

Key Native Ecosystem Operational Plan for Wainuiomata/Orongorongo

2023-2028



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1. Purpose

The purpose of the five-year Key Native Ecosystem (KNE) Operational Plan for Wainuiomata/Orongorongo KNE site is to:

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

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

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

2. Policy Context

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

The KNE programme funding is allocated under The Greater Wellington Long Term Plan (2021-2031)² and is managed in accordance with The Greater Wellington Biodiversity Strategy³ that sets a framework for how Greater Wellington protects and manages indigenous biodiversity in the Wellington region. Goal One of the Biodiversity Strategy - *Areas of high biodiversity value are protected or restored* - drives the delivery of the KNE Programme.

Other important drivers for the KNE programme include the Proposed Natural Resources Plan⁴, the Regional Pest Management Plan 2019-2039⁵, Toitū Te Whenua Parks Network Plan⁶ and the Hutt and Wainuiomata/Orongorongo Water Collection Areas Management Plan⁷.

The last plan mentioned above guides the biodiversity management of the Wainuiomata/Orongorongo KNE site. The KNE operational plan for Wainuiomata/Orongorongo describes activities that mainly address Goal Three of the Water Collection Areas Management Plan – *Maintain and enhance the significant ecosystem and biodiversity values of the water collection areas*. However, outcomes of biodiversity management are key components in the delivery of all the water collection areas management plan's objectives. For instance, *optimum water quality* is achieved via healthy aquatic and terrestrial ecosystems. Maintaining low numbers of pest animals such as deer and goats reduces the risk of water contamination by protozoa such as cryptosporidium and giardia and reduces the loss of vegetation cover that can contribute to soil erosion, thereby threatening water quality.

3. The Key Native Ecosystem Programme

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

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

KNE sites can be located on private or publicly owned land. Any work undertaken on private land as part of this programme, it is at the discretion of landowners, and their involvement in the programme is entirely voluntary. Involvement may just mean allowing work to be undertaken on that land. Land managed by the Department of Conservation (DOC) is generally excluded from this programme.

Sites are identified as of high biodiversity value for the purposes of the KNE Programme by applying the four ecological significance criteria described below.

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

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

4. Wainuiomata/Orongorongo Key Native Ecosystem site

The Wainuiomata/Orongorongo KNE site (7,364 ha) is located in Wainuiomata, east of Moores Valley and west of the main range of the Remutaka Ranges (see Appendix 1, Map 1). It encompasses the headwaters of the Wainuiomata and Orongorongo rivers, and in terms of management areas includes all of the Wainuiomata/Orongorongo Water Collection Area and the Wainuiomata Regional Park. The site is not reserved under the Reserves Act but is set aside and gazetted for water supply and recreation purposes.

The KNE site is clad almost entirely with original native forest. It contains podocarp-broadleaf and beech forest, including one of the largest areas of unlogged lowland podocarp forest in the lower North Island⁸. It is rich in native flora and fauna constituting some of the highest biodiversity values of any forest ecosystem in the Wellington Region.

The KNE site is bounded by contiguous native forest of the Remutaka Forest Park to the east and south, and privately owned native scrub and farmland to the north and west.

In 2003 Wellington Regional Council approved the funding of an ecological mainland island within part of the KNE site; the Wainuiomata Mainland Island (see operational area D, Appendix 1, Map 5,). Work on establishing an intensive pest control infrastructure in this area commenced in 2005 and a strategic plan⁹ for the development of the project was produced in 2007. Although the strategic plan remains an important resource and reference point, this KNE plan now supersedes that document in describing the operational activities that are planned for the Wainuiomata Mainland Island.

A new proposal to establish a predator-proof fenced pest-free eco-sanctuary within the KNE site was put forward to Greater Wellington in 2021. More details of the proposal and its progress is contained in Section 10 of this plan.

5. Parties involved

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

5.1. Landowner and land managers

All land within the Wainuiomata/Orongorongo KNE site is owned by or vested in Greater Wellington and has been set aside for the purpose of harvesting source water for treatment and supply to the cities of Wellington, Porirua, Lower Hutt and Upper Hutt.

Wellington Water Limited (Wellington Water) manages the water supply in accordance with the Hutt and Wainuiomata/Orongorongo Water Collection Areas Management Plan¹⁰. This plan identifies the broad scale management required to protect biodiversity values of the site which play a role in providing quality source water (eg, a complete native forest structure). This KNE operational plan provides further detail of management activities being implemented to protect those biodiversity values. Wellington Water funds some of these management activities. Wellington Water operates water treatment and supply assets within the site.

The Greater Wellington Environment Restoration team manages the biodiversity values of the KNE site in accordance with the Hutt and Wainuiomata/Orongorongo Water Collection Areas Management Plan¹¹, this KNE operational plan, and the Service Level Agreement between Wellington Water and Greater Wellington's former Catchment Management group.

The Greater Wellington Eastern Parks team manages access to both the Wainuiomata/Orongorongo Water Collection Area and the Wainuiomata Regional Park. Together with the Parks Maintenance team they also maintain assets such as roads, tracks, and amenity areas within the KNE site.

5.2. Operational delivery

Within Greater Wellington, five teams are responsible for delivering the Wainuiomata/Orongorongo KNE operational plan.

- The Environment Restoration team is the overarching lead department for Greater Wellington on the longer-term planning and coordination of biodiversity management activities and advice within the KNE site. The Environment Restoration team allocates funding provided by the KNE programme and Wellington Water to biodiversity management activities which are coordinated by the Pest Plants, Pest Animals, and Monitoring – Land, Ecosystems and Air teams.
- The Pest Plants and Pest Animals teams coordinate and implements ecological weed and pest animal control measures.
- The Monitoring – Land, Ecosystems and Air team coordinates possum and small mammal monitoring. The Monitoring – Land, Ecosystems and Air team also carries out other ecological monitoring activities for Wellington Water directly. These activities don't form part of this KNE operational plan, although information obtained through them can help guide biodiversity management decisions.

- The Eastern Parks team primarily manages recreational access and maintains assets such as roads. However, the Eastern Parks team also contributes to ecological weed and pest animal control activities and lends a hand at times in supporting the logistics of biodiversity management activities.

Members of Hutt Valley Tramping Club contribute towards the delivery of the KNE plan by assisting the Monitoring – Land, Ecosystems and Air team to undertake small mammal monitoring.

5.3. Mana whenua partners

The Wainuiomata/Orongorongo KNE site area is significant to Taranaki Whānui ki Te Upoko o Te Ika (Taranaki Whānui), who, represented by Port Nicholson Block Settlement Trust, are mana whenua partners with Greater Wellington.

The cultural importance of the site to Taranaki Whānui is described in a cultural safety report on the site prepared by members of Taranaki Whānui in 2021¹². The report makes particular reference to the sites importance for the hunting and gathering of kai and rongoa and for a travelling route between Wainuiomata and Wairarapa.

Greater Wellington is committed to identifying ways in which kaitiakitanga can be strengthened by exploring opportunities on how mana whenua partners wish to be involved in the KNE plan development or operational delivery of the KNE site.

5.4. Stakeholders

The stakeholders in the KNE site are:

- the Remutaka Conservation Trust
- members of the Hutt Valley and Tararua tramping clubs
- Goodnature
- Victoria University of Wellington
- the Wellington Botanical Society
- some private ecologists.

The Remutaka Conservation Trust operates several lines of predator control traps within the KNE site as part of their project managing a population of North Island brown kiwi (*Apteryx mantelli*) in the adjacent Remutaka Forest Park. Kiwi from this managed population have spread into the KNE site during recent years which has led to the Trust's predator control aimed at protecting the kiwi being extended into the KNE site. The Trust undertakes monitoring of the kiwi population in the KNE site and the adjacent wider catchments.

Members of the Hutt Valley and Tararua tramping clubs have been assisting in the monitoring of small mammal pests and undertaking pest animal control at the site since 2003. The involvement of members of the tramping clubs was vital in the establishment of the monitoring and remains vital to its continuation. Their involvement in the pest animal control has now ceased.

Goodnature, a business that develops and sells pest animal control products, uses the KNE site for developmental testing of their products. Goodnature recently provided Greater Wellington with a report of findings from a completed trial. The trial included camera trapping of pest animals which provided some interesting and useful data on the presence of pest species in a section of the KNE site.

Students from Victoria University, the Wellington Botanical Society and some private ecologists have interests in the KNE site due to its high biodiversity values. These groups have undertaken studies on many aspects of KNE site's ecology, including on snails, mosses, and general flora.

6. Ecological values

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

6.1. Ecological designations

Table 1, below, lists ecological designations at all or part of the Wainuiomata/Orongorongo KNE site.

Table 1: Designations at the Wainuiomata/Orongorongo KNE site

Designation level	Type of designation
Regional	<p>Parts of the Wainuiomata/Orongorongo KNE site are designated under Greater Wellington's Proposed Natural Resources Plan (PNRP) as:</p> <ul style="list-style-type: none"> • River with outstanding indigenous ecosystem values (Schedule A1): Wainuiomata River, upstream of a point 20 metres above the Wainuiomata Water Supply Intake • River with Significant Indigenous Ecosystems – habitat with high macroinvertebrate community health (Schedule F1): Wainuiomata and Orongorongo rivers and all of their tributaries • River with Significant Indigenous Ecosystems – habitat for threatened and at risk fish species (Schedule F1): Wainuiomata and Orongorongo rivers and all of their tributaries • River with Significant Indigenous Ecosystems – habitat for six or more migratory indigenous fish species (Schedule F1): Wainuiomata and Orongorongo rivers and all of their tributaries • Wetland with outstanding indigenous biodiversity values (Schedule A3): Orongorongo Swamp • Identified significant natural wetland (Schedule F3): Skull Gully Wetland and Wainuiomata Waterworks Swamp Lower (Wainuiomata Lower Dam wetland)
District	<p>The entire KNE site is designated within Hutt City Council's District Plan¹³ as Significant Natural Resources:</p> <ul style="list-style-type: none"> • SNR 40: Orongorongo Swamp • SNR 46: Remutaka Ranges and Orongorongo and Wainuiomata Catchments (the remainder of the KNE site)
Other	The entire KNE site is set aside for water supply and recreation purposes.

6.2. Ecological significance

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

- It contains highly **representative** ecosystems that were once typical or commonplace in the region
- It contains ecological features that are **rare or distinctive** in the region
- It contains high levels of ecosystem **diversity**, with several ecosystem types represented within the KNE site boundary
- Its **ecological context** is valuable at the landscape scale as it is a large site containing the whole headwaters of two river catchments, it is contiguous with

other large areas of indigenous habitat, and it provides core habitat for threatened indigenous plant and animal species.

Representativeness

The vegetation types within the Wainuiomata/Orongorongo KNE site have remained largely unchanged since the time of European settlement. Although the existing ecosystems have been modified by the impacts of introduced pests, the vegetation types remain highly representative of the original vegetation types¹⁴. The Singers and Rogers (2014)¹⁵ classification of pre-human vegetation indicates that the KNE site contains five forest and four wetland ecosystem types (see Appendix 1, Map 2). They are:

- kāmahī, broadleaf, podocarp forest (MF8)
- hard beech forest (MF20)
- red beech, podocarp forest (CLF9)
- silver beech forest (CLF11-2)
- silver beech, kāmahī forest (CLF11-3)
- mānuka, tangle fern scrub/fernland (WL12)
- flaxland (WL18)
- raupō reedland (WL19)
- coprosma, twiggy tree daisy scrub (WL20).

The forest ecosystem type MF20 is considered regionally threatened, as it is estimated that there is now only about 26% of the pre-human extent of this forest type remaining in the Wellington Region¹⁶.

The Threatened Environment Classification system¹⁷ indicates that parts of the KNE site are classified as Acutely Threatened or At Risk environments because there is less than 10% and 20-30% respectively of native vegetation remaining on these types of land in New Zealand¹⁸. These areas of threatened environments within the KNE site are located on valley floors and river terraces and mostly have close to their original indigenous vegetation intact (see Appendix 1, Map 3).

Rarity/distinctiveness

The KNE site contains four wetlands. Wetlands are now considered an uncommon habitat type in the Wellington Region with less than 3% remaining of their original extent¹⁹. Two of the wetlands within the KNE site, the Orongorongo Swamp and the Skull Gully Wetland, are in close to their original state. The Orongorongo Swamp is the only montane-alluvial wetland in the region and is considered one of the most pristine wetlands of a significant size in the region²⁰.

Many of the plant, bird, lizard, and fish species found within the KNE site are identified as nationally or regionally 'Threatened' or 'At Risk' through New Zealand's national and regional threat classification systems. Appendices 2 and 3 contain lists of the nationally and regionally threatened species found within the KNE site.

Diversity

The KNE site contains two ecosystem types: forests and wetlands. The forest ecosystems are diverse, containing several distinct forest types and two differing river systems.

Ecological context

The KNE site is one of the largest areas of original forest in the Wellington Region. It provides core breeding habitat for a large assemblage of native forest bird species including Threatened and At-Risk species and is refuge for nationally and regionally threatened plant species. The KNE site is contiguous with the Remutaka Forest Park and Pākuratahi Forest: two other large areas of similar habitat. The KNE site contains all of the headwaters of the Wainuiomata and Orongorongo rivers providing the opportunity to carry out management at a catchment scale.

6.3. Ecological features

The two river catchments within the site are both long and narrow with southwest aspects. Altitude rises from 100 metres ASL at the Reservoir Road entrance to the Wainuiomata Regional Park to 902 metres ASL at Papatahi situated in the Remutaka range.

