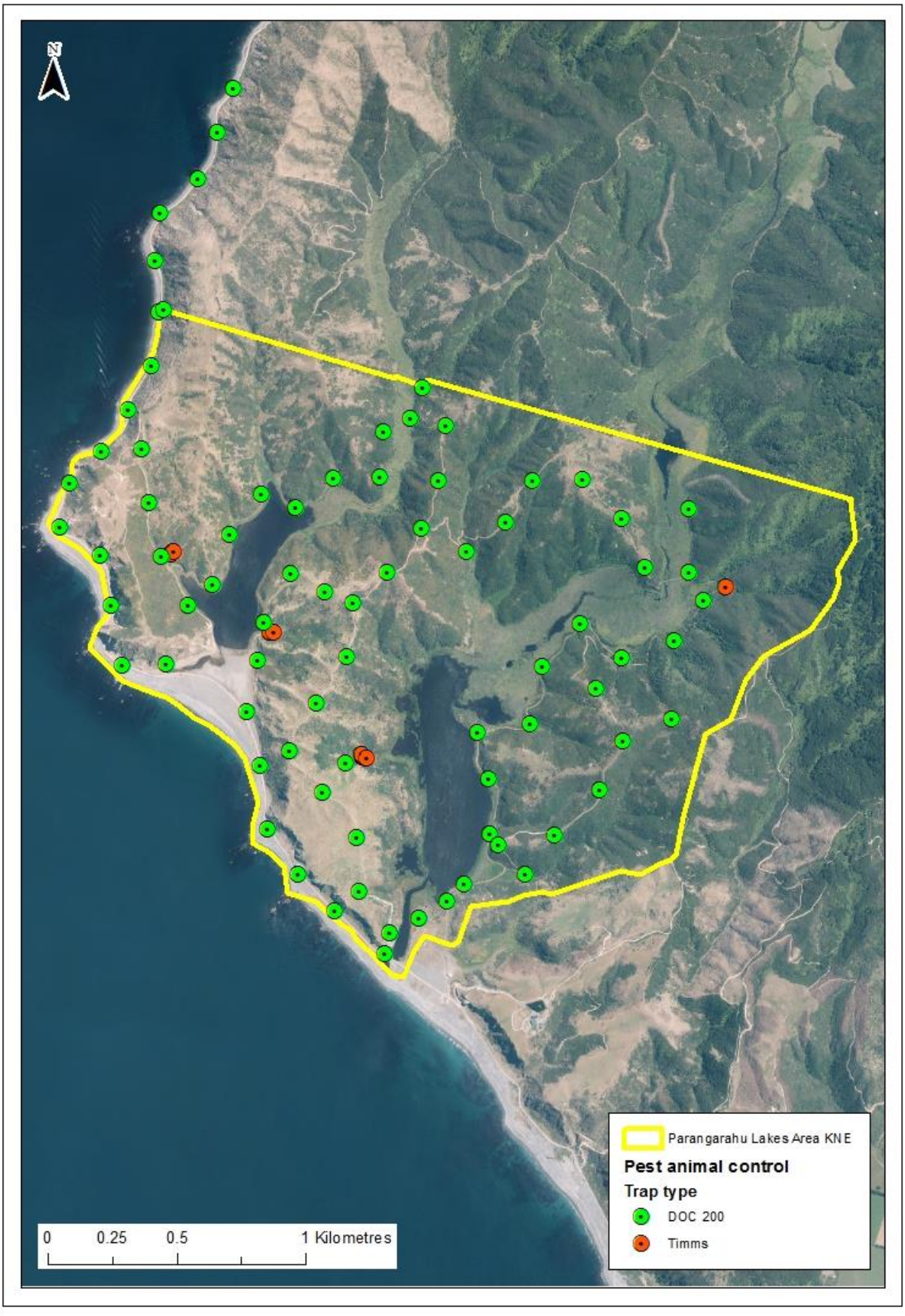
Map 4: Operational areas in Parangarahu Lakes Area KNE.



