Key Native Ecosystem Operational Plan for Waitohu Coast and Wetlands

2021-2026

Contents

1. Purpose 5
2. Policy Context 5
3. The Key Native Ecosystem Programme 6
4. Waitohu Coast and Wetlands Key Native Ecosystem site 7
5. Parties involved 8
6. Ecological values 11
7. Threats to ecological values at the KNE site 18
8. Vision and objectives 20
9. Operational activities 21
10. Future opportunities 27
11. Operational delivery schedule 28
12. Funding contributions 32

Appendix 1: Site maps 33

Appendix 2: Nationally threatened species list 41

Appendix 3: Regionally threatened plant species list 44

Appendix 4: Not Threatened bird species list 46

Appendix 5: Threat table 48

Appendix 6: Ecological weed species 51

Appendix 7: Revegetation plant list 54

References 55

1. Purpose

The purpose of the five-year Key Native Ecosystem (KNE) Operational Plan for Waitohu Coast and Wetlands 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

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

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

Greater Wellington Long Term Plan

The Long Term Plan (2018-2028)[2] outlines the long term direction of the Greater Wellington Regional Council (Greater Wellington) and includes information on all our major projects, activities and programmes for the next 10 years and how they will be paid for. This document outlines that Greater Wellington will actively manage selected high value biodiversity sites. Most of this work is undertaken as part of the KNE Programme.

Proposed Natural Resources Plan

The Proposed Natural Resources Plan for the Wellington Region (PNRP)[3] provides the high level strategic framework which sets out how Greater Wellington, Mana whenua partners and the community work together and includes

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

Greater Wellington Regional Pest Management Plan 2019-2039

The Regional Pest Management Plan[4] is an important driver for managing many of the pests that are prioritised in this KNE Operational Plan. Without active management of KNE sites, many native plants and animals in these ecosystems would struggle to thrive. The KNE programme aims to provide protection to maintain or restore the ecological function of these ecosystems as well as the native plants and animals they support. This is done mainly by managing threats such as harmful pests or introduced plants and animals.

Greater Wellington Biodiversity Strategy

The Greater Wellington Biodiversity Strategy[5] (the Strategy) is an internal document that sets a framework that guides how Greater Wellington protects and manages biodiversity in the Wellington region to work towards the Vision.

Vision

Healthy ecosystems thrive in the Wellington region and provide habitat for native biodiversity

Principles

Use best practice work with others Lead by example partner with mana whenua

Goal One drives the delivery of the KNE Programme.

Goal One

Areas of high biodiversity value are protected or restored

3. The Key Native Ecosystem Programme

The KNE Programme is a voluntary programme of work. There is no statutory obligation for Greater Wellington to do this work. Greater Wellington invites selected landowners to discuss whether they would like to be involved in the programme. When work is done on private land, it is at the discretion of landowners, and their involvement in the programme is entirely voluntary. Involvement may just mean allowing work to be undertaken on that land.

The programme seeks to protect some of the best examples of original (pre-human) ecosystem types in the Wellington region by managing, reducing, or removing threats to their ecological values. Sites with the highest biodiversity values have been identified and prioritised for management. Sites are identified as of high biodiversity value for the purposes of the KNE Programme by applying the four ecological significance criteria described below.

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

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

4. Waitohu Coast and Wetlands Key Native Ecosystem site

The Waitohu Coast and Wetlands KNE site (32 ha) is located approximately 3 km north of the Ōtaki River on the Kāpiti Coast (see Appendix 1, Map 1) and is part of a long belt of coastal sand dunes on the west coast extending from south Taranaki to Paekākāriki.

The KNE site, although relatively small, has several distinctive ecosystems ranging from coastal dunes, intertidal sandflats and saltmarsh wetlands through to the lower reaches and estuary of the Waitohu Stream[6]. The Waitohu Stream flows from the Tararua Ranges through the KNE site to the Tasman Sea via a relatively small tidal river mouth estuary. The estuary is shallow and confined within stable steep-sided river banks[7].

The two wetlands located within the KNE site are some of the last remaining estuarine wetlands in the district[8] and some of the few remnants of the once vast coastal wetland system linking together along the Kāpiti coast[9]. Both wetlands are scheduled as significant Natural Wetlands in Schedule F3 the Proposed Natural Resources Plan (PNRP)[10] for their representativeness and rarity.

The Waitohu Coast and Wetlands KNE site supports a number of indigenous bird, fish and plant species of conservation concern and provides important habitat for a high diversity of nesting shorebirds[11]. The KNE site is surrounded by farmland in the north and urban development in the south but provides an important role within the wider landscape context as it is located within close proximity to several other important wetland and coastal KNE sites including; Ōtaki Coast, Lake Waiorongomai and Stream, Otepua-Paruāuku Wetlands and Haruātai/Pareomatangi.

5. Parties involved

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

5.1. Landowner

The Waitohu Coast and Wetlands KNE site has both private and public landowners:

- Kāpiti Coast District Council (KCDC) own a total of 6.1 ha of the KNE site including; 5.7 ha of the southern foredunes and part of the southern side of the lower Waitohu Stream.
- The Sims family, a private landowner, owns 8.6 ha of the KNE site including; the majority of the northern foredunes, Sims Wetland and part of Waitohu River Mouth wetland.
- The Winterburn family, a private landowner, owns 0.9 ha of the KNE site which comprises parts of the lower Waitohu Stream margins and Waitohu River Mouth wetland.
- The Wootton family, a private landowner, owns 4.1 ha of the KNE site which comprises the majority of the Waitohu River Mouth wetland.
- The remaining foredune and estuary areas are Crown owned land (~12.3 ha).

Landowners on both sides of the stream bed have common law ownership rights that extend to the centre of the stream; however the Crown can override these rights.

Land ownership boundaries are provided in Appendix 1, Map 2.

5.2. Operational delivery

Greater Wellington, KCDC and the Waitohu Stream and Dune Care Group (WSDCG) are the key management partners and have worked collaboratively to manage and deliver the KNE site's restoration activities for a number of years. Private landowners are also committed to undertaking restoration activities, to varying degrees, on their properties.

Within Greater Wellington, four departments are responsible for delivering the KNE operational plan.

- The Biodiversity department is the overarching lead department for Greater Wellington on the longer term planning and coordination of biodiversity management activities and advice within the KNE site. The Biodiversity department's KNE budget funds the Biosecurity department to coordinate and carry out pest control activities.
- The Biosecurity department coordinates and implements pest controls measures at the KNE site.
- The Land Management department plan and provide advice on sustainable land use, soil conservation and water quality with their funding within designated areas located within the KNE site.

- The Flood Protection department is responsible for the management of the stream under the Soil Conservation and Rivers Control Act 1941. Flood protection works are carried out only when necessary within the KNE site to manage flood and erosion risk to properties and manage the Waitohu Stream mouth alignment. The Flood Protection department operate under set guidelines when cutting the stream mouth to ensure ecological values are kept intact and to mitigate effects from operations.

KCDC co-fund operational activities undertaken at the KNE site and contribute to the annual planning of operational activities in line with the operational delivery schedule contained in this operational plan. In addition, KCDC manage part of the KNE site as an Ecological Site of Significance (K014 Waitohu Stream Mouth) in accordance with the Kāpiti Coast District Plan[12]. The District Plan includes rules that prevent modifications of SESs without resource consent. KCDC also provides ongoing support to the Waitohu Stream and Dune Care Group with weed control and planting preparation and maintenance.

The Waitohu Stream and Dune Care Group (WSDCG) is an incorporated community group who play an important role in representing the community in the management and protection of the Waitohu Stream and dunes as well as delivering extensive restoration work within the KNE site. Since 1999, the group has undertaken restoration activities on both public and private land including; revegetation planting of the Waitohu Stream margins, fencing and planting wetland areas, supporting community involvement by hosting local schools and local organisations to undertake restoration activities, as well as enabling significant reestablishment of native dune species and increasing biodiversity across the southern dunes through ongoing revegetation planting and weed control. The WSDCG have also erected interpretation panels around the southern dune area.

The Biodiversity department provide the WSDCG with funding support through the KNE programme in accordance with an annual funding agreement. The provision of this funding is to enable the community group to undertake their management and restoration activities that work towards the vision and objectives set out in this operational plan (see section 8).

The Wootton family is active in protecting their wetland and have undertaken weed control and revegetation planting in the wetland for several years. Greater Wellington also worked with the Wootton's to enhance īnanga spawning habitat on the northern side of the Waitohu stream margins of their property. This involved the removal of pines, willows, poplars and blackwood to allow for greater sunlight and growth of dense grass mats, as well as further revegetation planting of grasses and toetoe.

The Sims family is active in protecting the dunes on their property in partnership with KCDC and Greater Wellington. These dunes were fenced several years ago to prevent access from recreational vehicles.

5.3. Mana whenua partners

The Waitohu Coast and Wetlands KNE site is located within the rohe (district) of Ngā Hapū o Ōtaki who are one of Greater Wellington's six mana whenua partners in the region. The KNE site is a site of significance for Ngā Hapū o Ōtaki (see Table 1) and they are aware that their areas of interest are located on territorial authority and private land.

Greater Wellington is committed to identifying ways in which kaitiakitanga can be strengthened by exploring opportunities on how Ngā Hapū o Ōtaki wish to be further involved in the operational delivery of the KNE site.

Table 1: Ngā Hapū ō Ōtaki sites of significance in Waitohu Coast and Wetlands KNE site[13]

Sites of significance	Mana whenua values
Schedule C1: Waitohu Stream mouth	mahinga kai, ara waka, papa kāinga, kauhoe, raranga, tohu ahurea
Schedule C1: Waitohu Stream - G-bung	mahinga kai, ara waka, puna raranga, wai ora, kauhoe, kaukau, ngā mahi pārekareka, i/ki te wai

6. Ecological values

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

6.1. Ecological designations

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

Table 2: Designations at the Waitohu Coast and Wetlands KNE site

Designation level	Type of designation
National	Part of the Waitohu Coast and Wetlands KNE site has been identified by DOC as a Designated Ecological Site (See Appendix 1, Map 3): • 162: Waitohu River Mouth (37.84 ha)
Regional	Parts of the Waitohu Coast and Wetlands KNE site are scheduled under Greater Wellington's proposed Natural Resources Plan (PNRP)[14] as Ecosystems and Habitats with Significant Indigenous Biodiversity Values: • River with significant indigenous ecosystems - Habitat for indigenous fish species of conservation interest: Waitohu Stream and all tributaries (Schedule F1) • River with significant indigenous ecosystems - Habitat for 6 or more migratory indigenous fish species: Waitohu Stream and all tributaries (Schedule F1) • Known rivers and parts of the coastal marine area with īnanga spawning habitat: Waitohu Stream (Schedule F1b) • Habitats for indigenous birds in the coastal marine area: Waitohu Stream mouth (Schedule F2c) • Significant Natural Wetland: Waitohu River Mouth, Sims Wetland (Schedule F3) • Sites with significant indigenous biodiversity values in the coastal marine area: Waitohu Stream Mouth / Estuary (Schedule F4) • Important trout fishery rivers and spawning waters: Waitohu Stream (Schedule I)

District	Parts of the Waitohu Coast and Wetlands have been identified by KCDC as Ecological Sites of Significance (See Appendix 1, Map 4). They are listed in the KCDC District Plan Heritage Register[15] as: • K014: Waitohu Stream Mouth (33.05 ha)

6.2. Ecological significance

The Waitohu Coast and Wetlands KNE site is considered to be of regional importance because:

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

Representativeness

The Threatened Environment Classification system[16] indicates that the majority of the coastal dune area is considered Chronically Threatened (16.7 ha) with 10-20% indigenous cover remaining. The south-eastern portion of the KNE site (11.2 ha), comprising mostly wetland areas, is considered Acutely Threatened with less than 10% indigenous cover remaining and the habitat under-protected on a national scale (see Appendix 1, Map 5).

Rarity/distinctiveness

Several naturally uncommon ecosystem types[17,18] are present within the KNE site. These include coastal turfs classified as 'Critically Endangered'; stable and active dunes classified as 'Endangered'; and estuaries classified as 'Vulnerable'.

Wetlands are now considered an uncommon habitat type in the Wellington Region with approximately 2.3% of their original extent remaining[19]. The Waitohu River Mouth Wetland and the Sims Wetland, located within the Waitohu Coast and Wetlands KNE site, are scheduled as Significant Natural Wetlands in the PNRP[20] and comprise some of the last remaining estuarine wetlands in the district[21] and some of the few remnants of the once vast coastal wetland system on the Kāpiti Coast[22].

New Zealand's national threat classification system[23] lists seven plant, twenty-one bird, eight freshwater fish and one invertebrate species as Nationally Threatened or At Risk within the KNE site. Five plant and twenty bird species present have also been listed as regionally threatened. Nationally threatened species are listed in Appendix 2 and regionally threatened species in Appendix 3.