The Orongorongo catchment, the higher and more rugged of the two catchments, has steep sided V-shaped valleys. Evidence of the many landslides triggered by the 1855 earthquake caused by the movement of the Wairarapa Fault can still be seen on the steep faces of the main range. The valleys of the Wainuiomata catchment are less deep, with the more U-shaped valley floors of the three main tributaries all being about 250 metres wide²¹.

Yearly rainfall in the KNE site is high, making it ideal for water collection. Annual rainfall is about 2,000mm in the Wainuiomata catchment and about 2,500mm in the Orongorongo catchment. Snow occasionally covers the main ranges in winter²².

Vegetation communities and plants

The Wainuiomata/Orongorongo KNE site contains several native forest habitats ranging from lowland broadleaf-podocarp forest, through steep-land beech forest, to sub-alpine scrub. Two river systems including numerous tributary streams are contained within the forest habitats. Three major and one smaller wetland are present, associated with main river courses or streams.

Vegetation

Most of the KNE site is clothed in much the same vegetation today as it was at the time of European settlement. As elsewhere in the country, introduced pests have altered the species mix of the forest and devastated indigenous fauna, but the largely original forest, complete with huge podocarp trees festooned in epiphytes, is still present. Some logging of the lower Wainuiomata catchment occurred in the late 19th century, mainly in the area that is now the Wainuiomata Regional Park, but the headwaters were left unmodified in this regard.

The Wainuiomata catchment contains one of the largest areas of unlogged lowland podocarp forest in the lower North Island and it is regarded as being nationally

representative of this forest type. Noteworthy elements of the flora are the advanced age and large stature of the rimu (*Dacrydium cupressinum*) and the large component of northern rata (*Metrosideros robusta*), important keystone species in the forests of the lower North Island.

On the valley floors in both catchments, the podocarp forest is composed of emergent rimu, miro (*Pumnopitys ferruginea*) and northern rata, towering over a canopy of kamahi (*Weimannia racemosa*), hinau (*Elaeocarpus dentatus*), rewarewa (*Knightia excelsa*) and black maire (*Nestegis cunninghamii*). Closer to the waterways in the Wainuiomata catchment, the forest also contains matai (*Prumnopitys taxifolia*), kahikatea (*Dacrycarpus dacrydioides*) and tawa (*Beilschmiedia tawa*). As altitude increases, the podocarp forest grades into a beech community. Around 500m, silver beech (*Lophozonia menziesii*) becomes dominant over a canopy of kamahi, miro, Hall's totara (*Podocarpus laetus*) and hinau. In some areas in the Wainuiomata catchment, black beech (*Fuscopora solandri*) is the dominant species. Above 600m in both catchments, silver beech forest becomes predominant. *Raukaua edgerlyi* and Kirk's tree daisy (*Brachyglottis kirkii* var. *kirkii*), species that are distributed very sparsely in the region, are present in small numbers.

Over 60 fern and allied species have been recorded in the KNE site – about a third of the New Zealand fern and allied species flora. Over 185 moss species have been recorded in the KNE site, 63 of which had not previously been recorded in the southern Tararua District at the time of recording. One moss species found in the KNE site, *Zygodon gracillimus*, has not been recorded anywhere else south of Lake Taupo²³.

Wetlands

Four wetlands are found within the KNE site. The upper Orongorongo valley contains the only montane-alluvial wetland in the region. It is considered one of the most pristine wetlands of a significant size in the region²⁴. Key species found in this wetland include manuka (*Leptospermum scoparium*), *Gahnia xanthocarpa* and a regionally rare *Baumea* species. A second wetland is a manuka fen in Skull Gully Stream, a major tributary of the upper Wainuiomata River. Dominant species present here include kahikatea, *Coprosma tenuicaulis* and *Carex secta*. The remaining two wetlands are located in the Wainuiomata Regional Park. These are the Wainuiomata Lower Dam wetland and a small sedge/flax wetland in Sledge Track Creek.

Species

Birds

Monitoring of forest bird populations in the Wainuiomata/Orongorongo KNE site has been undertaken annually since 1999. Fifteen native forest bird species have been recorded during monitoring surveys. All the native forest bird species found naturally in the Wellington Region, are found in the KNE site. Except for kākā (*Nestor meridionalis*), all appear to be resident and breeding in the KNE site. These species include yellow-crowned kākārīki (*Cyanoramphus auriceps*), red crowned kākārīki (*Cyanoramphus novaezelandiae*) pōpokatea/whitehead (*Mohoua albilii*), titipounamu/rifleman (*Acanthisitta chloris*), pipiwharuroa/shining cuckoo (*Chrysococcyx lucidus*), koekoeā/long-tailed cuckoo (*Eudynamys taitensis*) and kārearea/New Zealand falcon (*Falco novaeseelandiae*). The highest bird densities

found on Greater Wellington owned or managed land have been recorded here. The most common birds seen or heard are tui (*Prosthemadera novaeseelandiae*), miromiro/tomtit (*Petroica macrocephala*), riroriro/grey warbler (*Gerygone igata*), titipounamu/rifleman and tauhou/silvereye (*Zosterops lateralis*). A further 16 non-forest bird species (wetland or habitat generalist species) have also been recorded in the KNE site.

Average bird densities have increased notably in the Wainuiomata Mainland Island (the mainland island) portion of the site since intensive pest control began there in 2005. The greatest increases recorded have been in populations of kākārīki, tui and rifleman.

North Island brown kiwi have been resident in the KNE site since 2009. The species self-introduced into the KNE site from the adjacent Turere Stream catchment, part of Remutaka Forest Park. The species was re-introduced to the Turere catchment by the Remutaka Conservation Trust. Since the first birds set up territories in the KNE site the population has more than doubled. This has been due to further natural migration and successful breeding. It is known that at least two pairs of kiwi have bred successfully within the KNE site.

A translocation of 120 toutouwai/North Island (NI) robin (*Petroica longipes*) into the mainland island from Kāpiti Island was undertaken during 2012 and 2013. Initially the translocation appeared to be successful with 67% of monitored NI robin nests fledging chicks during the first breeding season following the release. However, during searches prior to the following breeding season, no pairs of birds could be found, and very few NI robins have been sighted in the mainland island since.

The recorded success of nesting of the NI robins in the first year after release appeared to show that the pest control regime was robust enough to protect the birds from predation. This points to other possible factors leading to the demise of the population, the likely one being dispersal beyond the mainland island boundary. It is thought that with no barriers surrounding the mainland island such as open countryside or coastline, most of the NI robins probably dispersed out of the mainland island into the surrounding contiguous native forest.

Reptiles

Three species of native lizard – northern grass skink (*Oligosoma polychroma*), ngahere gecko (*Mokopirirakau* “southern North Island”) and barking gecko (*Naultinus punctatus*) have been recorded in the KNE site. It is possible that copper skink (*Oligosoma aeneum*) is also present, as this species has been recorded nearby in similar habitat²⁵.

Fish and koura/crayfish

Surveys have been carried out at a variety of sites in both catchments by several organisations including Greater Wellington, NIWA, Wellington Fish & Game²⁶, Institute of Natural Resources-Ecology (Joy & Death)²⁷ and Aquanet Consulting Limited²⁸. Only five species of native fish and koura (*Paranephrops planifrons*) have been recorded in the KNE site within the last ten years. Most species of native fish present, apart from dwarf galaxias (*Galaxias* aff. *divergens* “northern”), appear to be in low numbers.

Dwarf galaxias are present in high numbers within the KNE site relative to areas further down the river catchments. The KNE site and particularly the Wainuiomata River above the Lower Dam spillway could be considered a strong hold for dwarf galaxias in this part of the region. The high abundance of dwarf galaxias here may be due to low numbers of brown trout (*Salmo trutta*) being present, a known predator of dwarf galaxias. The low numbers of brown trout present is likely to be due to their passage up the river being impeded by structures in the river.

Other native fish species that have been recorded in the KNE site are longfin eel (*Anguilla dieffenbachii*), koaro (*Galaxias brevipinnis*), lamprey (*Geotria australis*) and redfin bully (*Gobiomorphus huttoni*). Shortfin eel (*Anguilla australis*) and torrentfish (*Cheimarrichthys fosteri*) were recorded in the KNE site prior to ten years ago. The Orongorongo catchment is potentially an important area for fish conservation as apart from the water intake weir, which restricts the passage of many fish species, the catchment is otherwise almost entirely unmodified.

Invertebrates

A survey of native land snails undertaken in the KNE site in 2007-09 showed the KNE site contains a very high diversity of native land snail species. Eighty-eight species were recorded; more than at any other site surveyed in the Wellington Region. Included in the species recorded were seven species that are locally endemic or noteworthy²⁹.

Wellington tree wētā (*Hemideina crassidens*) and ground wētā (*Hemiandrus* sp) are present in the KNE site, with the former often being observed taking refuge in bait stations. An individual of the less common cave wētā species *Pachyrhamma longipes* was observed in the site in 2023³⁰.

7. Threats to ecological values at the KNE site

Ecological values can be threatened by human activities, and by introduced animals and plants that change ecosystem dynamics. The key to protecting and restoring biodiversity as part of the KNE Programme is to manage key threats to the ecological values at each KNE site. Appendix 4 presents a summary of all known threats to the Wainuiomata/Orongorongo KNE site.

7.1. Key threats

The most significant threats to the ecological values of Wainuiomata/Orongorongo KNE site come from a small suite of ecological weeds, browsing and predatory pest animals, barriers to fish passage and the potential impacts of some operational and recreational activities.

A relatively small number of ecological weed species are present in the KNE site and infestations are mostly small and not widespread throughout the site. This is due in large part to the KNE site's early preservation for water supply, but also due to ecological weed control that has been undertaken since at least 2005. Exceptions to this are the widespread infestations of buddleia (*Buddleia davidii*) in the Orongorongo catchment and tradescantia (*Tradescantia fluminensis*) and montbretia (*Crocasmia x crocosmiflora*) in the Wainuiomata Regional Park. Despite there being few ecological weeds present in the KNE site, there is still potential for those present to spread and incursions of new weeds to occur which could lead to the highly valued native dominance of the KNE site being progressively eroded.

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

Of all pest animals present, rats are likely to be having the greatest impact on ecological values. Monitoring has shown that outside of the mainland island rats are present in very high numbers (usually over 75% tracking tunnel index (TTI)³¹). Inside the mainland island where control is ongoing, numbers are much lower (usually under 10% TTI). Rat numbers are reduced to extremely low densities immediately after aerial possum control operations are undertaken, but densities increase to pre-control levels within 12 months of operations³². Stoats also appear to be present in high numbers beyond the mainland island and will also be impacting biodiversity values, particularly birdlife.

Possums are present in very low numbers due to regular aerial and ground control operations being carried out. If control was not continued it is likely that possums would increase in numbers over time to levels that would significantly impact on forest health and regeneration.

Feral goats and deer are kept to low numbers through a control programme that has been ongoing since 2005. However, there is continuous reinvasion of these species from adjacent Crown and private land meaning that populations would increase very rapidly if control was not maintained.

Feral pig numbers are high in the KNE site and continue to grow despite frequent control being undertaken. Pigs will travel long distances for favoured food sources, and

it appears that pigs are migrating from adjoining areas of the Remutaka Range to the Wainuiomata catchment part of the KNE site to take advantage of the highly productive podocarp forest there. This issue is accentuated during mast events when abundant fruiting of trees results in a strong attractant for pigs. Once present pigs don't only consume fruit but also churn up large areas of ground in search of invertebrates and roots. This destroys the forest floor ecosystem, inhibits forest regeneration and mobilises sediment.

Two large structures in the rivers within the KNE site appear to prevent the passage of most native fish species. This prevents these species from reaching large areas of potential habitat upstream of the structures. These structures are the spillway of the Lower Dam in the Wainuiomata River and the water intake weir in the Orongorongo River (see Appendix 1, Map 8). It appears that the structures are too high and steep for most species of native fish to swim or climb over them. Five species of native fish recorded in the Wainuiomata River below the lower dam have not been recorded above it and three species of native fish recorded in the Orongorongo River below the water intake weir have not been recorded above it. Only two species; koaro and longfin eel have been recorded above the Orongorongo weir³³. Three smaller weirs located in tributary streams are also likely to be barriers to fish passage into those intermediate stream catchments.

It should be noted that the large structures also appear to limit the passage of brown trout (*Salmo trutta*). This provides native fish upstream of the structures with a level of protection from predation by trout. This is likely to be a significant contributing factor in the high abundance of dwarf galaxias above the Wainuiomata lower dam spillway.

Operational activities such as the installation and maintenance of roads, tracks and structures can impact the ecological values of the KNE site if not undertaken in environmentally sensitive ways. Recreational activities such as hunting can impact native biodiversity by introducing ecological weeds.

8. Vision and objectives

8.1. Vision

This very special and significant area of indigenous forest, wetlands and sub-alpine ecosystems remains intact and flourishing. Its native plant communities are regenerating and thriving, and an increasingly large range of native birds are breeding successfully in the mainland island. It continues to provide an excellent source of clean water for public supply.

8.2. Objectives

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

The following objectives will guide the operational activities at the Wainuiomata/Orongorongo KNE site.

