Biodiversity Management Plan

for Maketū Ongatoro Wetland Society, Department of Conservation, Fish & Game and Western Bay of Plenty District Council

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Biodiversity Management Plan

Waihī Estuary Wildlife Management Reserve

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PART A

1 Site introduction

1.1 Description

The Waihī Estuary Wildlife Management Reserve is situated on the southern edge of Waihī Harbour and is administered by the Department of Conservation with input from Fish and Game. The reserve is gazetted as a Government Purpose (Wildlife Management) Reserve under the Reserves Act 1977. It runs from the mouth of the Kaikokopu Canal in the west to the eastern end of the Waihī Harbour and totals 45 ha. The reserve is divided in two by the Pongakawa River with land access to the western section via Wharere Road, and the eastern section down Cutwater Road. A large percentage of the reserve is natural saltmarsh, which is a significant habitat for Australasian bittern, North Island fernbird and other waterfowl.

The western section between the Kaikokopu Stream and the Pongakawa River is divided in two by a causeway, to the north is natural saltmarsh and to the south an area that was grazed and which is infested with weeds. There is a single culvert in the north-east corner of the previously farmed section with a flap gate that allows water to flow from the wetland into the Pongakawa River with a weir on the inside of the culvert to help maintain water levels.

This management plan should be read with reference to the attached map which provides detail regarding locations of the works

Protection Site: 55.67 (hectares)

Area number	Description	Size (ha)	LUC unit	Stream length[1] protected (m)	Stream margin[2] protected (m)	New fencing erected[3] (m)
1	Saltmarsh west of the Pongakawa River mouth	10.74	8w/ estuary	0	0	0
2	Saltmarsh east of the Pongakawa River mouth	23.23	8w/ estuary	0	0	0
3	Brackish wetland	14.95	3w/8w	0	0	0
4	Bunds west of the Pongakawa River	4.45	8w/3w	0	0	0
5	Bunds east of the Pongakawa River	2.3	8w/ estuary	0	0	0
TOTAL		**55.67**		**0**	**0**	**0**

Note 1: 'Stream length protected' measures the length of any stream, wetland or riparian area protected from stock access by these works (i.e. on both sides). If stock still have access to the same stream or wetland from the other bank then this is not counted.

Note 2: 'Stream margin protected' measures the length of streambank protected from stock access by these works (i.e. each side of the stream or wetland is counted separately).

Note 3: Actual length of new fencing to be erected under this agreement.

1.2 Ecological context

Waihī Estuary Wildlife Management Reserve is situated within the Tauranga Ecological District which is characterised by coastal plains, swampland, estuaries and low hills with warm summers, mild winters and a significant maritime influence (McEwan 1987). The site is part of the much larger Waihī Harbour which is a significant site for migratory and resident wader birds. The site has been identified as Regionally Significant and is part of a larger Category 1 Significant Natural Area (Wildland Consultants 2008). It is also listed in the proposed Regional Coastal Environment Plan as a Category A site which will mean that Policy 11(a) of the New Zealand Coastal Policy Statement 2010 will apply to it.

The majority of the Reserve has an unimpeded connection to the Waihī Estuary and remains in relatively high quality saltmarsh vegetation. However, a large area in the southern part of the reserve which was added in 1988 was previously farmed and has been extensively modified in an attempt to drain it. This area is completely surrounded by bunds and is connected to the saltmarsh only by a culvert which drains into the Pongakawa River and is fitted with a flap gate.

The hydrological disconnect between this area and the estuary means that the area experiences less influence from saltwater than it would have historically, although it is still brackish. As well as the isolation from saline water this part of the reserve is also isolated from surface-flowing fresh water. The adjacent Pongakawa River has been channelised and adjacent swamp has been drained so it is likely that as well as a significant reduction in the saltwater influence there has also been a significant reduction in freshwater inputs. It therefore seems likely that before the bunds were built to isolate this area it would have been predominantly saltmarsh vegetation but with a grade towards species more commonly found in brackish water towards the southern edge.