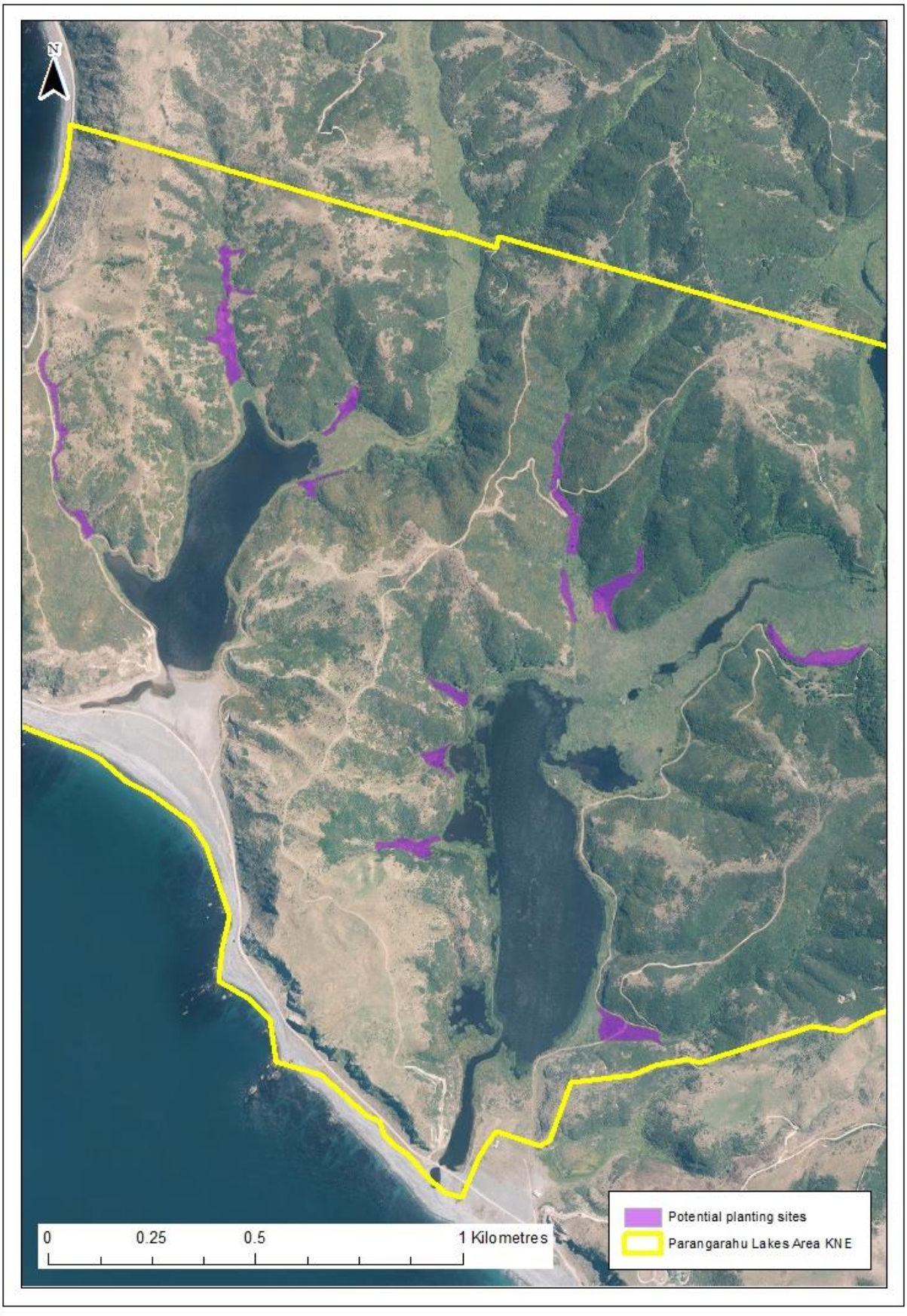
Map 5: Land Environments of New Zealand Threatened Ecosystems for Parangarahu Lakes Area KNE.