Diversity

The Singers and Rogers[24] classification of pre-human ecosystems in New Zealand indicates the KNE site would likely have comprised of five different ecosystem types. The foredune areas comprised of coastal sand dunes mosaic (DN2/5) and hard tussock, scabweed gravelfield/stonefield (BR1). The eastern areas of the KNE site now recognised as wetland comprised of spinifex, pīngao grassland/sedgeland (DN2), oioi, knobby clubrush sedgeland (DN5) and a swamp mosaic of flaxland (WL18), raupō reedland (WL19) and coprosma, twiggy tree daisy scrub (WL20) (see Appendix 1, Map 6).

Aspects of these original dune and wetland ecosystems types are still evident within the KNE site today, although in a modified and regenerating condition.

At present, the KNE site contains several distinctive habitat types including sedgeland, restiad rushland, shrubland, herbfield, sandflats, sand dunes, estuarine and subtidal zones[25]. These varied habitat types and the transitional ecotones that exist between different plant communities provides a range of habitats to support a high diversity of flora and fauna.

Ecological context

The KNE site is located within 3 km of a number of other KNE sites, including Ōtaki Coast, Lake Wairongomai and Stream, Otepua-Paruauku Wetlands and Haruātai/Pareomatangae. These KNE sites are thought to form an important network of habitat linkages within the wider ecological landscape, enabling coastal and wetland birds to forage, breed and disperse throughout the local area.

6.3. Ecological features

The Waitohu Coast and Wetlands KNE site is located within the Foxton Ecological District[26] which is characterised by Holocene sand-dune country. The climate is warm with prevailing westerly to north-westerly winds, frequent gales and an annual rainfall ranging between 800-1,000 mm[27].

Vegetation communities and plants

The Waitohu Coast and Wetlands KNE site comprises several distinctive ecosystems with varied vegetation communities[28], ranging from active and semi-stable coastal dunes, intertidal sandflats and saltmarsh wetlands through to the lower reaches and estuary of the Waitohu Stream[29]. Although the wetland and dune systems are highly modified by historic farming practices and development, they still retains elements of their original vegetation and provides habitat for a diverse array of wildlife[30].

The KNE site has been described below in four operational areas based on these distinctive ecosystems and vegetation communities (See Appendix 1, Map 7).

Northern dunes (Operational Area A)

The active foredune system, on the northern side of the Waitohu stream and estuary, comprise predominately of sand trapping and dune forming species such as spinifex (*Spinifex sericeus*) and exotic marram grass (*Ammophila arenaria*) with some pīngao (*Ficinia spiralis*) scattered in small areas[31]. The dry beach area in front of these dunes is

covered with driftwood deposited during storm events and king tides which offers some protection for native birds who utilise it for nesting and roosting sites.

On the landward side of these active dunes, where sand burial and movement is less significant, the dune vegetation gives way to a light cover of spinifex, but is largely dominated by exotic lupin (*Lupinus arboreus*). Some native backdune species are present including; speckled sedge (*Carex testacea*), harakeke flax (*Phormium tenax*), taupata (*Coprosma repens*) and toetoe (*Austroderia toetoe*) with infrequent tauhinu (*Ozothamnus leptophyllus*) and remnant populations of sand coprosma (*Coprosma acerosa*) and sand daphne (*Pimelea villosa*)[32]. Exotic woody and grass species are also present throughout including; pine (*Pinus radiata*), macrocarpa (*Cupressus macrocarpa*), gorse (*Ulex europaeus*) and pampas (*Cortaderia selloana*).

Further inland is a damp low-lying salt meadow, which retains moisture considerably longer than the dunes. The sand in this area is stable and subject to occasional flooding if the stream mouth migrates north or during storms combined with king tides. The vegetation is comprised of low growing herbs and pasture grasses such as three square (*Schoenoplectus pungens*), *Isolepis distigmatosa*, halfstar (*Selliera radicans*), *Campylopus clavatus* and exotic buck's horn plantain (*Plantago coronopus*), as well as rushes including wīwī (*Ficinia nodosa*), oioi (*Apodasmia similis*) and *Juncus caespiticius*.

Southern dunes (Operational Area B)

The dune system on the southern side of the Waitohu stream and estuary stretches from the coast over 250 m inland, making it one of the deepest dune systems on the Kāpiti Coast. The WSDCG have been restoring these dunes for the past 20 years actively replacing the marram dominated foredunes with native spinifex and pīngao. These foredunes have since had a considerable deposition of sand resulting in an extended base and increased height. Further inland, spinifex and pīngao are still common with other backdune species also present including; taupata, wīwī, speckled sedge, sand wind grass (*Lachnagrostis billardierei*), small-leaved pōhuehue (*Muehlenbeckia complexa var. complexa*), occasional tauhinu and the exotic ground covering treasure flower (*Gazania rigens/ G. linearis*) frequently interspersed amongst spinifex. The dunes also support small numbers of the threatened sand coprosma (*Coprosma acerosa*), sand daphne (*Pimelea villosa*) and native musk (*Thyridia repens*).

Further inland, between the foredunes and stream, is a line of high marram dominated dunes with a series of high peaks. These dunes are suffering extensive erosion from the northern side from wind and human activity. The WSDCG have planted the lower, southern end of these dunes to provide some stabilisation[33].

Lower Waitohu Stream and estuary (Operational Area C)

The Waitohu estuary comprises a relatively small stream mouth estuary which is shallow and confined within steep-sided river banks with no appreciable intertidal habitat[34]. The location of the stream channel near the coast varies widely as it migrates up to 800 m over the beach, intermittently creating a shallow lagoon on the upper beach to the north of the estuary[35]. The mouth can occasionally block for short periods as a consequence of coastal sand accretion[36].

Vegetation around the estuary is largely dominated by three square and sand sedge (*Carex pumila*)[37]. Oioi forms a band along the high tide mark, with harakeke flax and

toetoe also present[38]. Areas of tightly interlaced short-statured herbs, grasses, and sedges known as coastal turfs are found on slightly higher ground and include native musk, bachelor's button (*Cotula coronopifolia*) halfstar, sea primrose (*Samolus repens* var. *repens*), slender clubrush (*Isolepis cernua*) and mudwort (*Limosella lineata*). An extensive bed of salt marsh dominated by three square is present in a residual channel area on the northern side of the stream, although there is a strong terrestrial influence developing here due to limited inundation of saline water[39]. On the southern side behind the high peaked dunes, a small area of wetland species including oioi, harakeke flax, toetoe and wīwī are present in a depression beside the stream.

Further upstream, the riparian vegetation transitions to bands of sea rush, oioi and giant umbrella sedge with occasional patches of harakeke and taupata. Exotic tall fescue grass (*Festuca arundinacea*) grows thickly right up to the water's edge along the majority of the stream margin[40].

Waitohu wetlands (Operational Area D)

A ~2 ha area of low-lying saltmarsh wetland lies within the inside bend of the Waitohu stream at the southern end of the KNE site. The wetland comprises predominantly of searush (*Juncus maritimus* var. *australiensis*) with saltmarsh ribbonwood (*Plagianthus divaricatus*), three square, wīwī, oioi, harakeke flax, tall fescue (*Festuca arundinacea*) and a few scattered clumps of the large, introduced sharp rush (*Juncus acutus*) also common. Through the wetter central wetland area, the rushes are interspersed with giant umbrella sedge (*Cyperus ustulatus*) and *Carex* spp. and *Isolepis prolifer* is common around pools of water. A small area of planted ngaio (*Myoporum laetum*) is also present on north-western side directly adjacent to the Waitohu stream.

A very small stand of raupō (*Typha orientalis*) exists on eastern terrestrial edge of the KNE site indicating that this part of the wetland has enough fresh water influence to allow brackish water tolerant plants to establish[41]. The wetland margins are dominated by herb and grass species such as bachelor's button, buck's horn plantain (*Plantago coronopus*), arrow grass (*Triglochin striata*) and tall fescue, with some scattered beard-grass (*Polypogon monspeliensis*) and creeping bent (*Agrostis stolonifera*) present throughout[42].

A fringe of wetland extends northward on the landward side of the Waitohu stream and northern dunes. This area comprises of predominantly of tall fescue and harakeke flax grading in to oioi, wīwī, harakeke flax and another stand of raupō at the northernmost extent of the wetland area.

Species

Birds

The KNE site provides important habitat for a variety of native bird species, with the Waitohu Stream mouth, estuary and sandflats supporting a high diversity of nesting shorebirds, whilst waders and waterfowl commonly feed in the shallow wetlands[43,44].

Approximately 39 native bird species have been recorded within the KNE site, of which 21 are classified as nationally threatened. A list of nationally and regionally threatened native bird species recorded within the KNE site are listed in Appendix 2 and Appendix

3. A comprehensive list of native bird species classified as Not Threatened recorded within the KNE site are listed in Appendix 4.

Notably, the Waitohu Stream mouth has been recognised as one of only a few sites along the Kāpiti Coast that supports a coastal breeding population of banded dotterels (*Charadrius bicinctus bicinctus*; Threatened - Nationally Vulnerable)[45,46]. Northern New Zealand dotterels (*Charadrius obscurus aquilonius*; At Risk - Recovering) are also reasonable regular visitors to this site and are likely to be juveniles that fly around the New Zealand coast in their first year after fledging before finding suitable coastal breeding habitat[47,48].

Passage migrants such as the South Island pied oystercatcher (*Haematopus finschi;* At Risk - Declining)[49,50,51,52] and bar-tailed godwit (*Limosa lapponica baueri*; At Risk - Declining) are also known to feed in the area following each breeding season on the braided rivers in the South Island and on the Arctic coast and tundra respectively.

Other notable threatened bird species that have previously been recorded around the estuary and wetlands areas include; Australasian bittern (*Botaurus poiciloptilus*; Threatened - Nationally Critical), spotless crake (*Porzana tabuensis tabuensis*; At Risk - Declining), white heron (*Ardea modesta*; Threatened - Nationally Critical), black billed gull (*Larus bulleri*; Threatened - Nationally Critical), black fronted tern (*Chlidonias albostriatus*; Threatened - Nationally Endangered), wrybill (*Anarhynchus frontalis*; Threatened - Nationally Vulnerable) and Caspian Tern (*Hydroprogne caspia*; Threatened - Nationally Vulnerable) [53,54,55,56,57,58,59,60].

Reptiles

There are no records of lizards in the area, although the dunes and driftwood could provide suitable habitat for lizards[61].

Fish and aquatic invertebrates

The Waitohu Stream supports a wide range of native fish species in a variety of habitats from the upper catchment to the river mouth. Fourteen migratory native freshwater fish species[62,63,64,65,66,67] have been recorded in the catchment, including eight species which are classified as Nationally Threatened. These include;

- short-jawed kōkopu (*Galaxias postvectis*; Threatened - Nationally Vulnerable)
- lamprey (*Geotria australis*; Threatened - Nationally Vulnerable)
- giant kōkopu (*Galaxias argenteus*; At Risk - Declining)
- longfin eel (*Anguilla dieffenbachia*; At Risk - Declining)
- torrentfish (*Cheimarrichthys fosteri*; At Risk - Declining)
- kōaro (*Galaxias brevipinnis*; At Risk - Declining)
- īnanga (*Galaxias maculatus*; At Risk - Declining)
- brown mudfish (*Neochanna apoda*; At Risk - Declining)

Other non-threatened native freshwater fish species[68,69] known to be present within the KNE site include;

- shortfin eel (*Anguilla australis*)
- banded kōkopu (*Galaxias fasciatus*)

- common bully (*Gobiomorphus cotidianus*)
- redfin bully (*Gobiomorphus huttoni*)
- black flounder (*Rhombosolea retiaria*)
- common smelt (*Retropinna retropinna*)

Kōura/freshwater crayfish (*Paranephrops planifrons*; At Risk - Declining) have also been recorded in the Waitohu catchment and may be present within the KNE site[70].

A comprehensive list of threatened native fish species recorded within the KNE site are listed in Appendix 2.

Invertebrates

The threatened katipō spider (*Lactrodectus katipo*; At Risk - Declining) has been observed in the dune vegetation and driftwood in areas immediately adjacent to the estuary[71].

7. Threats to ecological values at the KNE site

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

While the key threats discussed in this section are recognised as the most significant, it is important to note that not all threats can be adequately addressed. This can be for a number of reasons including financial, legal, or capacity restrictions. A number of other threats to the KNE site's values have also been identified. Appendix 5 presents a summary of all known threats to the Waitohu Coast and Wetlands KNE site (including those discussed above), detailing which operational areas they affect, how each threat impacts on ecological values, and whether they will be addressed by operational activities.

7.1. Key threats

The primary threats to the ecological values of the Waitohu Coast and Wetlands KNE site are ecological weed species, pest animals and sand dune erosion resulting from human activities and the increasing effects of climate change.

Ecological weeds are widespread throughout the KNE site ranging from exotic climbers, ground covering plants, exotic grasses and woody tree species. The presence of ecological weeds can affect the biodiversity values of a habitat by out-competing and displacing native plants, inhibiting seedling establishment, affecting the structure and composition of ecosystems and altering hydrological conditions that sustain the wetland ecology. This further hinders the natural regeneration of native vegetation and reduces species diversity and the availability of food resources for native animals. In addition the non-local native species, karo (*Pittosporum crassifolium*) is also considered an ecological weed at the site as it is known to outcompete and/or hybridise with local native species.