- 1. To maintain the strong native integrity of the forest and wetland ecosystems**
- 2. To improve regeneration of the forest and the condition of the forest canopy**
- 3. To improve the abundance of threatened and uncommon native plant species**
- 4. To improve habitat for native birds, including threatened species**
- 5. To provide safe breeding conditions for native birds in the mainland island**
- 6. To improve the habitat for native lizards and invertebrates in the mainland island**
- 7. To explore methods of improving the passage of native freshwater fish**
- 8. To support the Remutaka Conservation Trust to protect North Island brown kiwi in the KNE site**
- 9. To raise community awareness of the ecological values of the KNE site**

9. Operational activities

Operational activities are targeted to work towards the objectives above (Section 8). The broad approach to operational activities is described briefly below, and specific actions, with budget figures attached, are set out in the operational delivery schedule (Table 2).

The operational activities undertaken in Wainuiomata/Orongorongo KNE site focus predominantly on controlling ecological weeds and pest animals. A basic level of control of possums, feral ungulates and ecological weeds is undertaken across the whole site, while more intensive control of these and several predatory pest animal species is undertaken within the mainland island. Of secondary concern is minimising the impact that management related activities can pose on biodiversity values.

9.1. Ecological weed control

The primary aim of ecological weed control at the KNE site is to protect the relatively unmodified native forest of the upper catchments of both rivers (operational areas A and B; see Appendix 1, Map 4). This is accomplished by heavily suppressing weed infestations in these areas and by eradicating key species when possible.

The secondary aim of ecological weed control is to protect the more modified lower portion of the Wainuiomata River catchment (operational area C; see Appendix 1, Map 4) from further degradation by weed infestation and to limit the spread of weeds from this area into operational areas A and B.

In operational areas A and B, intensive control of key ecological weed species is undertaken. This work includes:

- Annually controlling ecological weed species listed in Appendix 5 prior to them seeding, making a priority of eliminating buddleia from the Wainuiomata catchment, and working towards eradicating others from both catchments
- Checking and controlling historic sites of ecological weed infestations and areas prone to weed incursions such as slips, river terraces and other disturbed areas, and investigating observations of ecological weeds reported by staff and contractors working in the KNE site
- Undertaking surveillance for incursions and colonisation of new ecological weed species, such as Darwin's barberry which has only started appearing in the KNE site in recent years. This might include undertaking surveys of high-risk sections of the site and scaling up surveys and implementing control if infestations are found
- Monitoring the effects of the biological control agent buddleia leaf weevil (*Cleopus japonicas*) to control buddleia in operational area B (the Orongorongo River catchment). Buddleia leaf weevils were released in this area in 2012. The effect that they are having on buddleia plants is monitored annually with recent observations indicating that weevils are significantly impacting the health of buddleia plants and the population has dispersed well beyond the original release area

- Annually controlling all plants of the aquatic weed species beggars' ticks on the edges of the lower dam wetland.

In operational area C, less intensive control of key ecological weed species is undertaken. This work includes:

- Progressively controlling tradescantia, accepting that eliminating infestations completely is very difficult, therefore focusing on suppressing infestations found under forest canopy to a point that the species is having little impact on understory regeneration
- Annually checking and controlling historic infestation sites of highly invasive ecological weed species, such as Japanese honeysuckle and holly
- Searching for and controlling other ecological weed species at three yearly intervals.

Information regarding the historic locations and sizes of ecological weed infestations contained in the pest plant control plans for Wainuiomata/Orongorongo Water Collection Area³⁴ and Wainuiomata Recreation Area³⁵ serves as baseline data and shows that good progress on controlling infestations has been made since those plans were developed in 2002. For instance, large infestations of buddleia have nearly been eliminated from the Wainuiomata River catchment due to the large emphasis on controlling this species in that catchment. Without this emphasis it is likely that buddleia would have colonised all the river terraces, stream beds and slips in the catchment.

There are some infestations of ecological weeds within the KNE site that can't be substantially controlled within the resources of the KNE programme. These include areas of blackberry, montbretia, sycamore, Spanish heath, and gorse. The Eastern Parks Team funds and undertakes control of infestations of some of these weeds in a strategic approach – in combination with planting or other operational work and in areas of high ecological or amenity value. If sufficient resources become available in the future, it would be beneficial to broaden the scope of this work.

9.2. Pest animal control

The aim of pest animal control undertaken across the whole KNE site is to reduce the numbers of mammalian browsers and predators, such as possums, goats, pigs and deer, in order to achieve the objectives stated in Section 8. Possums are controlled through control operations which mostly rely on the use of aerially sown 1080, but also include some ground control. Ungulates (goats, pigs and deer) are regularly controlled through hunting. Further details of these activities follow below.

More intensive pest animal control is undertaken within the mainland island (see operational area D, Appendix 1, Map 5) with the aim of achieving more comprehensive ecosystem restoration in this part of the KNE site. This includes improving bird breeding success and protecting lizards and invertebrates from predation by a larger range of pest species. This higher level of protection recognises the significant ecological value of this part of the KNE site and the importance of protecting it and facilitating its recovery.

KNE site-wide control

Aerial 1080 possum control

Possums are controlled on a regular basis throughout the KNE site. This activity is usually planned and delivered as part of a programme of large-scale aerial possum control undertaken across the large native forests owned by Greater Wellington³⁶. Control is scheduled to be undertaken every five years, with the next operation in the Wainuiomata/Orongorongo KNE site scheduled for the winter of 2024.

However, OSPRI has let Greater Wellington know that it plans to undertake an aerial 1080 operation in the northern Remutaka Range around the same time and wishes to include the KNE site in its operation. Assuming this operation goes ahead, there will be no need for Greater Wellington and Wellington Water to undertake a possum control operation this time around. The OSPRI operation will be undertaken under its TBfree programme; a national strategy aimed at eradicating bovine tuberculosis from New Zealand. Possums are controlled as part of this programme as they are one of the main vectors of the disease.

It will be important for Greater Wellington to work with OSPRI to ensure that all of the KNE site is included in its control operation. Control will mainly be undertaken using aerially sown 1080 (sodium fluoroacetate). But some ground-based trapping or poisoning will be required beyond aerial boundaries such as in high public use areas.

It will also be important to know that the operation has delivered the target that Greater Wellington and Wellington Water would seek from a control operation. As it is unlikely that OSPRI will undertake possum population monitoring in the KNE site following the aerial operation, Wellington Water will fund Greater Wellington to undertake monitoring soon after the completion of the control operation to measure its success.

The next possum control operation to follow is be scheduled for 2029. Monitoring of the possum population levels is usually undertaken ahead of an operation to check that the operation is required at the scheduled time. Control is usually undertaken when monitoring indicates that possum numbers have grown to around 5% residual trap catch (RTC), or 22% wax tag index (WTI), depending on the method used. Operational timing might be altered if monitoring results are found to be well below this level. Past aerial 1080 operations were undertaken in the KNE site in 1999, 2005, 2012 and 2018. The 2018 operation was undertaken by OSPRI.

Rat and stoat control

Monitoring after aerial 1080 possum control operations has shown that in addition to controlling possums, these operations also control rat and stoat populations to very low levels. Although this control is likely to be short lived, with rat populations returning to pre-control levels within 18 months³⁷, it is hoped that native plants and animals will receive some benefit from these periods of reduced browsing and predation. Comprehensive ground-based rat or stoat control isn't undertaken over the whole KNE site due to the extreme difficulty and expense of such large-scale control of these animals.

Feral goat, deer and pig control

Feral goats, deer and pigs are culled annually to reduce population numbers to low levels. Culling utilises a combination of ground-based and aerial hunting methods to target areas most frequented by the separate species. About 58 person-days of ground-based hunting (38 targeting goats and deer, and 20 targeting pigs) and two hours of aerial hunting (targeting all three species) are undertaken annually. As it is apparent that population numbers of all three species are on the rise in the region and that the current input is only just keeping pace with current population levels, it is likely that resourcing will need to increase in coming years to maintain effective control.

The target for culling operations is to keep goat, deer and pig populations suppressed to levels at which professional hunters are not able to encounter more than one animal per day of hunting on foot, or five animals per hour of hunting by helicopter. It is considered that populations at these levels have low impacts on native plant regeneration and survival.

A deer fence runs along almost the full length of the western and northern boundaries of the KNE site. This fence controls the movement of farm stock and feral deer, goats and pigs into the KNE site from private land to the west and north of the site. The fence has stopped incursions of stock and appears to be fairly effective in controlling the movement of goats and deer. Far fewer of these animals are now encountered in the north-western half of the site. However, despite the fence, pig numbers continue to build up in this part of the KNE site. They appear to come from far away to the north and east in search of the plentiful native fruit to be found in the area.

Maintenance and repair of the fence is required frequently due to damage caused by wind-thrown trees, animals digging at its base, vegetation growing against it and deterioration from age. The road that runs along the full length of the fence is key to this maintenance and provides efficient access for culling operations. Therefore, it also requires ongoing maintenance. Wellington Water funds surveillance and maintenance of the fence and road. The Wainuiomata/Orongorongo Ranger undertakes the surveillance on Wellington Water's behalf. This maintenance should be scheduled and appropriate resources forecast in order to achieve the objective of the fence.

Wainuiomata Mainland Island intensive control*Possum, rodent, mustelid, and feral cat control*

Control of these pest species is undertaken in an integrated approach using a large intensive network of control devices located on marked routes and lines throughout the mainland island (see Appendix 1, Map 6). There are 30 pest control lines on which devices are positioned traversing the mainland island from west to east totalling about 90km in length. Devices are also positioned densely round the approximately 15km boundary. This control regime has been ongoing since its inception in 2005 and is serviced by Greater Wellington staff and contractors.

Possums are kept to very low levels within the mainland island using Warrior kill-traps. Traps within a 300m inner buffer of the mainland island are positioned in a 150m x 100m grid and traps in the interior are in a 300m x 300m grid.

Rodent control is undertaken using bait stations containing toxic bait. Permanent bait stations are positioned in a 150m x 100m grid and at 50m intervals around the boundary.

Mustelids are controlled using a mixture of DOC200 and BT200 kill-traps. These are spaced at about 300m intervals along lines through the interior of the mainland island that are approximately 1km apart, and at 200m intervals around the boundary. Many of the trap boxes contain two traps, known as double sets.

Feral cats are controlled using Timms traps on raised boards or in chimney boxes spaced at about 1km intervals.

Bait stations and possum traps around the boundary and all mustelid and cat traps are serviced about every five weeks. The remaining bait stations and possum traps within the mainland island interior are serviced about every 10 weeks (five times per year).

Feral pig control

Feral pig control is undertaken annually in the mainland island to combat the high numbers of feral pigs that appear to be attracted to the mainland island by the large quantity of forest fruit that is available in the absence of high possum and rat numbers. Culling is undertaken by experienced and proven professional hunters using hunting dogs to locate and flush pigs out of hiding. About 50 person days of pig culling is undertaken in the mainland island annually, in addition to the 20 person-days mentioned above for outside the mainland island. The target for culling operations is the same as that detailed above for culling undertaken across the wider site. Some resources allocated to feral pig culling are used for trialing alternative control methods such as trapping and poisoning. Some trapping has been trialed but not enough yet to know whether this is an effective or efficient approach.

Rat control in response to seed masting events

Experience has shown that masting events are likely to occur in the forests of the KNE site every few years. This is when unusually vigorous seeding of a wide range of native tree species occurs simultaneously or consecutively within the same year. Mast events have occurred as regularly as on consecutive years, to several years apart and some have been more pronounced than others.

As a result of these increases in food resources, sharp increases in numbers of rats, and consequently stoats, are likely to occur. As the seed supply inevitably dries up these predatory species turn to native birds for their sustenance which can have a devastating impact on bird populations.

To minimize the adverse effects of masting events, additional pest control is undertaken ahead of predicted spikes in pest numbers. National predictions of masting events are monitored and depending on the predicted strength of an anticipated event, pest control is stepped up in one of several ways. These range from undertaking additional servicing of bait stations with more toxic or faster acting bait, to undertaking aerial 1080 operations.

Provisional approval to undertake aerial 1080 operations in the mainland island and an adjacent buffer area (see operational area E, Appendix 1, Map 5) ahead of severe masting events has been granted by Wellington Water³⁸. Full approval from Wellington

Water will be dependent on the security of water supply at the time. Details of the planning and decision-making process regarding this are contained in an agreement between Wellington Water and the former Biodiversity department³⁹.

Control targeted at protecting specific native species

Mustelid control to protect kiwi

Mustelids are controlled in parts of the KNE site south of the mainland island by the Remutaka Conservation Trust to help protect NI brown kiwi that have spread from the managed population in the Turere Valley south of the KNE site. Control is undertaken using DOC200 and Good Nature A24 kill-traps positioned at 100m intervals along main ridgelines, spurs and roads (see Appendix 1, Map 6). These traps form a corridor of protection for kiwi between the Turere Valley and the mainland island.

To bolster this corridor of protection there is a line of traps and bait stations targeting mustelids, cats, possums and rats positioned alongside George Creek road and the catchment road linking to the southern end of the mainland island (indicated in Appendix 1, Map 6). These bait stations and traps are serviced by volunteers who have been doing so for the past 10 years. The Pest Animals Team supplies bait to the volunteers and trap catch data is recorded in a TrapNZ project.

Predator control to protect native waterfowl

Seven DOC200 traps and four Timms traps contained in wooden chimney boxes are positioned around the lower dam wetland (see operational area F; Appendix 1, Map 5). These were put in place to protect native wetland birds from predation by mustelids and cats. Operation of the traps has been paused while Goodnature undertakes trapping trials in the area. Use of the traps will resume once the Goodnature trials have been completed. They will be serviced by the Park Ranger with bait funded by the KNE programme.