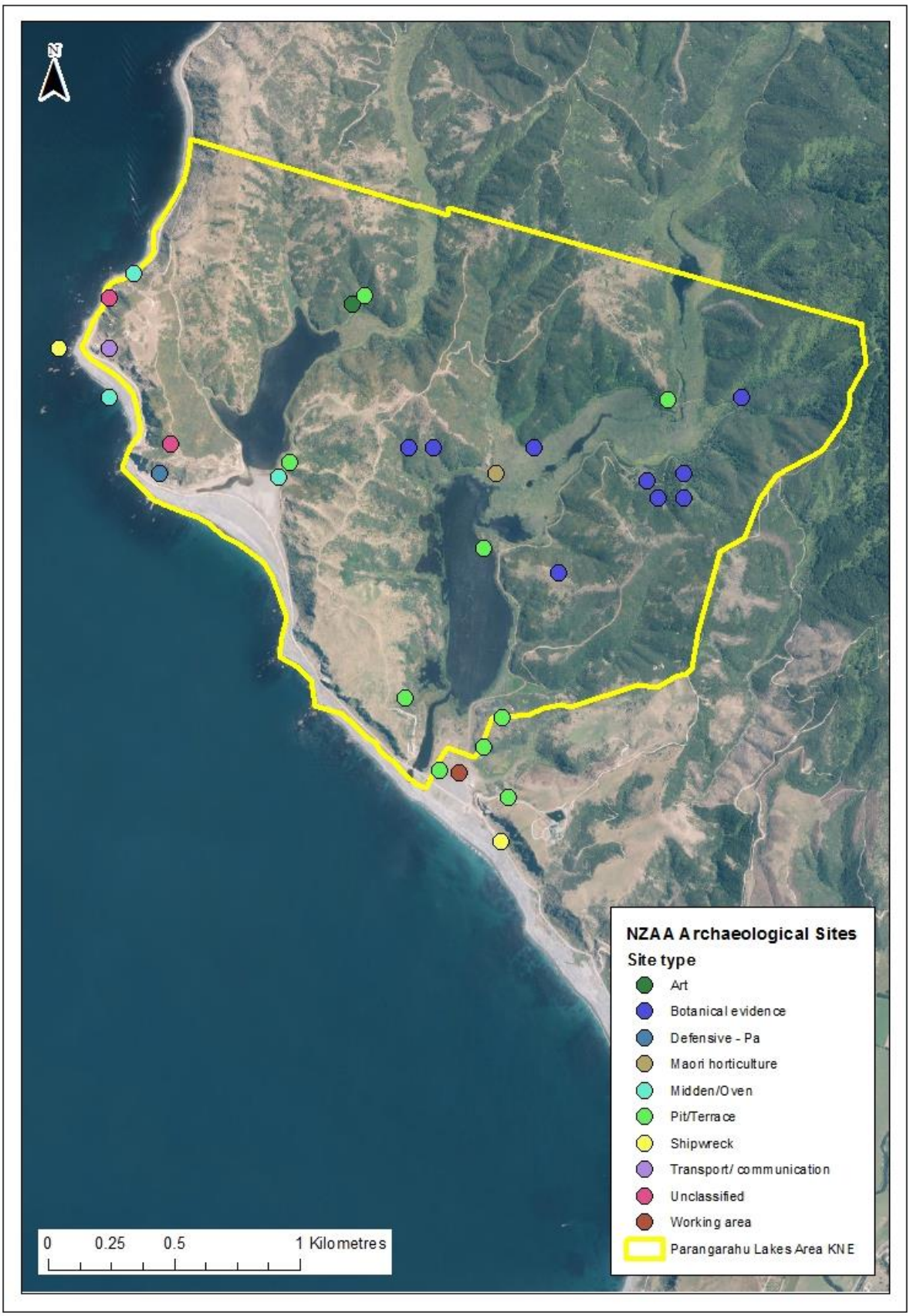
Map 6: Parangarahu Lakes Area KNE at catchment scale and also showing Baring Head Block and Northern Forests of East Harbour Regional Park.



Map 7: Pest animal control in Parangarahu Lakes Area KNE.



Map 8: Degraded wetland areas suitable for restoration planting in Parangarahu Lakes Area KNE.