1.3 Landowner

Current owner: Crown Land
Administered by Department of Conservation

Address: PO Box 9003
Chadwick Road
Greerton
Tauranga 3142

1.4 Site map

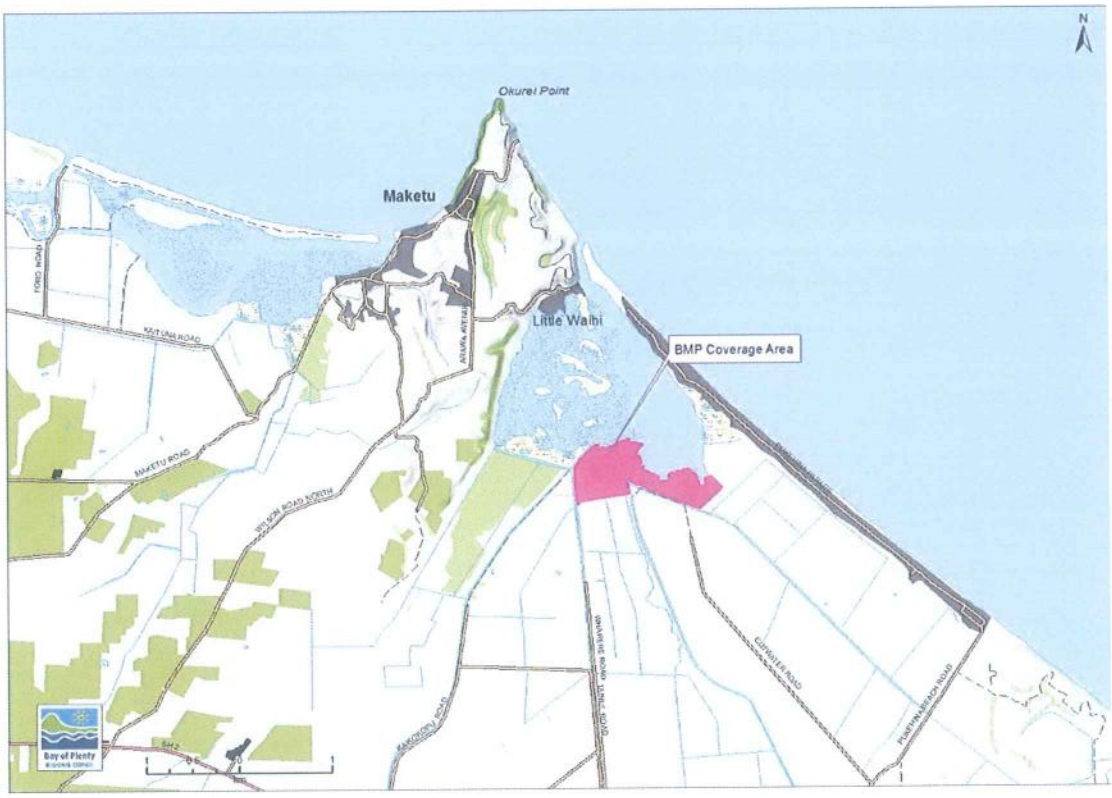

Figure 1 Location of the Waihī Estuary Wildlife Management Reserve.

1.5 Partners to the plan

Partner(s):	Maketū Ongatoro Wetland Society Inc. Department of Conservation Bay of Plenty Regional Council Fish and Game – Eastern region Western Bay of Plenty District Council
Project Manager(s):	Julian Fitter (MOWS) / Mark Anderson (DOC)
BOP Regional Council Liaison Officer:	Hamish Dean

2 Site biodiversity status

2.1 Vegetation and flora

Waihī Estuary Wildlife Management Reserve comprises 45 ha of saltmarsh (Management Areas 1 and 2) and an area which was previously drained for farming which now comprises brackish and freshwater wetland dominated by exotic grasses and pampas (Management Area 3). Management Areas 1 and 2 are dominated by a mosaic of sea rush (*Juncus krausii var australiensis*) and oioi (*Apodasmia similis*) with patches of purua grass (*Bolboschoenus fluviatilis*) and the shrubby saltmarsh ribbonwood (*Plagianthus divaricatus*).

Around the seaward edge there are a number of landing sites used by duck hunters and these and many other areas along the seaward edge are infested with kikuyu grass (*Pennisetum clandestinum*) and sea couch (*Elytrigia pycnantha*) which is very invasive and has spread up the eastern bund along the Pongakawa River as far as the causeway.

Other pest plants on the bunds and causeways are pampas (*Cortaderia selloana*), blackberry (*Rubus fruticosus* agg.), gorse (*Ulex europaeus*) and tree lupin (*Lupinus arboreus*). Silver wattle (*Acacia dealbata*) occurs on the bunds alongside both the Wharere Canal and Pongakawa River.

In the previously farmed area (Area 3) there are areas of sea rush and patches of jointed twig rush (*Machaerina articulata*) but much of this area is covered in mercer grass (*Paspalum distichum*) tall fescue (*Schedonorus arundinaceus*) with pampas and willow, and at the southern end there are large areas of kikuyu. In the south-east corner there is a stand of raupō (*Typha orientalis*).

The vegetation types identified in the project area are described below using the standard Atkinson (1985) naming conventions. Some vegetation types encompass considerable variation. Vegetation types were mapped using 2014 aerial photography and the mapping for the area to the east of the Pongakawa River was based on a vegetation map by Wildland Consultants (2008).

Key to vegetation descriptions (from Atkinson 1985).

species	>50% of total vegetation cover of underlined species in a particular tier.
species	20-49% of total vegetation cover of underlined species in a particular tier.
(species)	10-19% of total vegetation cover of a species in a particular tier.
[species]	1-10% of total vegetation cover of square bracketed species in a particular tier.
Species A/Species B	Species A in a tier above Species B (e.g. species emergent above the canopy).
Species A–Species B	Species A and B occur within the same tier.

1 **Mercer grass grassland**

This vegetation type comprises occasional pampas and sea rush over a dense sward of mercer grass which at the time of mapping had experienced severe dieback as a result of winter frosts. Areas of open water occur amongst the grass sward.

2 **Pampas/mercer grass tussockland**

Stands of pampas to around 2 m tall overtop a sward of predominantly mercer grass with occasional tall fescue, sea rush and Juncus pallidus.

3 **[Pampas]/jointed twig rush reedland**

This vegetation type comprises a dense stand of jointed twig rush with occasional pampas. Grass species including mercer grass and tall fescue occupy the groundcover where there are gaps in the taller vegetation.