Mustelids, such as stoats (*Mustela erminea*), weasels (*Mustela nivalis*) and ferrets (*Mustela furo*), as well as possums (*Trichosurus vulpecula*), rats (*Rattus* spp.), hedgehogs (*Erinaceus europaeus*) and feral cats (*Felix catus*) pose the greatest threats to the identified ecological values of wetland habitat within the KNE site. These pest species are known to impact native regeneration by over-browsing, compete for food resources and predate native invertebrates and wetland bird species, particularly nesting birds, chicks and eggs. Rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus occidentalis*) are the greatest threat to dune habitat within the KNE site as they cause considerable impact to the natural regeneration of native vegetation and hinder habitat restoration efforts by destroying seedlings and in newly planted areas. Pest animals are also likely to reinvade from the surrounding landscape and are likely to be an enduring threat to the biodiversity values within the KNE site.

Historical agricultural practices and other human use activities have transformed the once native-dominant foredune system to that dominated by marram grass. Marram grass alters sand dune structure and function creating higher, steeper dune systems that are particularly susceptible to dune erosion and collapse. The erodible nature of this dune system is exacerbated by the increasing effects of climate change, such as

more frequent storm events, extreme tides, severe winds and rising sea levels. These erosive process will increasingly impact dune formation and its ability to recover, likely leading to further habitat loss and increasing the vulnerability of nearshore areas to coastal hazards.

The use of recreational vehicles such as 4WDs and motorbikes within the KNE site causes further damage to the dune system as well as disturbing wildlife, including nesting native birds.

8. Vision and objectives

8.1. Vision

The Waitohu Coast and Wetlands KNE site comprises diverse, self-sustaining and connected coastal dune and wetland ecosystems resilient to the effects of climate change. The vegetation communities present are dominated by native species and support thriving native fauna populations. Public use and interaction with the area is enhanced through education and information.

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 Waitohu Coast and Wetlands KNE site.

1. Improve the resilience of the sand dune ecosystem to erosion and climate change

2. Improve the condition of the wetland ecosystem

3. Protect and maintain existing populations of threatened or regionally rare plant species

4. Protect threatened coastal and wetland bird and invertebrate species

5. Enhance the values of native fish habitat within 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 3).

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

For practicality of management, the KNE site has been divided into four operational areas based on their ecological features (See Appendix 1, Map 7). These are:

A: Northern dunes (8.5 ha)

B: Southern dunes (8.1 ha)

C: Lower Waitohu stream and estuary (8.9 ha)

D: Waitohu wetlands (6.5 ha)

9.1. Ecological weed control

The aim of weed control at the Waitohu Coast and Wetlands KNE site is to reduce the distribution and density of high impact weed species. This will enhance the likelihood of survival of restoration plantings, increase native plant dominance and facilitate natural regeneration of native plant species in line with objectives 1, 2, 3 and 5 of this operational plan.

In recent years significant progress has been made on reducing the density and impact of priority ecological weeds including:

- Marram grass in the foredunes, particularly on the southern side of the Waitohu stream
- Buffalo grass (*Stenotaphrum secundatum*) and cape ivy (*Senecio angulatus*) in the southern dunes
- Pampas in the northern and southern dunes
- Sharp rush in the Waitohu wetland areas

Ongoing management is required to further reduce priority weed infestations and ensure ecological weeds do not regenerate and spread. Greater Wellington's Biosecurity department will undertake weed control throughout the KNE site on an annual basis targeting species that have the highest ecological impact within each operational area (see Appendix 6).

Targeted weed control

Progressive control of marram grass will be undertaken on the foredunes on both the northern (Operational Area A) and southern (Operational Area B) side of the Waitohu stream. Where possible, marram control will be prioritised around existing spinifex and pīngao populations to reduce competitive pressure and allow for the natural spread of natives. Over the course of this plan, controlled marram will be replaced with spinifex

and pīngao plantings to support the gradual transition to a native-dominant foredune system (see section 9.3 and Appendix 7 for more details).

Annual control of lupin will be undertaken through the backdunes on the northern side of the Waitohu stream (Operational Area A). Lupin is widespread throughout this area and therefore control will be undertaken in a step-wise approach. To achieve this, small sections will be targeted each year starting from the landward side and progressively working towards the coast. Control will be prioritised around associations of native species to support natural native establishment in the gaps left where lupin has been controlled. Revegetation planting of backdune species will also be undertaken as needed to further prevent the invasion of non-native grasses as evidence suggests weed control alone is often not sufficient to restore native pre-lupin plant communities[72] (see section 9.3 and Appendix 7 for more details).

Targeted control of treasure flower (*Gazania linearis/ G.rigens*) will also be undertaken through the backdunes on the southern side of the Waitohu stream (Operational Area B). Where possible, the entire plant should be dug out including the root system to prevent the roots from reestablishing. In situations where the entire plant cannot be removed and the likelihood of non-target damage to native species via chemical control is too great, flower heads should be taken off before seeding to prevent the further spread of seed across the site.

Fine scaled and targeted ecological weed control will be undertaken around associations of rare and uncommon plant species throughout the KNE site with the intention of releasing these species from the competitive pressure of ground covering and woody weed species. Further detail regarding the management of rare and uncommon plant species within the site is outlined in Section 9.5.

Multi species weed control

A multi-species weed control sweep will be undertaken around the estuary and riparian margins of the lower Waitohu stream (Operational Area C) and within the saltmarsh wetland areas (Operational Area D) as required. Control in these areas will target species that are currently present in low numbers throughout the KNE site but could have a significant impact if allowed to establish and spread. Priority weed species include but are not limited to; buffalo grass, ice plant (*Carpobrotus edulis*), pampas, sharp rush, convolvulus (*Convolvulus arvensis*), gorse and cape ivy.

In addition, WSDCG members and KCDC staff will continue to control weed species around new plantings and in close proximity to spinifex and pīngao clusters throughout the dune system on the southern side of the Waitohu stream (Operational Area B). Greater Wellington, WSDCG and KCDC will discuss planned work for the following year and share work agreements prior to work being undertaken. This will ensure that a coordinated approach to weed control is achieved.

9.2. Pest animal control

The aim of pest animal control at the KNE site is to increase populations of native shorebirds and wetland birds through the control of mammalian predators, in line with objectives 2, 3 and 4 of this plan.

Pest animal control is undertaken across the entire KNE site to protect native birds that utilise the dunes, estuary and freshwater wetland areas from predation and improve nesting success. Twenty-four DOC 250 kill-traps and two Timms traps are positioned in key locations around the KNE site to target mustelids, feral/stray cats, rats and hedgehogs (see Appendix 1, Map 8).

Greater Wellington service and maintain the pest animal trapping network around the KNE site on a quarterly basis. WSDCG volunteers undertake additional services to the traps in the southern dunes (Operational Area B) on a fortnightly basis.

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

9.3. Revegetation

The aim of revegetation at the Waitohu Coast and Wetlands KNE site is to increase native plant species dominance, which will improve the resilience, structure and natural function of the dunes, provide a seed source to aid natural regeneration and enhance essential habitat for native birds in line with objectives 1, 3 and 5 of this plan.

A list of suitable plant species to be used in revegetation planting at the KNE site can be found in Appendix 7. All plants will be eco-sourced from the Foxton Ecological District.

Northern Dunes (Operational Area A)

Annual revegetation planting will be undertaken in the foredune areas on the northern side of the Waitohu stream in gaps left following progressive marram control. Native sand-binding plants, such as spinifex and pīngao, will be used to provide an ongoing seed source and assist the natural dune rebuilding process to form stable, low profile dunes which are more resilient to the erosive effects of storm surges, severe winds and sea-level rise.

Revegetation planting of suitable native species will also be undertaken in the backdune areas as needed to prevent the invasion of non-native grasses in gaps left following lupin control. Vegetation in these areas will focus on creating ‘nodes’ of 200-300 native plants with the aim of re-establishing and enhancing natural seed dispersal to enable natural regeneration as well as improving habitat and genetic diversity. Greater Wellington’s Biodiversity department will led and arrange delivery of planting in both these foredune and backdune areas.

Southern Dunes (Operational Area B)

The WSDCG have been working in partnership with Greater Wellington’s Biodiversity department and KCDC for a number of years to undertake extensive revegetation plantings within the KNE site. The group plans and undertakes all of the revegetation work in the southern dunes including eco-sourcing seeds from appropriate plant species and growing them in an onsite nursery. There are considerable expertise and experience of revegetation within the group’s membership and they have achieved particularly good results in increasing native dominance and providing for erosion control within the southern dunes.

The dynamic and unpredictable nature of the dune environments on both the northern and southern side of the Waitohu stream are likely to result in varying degrees of success of planting survival. However, it is currently considered that the benefits to be gained from further planting make the activity worthwhile.

Lower Waitohu stream riparian margins (Operational Area C)

Ongoing revegetation of the riparian margin of the lower reaches of the Waitohu Stream will also be undertaken within the term of this plan. Previous surveys[73,74] have found potential high quality īnanga spawning locations in this reach and a number of recommendations were made by Nga Hapū o Otaki for further habitat enhancement. Following these recommendations, revegetation planting has commenced and is specifically targeted at enhancing spawning habitat using appropriate plant species such as native grasses and toetoe. Greater Wellington's Mahi Waiora Waitohu prototype team are leading and delivering the planting in this area in accordance with the team's objectives to achieve improved water quality, cultural health and biodiversity outcomes within the Waitohu catchment.

9.4. Seed collection

The aim of seed collection at the Waitohu Coast and Wetlands KNE site is to protect the genetic diversity within local plant populations, maintain the area's unique local characteristics, provide the best chance of planting success by growing plants from seed that are adapted to local conditions and increase the populations of existing threatened or regionally rare species in line with objectives 1 and 3 of this plan.

Seed will be collected annually from local spinifex and pīngao populations and propagated to be planted in the foredune areas of the KNE site, particularly in gaps left following progressive marram control. The Greater Wellington Biodiversity Advisor for the KNE site will collect seed from the northern side of the Waitohu stream (Operational Area A) to be propagated by a specialist coastal nursery. WSDCG will collect seed from the southern side of the Waitohu stream (Operational Area B) and propagate plants themselves in their on-site nursery.

Seed may also be collected from threatened or regionally rare species such as sand daphne and sand coprosma to establish an insurance population stock. Seed will be propagated and planted in suitable backdune areas to sustain population numbers if a decline is observed.

9.5. Management of 'Threatened' native plant species

Management of specified native plant species classified as 'Threatened' and 'At Risk' will be undertaken to maintain or increase existing populations present within the KNE site in line with objectives 1, 2 and 3 of this plan.

Threatened species such as pīngao, sand coprosma, native musk, sand daphne, sand tussock, sea grass and *Juncus caespiticius* are present in small numbers across the dune system on both the northern (Operational Area A) and southern (Operational Area B) side of the Waitohu stream. A fine scale management approach will be used to undertake weed control in the vicinity of these threatened plant communities to protect their high ecological value and reduce potential non-target exposure to

herbicide during other operations. Such management methods will include use of selective herbicides only and hand weeding where herbicide use is not appropriate. Threatened plant populations will be monitored by the Greater Wellington Biodiversity Advisor for the KNE site on an annual basis after weed control works are completed. If these plant populations indicate decline, revegetation planting may be required to sustain their population numbers. Ecological weed control in these areas will be undertaken by Greater Wellington's Biosecurity department.

9.6. Monitoring

Dune profile monitoring

Long-term dune profile and vegetation cover monitoring will be established on both the northern (Operational Area A) and southern (Operational Area B) side of the Waitohu stream within year 1 of this operational plan. Dune monitoring will be undertaken annually in accordance with the monitoring guidelines outlined by the Coastal Restoration Trust of New Zealand[75]. Monitoring will help to indicate long term trends and changes in dune morphology and the extent of dune erosion as well as changes in vegetation cover and species composition over time. This information will be useful to measure the success of current restoration activities and inform future management decisions. This dune profile and vegetation cover monitoring will be lead and delivered by the Greater Wellington Biodiversity Advisor for the KNE site.

Īnanga monitoring

Greater Wellington will also continue to support members of Ngā Hapū o Ōtaki in undertaking īnanga monitoring within the lower reaches of the Waitohu Stream. In 2019, Ngā Hapū o Ōtaki assessed the habitat and spawn distribution in 18 sites where tidal conditions could support īnanga spawning[76] and provided baseline information and habitat enhancement recommendations. These recommended actions are being delivered through Greater Wellington's Mahi Waiora Waitohu prototype team and include the removal of large exotic trees on the northern side of the stream to allow greater sunlight and growth of the bankside grass habitat as well as revegetation planting around areas of identified īnanga spawn habitat to support greater spawn.