9.3. Ecological monitoring

Greater Wellington undertakes several ecological monitoring projects in the KNE site for one of the following two purposes:

1. To measure the effectiveness of the KNE programme's biodiversity management activities at the site
2. To assess the ecological health of the site as a water collection area.

Following is a list of the ecological monitoring projects undertaken.

- Small mammal monitoring – undertaken to assess whether control targets for rats and mustelids are being achieved in the mainland island, and to provide information about hedgehog and mouse populations
- Possum monitoring – undertaken to assess whether the control target for possum control is being achieved
- Bird monitoring (using five-minute bird count method) – undertaken to measure whether bird population numbers within the mainland island are improving, stable or declining

- Fruit fall monitoring – undertaken to measure the amounts of hinau and tawa fruit consumed by rats and possums to indicate the impact that these pests may be having on fruit availability for re-seeding of the forest and for birds
- Ungulate browse monitoring – undertaken to indicate whether levels of goats and deer are low enough to allow forest understory regeneration
- Vegetation plot monitoring – undertaken to assess the growth of the forest and change in forest structure over time and to determine if forest understory regeneration is improving, stable or declining
- Rata tree health monitoring – undertaken to assess the health of rata trees as an indicator of possum damage to the forest canopy.

The first of these projects (small mammal monitoring) is funded by the KNE programme, while the remainder are either funded by Wellington Water or Greater Wellington's Monitoring – Land, Ecosystems and Air Team. All monitoring is coordinated by the Monitoring – Land, Ecosystems and Air Team.

Other one-off surveys may be undertaken by the Monitoring – Land, Ecosystems and Air Team, such as for North Island brown kiwi, bats, or snails. Research into pest animal dynamics and behaviour which could assist in management decisions might also be undertaken.

North Island robin surveillance

Greater Wellington staff and contractors undertaking biodiversity management and other activities within the KNE site, and other adjacent KNE sites, continue to keep a look out for North Island (NI) robins in order to gain knowledge of any surviving populations within the KNE site or adjacent areas. Two translocations of the species into the mainland island were undertaken in 2012 and 2013 as described in Section 6.3.

If a NI robin is sighted, an expert in identification of the species will be engaged to survey the immediate area of the sighting to attempt to re-locate the bird and ascertain whether it is juvenile or adult, and whether it is alone or mated. This information will help indicate whether NI robins are surviving in the mainland island or the wider KNE site.

9.4. Revegetation

The aim of revegetation work currently being undertaken at the KNE site is to restore the Wainuiomata Lower Dam wetland environs by increasing the dominance and diversity of native plant species in and around the wetland.

A restoration management plan⁴⁰ was prepared for this work in 2019 by the Biodiversity department and the Eastern Parks Team are progressively implementing this plan. Plants are provided free of charge by the Forest and Bird nursery located at the site and planting is undertaken by community volunteers and staff. Site preparation and plant maintenance is mostly carried out by Eastern Parks staff and the Eastern Parks Team funds any sundry materials required.

Only native plants of appropriate species for the site and eco-sourced from the Tararua Ecological Region are used for this project and any other planting in the KNE site.

Map 7 shows the area of this restoration project.

9.5. Environmental Protocols

Greater Wellington and Wellington Water undertake biodiversity, water supply and recreational asset maintenance activities in the KNE site. In doing so, best practice methods are used, and the following procedures are followed to help protect the natural resources of the site from the potential impacts of human activities.

Environmental care

Greater Wellington and Wellington Water operational staff follow procedures to identify and avoid damage to biodiversity values such as plant and animal communities. Procedures may include undertaking assessments of environmental effects of planned works. This limits the risks to these values that could occur while carrying out the construction and maintenance of assets, and when permitting the use of the KNE site by other users.

Biosecurity guidelines⁴¹ are used by all Greater Wellington and Wellington Water personnel when entering and working in the KNE site. These guidelines involve checking for and removing seeds and plant fragments from clothing, equipment and vehicles before entering the site. A vehicle undercarriage washing facility is provided on site to assist with this and all vehicles entering the water collection area are required to use it.

Instructional information on how to avoid introducing ecological weeds and damage to ecological values are included in the conditions contained in permits issued to visiting researchers, private hunters and members of the public attending guided walks within the KNE site.

Research and the collection of natural materials

Research activities and the collection of native plants and animals in the KNE site is managed by a permit system run by the Monitoring – Land, Ecosystems and Air Team. However, illegal collection of native plants and animals has occurred occasionally in regional parks and forests. This has included the collection of native orchids which are sought after by collectors and the removal of native trees for use as firewood. The Park Ranger keeps a look out for such activities while carrying out normal duties within the regional park.

Dog control

Greater Wellington's dog control policies for the Wainuiomata Regional Park help to protect North Island brown kiwi that are present in the KNE site and reduce the disturbance of waterfowl at the Lower Dam wetland. Dogs are required to be kept on leads in all the regional park area and are not permitted near the Lower Dam wetland. The adjacent Hutt City Council managed Richard Prouse Park being designated an off-lead area can make enforcement a challenge.

Dogs are not permitted into the water collection area beyond the Wainuiomata Regional Park where public access is controlled. Exceptions to this policy are granted to Remutaka Conservation Trust using approved kiwi-finding dogs and to Greater Wellington's contracted hunters and staff using kiwi-aversion trained hunting or detection dogs.

9.6. Remediation of fish passage

Environment Restoration and Eastern Parks staff will explore practical options for improving the passage of native fish over or around the two structures currently presenting major barriers to fish passage in the KNE site (the spillway of the Wainuiomata Lower Dam and the Orongorongo water intake weir), (see Appendix 1, Map 8). Actions will initially consist of scoping and enquiry, but funding may be sought from other programmes or budgets to implement solutions if affordable solutions can be found.

The report produced for Greater Wellington in 2002 on the potential for enhancing fish communities by using a fish pass on the Orongorongo water intake weir⁴² will provide a good starting reference point for the first step of this process. This report showed that providing passage around the Orongorongo water intake weir for redfin bully and shortjaw kokopu, which are present below but not above the weir, would double the number of native fish species that would have access to a full range of habitat within that catchment. Shortjaw kokopu are classified as threatened species and therefore increasing the potential habitat for this species would be an important positive conservation outcome.

While solutions to improving the passage of native fish will be sought, it will be important to consider the impedance that the structures currently pose to the passage of trout and the benefit that this provides to the important population of dwarf galaxias present. No solution that would be at all likely to result in a dis-benefit to the dwarf galaxias population will be implemented.

9.7. Community engagement

The purpose of community engagement on native biodiversity of the KNE site is to increase the community's knowledge and interest of native biodiversity both within the KNE site and elsewhere, which might lead to greater public advocacy for and action on protecting native biodiversity.

Members of the public are informed of the ecological values of the site and the management actions being undertaken to protect them through:

- Public guided walks lead by the Park Ranger
- Community planting events
- Occasional/ad hoc press articles.

10. Future opportunities

10.1. Eco-sanctuary proposal

In 2020, Jim Lynch, the founder of Karori Wildlife Sanctuary (now Zealandia Ecosanctuary) proposed that the headwaters of the Wainuiomata River catchment would provide an excellent location to establish a predator-fenced pest-free mainland island. At the heart of the proposal was that the site has the potential to provide rare breeding habitat and ultimately lower the threat status for kākāpō and other nationally critically endangered species.

The proposal is to construct a 28.8km predator-proof fence around 3,313 ha of the upper Wainuiomata River catchment; eradicate all predatory and browsing pests within this area; and keep the area pest-free in perpetuity. The proposed area of the eco-sanctuary includes the area of the current Wainuiomata mainland island, which covers 1,200 ha.

Following the proposal and some preliminary investigation by a pilot group, the Greater Wellington Environment Committee resolved to support the concept in principle and authorised a working group to prepare a comprehensive feasibility study. The feasibility study⁴³ was presented to the Environment Committee for its consideration in March 2022.

If this proposal proceeds and the project goes ahead, the management of the eco-sanctuary will be separated from the KNE site, effectively reducing the KNE site by 3,313 ha. All biodiversity management of that area will be handed over to the eco-sanctuary project, including that of the current mainland island. If the project is approved, it is likely to be several years before implementation starts as securing funding and establishing a controlling organisation is likely to take some time.

10.2. Strengthened predator control

When and if the eco-sanctuary project described above is approved to proceed, it would be beneficial to both the eco-sanctuary and the biodiversity of the remainder of the KNE site to strengthen the predator control that is currently in place in areas of the KNE site beyond the future eco-sanctuary. The current predator control in this area is undertaken by volunteers of the Remutaka Conservation Trust with no input from Greater Wellington and the level of control is currently fairly light. Strengthening the predator control by adding trap-lines would help reduce incursions of predators into the eco-sanctuary and provide protection for native fauna spilling out of the eco-sanctuary.

10.3. Translocations of native species

It is possible that Greater Wellington may be approached by ecological restoration projects to either source native animal species from the Wainuiomata-Orongorongo KNE site for translocation to other sites, or to translocate species to the KNE site (particularly the mainland island). This is due to the KNE site's particularly rich native biodiversity, the level of biodiversity management undertaken at the site (particularly in the mainland island), and the knowledge of the native bird populations present that Greater Wellington holds as a result of many years of monitoring.

Any application to translocate native species from or to the KNE site will be managed according to an internal Greater Wellington process developed for the purpose. This

process includes an assessment of the appropriateness of proposed translocations in regards to the benefits and impacts on the biodiversity of the KNE site; and the benefit to the receiving or source site involved, the broader landscape, and species conservation. Greater Wellington will support and may apply some staff resource to approved translocations but is unlikely to lead or fund a translocation.

Zealandia Ecosanctuary undertook a translocation of North Island rifleman from the mainland island to Zealandia in March-April 2019. This translocation was approved through the above process and permitted by the Department of Conservation.

11. Operational delivery schedule

The operational delivery schedule shows the actions planned to achieve the stated objectives for the Wainuiomata/Orongorongo KNE site, and their timing and cost over the five-year period from 1 July 2023 to 30 June 2028. The budget for years 2024/25 to 2027/28 are indicative only and subject to change. Maps of operational areas can be found in Appendix 1 (see Maps 4-8).

Table 2: Five-year operational plan for the Wainuiomata/Orongorongo KNE site

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
1, 2	Ecological weed control: Control buddleia: <ul style="list-style-type: none"> • Check areas of previous control • Search areas prone to new infestation – slips, stream beds, river terraces • Control all plants prior to them flowering 	A	Buddleia is eliminated from the operational area Dominance of native plant communities is maintained	Greater Wellington Pest Plants team	\$3,000 ⁱ	\$3,000 ⁱ	\$2,000 ⁱ	\$2,000 ⁱ	\$2,000 ⁱ
1, 2	Ecological weed control: Control all key ecological weeds, apart from buddleia: <ul style="list-style-type: none"> • Include surveys of areas where the risk of incursion is high 	A, B	Key ecological weeds are suppressed to very low levels Dominance of native plant communities is maintained	Greater Wellington Pest Plants team	\$5,736 ⁱ	\$5,955 ⁱ	\$7,178 ⁱ	\$7,408 ⁱ	\$7,643 ⁱ

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
1, 2	Ecological weed control: Monitor the effects of buddleia leaf weevil on buddleia plants	B	Buddleia is diminishing in the operational area Dominance of native plant communities is maintained	Greater Wellington Pest Plants team	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)
1, 2	Ecological weed control: Control tradescantia under forest canopy	C	Tradescantia is having negligible impact on understory regeneration Regeneration of the understory has improved	Greater Wellington Pest Plants team	\$6,000	\$5,000	\$5,000	\$4,000	\$4,000
1, 2	Ecological weed control: Control other key ecological weeds	C	Key ecological weeds are reduced to a minor component of the plant community Condition of the native plant community has improved	Greater Wellington Pest Plants team	\$3,000	\$4,000	\$4,000	\$5,000	\$5,000

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
2, 3, 4	Pest animal control: Control possums by undertaking an aerial 1080 operation and ground based control <ul style="list-style-type: none"> • Undertaken by OSPRI as part of its Northern Remutaka operation • Greater Wellington and WWL input required in planning 	Entire KNE site	Improved condition of the native forest canopy and regeneration of the native forest understory	OSPRI Greater Wellington Environment Restoration team Wellington Water	--	--	--	--	--
2, 3, 4	Pest animal control: Undertake post-operational possum population monitoring	A, B	Scientific data is obtained to help assess the success of the possum control operation	Greater Wellington Monitoring – Land, Ecosystems and Air team	--	\$22,550 ⁱ	--	--	--
2, 3	Pest animal control: Control goats and deer, focusing on preferred habitats, using ground-based and aerial methods (~38 days ground hunting and two hours aerial hunting)	Entire KNE site	Improved regeneration of the native forest understory and abundance of uncommon palatable species	Greater Wellington Pest Animal team	\$26,496 ⁱ	\$27,283 ⁱ	\$28,090 ⁱ	\$28,917 ⁱ	\$29,765 ⁱ
2, 3	Pest animal control: Control pigs by ground-based hunting focusing on preferred habitats; (~20 days ground hunting annually)	Entire KNE site	Improved regeneration of the native forest understory	Greater Wellington Pest Animal team	\$10,000 ⁱ	\$10,000 ⁱ	\$10,000 ⁱ	\$10,000 ⁱ	\$10,000 ⁱ