4 **Sea rush rushland**

Sea rush forms a mono-specific stand over a groundcover of salt-tolerant herbs. Thyridia repens is common in some areas, as is bachelor's buttons. There are patches of glasswort and Triglochin striata and occasional remuremu.

5 **[Pampas]/sea rush/mercer grass grassland**

These areas grade into Vegetation Types 1 and 2 and comprise a sward of mercer grass but with scattered emergent sea rush and occasional pampas. Open water is common in this type.

6 **Oioi – sea rush rushland**

Oioi dominates these saltmarsh areas and sea rush is common. Vegetation Type 6 grades into Type 17 which is dominated by sea rush.

7 **(Pampas)/tall fescue grassland**

Common in the northern part of the ex-farmland area this type comprises a dense sward of tall fescue with occasional emergent pampas. Bolboschoenus caldwellii and kuawa are common and there are occasional blackberry.

8 **Grey willow/reed sweetgrass treeland**

Scattered grey willow occur over a groundcover of reed sweetgrass.

9 **Raupō – jointed twig rush reedland**

This small area near the southern edge of the site comprises a stand of raupō with patches of jointed twig rush. Both species are emergent from pooled water on which duck weeds (Lemna disperma and Landoltia punctata) and red Azolla are scattered.

10 **(Sea rush)/*Thyridia repens* – bachelor's buttons herbfield**

These open herbfields comprise scattered sea rush over a groundcover dominated by Thyridia repens. Bachelor's buttons is common.

11 **Manawa shrubland**

This vegetation type comprises open stands of seedling and sapling manawa over mud and sand.

12 **Pampas/jointed twig rush/tall fescue tussockland**

Jointed twig rush is common among dense stands of pampas. Open areas comprise patches of tall fescue.

13 **Grey willow treeland**

These very small areas comprise an open canopy of grey willow above scattered jointed twig rush, pampas, tall fescue and mercer grass.

14 **Sea couch grassland**

A dense sward of sea couch with occasional tall fescue and saltmarsh ribbonwood.

15 **Silver wattle/pampas/pasture grassland**

A canopy of silver wattle up to 10 m tall overtops pampas and a low pasture of exotic grasses and herbs.

16 **Tall fescue/mixed grasses and herbs grassland**

These bund areas comprise scattered tall fescue over a lower sward of various exotic herbs and grasses. Tree lupin and pampas are scattered.

17 **Sea rush – oioi rushland**

Occupying the majority of the saltmarsh area this vegetation type comprises a dense sward of sea rush with patches of oioi scattered throughout. Occasional saltmarsh ribbonwood and Machaerina juncea area also present.

18 **Saltmarsh ribbonwood – [coastal tree daisy]/sea rush – oioi shrubland**

Saltmarsh ribbonwood dominates this vegetation type with scattered coastal tree daisy over a lower canopy of sea rush and oioi.

19 **Saltmarsh ribbonwood – *Bolboschoenus fluviatilis* shrubland**

This vegetation type comprises saltmarsh ribbonwood intermixed with areas of Bolboschoenus fluviatilis.

20 **Saltmarsh ribbonwood/sea couch grassland**

Scattered saltmarsh ribbonwood occurs over a sward of sea couch. This type occurs predominantly along the seaward edge of the saltmarsh.

21 **Pampas tussockland**

Dense stands of pampas with only occasional gorse or wattle.

22 **[Pampas]/blackberry shrubland**

Scattered pampas to around 3 m tall over a dense shrubland of gorse.

23 **[Silver wattle]/[pampas]/blackberry shrubland**

Scattered silver wattle over dense gorse with occasional pampas.

24 **Saltmarsh ribbonwood/sea couch - sea rush - (Machaerina juncea) - (oioi) shrubland**

2.2 Fauna

The wetland provides good habitat for a number of threatened and at-risk bird species including Australasian bittern (*Botaurus poiciloptilus*), banded rail (*Gallirallus philippensis assimilis*), spotless crake (*Porzana tabuensis tabuensis*), pied stilt (*Himantopus himantopus leucocephalus*) and North Island fernbird (*Bowdleria punctata vealeae*), as well as pūkeko (*Porphyrio melanotus melanotus*), white-faced heron (Egretta novaehollandiae), New Zealand shoveler (*Anas rhynchotis variegata*), mallard (*Anas platyrhynchos*) and paradise duck (*Tadorna variegata*) (Table 1). Kahu (*Circus approximans*) are frequently seen coursing hunting over the wetland and royal spoonbill (*Platalea regia*) utilise the area.

The removal of invasive pest plant species is likely to improve the habitat for all native species and the duck species which are a valuable recreational resource in the area. The mudflats in the harbour to the north of the reserve are one of the best areas in North Island for shorebirds, both native and migratory. Chief among these are bar-tailed godwit (*Limosa lapponica baueri*; at risk – declining) and red knot (*Calidris canutus rogersi*; threatened – nationally vulnerable), but Pacific golden plover (*Pluvialis fulva*) and glossy ibis (*Plegadis falcinellus*) are regularly recorded there.

The streams and canals are known habitat for inanga (*Galaxias maculatus*; at risk - declining[1]) and tuna (*Anguilla australis, A. dieffenbachii*; at risk – declining[1]), and any work in the reserve will seek to monitor fish species and improve the habitat. The pest fish *Gambusia affinis* are present in the enclosed area of the reserve.