Map 9: Cultural Heritage Sites at Parangarahu Lakes Area KNE (Source: New Zealand Archaeological Association)

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 three-year cycle[30]. 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 5: Threatened species at Parangarahu Lakes Area KNE.

Scientific name	Common name	Threat status	Source/Comments
Plants (vascular)[31]			
Centipeda aotearoana	Sneezeweed	Naturally Uncommon	Gibbs (2002)
Craspedia uniflora var. *maritima*		Naturally Uncommon	Gibbs (2002)
Crassula kirkii	Kirk's crassula	Naturally Uncommon	Gibbs (2002)
Crassula sinclairii		Naturally Uncommon	Gibbs (2002)
Chenopodium allanii		Naturally Uncommon	Gibbs (2002)
Eryngium vesiculosum	Sea holly	Declining	Gibbs (2002)
Ficinica spiralis	Pīngao	Relict	Gibbs (2002)
Geranium aff. *microphyllum*		Naturally Uncommon	Gibbs (2002)
Geranium retrorsum		Nationally Vulnerable	Gibbs (2002)
Lepilaena bilocularis		Nationally Vulnerable	de Winton (2013a)
Leptinella dispersa subsp. *dispersa*		Naturally Uncommon	Gibbs (2002)
Melicytus aff. *obovatus (*Cook Strait*)*		Declining	Gibbs (2002) Undescribed species endemic to Cook Strait.
Melicytus crassifolius	Porcupine bush	Declining	Gibbs (2002)
Muehlenbeckia ephedroides	Leafless pōhuehue, dead stick plant	Declining	Gibbs (2002) This is the northern extent of its range
Nematoceras macranthum	Spider orchid	Naturally Uncommon	Gibbs (2002)
Nematoceras trilobum agg. (Rimutaka)	Spider orchid	Data Deficient	Gibbs (2002) Taxonomically uncertain entity

Scientific name	Common name	Threat status	Source/Comments
Pimelea spp.	NZ daphne	Data Deficient	Gibbs (2002) / Burrows, GWRC, pers comm 2012. undescribed species/hybrid swarm
Ranunculus limosella		Declining	Gibbs (2002)
Ranunculus macropus	Swamp buttercup	Data Deficient	Gibbs (2002)
Stuckenia pectinata	Sago pondweed	Naturally Uncommon	de Winton (2013a)
Zannichellia palustris	Horned pondweed	Naturally Uncommon	de Winton (2013a)
Birds[32]			
Anthus novaeseelandiae	NZ pipit	Declining	Gibbs (2002)
Charadrius bicinctus	Banded dotterel	Nationally Vulnerable	Gibbs (2002)
Hydroprogne caspia	Taranui, Caspian tern	Declining	Gibbs (2002)
Larus novaehollandiae scropulinus	Tarāpunga, red billed gull	Nationally Vulnerable	Gibbs (2002)
Phalacrocorax carbo	Large black shag	Naturally Uncommon	Gibbs (2002)
Phalacrocorax varius varius	Pied shag	Nationally Vulnerable	Gibbs (2002)
Poliocephalus rufopectus	NZ dabchick	Nationally Vulnerable	Gibbs (2002)
Sterna striata striata	Tara, white fronted tern	Declining	Gibbs (2002)
Freshwater fish[33]			
Anguilla dieffenbachii	Longfin eel	Declining	Gibbs (2002)
Galaxias argenteus	Giant kōkopu	Declining	Gibbs (2002)
Galaxias brevipinnis	Kōaro	Declining	Gibbs (2002)
Galaxias maculatus	Inanga, whitebait	Declining	Gibbs (2002)
Geotria australis	Lamprey	Declining	Gibbs (2002)
Gobiomorphus huttoni	Redfin bully	Declining	Gibbs (2002)
Invertebrates (less well known terrestrial invertebrates)[34]**(butterflies and moths)**[35]			
Ericodesma aerodana	Moth	Nationally Endangered	Gibbs (2002)
Hyridella menziesi	Kākahi, freshwater mussel	Declining	McEwan (2013)
Notoreas perornata (Wellington)	Coastal moth	Nationally Critical	Gibbs (2002)

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For more information contact the 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

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info@gw.govt.nz
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