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
2, 3	Pest animal control: Maintain the deer fence and associated road <ul style="list-style-type: none"> • Park Ranger regularly checks fence for damage (about quarterly plus after heavy weather events) • Wellington Water Ltd arranges repairs 	Western and northern boundary	Neighbouring stock and feral goats, deer and pigs are prevented from entering the site on the western and northern boundaries	Greater Wellington Eastern Parks team and Wellington Water	\$1,400 ⁱⁱⁱ	\$1,400 ⁱⁱⁱ	\$1,400 ⁱⁱⁱ	\$1,400 ⁱⁱⁱ	\$1,400 ⁱⁱⁱ
2, 3, 4, 5, 6	Pest animal control: Control possums, rats, mustelids and cats by: <ul style="list-style-type: none"> • Check and re-bait all bait stations and possum traps every 10 weeks • Check and re-bait all mustelid and cat traps, and all bait stations and possum traps on the boundary every 5 weeks 	D (Mainland Island)	Suppression of populations is maintained to: Possums <2% RTC* Rats <5% TTI** Mustelids <2% TTI** Native bird abundance has increased	Greater Wellington Pest Animal team	\$141,560	\$141,560	\$141,560	\$141,560	\$141,560

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
2, 3, 6	Pest animal control: Control pigs by ground-based hunting; (~50 days ground hunting annually)	D (Mainland Island)	Improved regeneration of the native forest understory	Greater Wellington Pest Animal team	\$23,967	\$23,967	\$23,967	\$23,967	\$23,967
1, 4, 5, 6	Pest animal control: Control rats during seed masting events using aerial 1080	D, E (Mainland Island & adjacent buffer zone)	Rat population is maintained to below 5% TTI** Native bird abundance has increased	Greater Wellington Pest Animal team		\$124,000 ^{iv}		\$132,000 ^{iv}	
4, 5, 8	Pest animal control: Control mustelids by trapping in a wide corridor between the Turere Valley on the southern boundary and the mainland island	See RCT traps on map 6, Appendix 1	Kiwi migrating from the Turere Valley to the Mainland Island are protected from predation by mustelids	Remutaka Conservation Trust (NI brown kiwi project)	Funded by RCT	Funded by RCT	Funded by RCT	Funded by RCT	Funded by RCT
4	Pest animal control: Control mustelids and feral cats by trapping around the Lower Dam wetland	F	Successful breeding of native wetland birds has increased	Greater Wellington Eastern Parks team	\$150 (bait only)	\$150 (bait only)	\$150 (bait only)	\$150 (bait only)	\$150 (bait only)
5, 6	Monitoring: Undertake monitoring of small mammal populations	D, E (Mainland Island & non-treatment area)	Scientific data is obtained that helps inform management decisions	Greater Wellington Environmental Science department	\$28,009	\$28,009	\$28,009	\$28,009	\$28,009

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
5	Monitoring: All staff and contractors keep a look out for North Island robins Survey the location of any observed North Island robins to obtain information about individual birds and the population	Entire KNE site	All observations are investigated Knowledge of presence/absence of remnant populations in gathered	Greater Wellington Biosecurity and Environmental Science departments	\$1,000 ^v	\$1,000 ^v	\$1,000 ^v	\$1,000 ^v	\$1,000 ^v
2, 3, 4, 5	Monitoring: Undertake monitoring of birds, fruit-fall, ungulate browse, vegetation health and rata tree health	Various locations across the KNE site	Increased knowledge of management outcomes	Greater Wellington Monitoring – Land, Ecosystems and Air team	Funded by GW Monitoring LEA team and WWL	Funded by GW Monitoring LEA team and WWL	Funded by GW Monitoring LEA team and WWL	Funded by GW Monitoring LEA team and WWL	Funded by GW Monitoring LEA team and WWL
1, 4	Revegetation: Continue implementation of the Lower Dam wetland restoration plan	G	Increased and enhanced native wetland habitat	Greater Wellington Eastern Parks team and community	\$700	\$700	\$700	\$700	\$700

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
1, 2, 3, 4, 8	<p>Environmental protocols: Adhere to Greater Wellington best practice guidelines and policies aimed at protecting the natural environment while undertaking operational activities and managing recreational and commercial activities in the KNE site, including:</p> <ul style="list-style-type: none"> • assessment of environmental effects procedures • pest plant biosecurity guidelines • research and natural material collection permitting system and surveillance for illegal collecting • dog control policy 	Entire KNE site	Biodiversity values aren't unnecessary impacted by management, recreational or commercial activities	All Greater Wellington and Wellington Water staff operating in the KNE site	Nil (staff time and attention only)	Nil (staff time and attention only)	Nil (staff time and attention only)	Nil (staff time and attention only)	Nil (staff time and attention only)
7	Fish passage: Explore practical solutions to improving fish passage	Lower Dam spillway and Orongorongo weir	Passage for native fish has improved	Greater Wellington Environmental Restoration and Eastern Parks teams	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)

Objective	Activity	Operational area	Intended 5-year outcome	Implementing party	Timetable and resourcing where allocated				
					2023/2024	2024/25	2025/26	2026/27	2027/28
9	Community engagement: Convey the biodiversity values of the KNE site and the value of protecting them to the public through public events and media releases	Entire KNE site	The public are aware of native biodiversity and are willing to protect native biodiversity values	Greater Wellington Environmental Restoration, Eastern Parks and Communications teams	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)	Nil (staff time only)

ⁱFunded by Wellington Water Limited

ⁱⁱ Control operation funded by OSPRI. Some Greater Wellington staff time required during planning

ⁱⁱⁱThis funding is for monitoring the fence condition only, not for repairs of it or the associated road which are unpredictable. Funded by Wellington Water Limited

^{iv}It is indeterminable in what year this activity will be required therefore the scheduling of funding is indicative only.

^vIf funding is not required for this activity in any given financial year it will be re-allocated to ecological weed control towards the end of that year

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

**TTI = Tracking Tunnel Index

12. Funding contributions

12.1. Budget allocated by Greater Wellington

The budget for the years 2024/25 to 2027/28 are indicative only and subject to change.

Table 3: Greater Wellington allocated budget for the Wainuiomata/Orongorongo KNE site

Management activity	Timetable and resourcing				
	2023/24	2024/25	2025/26	2026/27	2027/28
Ecological weed control	\$9,000	\$9,000	\$9,000	\$9,000	\$9,000
Regular mainland island pest animal control	\$165,677	\$165,677	\$165,677	\$165,677	\$165,677
Mast year pest animal control		\$124,000 ⁱ		\$132,000 ⁱ	
Small mammal monitoring	\$29,009	\$29,009	\$29,009	\$29,009	\$29,009
Revegetation	\$700 ⁱⁱ	\$700 ⁱⁱ	\$700 ⁱⁱ	\$700 ⁱⁱ	\$700 ⁱⁱ
Total	\$204,386	\$328,386	\$204,386	\$336,386	\$204,386

ⁱ Scheduled timing is indicative only because timing of mast years is indeterminable.

ⁱⁱ Funded by Greater Wellington Eastern Parks team.

12.2. Budget allocated by Wellington Water Limited

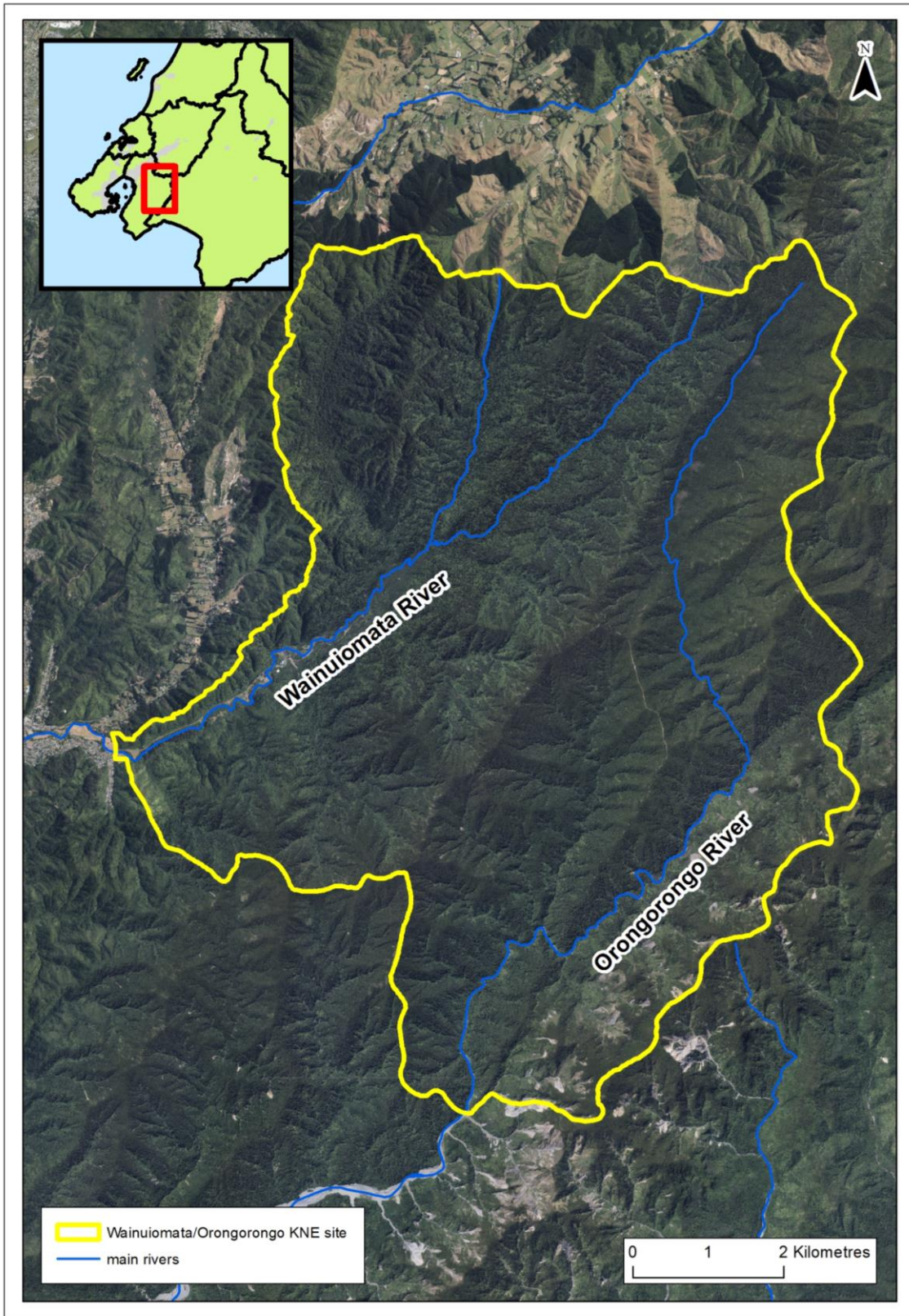
The budget is subject to confirmation through the Wellington Water Limited ten-year planning process.

Table 4: Wellington Water Limited allocated budget for the Wainuiomata/Orongorongo KNE site

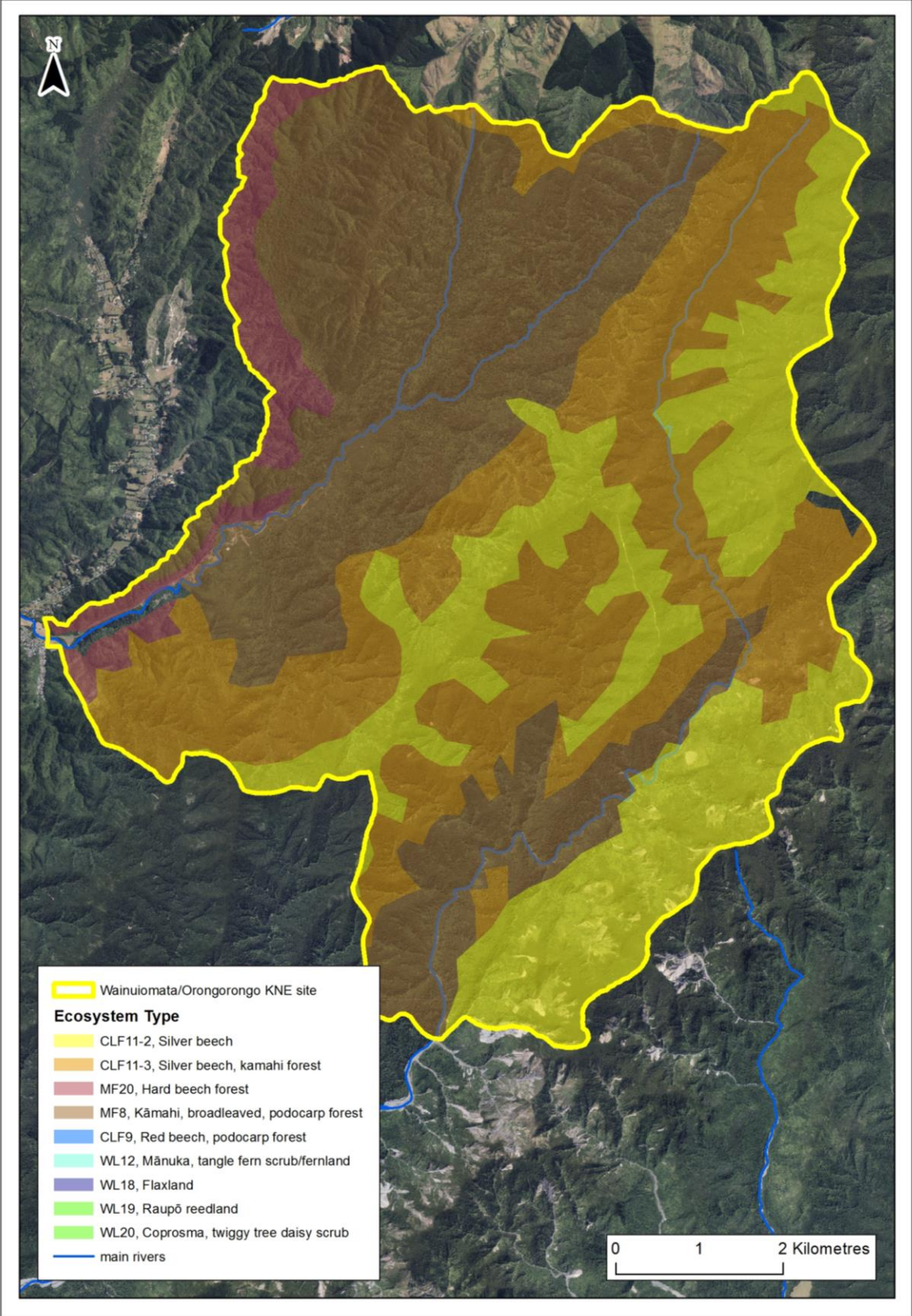
Management activity	Timetable and resourcing				
	2023/24	2024/25	2025/26	2026/27	2027/28
Ecological weed control	\$8,736	\$8,955	\$9,178	\$9,408	\$9,643
Aerial possum control	--	\$22,550	--	--	--
Goat, deer & pig control	\$36,496	\$37,283	\$38,090	\$38,917	\$39,765
Fence surveillance	\$1,400 ⁱ	\$1,400 ⁱ	\$1,400 ⁱ	\$1,400 ⁱ	\$1,400 ⁱ
Total	\$46,632	\$70,188	\$48,668	\$49,725	\$50,808

ⁱ This funding is for monitoring the fence condition only, not for repairs to it or the associated road which are unpredictable.