In early 2020, Ngā Hapū o Ōtaki also surveyed the state of īnanga stock to better understand the habitat preferences of adult īnanga. A second round of monitoring is scheduled to be carried out during the 2020/21 spawning season.

Wetland Health monitoring

Sims wetland and the Waitohu Rivermouth saltmarsh wetland, located within the Waitohu Coast and Wetlands KNE site, are both part of Greater Wellington's Wetland Health State of the Environment (SoE) monitoring programme. The SoE monitoring programme is undertaken by the Environmental Science department on a five-yearly cycle at key wetland sites throughout the region. Sims wetland and Waitohu Rivermouth saltmarsh wetland were both first surveyed in 2017/2018 and will be surveyed again in 2021/2022. As part of this survey the vegetation composition, soil condition, plant nutrient status, wetland condition and wetland pressure index are recorded in plots throughout each wetland. The follow-up survey in 2021/2022 will be

used to identify trends in wetland health and areas for improvement to guide management activities within the KNE site.

10. Future opportunities

Below is a list of some further management activities that have been identified as having the potential to improve the biodiversity values of the KNE site or would provide information to further our understanding of the present ecological values and how to protect them:

- Increase the frequency of pest animal control network servicing to fortnightly during peak nesting periods (September-November) to reduce predation pressure on coastal and wetland bird species during the breeding season, particularly threatened species.
- Undertake regular rabbit monitoring and control, particularly following revegetation planting, to further reduce the pressure of over-browsing on native vegetation.
- Increase the revegetation planting effort of native dune and threatened plant species to accelerate native regeneration and assist regeneration of declining plant species within the region.
- Undertake a baseline lizard and invertebrate survey within the KNE site to better understand what species exist and what management and protection measures may be necessary.
- Undertake a baseline katipō spider survey within the KNE site to determine a rough population density and identify necessary management and protection measures.
- Increased reporting of wildlife sightings through citizen science platforms such as iNaturalist and eBird.

11. Operational delivery schedule

The operational delivery schedule shows the actions planned to achieve the stated objectives for the Waitohu Coast and Wetlands KNE site, and their timing and cost over the five-year period from 1 July 2021 to 30 June 2026. The budget for years 2021/22 to 2025/26 are indicative only and subject to change. A map of operational areas can be found in Appendix 1 (see Map 7).

Table 3: Five-year operational plan for the Waitohu Coast and Wetlands KNE site

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5 year outcomes	Delivery	Frequency and funding where allocated				
						2021/22	2022/23	2023/24	2024/25	2025/26
1, 3	Ecological weed control	A, B	Progressive control of marram grass on the foredunes	Increase in native plant dominance and development of a more stable, low profile foredune system which is resilient to extreme dune erosion	Greater Wellington Biosecurity department	✓ $1,600	✓ $1,620	✓ $1,640	✓ $1,660	✓ $1,680
1, 3	Ecological weed control	A	Step-wise control of lupin through the backdunes	Reduction in lupin infestation to a level that allows for an increase in native plant dominance and successful establishment of revegetation plantings	Greater Wellington Biosecurity department	✓ $1,900	✓ $1,950	✓ $2,000	✓ $2,050	✓ $2,100
1, 3	Ecological weed control	B	Targeted control of treasure flower through the backdunes	No new infestations of treasure flower and existing infestations are eradicated or suppressed to a level that prevents further spread	Greater Wellington Biosecurity department	✓ $350	✓ $360	✓ $360	✓ $370	✓ $380

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5 year outcomes	Delivery	Frequency and funding where allocated				
						2021/22	2022/23	2023/24	2024/25	2025/26
2, 3, 5	Ecological weed control	C, D	Multi-species weed sweep around estuary and riparian margins as required.	No new infestations of priority weed species and existing infestations are eradicated or suppressed to a level that prevents further spread	Greater Wellington Biosecurity department	✓ $300	✓ $300	✓ $320	✓ $330	✓ $340
1, 3	Ecological weed control	B	Control of priority ecological weed species within dune system.	No new infestations of priority weed species and existing infestations are suppressed to a level that prevents further spread	WDSCG; KCDC	✓	✓	✓	✓	✓
2, 3, 4	Pest animal control	Entire KNE site	Traps serviced on a quarterly basis and annual audit.	Browsing pest animal populations are maintained to: possums <5% RTC*; rats <10% TTI**; mustelids <2% TTI** to facilitate native vegetation growth and protect native bird species	Greater Wellington Biosecurity department	✓ $3,200	✓ $3,260	✓ $3,330	✓ 3,400	✓ $3,470
2, 3, 4	Pest animal control	B	Traps serviced on a fortnightly basis.	Browsing pest animal populations are maintained to: possums <5% RTC*; rats <10% TTI**; mustelids <2% TTI** to facilitate native vegetation growth and protect native bird species	WDSCG	✓	✓	✓	✓	✓

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5 year outcomes	Delivery	Frequency and funding where allocated				
						2021/22	2022/23	2023/24	2024/25	2025/26
1, 3	Revegetation	A	Revegetation of foredune and backdune species in the northern dunes following weed control	Increase in the diversity and regeneration of native plant communities and development of a more stable, low profile dune system	Greater Wellington Biodiversity department	✓ $650	✓ $850	✓ $850	✓ $850	✓ $850
1, 3	Revegetation	B	Revegetation of foredune and backdune species in the southern dunes	Increase in the diversity and regeneration of native plant communities and development of a more stable, low profile dune system	WDSCG	✓	✓	✓	✓	✓
5	Revegetation	C	Revegetation of the riparian margin of the lower reaches of the Waitohu Stream	Enhanced īnanga spawning habitat and an increase in the number of īnanga recorded in this reach of the Waitohu Stream	Greater Wellington Mahi Waiora Waitohu prototype team	✓†				
1, 3	Seed collection	A, B	Annual seed collection from local pīngao and spinifex populations	Pīngao and spinifex propagated from seed and planted in the foredune are well adapted to the conditions and successfully establishing within the site	Greater Wellington Biodiversity department, WSDCG	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)
1, 3	Seed collection	A, B	Seed collection from threatened and uncommon dune species	Maintain existing populations of threatened plant species present	Greater Wellington Biodiversity department	✓^ (staff time only)	✓^ (staff time only)	✓^ (staff time only)	✓^ (staff time only)	✓^ (staff time only)

Objective	Management activity	Operational area	The Actions: Description/detail	Intended 5 year outcomes	Delivery	Frequency and funding where allocated				
						2021/22	2022/23	2023/24	2024/25	2025/26
1, 2, 3	Management of threatened and uncommon native plant species	A, B	Fine scale ecological weed control around threatened plant species and revegetation planting as required	Existing populations of 'threatened' plant species are maintained and there is an increase in their distribution across the site	Greater Wellington Biosecurity department	✓	✓	✓	✓	✓
1, 3	Monitoring	A, B	Dune profile and vegetation cover monitoring	Trends and changes in dune morphology, the extent of dune erosion, vegetation cover and species composition over time are determined and used to measure restoration success and inform management	Greater Wellington Biodiversity department	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)	✓ (staff time only)
2, 3, 4	Monitoring	D	SOE wetland health monitoring of vegetation and birds.	Trends in wetland health are quantified and areas for improvement are identified	Greater Wellington Environmental Science department	✓				

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

**TTI = Tracking Tunnel Index. The control regime has been designed to control rats/mustelids to this level but monitoring will not be undertaken. Experience in the use of this control method indicates this target will be met

† = The timeframe for this action is indicative only and may be undertaken at any time and over multiple years over the duration of this plan.

^ =This work is reviewed annually and subject to change year to year depending on the needs of the site.

12. Funding contributions

12.1. Budget allocated by Greater Wellington

The budget for the years 2021/22 to 2025/26 are indicative only and subject to change.

Table 4: Greater Wellington allocated budget for the Waitohu Coast and Wetlands KNE site

Management activity	Timetable and resourcing				
	2021/22	2022/23	2023/24	2024/25	2025/26
Ecological weed control	$2,650	$2,700	$2,760	$2,820	$2,880
Pest animal control	$2,200	$2,240	$2,290	$2,340	$2,390
Revegetation	$1,000	$1,000	$1,000	$1,000	$1,000
Fencing	$2,150	$2,150	$2,150	$2,150	$2,150
Total	**$8,000**	**$8,090**	**$8,200**	**$8,310**	**$8,420**

12.2. Budget allocated by KCDC

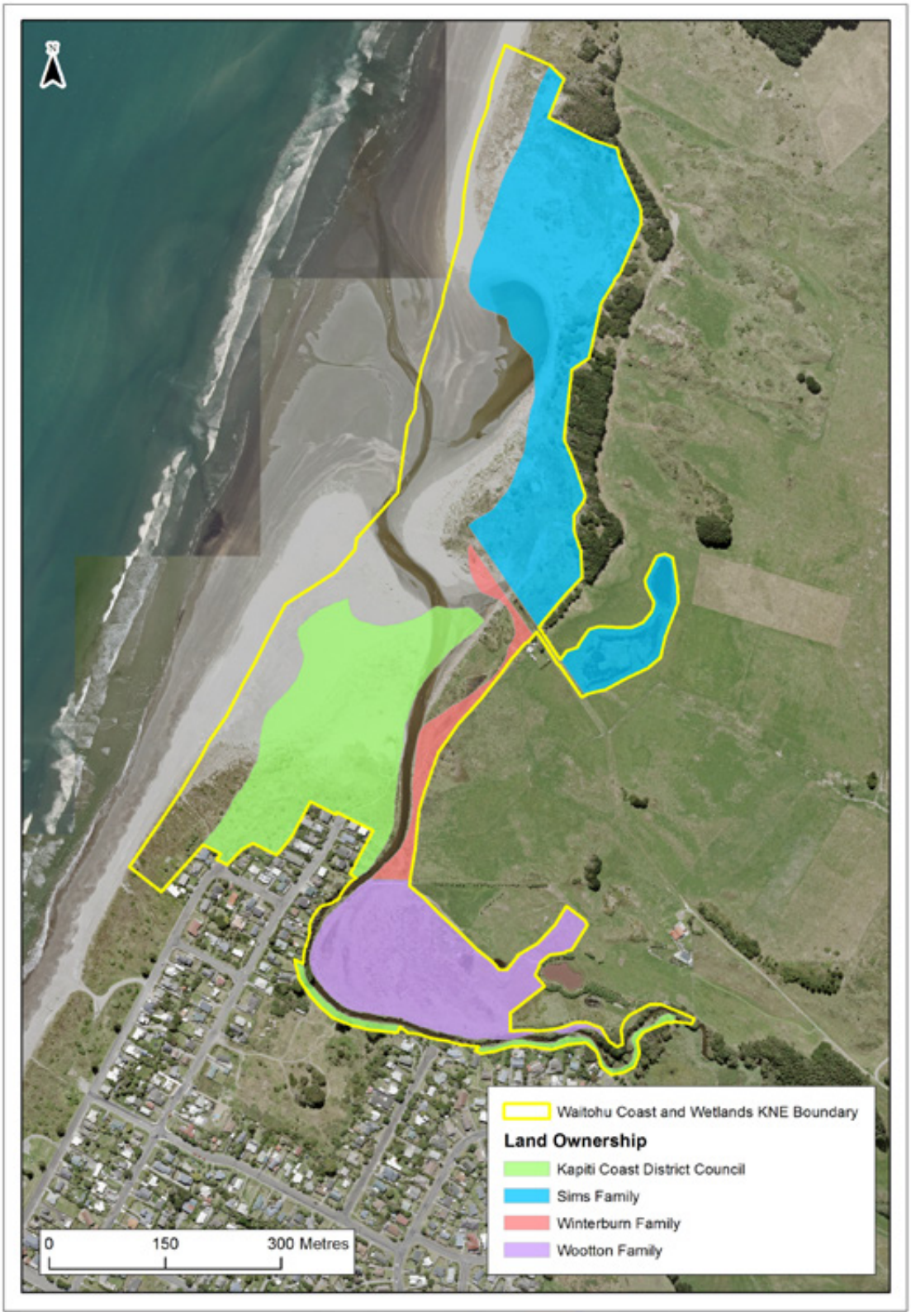
The budget is subject to confirmation through KCDC's ten-year planning process.