Native skinks and geckos are likely to be present. Skink tracks were recorded during a rat monitoring operation but these have yet to be confirmed.

Photo 1 Royal spoonbill in Area 3.

[1] Goodman *et al.* 2014.

Table 1 Bird species occurring in the reserve.

Common name	Scientific name	Conservation status (Robertson *et al.* 2013)
Banded rail	*Gallirallus philippensis assimilis*	At risk - declining
Bittern	*Botaurus poiciloptilus*	Threatened - nationally endangered
Chaffinch	*Fringilla coelebs*	Introduced and naturalised
Common starling	*Sturnus vulgaris*	Introduced and naturalised
Eurasian skylark	*Alauda arvensis*	Introduced and naturalised
Grey warbler	*Gerygone igata*	Not threatened
House sparrow	*Passer domesticus*	Introduced and naturalised
Little black shag	*Phalacrocorax sulcirostris*	At risk - naturally uncommon
Little shag	*Phalacrocorax melanoleucos brevirostris*	Not threatened
Mallard	*Anas platyrhynchos*	Introduced and naturalised
New Zealand Shoveler	*Anas rhynchotis variegata*	Not threatened
North Island fantail	*Rhipidura fuliginosa placabilis*	Not threatened
North Island fernbird	*Bowdleria punctata vealeae*	At risk - declining
Paradise shelduck	*Tadorna variegata*	Not threatened
Pied shag	*Phalacrocorax varius varius*	Threatened - nationally vulnerable
Pūkeko	*Porphyrio melanotus melanotus*	Not threatened
Royal spoonbill	*Platalea regia*	At risk - naturally uncommon
Sacred kingfisher	*Todiramphus sanctus vagans*	Not threatened
Silvereye	*Zosterops lateralis lateralis*	Not threatened
Spotless Crake	*Porzana tabuensis tabuensis*	At risk - relict
Spur-winged plover	*Vanellus miles novaehollandiae*	Not threatened
Welcome Swallow	*Hirundo neoxena neoxena*	Not threatened

3 Site threat evaluation

3.1 Threat assessment

Pest animals

Possums (observed), rats, stoats, weasels, ferrets and hedgehogs are all likely present in the reserve, especially along the bunds. Feral cats may also visit from time-to-time. Mustelids, cats and rats pose a significant threat to wader bird populations. Mustelids and rats should be controlled in the reserve as a minimum and this has been provided for in this Biodiversity Management Plan (BMP).

Table 2 Animal pests known or likely to be present in the project area.

Pest animals	Prevalence	Notes/trends
Possums	☐Absent ☒ Present ☐ High ☐ Medium ☐ Low	Possums observed and sign seen.
Mustelids	☐Absent ☒ Present ☐ High ☐ Medium ☐ Low	
Rabbits/hares	☐Absent ☒ Present ☐ High ☐ Medium ☐ Low	Rabbits are likely to be present at least on the bunds although no sign has been seen.
Hedgehogs	☐Absent ☒ Present ☐ High ☒ Medium ☐ Low	Likely to be present but no sign seen.
Rats	☐Absent ☒ Present ☐ High ☒ Medium ☐ Low	There is good habitat for rats in vegetation along the bunds.
Cats	☐Absent ☒ Present ☐ High ☐ Medium ☒ Low	

Given the importance of the site for wetland and wader birds it is important that control of pest animals is started quickly. Allowance has been made in the work plan and cost table for stoat, rat and possum control which will be concentrated on the bunds around the wetland for practicality and because it is likely that many pests utilise these for travel as well as general habitat.

Rats

Rats will be controlled using dedicated rat bait stations which will be deployed during late winter and early spring for a period of one or two months. Stations will be baited with diphacinone or another first generation anticoagulant toxin for which a Department of Conservation permit will be required. Avoid placing bait stations where there is likely to be standing water or attach them to a structure to keep them above water level. After the baiting is done the stations will be removed for deployment elsewhere in the site or in another Maketū Ongatoro Wetland Society (MOWS) project, after which rats will be controlled with DOC 200 traps. Rat numbers should be monitored using tracking tunnels.

Mustelids

Mustelids should be controlled with a network of DOC 200 kill traps spaced at 200 m apart or closer and baited with fresh rabbit or an egg. Traps will be deployed during the spring and summer and removed during winter. The double-set traps which will be used for this project will provide a high level of control for mustelids and will also provide control for rats to augment annual poisoning.

Possums

Possums can be controlled with Goodnature self-resetting kill traps spaced at 100–150 m apart along the bunds. Traps may need to be attached to specially installed posts. Goodnature traps will remain in place year-round and will be periodically checked and serviced as part of other work at the site.

Because of the size and shape of the site pest animals will constantly re-invade even with effective control in place so control efforts will need to be ongoing.

Pest plants

The saltmarsh area is in good condition with relatively few pest plants. These are primarily invasive grasses such as sea couch, saltwater paspalum, kikuyu and tall fescue and are relatively restricted in distribution. These may continue to spread if left unchecked although suitable habitat for these species is limited.

The previously farmed area (Area 3) is dominated by exotic species and pampas, tall fescue and Mercer grass are the most prevalent. Other weed species in Area 3 include blackberry (*Rubus fruticosus* agg.), boneseed (*Chrysanthemoides monilifera subsp. monilifera*) and sea couch. There are some indigenous-dominated areas but large areas will require weed control and subsequent planting if indigenous cover is to be restored. It is unlikely that planting of this area will be done in the first five years however.