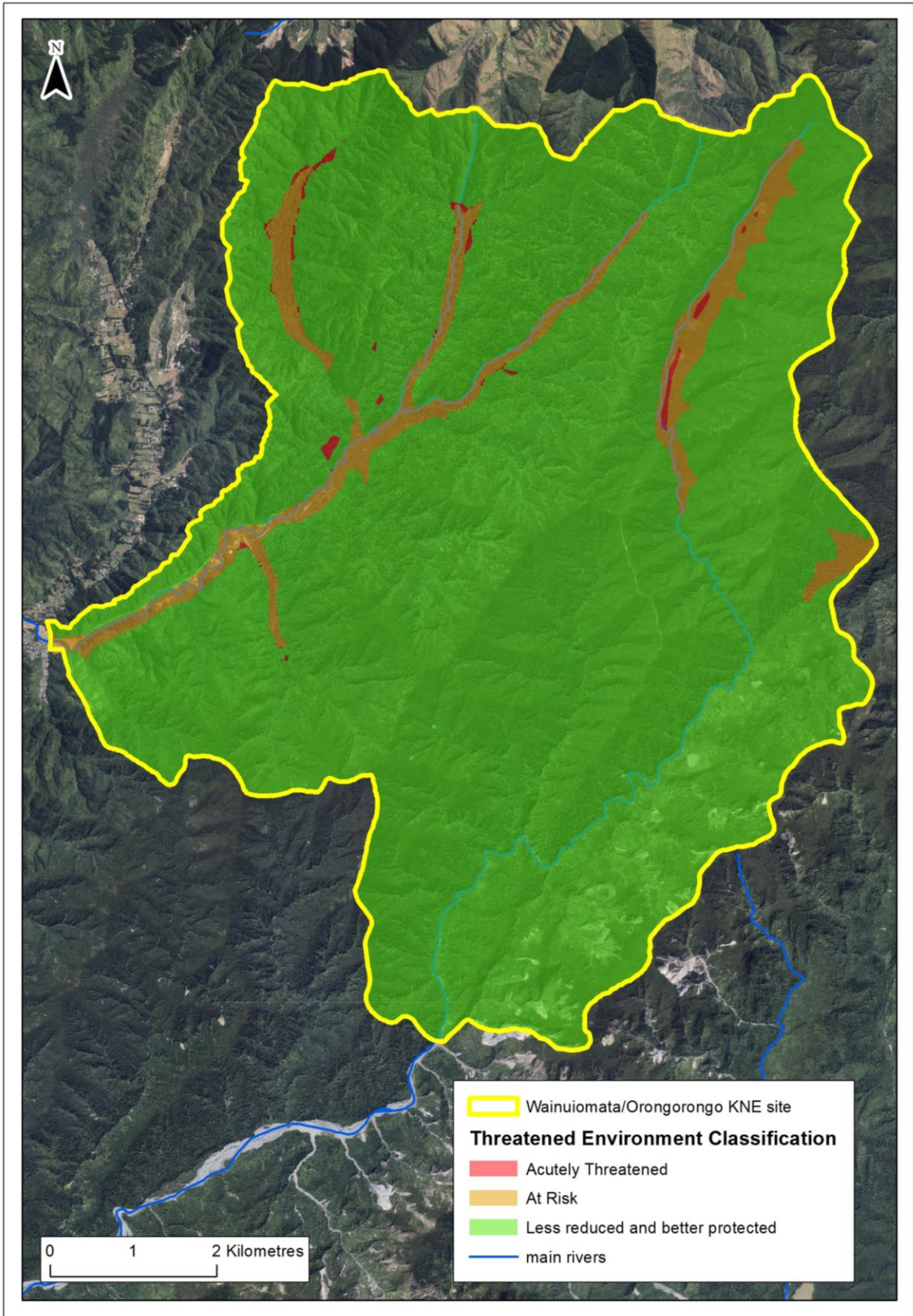
Appendix 1: Wainuiomata/Orongorongo KNE site maps



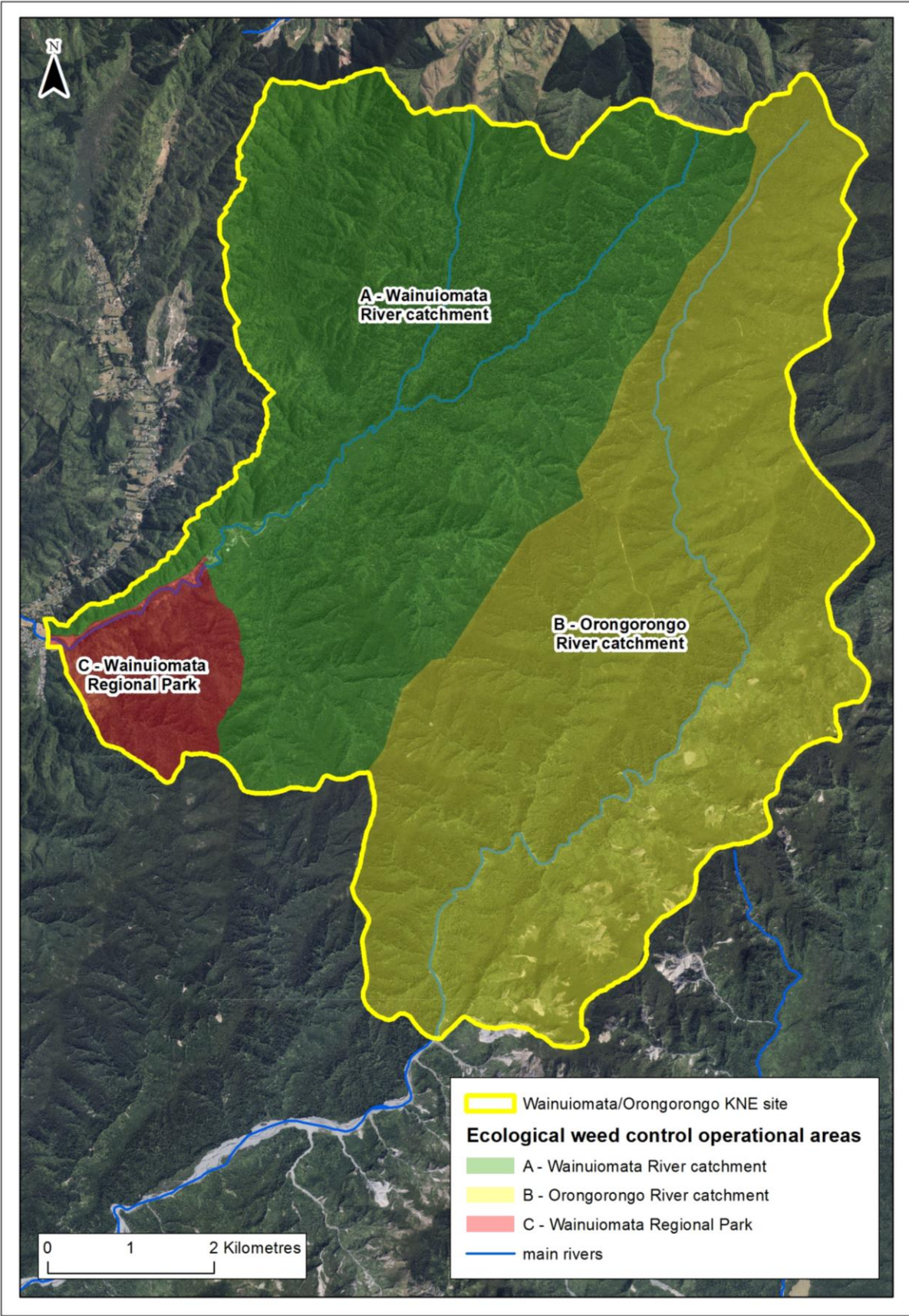
Map 1: The Wainuiomata/Orongorongo KNE site boundary



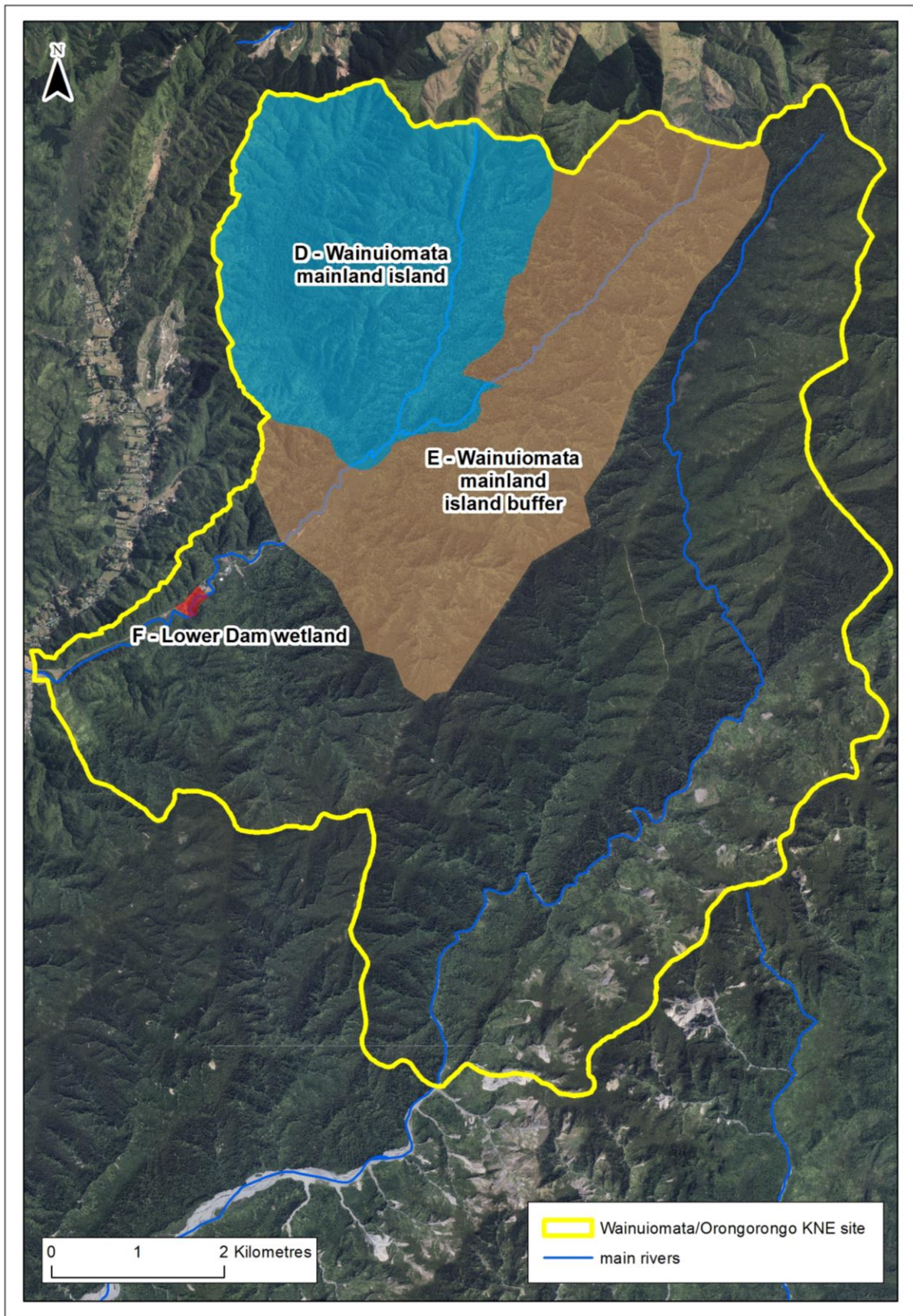
Map 2: The existing forest and wetland types of the Wainuiomata/Orongorongo KNE site indicated by Singers and Rogers⁴⁴ and Singers, Crisp and Spearpoint⁴⁵. The areas of forest type CLF9 and the four wetland types are too small to be visible on the map.