Table 5: KCDC allocated budget for the Waitohu Coast and Wetlands KNE site

Management activity	Timetable and resourcing				
	2021/22	2022/23	2023/24	2024/25	2025/26
Ecological weed control	$1,500	$1,530	$1,560	$1,590	$1,620
Pest animal control	$1,000	$1,020	$1,040	$1,060	$1,080
Total	**$2,500**	**$2,550**	**$2,600**	**$2,650**	**$2,700**

Appendix 1: Site maps

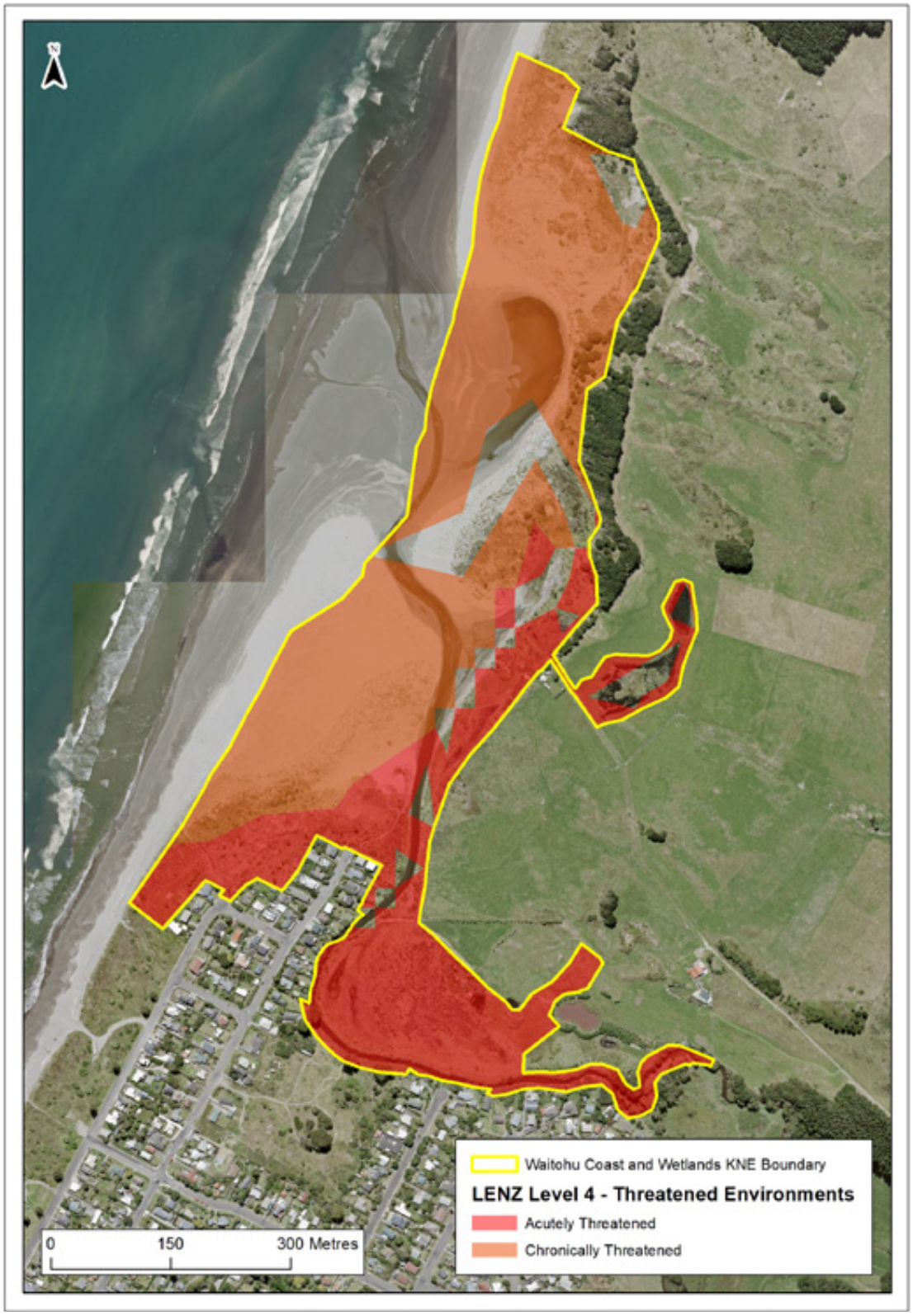
Map 1: The Waitohu Coast and Wetlands KNE site boundary



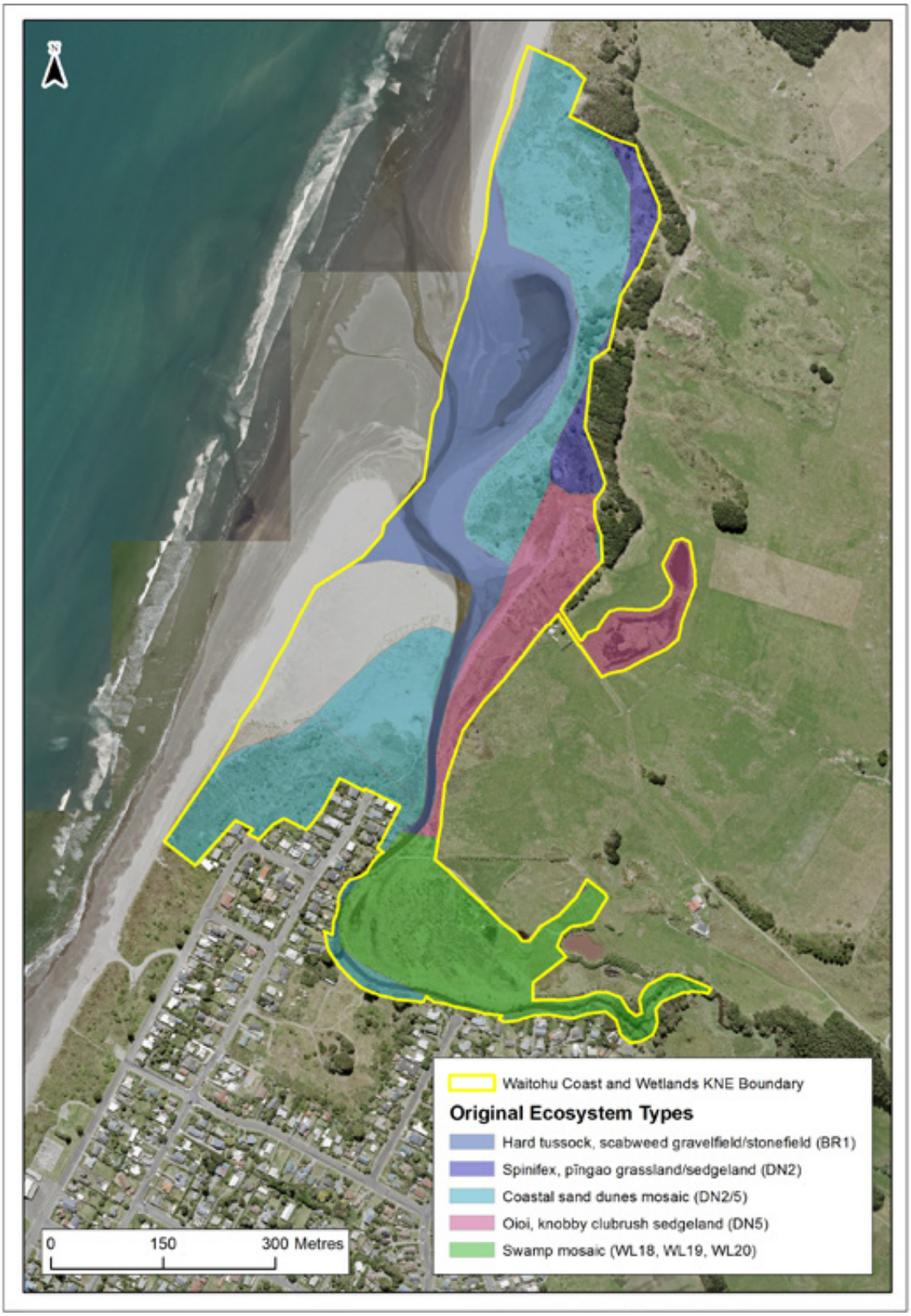
Map 2: Waitohu Coast and Wetlands KNE site land ownership boundaries

Map 3: DOC Designated Ecological Site areas at the Waitohu Coast and Wetlands KNE site

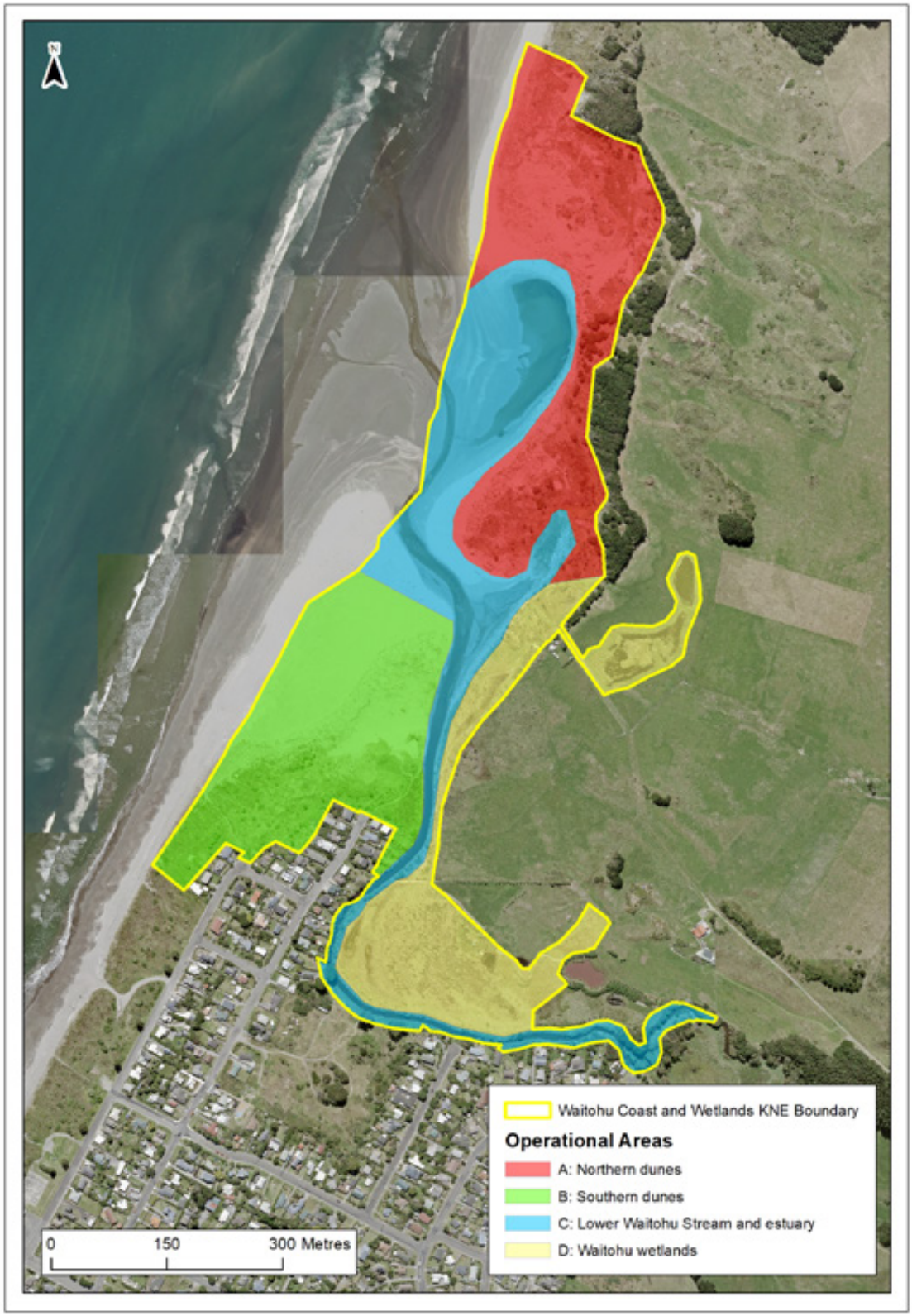
Map 4: Designated KCDC Ecological Site of Significance areas within the Waitohu Coast and Wetlands KNE site



Map 5: Land Environment New Zealand threat classifications for the Waitohu Coast and Wetlands KNE site



Map 6: Singers and Rogers classification of pre-human ecosystem types in the Waitohu Coast and Wetlands KNE site



Map 7: Operational areas in the Waitohu Coast and Wetlands KNE site

Map 8: Pest animal control in the Waitohu Coast and Wetlands 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[77]. 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 Waitohu Coast and Wetlands KNE site.