Pampas, saltwater paspalum and sea couch control are the highest priority and will be started in the first year of the BMP and will continue progressively through the site in subsequent years. Gorse and wattle are not major threats to the wetland but are preventing access and will need to be controlled.

Table 3 Pest plant prevalence in the project area.

Common name	Botanical name	Density	Area	Descriptive location	Level of threat
Blackberry	*Rubus fruticosus* agg.	Low	3, 4, 5	Some in brackish wetland (Area 3) and common on bunds east of the Pongakawa River.	Low
Boneseed	*Chrysanthemoides monilifera subsp. monilifera*	Low	3	Only one plant seen in Area 3.	Moderate
Gorse	*Ulex europaea*	Medium	4, 5	Gorse is common on bunds adjacent to the Pongakawa River.	Medium
Pampas	*Cortaderia selloana*	High	1-5	Throughout.	High
Saltwater paspalum	*Paspalum vaginatum*	Low	1	Very local.	High

Common name	Botanical name	Density	Area	Descriptive location	Level of threat
Sea couch	*Elytrigia pycnantha*	Medium	2, 3, 4, 5	Harbour edge and seaward end of bunds. Also some in Area 3.	High
Silver wattle	*Acacia dealbata*	High	4, 5	Along canal bunds.	Medium
Tall Fescue	*Schedonorus arundinaceus*	Dense	1-4	Throughout.	High
Tree Lupin	*Lupinus arboreus*	Low	1-5	Throughout.	Low

Water quality and hydrology

The wetland in Area 3 is disconnected from both the harbour and the adjacent streams by flood protection and drainage structures including bunds and a flap gate. As a result there is no inflow of surface water to the wetland except a small amount on the incoming tide which comes through the leaky flap gate. This has led to very variable water quality in the wetland with dissolved oxygen levels as low as 1.46 mg L^{-1} recorded in some areas.

Seven day mean DO levels below 5.0 are toxic to early life stages of most freshwater fish in New Zealand (Franklin 2010). Options which could be considered to improve water quality are allowing more tidal water to enter via the floodgate or piping water from the Pongakawa River through the bund and into the southeast corner of Area 3. However, the impact of these actions would need to be carefully considered and since the current habitat is favourable to a number of bird species alteration to hydrology should be a low priority.

4 Site goals, objectives and outcome monitoring

4.1 Biodiversity Management Plan goals

- Protect indigenous fauna and mallard ducks through habitat enhancement and pest animal control,
- Protect and restore indigenous vegetation communities to the site,
- Maintain and improve accessibility for recreational users of the site.

4.2 Site operational objectives

The following objectives define operational targets and timelines.

1 Continue pest plant control with the focus of progressively reducing pampas, wattle, gorse, willow, saltwater paspalum and sea couch in the site to near zero density within five years,

2 Undertake restoration plantings in areas where pest plant control has been carried out on the bunds and causeways,

3 Begin pest animal control to ensure mustelid, rat, and possum numbers are kept at low levels during the bird breeding season: Rats should be kept below 2% tracking index between August and March. Other pest species need not be formally monitored but trapping results should be recorded and reported,

4 Develop a monitoring/survey programme for birds, reptiles, fish and invertebrates in Year 1 of the BMP,

5 Develop a plan for public use of the wetland by FY2016/2017, taking into account the potential effects of disturbance on indigenous fauna.

5 Work Programme

5.1 Work Programme

The Bay of Plenty Regional Council (BOPRC) bases its annual programme of works on the financial year starting 1 July through to 30 June; the following is an agreed timetable of works. Note that Appendix 4 includes restrictions on what work can be done during specified times of the year and should be strictly adhered to.

2015/2016

- BOPRC to organise helicopter to spray inaccessible pampas across whole site. This will be done using a wand, or spot-spray bucket.
- DOC to arrange permits for MOWS to use toxin in the reserve.
- MOWS to conduct pest plant spraying with a focus on sea couch in Area 1, and pampas, wattle, lupin and gorse on the bunds in Area 4.
- An excavator will be used to clear sprayed pampas from Area 4 bunds.
- Fish and Game to arrange a mowing contractor to periodically mow the bunds in the western part of the site.
- DOC to undertake control of silver wattle on the bunds.
- MOWS to spread grass seed on the areas which have been cleared of pampas on the bunds to help with weed suppression.
- MOWS and BOPRC to organise planting of 500 plants, continuing on from October 2015 plantings. The aim is to supress weeds and establish some natural riparian habitat.
- MOWS to undertake maintenance releasing of the 1,000 plants planted in 2015/2016.
- DOC to provide toxin warning signs for pest control operation.
- MOWS to provide and set up DOC 200 and Goodnature A12 traps for mustelids and possums respectively. Traps should be checked every two weeks for six months (13 times) and can be removed afterwards and deployed again the next spring.
- MOWS to provide rat-specific bait stations for Areas 1, 3 and 4, place them approximately according to the pest control map, and fill with six d-blocks per station. Check again after a week or 10 days and re-fill, then retrieve after 3-4 weeks.
- MOWS to undertake rat monitoring using tracking tunnels before and after rat control.
- BOPRC and MOWS to undertake biodiversity survey and monitoring: Year 1 monitoring will include vegetation plots, transects, photo-points, lizard and bird monitoring.
- MOWS to organise purchase of pit-fall traps for lizard monitoring.
- MOWS to manage the project with assistance from BOPRC.
- MOWS to organise a volunteer rubbish removal day.