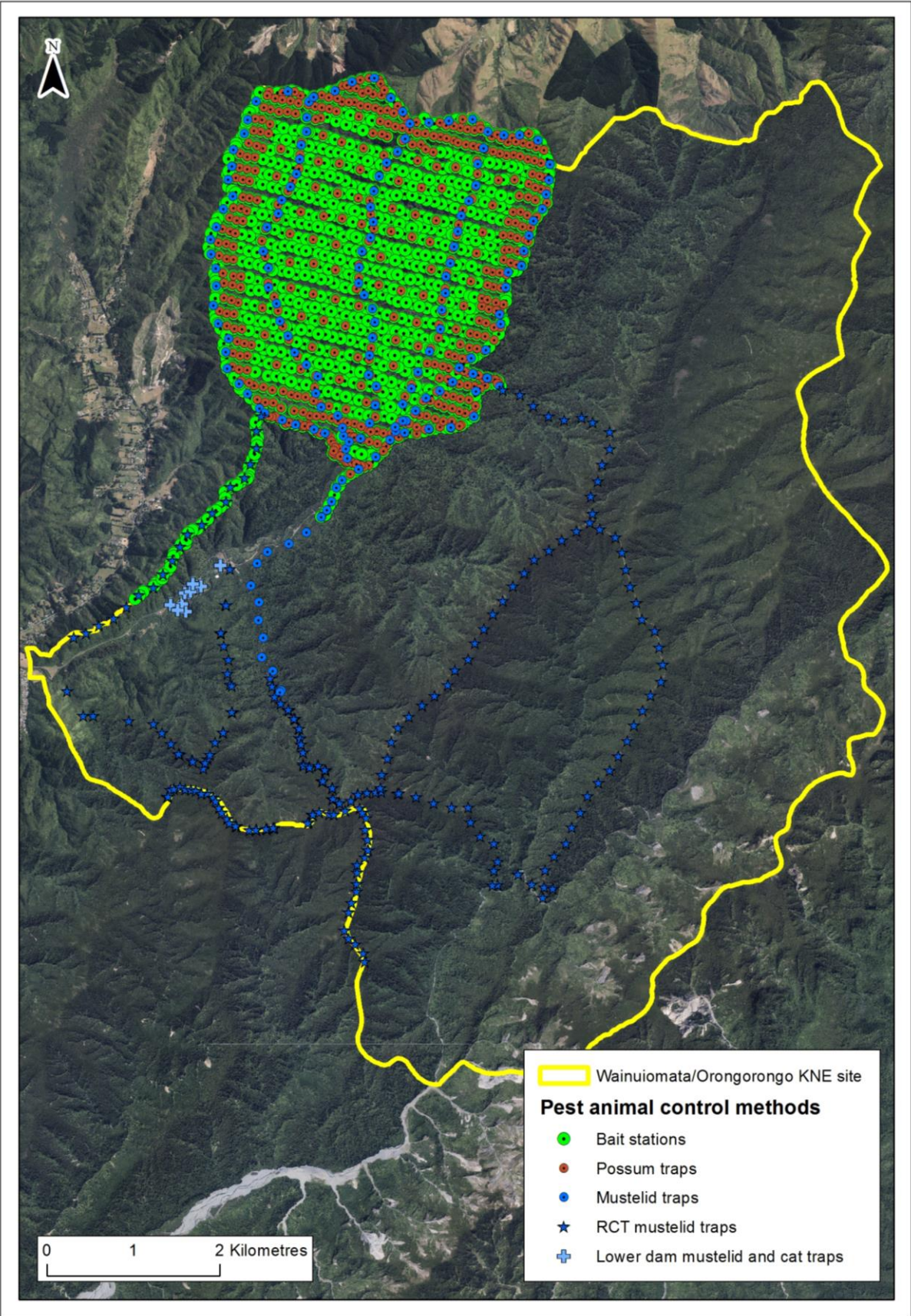
Map 3: Forest cover threat classification for the Wainuiomata/Orongorongo KNE site



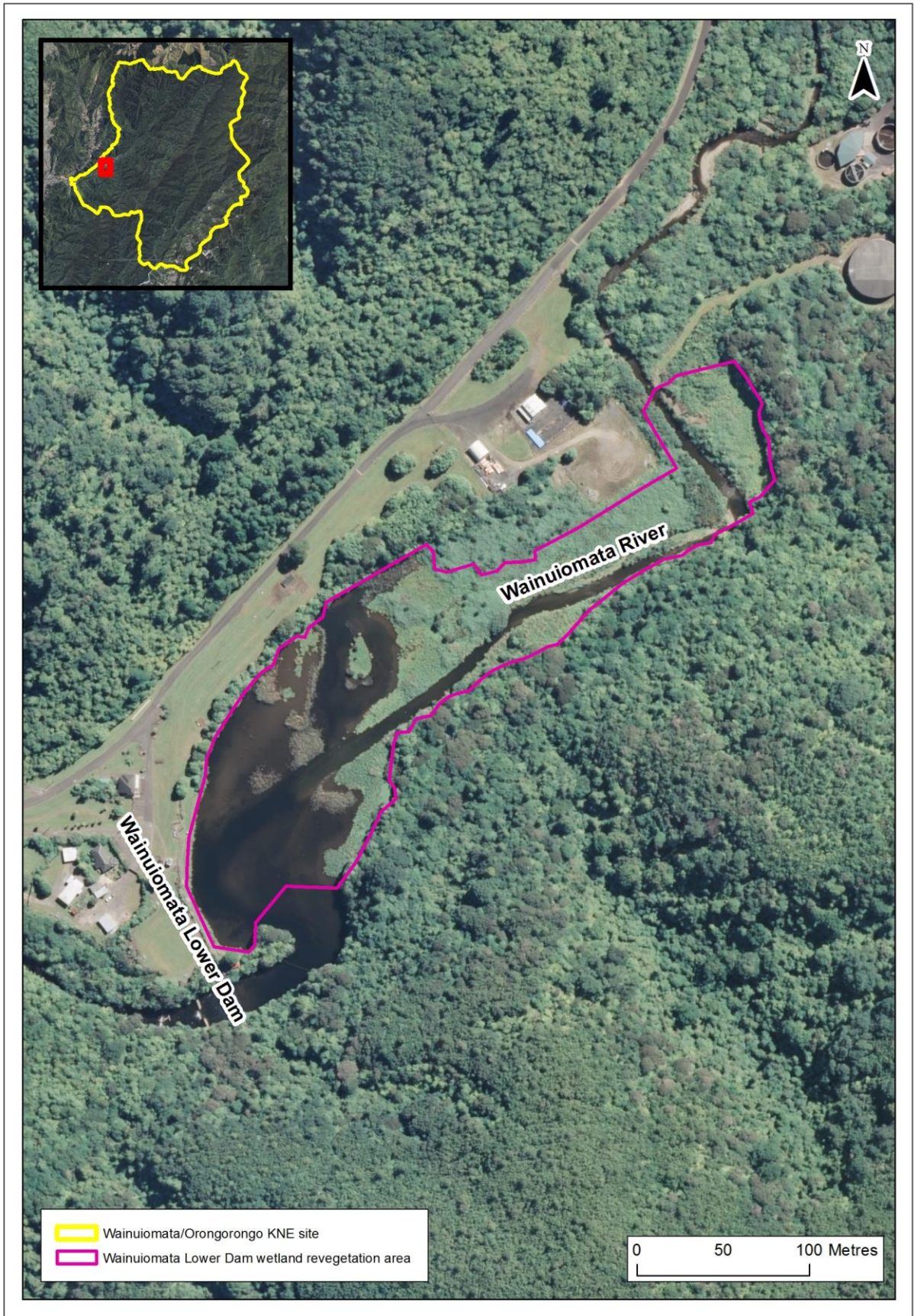
Map 4: Operational areas for ecological weed control in the Wainuiomata/Orongorongo KNE site



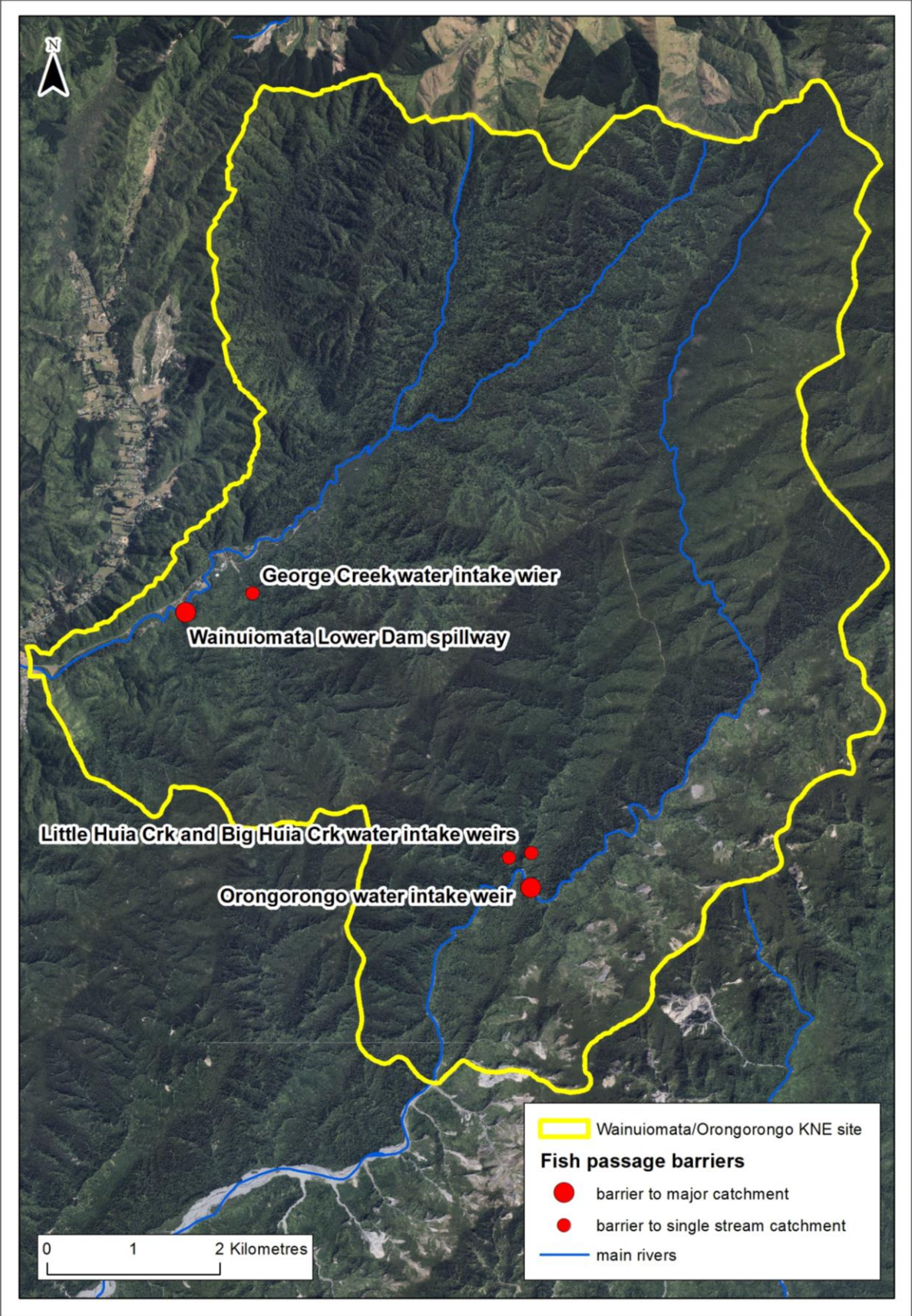
Map 5: Operational areas for pest animal control in the Wainuiomata/Orongorongo KNE site



Map 6: Pest animal control infrastructure in the Wainuiomata/Orongorongo KNE site



Map 7: Revegetation area in the Wainuiomata/Orongorongo KNE site



Map 8: Barriers to fish passage in the Wainuiomata/Orongorongo KNE site

Appendix 2: Nationally threatened species list

The New Zealand Threat Classification System lists species according to their threat of extinction. The status of each species group (plants, reptiles, etc) is assessed over a five-year cycle^{46,47,48}. Species are regarded as Threatened if they are classified as Nationally Critical, Nationally Endangered or Nationally Vulnerable. They are regarded as At Risk if they are classified as Declining, Recovering, Relict or Naturally Uncommon. The following table lists Threatened and At Risk species that are resident in, or regular visitors to, the Wainuiomata/Orongorongo KNE site.