Table 6: Threatened and At Risk species at the Waitohu Coast and Wetlands KNE site

Scientific name	Common name	Threat status	Observation
Plants(vascular)[78]			
Coprosma acerosa	Sand coprosma	At Risk - Declining	Smith, 2007[79]; Todd et al, 2016[80]
Ficinia spiralis	Pīngao	At Risk – Nationally Vulnerable	Smith, 2007; Todd et al, 2016; Hurley, 2020[81]
Juncus caespiticius	*Juncus caespiticius*	At Risk - Declining	Inaturalist, 2020[82]
Thyridia repens	Native musk	At Risk - Naturally Uncommon	Ward, 2013[83]; Todd et al, 2016
Pimelea villosa	Sand daphne	At Risk - Declining	Smith, 2007; Todd et al, 2016; Bannon, 2020[84]
Poa billardierei	Sand tussock	At Risk - Declining	Smith, 2007
Zostera muelleri subsp. novazelandica	Seagrass	At Risk - Declining	Robertson and Stevens, 2007[85]; Todd et al, 2016
Birds[86]			
Anarhynchus frontalis	Wrybill	Threatened - Nationally Vulnerable	http://ebird.org/content/newzealand/ (accessed May 2021) [87]
Anas superciliosa	Grey duck	Threatened - Nationally Critical	Graeme, 2003[88]
Ardea modesta	White Heron	Threatened - Nationally Critical	Graeme, 2003
Botaurus poiciloptilus	Australasian bittern	Threatened - Nationally Critical	Treacher and Monk, 2003[89]; Monk, 2012[90]; http://ebird.org/content/newzealand/ (accessed May 2021); Wootton, 2021[91]
Charadrius bicinctus bicinctus	Banded dotterel	Threatened - Nationally Vulnerable	Smith, 2010[92]; Todd et al, 2016; McArthur et al, 2019[93]; http://ebird.org/content/newzealand/ (accessed May 2021)

Scientific name	Common name	Threat status	Observation
Charadrius obscurus aquilonius	Northern New Zealand dotterel	At Risk - Recovering	Dowding, 2013[94]; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Chlidonias albostriatus	Black-fronted tern	Threatened - Nationally Endangered	Todd et al, 2016
Elseyornis melanops	Black-fronted dotterel	At Risk - Naturally Uncommon	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Haematopus finschi	South Island pied oystercatcher	At Risk - Declining	McIntosh, 2014[95]; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021); Hurley, 2021[96]
Haematopus unicolor	Variable oystercatcher	At Risk - Recovering	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; Hurley, 2020[97]; http://ebird.org/content/newzealand/ (accessed May 2021)
Hydroprogne caspia	Caspian tern	Threatened - Nationally Vulnerable	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Larus bulleri	Black-billed gull	Threatened - Nationally Critical	Todd et al, 2016; McArthur et al, 2019
Larus novaehollandiae scopulinus	Red-billed gull	At Risk - Declining	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Limosa lapponica baueri	Bar-tailed godwit	At Risk - Declining	Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax carbo novaehollandiae	Black shag	At Risk - Naturally Uncommon	Graeme, 2003; McIntosh, 2013[98]; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax sulcirostris	Little black shag	At Risk - Naturally Uncommon	McIntosh, 2013; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax varius	Pied shag	At Risk - Recovering	McIntosh, 2013; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Platalea regia	Royal spoonbill	At Risk - Naturally Uncommon	Smith, 2011[99]; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)

Scientific name	Common name	Threat status	Observation
Porzana pusilla affinis	Marsh crake	At Risk - Declining	Monk, 2002[100]
Porzana tabuensis	Spotless crake	At Risk - Declining	Cheyne, 2013[101]
Sterna striata striata	White-fronted tern	At Risk - Declining	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Freshwater fish[102]			
Anguilla dieffenbachii	Longfin eel	At Risk - Declining	Bansal et al, 2012[103]; Todd et al, 2016; NIWA freshwater fish database, 2017[104]
Chiemarrichthys fosteri	Torrentfish	At Risk - Declining	Bansal et al, 2012; Todd et al, 2016
Galaxias argenteus	Giant kōkopu	At Risk - Declining	Graeme, 2003; Bansal et al, 2012; Todd et al, 2016; NIWA freshwater fish database, 2017
Galaxias brevipinnis	Kōaro	At Risk - Declining	Todd et al, 2016
Galaxias maculatus	Īnanga	At Risk - Declining	Graeme, 2003; Bansal et al, 2012; Todd et al, 2016; NIWA freshwater fish database, 2017
Galaxias postvectus	Shortjaw kōkopu	Nationally Vulnerable	Todd et al, 2016
Geotria australis	Lamprey	Nationally Vulnerable	Bansal et al, 2012; Todd et al, 2016; NIWA freshwater fish database, 2017
Neochanna apoda	Brown mudfish	At Risk - Declining	NIWA freshwater fish database, 2017 (last observed 1954)
Invertebrates (Araneae – Spiders)[105]			
Latrodectus katipō	Katipō spider	At Risk - Declining	iNaturalist, 2020

Appendix 3: Regionally threatened plant species list

The following table lists regionally threatened species that have been recorded in the Waitohu Coast and Wetlands KNE site.

Table 7: Regionally threatened species recorded in the Waitohu Coast and Wetlands KNE site

Scientific name	Common name	Threat status	Observation
Plants(vascular) [106]			
Coprosma acerosa	Sand coprosma	Regionally declining	Smith, 2007[107]; Todd et al, 2016[108]
Ficinia spiralis	Pīngao	Regionally vulnerable	Smith, 2007; Todd et al, 2016; Hurley, 2020[109]
Thyridia repens	Native musk	Regionally naturally uncommon	Ward, 2013[110]; Todd et al, 2016[111]
Pimelea villosa	Sand daphne	Regionally declining	Smith, 2007; Todd et al, 2016; Bannon, 2020[112]
Poa billardierei	Sand tussock	Regionally declining	Smith, 2007
Birds[113]			
Anarhynchus frontalis	Wrybill	Regional Migrant	http://ebird.org/content/newzealand/ (accessed May 2021) [114]
Anas superciliosa	Grey duck	Regionally Critical	Graeme, 2003[115]
Ardea modesta	White Heron	Regional Vagrant	Graeme, 2003[116]
Botaurus poiciloptilus	Australasian bittern	Regionally Critical	Treacher and Monk, 2003[117]; Monk, 2012[118]; http://ebird.org/content/newzealand/ (accessed May 2021); Wootton, 2021[119]
Charadrius bicinctus bicinctus	Banded dotterel	Regionally Vulnerable	Smith, 2010[120]; Todd et al, 2016; McArthur et al, 2019[121]; http://ebird.org/content/newzealand/ (accessed May 2021)
Charadrius obscurus aquilonius	Northern New Zealand dotterel	Regionally Critical	Dowding, 2013[122]; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Chlidonias albostriatus	Black-fronted tern	Regional Migrant	Todd et al, 2016
Elseyornis melanops	Black-fronted dotterel	Regionally Vulnerable	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Haematopus finschi	South Island pied oystercatcher	Regional Migrant	McIntosh, 2014[123]; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)

Scientific name	Common name	Threat status	Observation
Haematopus unicolor	Variable oystercatcher	Regionally Vulnerable	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; Hurley, 2020[124]; http://ebird.org/content/newzealand/ (accessed May 2021)
Himantopus himantopus leucocephalus	Pied stilt	Regionally Vulnerable	Graeme, 2003; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Hydroprogne caspia	Caspian tern	Regionally Critical	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Larus bulleri	Black-billed gull	Regionally Critical	Todd et al, 2016; McArthur et al, 2019
Larus novaehollandiae scopulinus	Red-billed gull	Regionally Vulnerable	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Limosa lapponica baueri	Bar-tailed godwit	Regionally Critical	Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax carbo novaehollandiae	Black shag	Regionally Critical	Graeme, 2003; McIntosh, 2013[125]; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax sulcirostris	Little black shag	Regionally Vulnerable	McIntosh, 2013; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax varius	Pied shag	Regionally Vulnerable	McIntosh, 2013; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)
Platalea regia	Royal spoonbill	Regional Coloniser	Smith, 2011[126]; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Porzana pusilla affinis	Marsh crake	Regionally Critical	Monk, 2002[127]
Porzana tabuensis tabuensis	Spotless crake	Regionally Critical	Cheyne, 2013[128]
Sterna striata striata	White-fronted tern	Regionally Endangered	Smith, 2010; Todd et al, 2016; McArthur et al, 2019; http://ebird.org/content/newzealand/ (accessed May 2021)

Appendix 4: Not Threatened bird species list

The following table lists all native bird species classified as Not Threatened that have been recorded in the Waitohu Coast and Wetlands KNE site.

Table 8: Native, Not Threatened bird species recorded in the Waitohu Coast and Wetlands KNE site

Scientific name	Common name	Observation
Anas rhynchotis	Australasian shoveler	Graeme, 2003[129]; Todd et al, 2016[130]; http://ebird.org/content/newzealand/ (accessed May 2021)
Anthornis melanura	Bellbird	http://ebird.org/content/newzealand/ (accessed May 2021)
Chrysococcyx lucidus	Shining cuckoo	Graeme, 2003
Circus approximans	Swamp harrier	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Cygnus atratus	Black swan	http://ebird.org/content/newzealand/ (accessed May 2021); Todd et al, 2016
Egretta novaehollandiae	White-faced heron	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Gerygone igata	Grey warbler	http://ebird.org/content/newzealand/ (accessed May 2021)
Hirundo neoxena	Welcome swallow	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Larus dominicanus	Southern black-backed gull	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Phalacrocorax melanoleucos	Little shag	Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Porphyrio melanotus	Pūkeko	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Prosthemadera novaeseelandiae	Tūī	Graeme, 2003; http://ebird.org/content/newzealand/ (accessed May 2021)
Rhipidura fuliginosa	New Zealand fantail	Graeme, 2003; http://ebird.org/content/newzealand/ (accessed May 2021)
Tadorna variegata	Paradise shelduck	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Todiramphus sanctus	New Zealand kingfisher	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)

Scientific name	Common name	Observation
Vanellus miles	Spur-winged plover	Graeme, 2003; Todd et al, 2016; http://ebird.org/content/newzealand/ (accessed May 2021)
Zosterops lateralis	Silvereye	http://ebird.org/content/newzealand/ (accessed May 2021)

Appendix 5: Threat table

Table 9: Summary of all threats to ecological values present in the Waitohu Coast and Wetlands KNE site

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
Ecological weeds		
EW-1	Ground covering ecological weeds smother and displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key ground covering ecological weed species for control include marram grass (*Ammophila arenaria*), treasure flower (*Gazania linearis/ G.rigens*), pampas (*Cortaderia selloana*), agapanthus (Agapanthus praecox) and ice plant (*Carpobrotus edulis*) (see full list in Appendix 6)	Entire KNE site
EW-2	Woody weed species displace native vegetation, inhibit indigenous regeneration, and alter vegetation structure and composition. Key woody ecological weed species include gorse (*Ulex europaeus*), pine (*Pinus radiata*) and karo (*Pittosporum crassifolium*) (see full list in Appendix 6)	B, C, D
EW-3	Climbing weeds smother and displace native vegetation often causing canopy collapse, inhibit indigenous regeneration, and alter vegetation structure and composition. Key climbing ecological weed species include cape ivy (*Senecio angulatus*) and convolvulus (*Convolvulus arvensis*) (see full list in Appendix 6)	B, C, D
Pest animals		
PA-1	Mustelids (stoats[131,132] (*Mustela erminea*), ferrets[133,134] (*M. furo*) and weasels[135,136] (*M. nivalis*)) prey on native birds, lizards and invertebrates, reducing their breeding success and potentially causing local extinctions	Entire KNE site
PA-2	Pest and domestic cats (*Felis catus*) prey on native birds[137], lizards[138] and invertebrates[139], reducing native fauna breeding success and potentially causing local extinctions[140]	Entire KNE site
PA-3	Rats (*Rattus* spp.) browse native fruit, seeds and vegetation. They compete with native fauna for food and can reduce forest regeneration. They also prey on invertebrates, lizards and native birds[141,142]	Entire KNE site
PA-4	Hedgehogs (*Erinaceus europaeus*) prey on native invertebrates[143], lizards[144] and the eggs[145] and chicks of ground-nesting birds[146]	Entire KNE site
PA-5*	Possums (*Trichosurus vulpecula*) browse palatable canopy vegetation until it can no longer recover[147,148]. This destroys the forest's structure, diversity and function. Possums may also prey on native birds and invertebrates[149]	Entire KNE site

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
PA-6*	House mice (*Mus musculus)* browse native fruit, seeds and vegetation, and prey on invertebrates. They compete with native fauna for food and can reduce forest regeneration. They also prey on invertebrates, lizards and small eggs and nestlings[150,151]	Entire KNE site
PA-7*	Rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*) graze on palatable native vegetation and prevent natural regeneration in some environments[152]. Rabbits are particularly damaging in sand dune environments where they graze native binding plants and restoration plantings. In drier times hares especially, will penetrate into wetland forest areas browsing and reducing regenerating native seedlings	Entire KNE site
PA-8*	Wasps (Vespula spp.) adversely impact native invertebrates and birds through predation and competition for food resources. They also affect nutrient cycles in beech forests[153]	Entire KNE site
Human activities		
HA-1*	Garden waste dumping often leads to ecological weed invasions into natural areas. Common weed species introduced at this KNE site include:	A, B, C
HA-2*	Recreational vehicles such as 4WDs and motorbikes can cause damage to dune systems and disturbance of the native ecosystem	A, B, C
HA-3*	Freshwater activities such as boating, fishing, white baiting and duck shooting can introduce aquatic weed species to waterways	C, D
HA-4*	Dogs (*Canis lupus familiaris*), if uncontrolled/unleashed can disturb or kill nesting birds and chicks, and lizards within the KNE site, particularly in close proximity to walking tracks[154]	A, B, C
HA-5*	Agricultural practices, particularly grazing livestock can result in pugging soils, grazing native vegetation inhibiting regeneration, wildlife disturbance and increasing nutrient content of soils and watercourses[155]	C, D
HA-6*	Encroachment of residential gardens into the KNE site from urban areas causes habitat loss and introduces ecological weeds	A, B, C
HA-7*	Poor water quality affects a range of species in the estuary and stream. High nutrient levels and contaminants within watercourses are often caused by upstream land management practices and pollution events including development practices, forestry and agricultural practices, road run-off and storm water entering the watercourse, and sceptic tank leakages	C
Other threats		
OT-1*	Spring tides combined with an increasing number of storm events and sea-level rise resulting from climate change damage coastal ecosystems such as coastal turf, wetlands, and estuaries. Warmer temperatures resulting from climate change may allow faster and more widespread colonisation of invasive exotic plant species	Entire KNE site