2016/2017

- DOC to arrange permits for MOWS to use toxin in the reserve and toxin warning signs.
- BOPRC and MOWS to arrange an excavator or mulcher to clear access along the bund east of the Pongakawa River. This would be mostly blackberry mulching and some pampas removal.
- MOWS to conduct pest plant spraying with a focus on sea couch and saltwater paspalum in Areas 1 and 2, and pampas on the bunds in Areas 4 and 5.
- DOC to undertake control of silver wattle on the bunds.
- MOWS to spread grass seed on the areas which have been cleared of pampas on the bunds to help with weed suppression.
- MOWS and BOPRC to organise planting of another 1,000 plants, continuing on from previous plantings. The aim is to supress weeds and provide some natural riparian habitat.
- MOWS to undertake maintenance releasing of the 1,000 plants planted in 2016/2017.
- MOWS to provide and set up DOC 200 and Goodnature A12 traps for mustelids and possums respectively, over the whole site. Traps should be checked every two weeks for six months (13 times) and can be removed afterwards and deployed again the next spring.
- MOWS to provide rat-specific bait stations for the whole site, place them approximately according to the pest control map, and fill with six d-blocks per station. Check again after a week or 10 days and re-fill, then retrieve after 3-4 weeks.
- MOWS to undertake rat monitoring using tracking tunnels before and after rat control (whole site).
- BOPRC and MOWS to undertake bird counts, lizard monitoring and photo-point monitoring in all areas.
- BOPRC and MOWS to organise interpretive signage for western part of site.
- MOWS to manage the project with assistance from BOPRC.

2017/2018 – 2019/2020

- DOC to arrange permits for MOWS to use toxin in the reserve and provide warning signs.
- MOWS to conduct follow-up pest plant spraying with a focus on sea couch and saltwater paspalum in Areas 1 and 2, and pampas on the bunds in Areas 4 and 5. Follow-up spraying in Area 3 may also be required.
- DOC to undertake control of silver wattle on the bunds.
- Fish and Game to continue mowing bunds - east and west, to keep them clear of weeds.
- MOWS and BOPRC to organise planting of another 500 plants, continuing on from previous plantings.
- MOWS to undertake maintenance releasing of the 1,000 plants planted this financial year.

- MOWS to continue to trap possums and mustelids over the whole site. Traps should be checked every two weeks for six months (13 times).
- MOWS to continue rat control: Fill each station with six d-blocks, check again after a week or 10 days and re-fill, then retrieve after 3-4 weeks.
- MOWS to undertake rat monitoring using tracking tunnels before and after rat control (whole site).
- BOPRC and MOWS to undertake bird counts, lizards and photo-point monitoring.
- MOWS to manage the project with assistance from BOPRC.