Table 5: Nationally Threatened and At Risk species at the Wainuiomata/Orongorongo KNE site

Scientific name	Common name	National threat status	Observation
Plants(vascular)⁴⁹			
<i>Brachyglottis kirkii</i> var. <i>kirkii</i>	Kirk's daisy/kohurangi	Threatened – Nationally Vulnerable	Greater Wellington 2008 ⁵⁰
<i>Spiranthes novae-zealandiae</i>	Lady's tresses	At Risk – Declining	Crisp P. 2020 ⁵¹
<i>Trichomanes colensoi</i>	Bristle fern	At Risk – Naturally Uncommon	Crisp P. 2020
Birds⁵²			
<i>Acanthisitta chloris</i>	Rifleman/titipounamu	At Risk – Declining	McArthur N. 2021 ⁵³
<i>Anthus novaeseelandiae</i>	New Zealand pipit	At Risk – Declining	McArthur N. 2021
<i>Cyanoramphus auriceps</i>	Yellow crowned parakeet/kākāriki	At Risk – Declining	McArthur N. 2021
<i>Cyanoramphus novaezealandiae</i>	Red crowned parakeet/kākāriki	At Risk – Relict	McArthur N. 2021
<i>Eudynamis taitensis</i>	Long-tailed cuckoo/koekoeā	Threatened – Vulnerable	McArthur N. 2021
<i>Falco novaeseelandiae ferox</i>	New Zealand falcon/kārearea	Threatened – Vulnerable	McArthur N. 2021
<i>Nestor meridionalis</i>	Kaka	At Risk – Recovering	McArthur N. 2021
<i>Petroica longipes</i>	North Island robin/toutouwai	At Risk – Declining	McArthur N. 2021
<i>Phalacrocorax carbo</i>	Black shag/kawau	At Risk – Relict	McArthur N. 2021
<i>Phalacrocorax sulcirostris</i>	Little black shag/kawau tūi	At Risk – Naturally Uncommon	McArthur N. 2021
<i>Poliiocephalus rufopectus</i>	New Zealand dabchick/weweia	Threatened – Increasing	McArthur N. 2021
Reptiles⁵⁴			
<i>Mokopirirakau</i> “southern North Island”	Ngahere gecko/moko pirirākau	At Risk – Declining	Romijn R. 2021 ⁵⁵

Scientific name	Common name	National threat status	Observation
<i>Naultinus punctatus</i>	Barking gecko	At Risk – Declining	Romijn R. 2021
Freshwater fish⁵⁶			
<i>Anguilla dieffenbachii</i>	Longfin eel	At Risk – Declining	Aquanet Consulting Limited ⁵⁷
<i>Galaxias brevipinnis</i>	Kōaro	At Risk – Declining	Aquanet Consulting Limited
<i>Galaxias divergens</i>	Dwarf galaxias (West Coast)	At Risk – Declining	Aquanet Consulting Limited
<i>Gobiomorphus huttoni</i>	Redfin bully	At Risk – Declining	Aquanet Consulting Limited
<i>Geotria australis</i>	Lamprey	Threatened – Nationally Vulnerable	NIWA 2021 ⁵⁸

Appendix 3: Regionally threatened species list

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

The following table lists regionally threatened species that have been recorded in the Wainuiomata/Orongorongo KNE site.

Table 6: Regionally threatened species recorded in the Wainuiomata/Orongorongo KNE site

Scientific name	Common name	Regional threat status	Observation
Plants⁵⁹			
<i>Brachyglottis kirkii</i> var. <i>kirkii</i>	Kirk's daisy/kohurangi	Endangered	Greater Wellington 2008 ⁶⁰
<i>Craspedia minor</i>	Woolly head	Naturally Uncommon	Greater Wellington 2008
<i>Epilobium insulare</i>	Willow herb	Data Deficient	Greater Wellington 2008
<i>Notogrammitis pseudociliata</i>	Strapfern	Naturally Uncommon	Crisp P. 2020 ⁶¹
<i>Pittosporum cornifolium</i>	Tawhirikaro	Naturally Uncommon	Greater Wellington 2008
<i>Pterostylis tasmanica</i>	Plumed greenhood	Extirpated	Greater Wellington 2008
<i>Raukawa edgerleyi</i>	Raukawa	Naturally Uncommon	Greater Wellington 2008
<i>Trichomanes elongatum</i>	Bristle fern	Critical	Crisp P. 2020
Birds⁶²			
<i>Acanthisitta chloris</i>	Rifleman/titipounamu	At Risk – Declining	McArthur N. 2021 ⁶³
<i>Anthus novaeseelandiae</i>	New Zealand pipit/pīhoihoi	Threatened – Vulnerable	McArthur N. 2021
<i>Anus gracilis</i>	Grey teal/tētē moroiti	At Risk – Recovering	McArthur N. 2021
<i>Apteryx mantelli</i>	North Island brown kiwi	Threatened – Critical	McArthur N. 2021
<i>Cyanoramphus auriceps</i>	Yellow crowned parakeet/kākāriki	Threatened – Endangered	McArthur N. 2021
<i>Cyanoramphus novaezelandiae</i>	Red crowned parakeet/kākāriki	At Risk – Recovering	McArthur N. 2021

Scientific name	Common name	Regional threat status	Observation
<i>Eudynamys taitensis</i>	Long tailed cuckoo/koekoeā	At Risk – Naturally Uncommon	McArthur N. 2021
<i>Falco novaeseelandiae</i>	New Zealand falcon/kārearea	Threatened – Critical	McArthur N. 2021
<i>Hemiphaga novaeseelandiae</i>	New Zealand pigeon/kererū	At Risk – Recovering	McArthur N. 2021
<i>Nestor meridionalis</i>	Kaka	At Risk – Recovering	McArthur N. 2021
<i>Phalacrocorax carbo</i>	Black shag/kawau	Threatened – Critical	McArthur N. 2021
<i>Phalacrocorax melanoleucos</i>	Little shag/kawau paka	Threatened – vulnerable	McArthur N. 2021
<i>Phalacrocorax sulcirostris</i>	Little black shag/kawau tūi	Threatened – vulnerable	McArthur N. 2021
<i>Poliiocephalus rufopectus</i>	New Zealand dabchick/weweia	Threatened – vulnerable	McArthur N. 2021
Lizards⁶⁴			
<i>Mokopirakau</i> “southern North Island”	Ngahere gecko/moko pirirākau	At Risk – Declining	Romijn R. 2021 ⁶⁵
<i>Naultinus punctatus</i>	Barking gecko	At Risk – Declining	Romijn R. 2021

Appendix 4: Threat table

Appendix 4 presents a summary of all known threats to the Wainuiomata/Orongorongo KNE site including those discussed in Section 7.

Table 7: Threats to the Wainuiomata/Orongorongo KNE site

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
Ecological weeds		
EW-1	Ground covering ecological weeds smother and displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key ground covering ecological weed species for control in the KNE site include tradescantia (<i>Tradescantia fluminensis</i>), African club moss (<i>Selaginella kraussiana</i>) and beggars' ticks (<i>Bidens frondosa</i>), (see full list in Appendix 5).	Entire KNE site
EW-2	Woody ecological weed species displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key woody ecological weed species for control in the KNE site include buddleia (<i>Buddleia davidii</i>), Darwin's barberry (<i>Berberis darwinii</i>), holly (<i>Ilex aquifolium</i>) and sycamore (<i>Acer pseudoplatanus</i>), (see full list in Appendix 5).	Entire KNE site
EW-3	Climbing ecological weeds smother and displace native vegetation often causing canopy collapse, inhibit indigenous regeneration, and alter vegetation structure and composition. Key climbing ecological weed species for control in the KNE site are Japanese honeysuckle (<i>Lonicera japonica</i>) and old man's beard (<i>Clematis vitalba</i>) (see full list in Appendix 5).	Entire KNE site
Pest animals		
PA-1	Possums (<i>Trichosurus vulpecula</i>) browse palatable canopy vegetation until it can no longer recover ^{66,67} . This destroys the forest's structure, diversity and function. Possums may also prey on native birds and invertebrates ⁶⁸ .	Entire KNE site
PA-2**	Rats (<i>Rattus</i> spp.) browse native fruit, seeds and vegetation. They compete with native fauna for food and can reduce forest regeneration. They also prey on invertebrates, lizards and native birds ^{69,70} .	Entire KNE site
PA-3	Mustelids (stoats ^{71,72} (<i>Mustela erminea</i>), ferrets ^{73,74} (<i>M. furo</i>) and weasels ^{75,76} (<i>M. nivalis</i>)) prey on native birds, lizards and invertebrates, reducing their breeding success and potentially causing local extinctions.	Entire KNE site
PA-4**	Hedgehogs (<i>Erinaceus europaeus</i>) prey on native invertebrates ⁷⁷ , lizards ⁷⁸ and the eggs ⁷⁹ and chicks of ground-nesting birds ⁸⁰ .	Entire KNE site
PA-5*	House mice (<i>Mus musculus</i>) browse native fruit, seeds and vegetation, and prey on invertebrates. They compete with native fauna for food and can reduce forest regeneration. They also prey on invertebrates, lizards and small eggs and nestlings ^{81,82} .	Entire KNE site

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
PA-6**	Pest and domestic cats (<i>Felis catus</i>) prey on native birds ⁸³ , lizards ⁸⁴ and invertebrates ⁸⁵ , reducing native fauna breeding success and potentially causing local extinctions ⁸⁶ .	Entire KNE site
PA-7*	Rabbits (<i>Oryctolagus cuniculus</i>) and hares (<i>Lepus europaeus</i>) graze on palatable native vegetation and prevent natural regeneration in some environments ⁸⁷ . 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.	Forest margins
PA-8*	Wasps (<i>Vespula</i> spp.) adversely impact native invertebrates and birds through predation and competition for food resources. They also affect nutrient cycles in beech forests ⁸⁸ .	Entire KNE site
PA-9	Red deer (<i>Cervus elaphus</i>) and fallow deer (<i>Dama dama</i>) browse the forest understory and can significantly change vegetation composition by preferential browsing and preventing regeneration ^{89,90,91} .	Entire KNE site
PA-10	Feral pigs (<i>Sus scrofa</i>) root up the soil and eat roots, invertebrates, seeds and native plants preventing forest regeneration ⁹² .	Entire KNE site
PA-11	Goats (<i>Capra hircus</i>) browsing affects the composition and biomass of native vegetation in the understory tiers of forest habitats, preventing regeneration of the most palatable understory species and reducing species diversity ⁹³ .	Entire KNE site
PA-12*	Brown trout (<i>Salmo trutta</i>) and rainbow trout (<i>Oncorhynchus mykiss</i>) prey on native fish and compete with them for food resources ⁹⁴ .	Rivers and main streams
PA-13*	Eastern rosella (<i>Platycercus eximius</i>) parakeets are known to out-compete native red-crowned parakeets for nest-sites and are a vector of avian diseases. The continued presence of eastern rosella in the KNE site could limit the ability of red crowned parakeets to establish functional populations ^{95,96} .	Entire KNE site
Human activities		
HA-1	Management activities such as structure installation, road maintenance, pest control and ecological monitoring can cause the accidental introduction of weed species through the carriage of seeds and plant fragments on machinery, equipment and clothing, and cause damage to native vegetation.	Entire KNE site
HA-2	Dogs (<i>Canis lupus familiaris</i>), if uncontrolled/unleashed can disturb or kill nesting birds and chicks, and lizards within the KNE site, particularly near walking tracks ⁹⁷ .	C
HA-3	Barriers to native fish passage are present in streams within the KNE site preventing migrating fish from completing their lifecycle.	Lower sections of both rivers

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
Other threats		
OT-1	A lack of legal protection can leave a site at risk of future development or destruction and resources invested in the site may be wasted. The KNE site has no protection status.	Entire KNE site

*These threats are not addressed by actions in the operational delivery schedule

**These threats are intermittently controlled or only controlled in parts of the KNE site. See the operational delivery schedule for details

Appendix 5: Ecological weed species

The following table lists key ecological weed species that have been recorded in the Wainuiomata/Orongorongo KNE site. This list has been compiled through many years of weed management experience at the site.

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

Table 8: Ecological weed species recorded in the Wainuiomata/Orongorongo KNE site listed in order of management aim

Scientific name	Common name	Level of distribution	Management aim
<i>Calceolaria tripartita</i>	Lady's slipper	Localised and sparse	Eradication
<i>Cardiocrinum giganteum</i>	Giant Himalayan lily	Localised and sparse	Eradication
<i>Clematis vitalba</i>	Old man's beard	Localised and sparse	Eradication
<i>Cortaderia selloana</i>	Pampas	Localised and sparse	Eradication
<i>Bidens frondosa</i>	Beggars' ticks	Localised and sparse	Eradication
<i>Lonicera japonica</i>	Japanese honeysuckle	Localised and sparse	Eradication
<i>Pinus radiata</i>	Wilding pine	Localised and sparse	Eradication
<i>Selaginella kraussina</i>	African club moss	Localised and sparse	Eradication
<i>Zantedeschia aethiopica</i>	Arum lily	Localised and sparse	Eradication
<i>Acer pseudoplatanus</i>	Sycamore	Localised and abundant	Suppression
<i>Berberis darwinii</i>	Darwin's barberry	Localised and sparse	Suppression
<i>Berberis glaucarpa</i>	Barberry	Localised and sparse	Suppression
<i>Buddleia davidii</i>	Buddleia	Localised and sparse	Suppression
<i>Crocasmia x crocosmiflora</i>	Montbretia	Patchy and dense	Suppression
<i>Ilex aquifolium</i>	Holly	Localised and sparse	Suppression
<i>Rubus fruticosus</i>	Blackberry	Patchy and dense	Suppression
<i>Tradescantia fluminensis</i>	Tradescantia	Patchy and abundant	Suppression
<i>Ulex europaeus</i>	Gorse	Patchy and abundant	Suppression
<i>Allium triquetrum</i>	Onion weed/three-cornered garlic	Patchy and abundant	Surveillance
<i>Erica lusitanica</i>	Spanish Heath	Patchy and abundant	Surveillance
<i>Eucalyptus globulus subsp. globulus</i>	Blue gum	Localised and abundant	Surveillance

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