Threat code	Threat and impact on biodiversity in the KNE site	Operational area/location
OT-2*	Sedimentation of the stream course exacerbated by stream bank slumping following the release of the stream after mouth cutting and intensified natural erosive processes. Sedimentation reduced turbidity and can have significant impacts on native aquatic plants, invertebrates and fish.	C

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

Appendix 6: Ecological weed species

The following table lists key ecological weed species that have been recorded in the Waitohu Coast and Wetlands KNE 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 10: Ecological weed species recorded in the Waitohu Coast and Wetlands KNE site

Scientific name	Common name	Priority	Operational area	Level of distribution	Management aim
Ammophila arenaria	Marram	Very high	A, B	Localised and abundant	Suppression
Carpobrotus edulis	Ice plant	Very high	A, B, C	Localised and sparse	Eradication
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed	Very high	-	Not yet present	Surveillance and eradication if found
Cortaderia selloana	Pampas	Very high	A, B, C, D	Widespread and sparse	Eradication
Juncus acutus	Sharp rush	Very high	B, D	Localised and sparse	Eradication
Lycium ferocissimum	Boxthorn	Very high	-	Not yet present	Surveillance and eradication if found
Lythrum salicaria	Purple loosestrife	Very high	-	Not yet present	Surveillance and eradication if found
Acer pseudoplatanus	Sycamore	High	B	Localised and sparse	Eradication
Agapanthus praecox subsp. *orientalis*	Agapanthus	High	B, C	Localised and sparse	Eradication
Cupressus macrocarpa	Macrocarpa	High	A	Localised and sparse	Eradication
Datura stramonium	Thornapple	High	B	Historically present	Surveillance and eradication if found
Gazania linearis	Uniform treasure flower	High	B	Localised and abundant	Eradication

Scientific name	Common name	Priority	Operational area	Level of distribution	Management aim
Gazania rigens	Striped treasure flower	High	B	Localised and abundant	Eradication
Helichrysum petiolare	Licorice plant	High	C	Patchy and sparse	Eradication
Juglans sp.	Walnut	High	B	Localised and abundant	Eradication
Lupinus arboreus	Lupin	High	A, B	Localised and dense	Suppression
Pinus radiata	Pine	High	A, C, D	Localised and sparse	Suppression
*Pittosporum crassifolium**	Karo	High	B	Localised and sparse	Eradication
Prunus sp.	Cherry	High	A, B	Patchy and sparse	Eradication
Rubus fruticosus agg.	Blackberry	High	C, D	Patchy and sparse	Suppression
Senecio angulatus	Cape ivy	High	B, C, D	Patchy and sparse	Eradication
Senecio elegans	Purple groundsel	High	A, B	Localised and abundant	Eradication
Senecio glastifolius	Pink ragwort	High	A, B	Localised and abundant	Eradication
Stenotaphrum secundatum	Buffalo grass	High	A, B, C, D	Widespread and sparse	Eradication
Zantedeschia aethiopica	Arum lily	High	A, B, C, D	Widespread and sparse	Suppression
Banksia integrifolia	Coastal banksia	Moderate	A, B	Patchy and sparse	Suppression
Cakile maritima subsp. *maritima*	Sea rocket	Moderate	C	Localised and abundant	Suppression
Lilium formosanum	Formosan lily	Moderate	B	Localised and sparse	Eradication
Convolvulus arvensis	Convolvulus	Moderate	C, D	Patchy and abundant	Suppression
Ulex europaeus	Gorse	Moderate	A, B, C, D	Widespread and sparse	Suppression
Agrostis stolonifera	Creeping bent	Low	C, D	Patchy and abundant	None at present
Erigeron sp.	Fleabane	Low	C, D	Patchy and abundant	None at present
Hypochaeris radicata	Catsear	Low	C, D	Patchy and abundant	None at present

Scientific name	Common name	Priority	Operational area	Level of distribution	Management aim
Plantago coronopus	Buck's horn plantain	Low	A, C, D	Widespread and abundant	None at present
Polypogon monspeliensis	Beard grass	Low	D	Localised and abundant	None at present
Schedonorus arundinaceus	Tall fescue	Low	C, D	Patchy and abundant	None at present
Vicia sativa	Vetch	Low	C, D	Localised and abundant	None at present

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

Appendix 7: Revegetation plant list

Plants from the following table will be used in any revegetation planting as per Section 9.3.

Table 11: Revegetation plant list for use within the Waitohu Coast and Wetlands KNE site

Scientific name	Common name	Operational area/location
Apodasmia similis	Oioi / jointed wire rush	Backdune
Carex testacea	Speckled sedge	Backdune
Coprosma acerosa	Sand coprosma	Backdune
Coprosma repens	Taupata	Backdune
Ficinia nodosa	Wīwī	Backdune
Ficinia spiralis	Pīngao	Frontdune
Lachnagrostis billardierei susp. *billardierei*	Sand wind grass	Backdune
Thyridia repens	Native musk	Backdune
Ozothamnus leptophyllus	Tauhinu	Backdune
Muehlenbeckia complexa var. *complexa*	Small-leaved pōhuehue	Backdune
Pimelea villosa	Sand pimelea	Backdune
Poa billardierei	Sand tussock	Backdune
Spinifex sericeus	Spinifex	Frontdune

Dune planting will be undertaken in autumn or spring each year and slow release fertiliser tablets may be used if deemed necessary to support initial growth of plantings. Due to the ongoing threat of rabbit browse on dune vegetation, rabbit repellent spray may also be applied in the spring to provide some level of deterrent to rabbits and fertilise the plantings.

References

[1] New Zealand legislation. 1991. Resource Management Act 1991.
[2] Greater Wellington Regional Council. Greater Wellington Regional Council Long Term Plan: 2018 – 2028.
[3] Proposed Natural Resources Plan for the Wellington Region. 2019.
[4] Greater Wellington Regional Council. 2019. Greater Wellington Regional Pest Management Plan 2019–2039. GW/BIO-G-2019/74
[5] Greater Wellington Regional Council. 2016. Greater Wellington Regional Council Biodiversity Strategy. http://www.gw.govt.nz/assets/council-publications/Biodiversity-Strategy-2016.pdf
[6] Kāpiti Coast District Council. 2018. Proposed Kāpiti Coast District Plan: Chapter 3 Natural Environment: Schedule 3.1 Ecological Sites. 287 p.
[7] Stevens LM, Forrest BM 2019. Kāpiti Whaitua. Review of estuary ecological condition and habitat vulnerability. Salt Ecology Report 028 prepared for Greater Wellington Regional Council. 60p.
[8] Kāpiti Coast District Council. 2018. Proposed Kāpiti Coast District Plan: Chapter 3 Natural Environment: Schedule 3.1 Ecological Sites. 287 p.
[9] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[10] Greater Wellington Regional Council. Proposed Natural Resources Plan for the Wellington Region. 2019.
[11] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[12] Kapiti Coast District Council. 1999. Kapiti Coast District Plan Heritage Register E: Ecological Sites (areas of significant indigenous vegetation and significant habitats of indigenous flora).
[13] Greater Wellington Regional Council. Proposed Natural Resources Plan for the Wellington Region. 2019.
[14] Greater Wellington Regional Council. Proposed Natural Resources Plan for the Wellington Region. 2019.
[15] Kāpiti Coast District Council. 2018. Proposed Kāpiti Coast District Plan: Chapter 3 Natural Environment: Schedule 3.1 Ecological Sites. 287 p.
[16] Walker S, Cieraad E, Grove P, Lloyd K, Myers S, Park T, Porteous T. 2007. Guide for users of the threatened environment classification, Version 11, August 2007. Landcare Research New Zealand. 34p plus appendix.
[17] Williams PA, Wiser S, Clarkson B, Stanley MC. 2007. New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. New Zealand Journal of Ecology 31(2): 119–128.
[18] Holdaway RJ, Wiser SK, Williams PA. 2012. Status assessment of New Zealand's naturally uncommon ecosystems. Conservation Biology 26: 619–629.
[19] Ausseil A-G, Gerbeaux P, Chadderton W, Stephens T, Brown D, Leathwick J. 2008. Wetland ecosystems of national importance for biodiversity. Landcare Research Contract Report LC0708/158 for Chief Scientist, Department of Conservation.
[20] Greater Wellington Regional Council. Proposed Natural Resources Plan for the Wellington Region. 2019.
[21] Kāpiti Coast District Council. 2018. Proposed Kāpiti Coast District Plan: Chapter 3 Natural Environment: Schedule 3.1 Ecological Sites. 287 p.
[22] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[23]New Zealand Threat Classification System (NZTCS) http://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/
[24] Singers NJD, Rogers GM. 2014. A classification of New Zealand's terrestrial ecosystems. Science for Conservation No. 325. Department of Conservation, Wellington. 87 p.

[25] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[26] McEwen M (compiler). 1987. Ecological Regions and Districts of New Zealand. New Zealand Biological Resources Centre Publication No. 5. Department of Conservation, Wellington.
[27] McEwen WM. (Ed.) 1987. Booklet to accompany SHEET 2. Descriptions of Districts in central New Zealand, from Meremere to Eastern Hawkes Bay. Ecological Regions and Districts of New Zealand. Wellington, Department of Conservation. 92 p.
[28] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[29] Kāpiti Coast District Council. 2018. Proposed Kāpiti Coast District Plan: Chapter 3 Natural Environment: Schedule 3.1 Ecological Sites. 287 p.
[30] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[31] Spence H, Bergin D. 2009. North Waitohu Estuary Dunes - Five Year Restoration Plan. Report prepared for Greater Wellington Regional Council by Coastline Consultants & Environmental Restoration Ltd.
[32] Spence H, Bergin D. 2009. North Waitohu Estuary Dunes - Five Year Restoration Plan. Report prepared for Greater Wellington Regional Council by Coastline Consultants & Environmental Restoration Ltd.
[33] Knowles L, WSDCG, pers comms 2020.
[34] Stevens LM, Forrest BM 2019. Kāpiti Whaitua. Review of estuary ecological condition and habitat vulnerability. Salt Ecology Report 028 prepared for Greater Wellington Regional Council. 60p.
[35] Wallace P. 2006. Waitohu Stream Study Summary Document. Greater Wellington Regional Council, Publication No. WGTN #304657-v1A, Wellington.
[36] Stevens LM, Forrest BM 2019. Kāpiti Whaitua. Review of estuary ecological condition and habitat vulnerability. Salt Ecology Report 028 prepared for Greater Wellington Regional Council. 60p.
[37]Todd M, Kettles H, Graeme C, Sawyer J, McEwan M, Adams L. 2013. Estuarine systems in the lower North Island: ranking of significance, current status and future management options. Department of Conservation.
[38] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[39] Stevens LM, Forrest BM 2019. Kāpiti Whaitua. Review of estuary ecological condition and habitat vulnerability. Salt Ecology Report 028 prepared for Greater Wellington Regional Council. 60p.
[40] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[41] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[42] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[43] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[44] Stevens LM, Forrest BM 2019. Kāpiti Whaitua. Review of estuary ecological condition and habitat vulnerability. Salt Ecology Report 028 prepared for Greater Wellington Regional Council. 60p.
[45] McArthur N; Ray S; Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[46] McArthur N, Lawson J. 2014. Coastal and freshwater sites of significance for indigenous birds in the Wellington region. Greater Wellington Regional Council, Publication No. GW/ESCI-T-14/67, Wellington.
[47]Dowding J, Ecologist and bird expert, pers comms 2013.