5.2 Work programme costs

		2015/2016										
Year	Area	Activity	Task details	Unit	Quantity	Rate	Cost	BOPRC	MOWS	F&G	DOC	WBOPDC
1	All	Plant control (aerial - pampas)	BOPRC to organise helicopter to spray inaccessible pampas across whole site. This will be done using a wand, or spot-spray bucket.	Hour	5	$1,500.00	7,500	7,500	0	0	0	0
1	All	Animal Pest Control Operation - DOC permits	DOC to arrange permits for MOWS to use toxin in the reserve.	Hour	4	$55.00	220	0	0	0	220	0
1	1, 3, 4	Plant Control (ground spraying)	MOWS to conduct pest plant spraying with a focus on sea couch in Area 1, and pampas on the bunds in Area 4.	Hour	50	$55.00	2,750	2,250	500	0	0	0
1	4	Plant control (excavator)	An excavator will be used to clear sprayed pampas from Area 4 bunds.	Hour	11	$100.00	1,100	1,100	0	0	0	0
1	4	Plant Control (mowing)	Fish and Game to arrange a mowing contractor to periodically mow the bunds in the western part of the site.	Hour	5	$100.00	500	0	0	500	0	0
1	4	Plant Control (chainsaw work for wattle)	DOC to undertake control of silver wattle on the bunds.	Day	6	$400.00	2,400	0	0	0	2,400	0
1	4	Riparian Management (harrowing and seeding for weed suppression)	MOWS to seed the areas which have been cleared of pampas on the bunds which will help to supress weeds.	Hour	16	$55.00	880	294	293	0	0	293
1	4	Estuarine Margin Protection Planting	MOWS and BOPRC to organise planting of another 500 plants, continuing on from October 2015 plantings. The aim is to supress weeds and provide some natural riparian habitat.	Plant	500	$4.50	2,250	563	563	0	562	562
1	4	Releasing - x2	MOWS to undertake maintenance releasing of the 1000 plants planted in 2015/16.	Plant	2,000	$0.50	1,000	500	500	0	0	0
1	1, 3, 4	Animal Pest Control Operation - D-Blocks		kg	30	$11.00	330	330	0	0	0	0
1	1, 3, 4	Animal Pest Control Operation - Eggs		doz	9	$6.50	59	59	0	0	0	0
1	1, 3, 4	Animal Pest Control Operation - Tracking tunnels	BOPRC to purchase 20 tracking tunnels for the western part of the site.	tunnels	20	$13.75	275	275	0	0	0	0
1	1, 3, 4	Animal Pest Control Operation - Tracking cards	BOPRC to purchase 40 tracking cards to undertake 2 lots of monitoring using 20 tunnels.	Cards	40	$1.50	60	45	0	0	0	15
1	1, 3, 4	Animal Pest Control Operation - DOC200 traps	MOWS will provide double-set DOC200s from existing stock to use in the western part of the site	Traps	7	$122.50	858	0	858	0	0	0
1	1, 3, 4	Animal Pest Control Operation - Rat bait stations	MOWS to provide 40 rat-secific bait stations from existing stock.	Bait station	40	$18.00	720	0	720	0	0	0
1	1, 3, 4	Animal Pest Control Operation - GoodNature A12 Possum trap + consumables	MOWS to provide GoodNature A12 traps.	Traps	7	$210.00	1,470	0	1,470	0	0	0
1	1, 3, 4	Animal Pest Control Operation - DOC 200 + possum trap setup and checks	Checking traps every 2 weeks for 6 months (13 times) - takes 2.5hrs can be removed afterwards and deployed again the next spring.	Hours	32.5	$45.00	1,463	1,463	0	0	0	0
1	1, 3, 4	Animal Pest Control Operation - rat bait station setup and checks	Place bait stations approximately according to the pest control map and fill with 6 d-blocks per station (5hrs). Check again after a week or 10days and re-fill (5hrs). Retrieve after 3 - 4 weeks (4hrs)	Hours	14	$45.00	630	630	0	0	0	0
1	1, 3, 4	Animal Pest Monitoring Operation	BOPRC and MOWS to arrange placement of 20 tracking tunnels and undertake monitoring of rats over one night prior to spring control. Repeat after control.	Hours	10	$45.00	450	338	0	0	0	112
1	1, 3, 4	Animal Pest Control Operation - Warning signs	DOC to provide toxin warning signs for pest control operation.	total	1	$50.00	50	0	0	0	50	0
1	All	Ecological Baseline Monitoring	Year 1 monitoring will include plots, transects, photopoints, lizard and bird monitoring.	Hours	55	$55.00	3,025	2,269	0	0	0	756
1	All	Ecological Baseline Monitoring - equipment	MOWS to organise purchase of pit-fall traps for lizard monitoring.	Total	1	$500.00	500	375	0	0	0	125
1	All	Project Management	MOWS to manage the project with assistance from BOPRC.	Hours	80	$40.00	3,200	2,400	0	0	0	800
1	All	Volunteer Labour - Rubbish removal	MOWS to organise a volunteer rubbish removal day.	Hours	40	$20.00	800	0	800	0	0	0
		2015/2016 - Total					**$32,490**	**$20,391**	**$5,704**	**$500**	**$3,232**	**$2,663**
Share								62.8%	17.6%	1.5%	9.9%	8.2%