[48] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[49] McIntosh S, WSDCG, pers comms 2014.
[50] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[51] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: May 2021).
[52] Hurley A, Greater Wellington, pers obs 2021.
[53] Treacher M. and Monk G, WSDCG, pers comms 2003.
[54] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[55] Monk G, WSDCG, pers obs 2012.
[56] Wootton B, pers obs 2021.
[57] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: May 2021).
[58] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[59] McArthur N; Ray S, Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[60] Smith R, Greater Wellington, pers obs 2010.
[61] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[62] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[63] Bansal N, Brighten A, Craig E, Holdom A, Olley L, Reddy T, Sievwright K. 2012. Baseline Assessment of native fish species both prior to and immediately following riparian vegetation removal in the Waitohu Stream, Otaki, New Zealand. Unpublished report for Greater Wellington Regional Council.
[64] Blaschke P, Forsyth F. 2004. Waitohu Stream Study: Ecological assessment of the Waitohu catchment and stream, Kapiti Coast. Prepared for Wellington Regional Council.
[65] Wallace P. 2006. Waitohu Stream Study Summary Document. Greater Wellington Regional Council, Publication No. WGTN #304657-v1A, Wellington.
[66]Strickland R, Quarterman A. 2001. Review of freshwater fish in the Wellington Region. Prepared for Wellington Regional Council by Cawthron Institute. WRC/RP-T-01/58.
[67] Stevens LM, Forrest BM 2019. Kāpiti Whaitua. Review of estuary ecological condition and habitat vulnerability. Salt Ecology Report 028 prepared for Greater Wellington Regional Council. 60p.
[68] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[69] Bansal N, Brighten A, Craig E, Holdom A, Olley L, Reddy T, Sievwright K. 2012. Baseline Assessment of native fish species both prior to and immediately following riparian vegetation removal in the Waitohu Stream, Otaki, New Zealand. Unpublished report for Greater Wellington Regional Council.
[70] Wallace P. 2006. Waitohu Stream Study Summary Document. Greater Wellington Regional Council, Publication No. WGTN #304657-v1A, Wellington.
[71] iNaturalist. 2020. https://www.inaturalist.org/. Accessed December 2020.
[72] Konlechner TM, Lord JM. 2015. Plant community response following the removal of the invasive Lupinus arboreus in a coastal dune system: Community response following L. arboreus removal. Restoration Ecology. 23(5), 607-614.
[73] Marshall W. 2019. Īnanga Swamp Site Condition of the Waitohu Stream. Aquatic Ecology Limited.

[74] King, B. 2020. Review of Mahi Waiora Environmental Targets for Waitohu Catchment. Greater Wellington Regional Council (unpublished report).
[75] https://monitoring.coastalrestorationtrust.org.nz/guidelines/
[76] King, B. 2020. Review of Mahi Waiora Environmental Targets for Waitohu Catchment. Greater Wellington Regional Council (unpublished report).
[77] Department of Conservation. 2008. New Zealand Threat Classification System manual.
[78] de Lange PJ, Rolfe JR, Barkla JW, Courtney SP, Champion PD, Perrie LR, Beadel SM, Ford KA, Breitwieser I, Schönberger I, Hindmarsh-Walls R, Heenan PB and Ladley K. 2017. Conservation status of New Zealand indigenous vascular plants, New Zealand Threat Classification Series 22. 82 p.
[79] Smith R, Greater Wellington, pers obs 2007.
[80] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[81] Hurley A, Greater Wellington, pers obs 2020.
[82] iNaturalist. 2020. https://www.inaturalist.org/. Accessed December 2020.
[83] Ward M, botanist, pers comms 2013.
[84] Bannon C, Greater Wellington, pers obs 2020.
[85] Robertson B, Stevens L. 2007: Kapiti, Southwest, South Coasts and Wellington Harbour: risk assessment and monitoring recommendations. Report prepared for Greater Wellington Regional Council by Wriggle Coastal Management, Nelson.
[86] Robertson HA, Baird K, Dowding JE, Elliot GP, Hitchmough RA, Miskelly CM, McArthur N, O'Donnell CFJ, Sagar PM, Scofield P, Taylor GA. 2017. Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. 27p.
[87] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: May 2021).
[88] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[89] Treacher M. and Monk G, WSDCG, pers comms 2003.
[90] Monk G, WSDCG, pers obs 2012.
[91] Wootton B, pers obs 2021.
[92] Smith R, Greater Wellington, pers obs 2010.
[93] McArthur N; Ray S, Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[94] Dowding J, Ecologist and bird expert, pers comms 2013.
[95] McIntosh S, WSDCG, pers comms 2014.
[96] Hurley A, Greater Wellington, pers obs 2021.
[97] Hurley A, Greater Wellington, pers obs 2020.
[98] McIntosh S, WSDCG, pers comms 2013.
[99] Smith R, Greater Wellington, pers obs 2011.
[100] Monk G, WSDCG, pers obs 2002.
[101] Cheyne, J. 2013. Waitohu Wetlands Bird Survey: 8-9 November 2013. WetlandWorks. Prepared for Greater Wellington Regional Council. 8p.
[102]Dunn NR, Allibone RM, Closs GP, Crow SK, David BO, Goodman JM, Griffiths M, Jack DC, Ling N, Waters JM and Rolfe JR. 2017. Conservation status of New Zealand freshwater fishes. New Zealand Threat Classification Series 24. 11 p.
[103] Bansal N, Brighten A, Craig E, Holdom A, Olley L, Reddy T, Sievwright K. 2012. Baseline Assessment of native fish species both prior to and immediately following riparian vegetation removal in the Waitohu Stream, Otaki, New Zealand. Unpublished report for Greater Wellington Regional Council.
[104] NIWA. 2017. New Zealand Freshwater Fish Database. National Institute of Water and Atmospheric Research. Accessed 19 February 2020.
[105]Sawyer JWD. 2004. Plant conservation strategy, Wellington Conservancy (excluding Chatham Islands), 2004–2010. Department of Conservation, Wellington. 91 p.

[105] Sirvid PJ, Vink CJ, Wakelin MD, Fitzgerald BM, Hitchmough RA Stringer IAN. 2012. The conservation status of New Zealand Araneae, New Zealand Entomologist, 35(2), 85-90
[106] Crisp, P. 2020. Conservation status of indigenous vascular plant species in the Wellington region. Greater Wellington Region Council. GW/ESCI-G-20/20.
[107] Smith R, Greater Wellington, pers obs 2007.
[108] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[109] Hurley A, Greater Wellington, pers obs 2020.
[110] Ward M, botanist, pers comm 2013.
[111] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[112] Bannon C, Greater Wellington, pers obs 2020.
[113] Crisp P. 2020. Conservation status of native bird species in the Wellington region. Greater Wellington Regional Council, Publication No. GW/ESCI-G-20/75, Wellington.
[114] eBird: An online database of bird distribution and abundance. eBird, Ithaca, New York. Available: http://www.ebird.org. (Accessed: May 2021).
[115] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[116] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[117] Treacher M. and Monk G, WSDCG, pers comms 2003.
[118] Monk G, WSDCG, pers obs 2012.
[119] Wootton B, pers obs 2021.
[120] Smith R, Greater Wellington, pers obs 2010.
[121] McArthur N; Ray S, Crowe P, Bell M. 2019. A baseline survey of the indigenous bird values of the Wellington region coastline. Client report prepared for Greater Wellington Regional Council, Wildlife Management International Ltd, Blenheim.
[122] Dowding J, Ecologist and bird expert, pers comms 2013.
[123] McIntosh S, WSDCG, pers comms 2014.
[124] Hurley A, Greater Wellington, pers obs 2020.
[125] McIntosh S, WSDCG, pers comms 2013.
[126] Smith R, Greater Wellington, pers obs 2011.
[127] Monk G, WSDCG, pers obs 2002.
[128] Cheyne, J. 2013. Waitohu Wetlands Bird Survey: 8-9 November 2013. Wetland Works. Prepared for Greater Wellington Regional Council. 8p.
[129] Graeme C. 2003. Waitohu Wetland: Ecological Report & Reserve Management Plan. Report prepared for: The Waitohu Stream Care Group. 45p.
[130] Todd M, Kettles H, Graeme C, Sawyer J, McEwan A, Adams L. 2016. Estuarine systems in the lower North Island/Te Ika-a-Māui: ranking of significance, current status and future management options. Department of Conservation, Wellington, New Zealand. 400 p.
[131] Murphy E, Maddigan F, Edwards B, Clapperton K. 2008. Diet of stoats at Okarito Kiwi Sanctuary, South Westland, New Zealand. New Zealand Journal of Ecology 32(1): 41–45.
[132] King CM and Murphy EC. 2005. Stoat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 261–287.
[133] Ragg JR. 1998. Intraspecific and seasonal differences in the diet of feral ferrets (*Mustela furo*) in a pastoral habitat, east Otago, New Zealand. New Zealand Journal of Ecology 22(2): 113–119.
[134] Clapperton BK, Byron A. 2005. Feral ferret. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 294–307.
[135] King CM. 2005. Weasel. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 287–294.

[136] King CM, Flux M, Innes JG, Fitzgerald BM. 1996. Population biology of small mammals in Pureora Forest Park: 1. Carnivores (*Mustela erminea, M.furo, M.nivalis* and *Felis catus*). New Zealand Journal of Ecology 20(2): 241–251.
[137] King CM, Flux M, Innes JG, Fitzgerald BM. 1996. Population biology of small mammals in Pureora Forest Park: 1. Carnivores (*Mustela erminea, M.furo, M.nivalis* and *Felis catus*). New Zealand Journal of Ecology 20(2): 241–251.
[138] Reardon JT, Whitmore N, Holmes KM, Judd LM, Hutcheon AD, Norbury G, Mackenzie DI. 2012. Predator control allows critically endangered lizards to recover on mainland New Zealand. New Zealand Journal of Ecology 36(2): 141–150.
[139] King CM, Flux M, Innes JG, Fitzgerald BM. 1996. Population biology of small mammals in Pureora Forest Park: 1. Carnivores (*Mustela erminea, M.furo, M.nivalis* and *Felis catus*). New Zealand Journal of Ecology 20(2): 241–251.
[140] Gillies C, Fitzgerald BM. 2005. Feral cat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 308–326.
[141] Daniel MJ. 1973. Seasonal diet of the ship rat (*Rattus r. rattus*) in lowland forest in New Zealand. Proceedings of the New Zealand Ecological Society 20: 21–30.
[142] Innes JG. 2005. Ship rat. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 187–203.
[143] Jones C, Sanders MD. 2005. European hedgehog. In: King CM ed. The handbook of New Zealand mammals. 2nd edition. Melbourne, Oxford University Press. Pp. 81–94.
[144] Spitzen-van der Sluijs AM, Spitzen J, Houston D, Stumpel AHP. 2009. Skink predation by hedgehogs at Macraes Flat, Otago, New Zealand. New Zealand Journal of Ecology 33(2): 205–207.
[145] Jones C, Moss K, Sanders M. 2005. Diet of hedgehogs (*Erinaceus europaeus*) in the upper Waitaki Basin, New Zealand. Implications for conservation. New Zealand Journal of Ecology 29(1): 29–35.
[146] Jones C, Sanders MD. 2005. European hedgehog. In: King CM ed. The handbook of New Zealand mammals. 2nd edition. Melbourne, Oxford University Press. Pp. 81–94.
[147] Pekelharing CJ, Parkes JP, Barker RJ. 1998. Possum (*Trichosurus vulpecula*) densities and impacts on fuchsia (*Fuchsia excorticata*) in South Westland, New Zealand. New Zealand Journal of Ecology 22(2): 197–203.
[148] Nugent G, Sweetapple P, Coleman J, Suisted P. 2000. Possum feeding patterns. Dietary tactics of a reluctant folivore. In: Montague TL ed. The brushtail possum: Biology, impact and management of an introduced marsupial. Lincoln, Manaaki Whenua Press. Pp. 10–19.
[149] Sweetapple PJ, Fraser KW, Knightbridge PI. 2004. Diet and impacts of brushtail possum populations across the invasion front in South Westland, New Zealand. New Zealand Journal of Ecology 28(1): 19–33.
[150] Ruscoe WA, Murphy EC. 2005. House mouse. In: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 204–221.
[151] Newman DG. 1994. Effect of a mouse *Mus musculus* eradication programme and habitat change on lizard populations on Mana Island, New Zealand, with special reference to McGregor's skink, *Cyclodina macgregori.* New Zealand Journal of Ecology 21: 443–456.
[152] Norbury G, Flux JEC. 2005. Brown hare. in: King CM ed. The handbook of New Zealand mammals. Oxford University Press. Pp. 151–158.
[153] Beggs JR. 2001. The ecological consequences of social wasps (*Vespula* spp.) invading an ecosystem that has an abundant carbohydrate resource. Biological Conservation 99: 17– 28
[154] Holderness-Roddam B. 2011. The effects of domestic dogs (*Canis familiaris*) as a disturbance agent on the natural environment. Thesis submitted at University of Tasmania, Hobart.
[155] Smale MC, Dodd MB, Burns BR, Power IL. 2008. Long-term impacts of grazing on indigenous forest remnants on North Island hill county, New Zealand. New Zealand Journal of Ecology 32(1): 57–66.

Greater Wellington Regional Council:

Wellington office
PO Box 11646
Manners Street
Wellington 6142

T 04 384 5708
F 04 385 6960

Upper Hutt office
PO Box 40847
Upper Hutt 5018

T 04 526 4133
F 04 526 4171

Masterton office
PO Box 41
Masterton 5840

T 06 378 2484
F 06 378 2146

Follow the Wellington Regional Council

info@gw.govt.nz
www.gw.govt.nz

June 2021
GW/BD-G-21/29

Please recycle
Produced sustainably