		2016/2017										
Year	Area	Activity	Task details	Unit	Quantity	Rate	Cost	BOPRC	MOWS	F&G	DOC	WBOPDC
2	All	Animal Pest Control Operation - DOC permits	DOC to arrange permits for MOWS to use toxin in the reserve.	Hour	4	$55.00	220	0	0	0	220	0
2	All	Plant Control (ground spraying)	MOWS to conduct pest plant spraying with a focus on sea couch in Areas 1 & 2, and pampas on the bunds in Area 4.	Hour	90	$55.00	4,950	4,050	900	0	0	0
2	4	Plant Control (chainsaw work for wattle)	DOC to undertake control of silver wattle on the bunds.	Day	6	$400.00	2,400	0	0	0	2,400	0
2	4, 5	Plant control (excavator)	Excavator/mulcher used for clearing walking access along bund east of the Pongakawa. This would be mostly gorse mulching and some pampas removal.	Hour	50	$100.00	5,000	5,000	0	0	0	0
2	4, 5	Plant Control - Mowing	Fish and Game to arrange a mowing contractor to periodically mow the bunds in the western part of the site.	Hour	10	$100.00	1,000	0	0	1,000	0	0
2	4, 5	Riparian Management (harrowing and seeding for weed suppression)	MOWS to seed the areas which have been cleared of pampas on the bunds which will help to supress weeds.	Hour	16	$55.00	880	294	293	0	0	293
2	4	Estuarine Margin Protection Planting	MOWS and BOPRC to organise planting of another 1000 plants, continuing on from previous plantings. The aim is to supress weeds and provide some natural riparian habitat.	Plant	1,000	$4.50	4,500	1,125	1,125	0	1,125	1,125
2	4	Releasing - x2	MOWS to undertake maintenance releasing of the 1000 plants planted in 2016/17.	Plant	2,000	$0.50	1,000	500	500	0	0	0
2	All	Animal Pest Control Operation - D-Blocks		kg	60	$11.00	660	0	660	0	0	0
2	All	Animal Pest Control Operation - Eggs		doz	13	$6.50	85	0	85	0	0	0
2	All	Animal Pest Control Operation - Tracking cards	BOPRC to purchase tracking card for tracking tunnels.	Cards	80	$1.50	120	90	0	0	0	30
2	2, 5	Animal Pest Control Operation - DOC200 traps	MOWS will provide double-set DOC200s from existing stock to use in eastern part of the site.	Traps	5	$122.50	613	0	613	0	0	0
2	2, 5	Animal Pest Control Operation - Rat bait stations	MOWS to provide 40 rat-secific bait stations from existing stock.	Bait station	35	$18.00	630	0	630	0	0	0
2	All	Animal Pest Control Operation - GoodNature A12 Possum trap + consumables	MOWS to provide GoodNature A12 traps.	Traps	5	$210.00	1,050	0	1,050	0	0	0
2	All	Animal Pest Control Operation - DOC 200 + possum trap setup and checks	Checking traps every 2 weeks for 6 months (13 times) - takes 5hrs can be removed afterwards and deployed again the next spring.	Hours	65	$45.00	2,925	2,925	0	0	0	0
2	All	Animal Pest Control Operation - Rat bait station setup and checks	Place bait stations approximately according to the pest control map and fill with 6 D-blocks per station (6hrs). Check again after a week or 10 days and re-fill (6hrs).	Hours	28	$45.00	1,260	1,260	0	0	0	0
2	All	Animal Pest Monitoring Operation	BOPRC and MOWS to arrange placement of 20 tracking tunnels and undertake monitoring of rats over one night prior to spring control. Repeat after control.	Hours	16	$45.00	720	540	0	0	0	180
2	All	Animal Pest Control Operation - Warning signs	DOC to provide toxin warning signs for pest control operation.	total	1	$50.00	50	0	0	0	50	0
2	All	Biodiversity Monitoring	BOPRC and MOWS to undertake bird counts, lizards and photopoint monitoring.	Hours	26	$55.00	1,430	1,073		0	0	357
2	All	Ecological Baseline Monitoring - equipment	MOWS to organise purchase of pit-fall traps for lizard monitoring.	Total	1	$250.00	250	188	0	0	0	62
2	1 & 3	Signage and Interpretation	BOPRC and MOWS to organise interpretive signage for western part of site.	Total	1	$1,500.00	1,500	750	0	0	375	375
2	All	Project Management	MOWS to manage the project with assistance from BOPRC.	Hours	80	$40.00	3,200	2,200	0	0	0	1,000
		2016/2017 - Total					**$34,443**	**$19,995**	**$5,856**	**$1,000**	**$4,170**	**$3,422**
Share								**58.1%**	**17.0%**	**2.9%**	**12.1%**	**9.9%**

		2017/2018										
Year	Area	Activity	Task details	Unit	Quantity	Rate	Cost	BOPRC	MOWS	F&G	DOC	WBOPDC
3	All	Animal Pest Control Operation - DOC permits	DOC to arrange permits for MOWS to use toxin in the reserve.	Hour	4	$55.00	220	0	0	0	220	0
3	All	Plant Control (ground spraying)	MOWS to conduct follow-up pest plant spraying with a focus on sea couch in Areas 1 & 2, and pampas on the bunds in Areas 4 & 5. Follow-up spraying in Area 3 may also be required.	Hour	40	$55.00	2,200	1,800	400	0	0	0
3	4, 5	Plant Control (chainsaw work for wattle)	DOC to undertake control of silver wattle on the bunds.	Day	6	$400.00	2,400	0	0	0	2,400	0
3	4	Plant Control - Mowing	Fish and Game to continue mowing bunds - east and west, to keep them clear of weeds.	Hour	10	$100.00	1,000	0	0	1,000	0	0
3	4	Estuarine Margin Protection Planting	MOWS and BOPRC to organise planting of another 500 plants, continuing on from previous plantings. The aim is to supress weeds and provide some natural riparian habitat.	Plant	500	$4.50	2,250	1,125	1,125	0	1,125	1,125
2	4	Releasing - x2	MOWS to undertake maintenance releasing of the 1000 plants planted in 2016/17.	Plant	1,000	$0.50	500	250	250	0	0	0
3	All	Animal Pest Control Operation - D-Blocks		kg	40	$11.00	440	0	440	0	0	0
3	All	Animal Pest Control Operation - Eggs	13 checks x 12 traps	doz	13	$6.50	85	0	85	0	0	0
3	All	Animal Pest Control Operation - Tracking cards	BOPRC to purchase tracking cards for tracking tunnels - 2 lots of monitoring.	Cards	80	$1.50	120	0	90	0	0	30
3	All	Animal Pest Control Operation - DOC 200 + possum trap setup and checks	MOWS to check stoat traps every 2 - 3 weeks for 6 months of the year (13 times between September & April). Allow 5hrs for both sides of site. Traps may be removed afterwards and deployed again the next spring.	Hours	65	$45.00	2,925	2,633	292	0	0	0
3	All	Animal Pest Control Operation - Rat bait station setup and checks	Place bait stations approximately according to the pest control map and fill with 6 D blocks per station (6hrs). Check again after a week or 10 days and re-fill (6hrs).	Hours	28	$45.00	1,260	1,260	0	0	0	0
3	All	Animal Pest Monitoring Operation	BOPRC and MOWS to arrange placement of 20 tracking tunnels and undertake monitoring of rats over one night prior to spring control. Repeat after control.	Hours	16	$45.00	720		540	0	0	180
3	All	Animal Pest Control Operation - Warning signs	DOC to provide toxin warning signs for pest control operation.	total	1	$50.00	50	0	0	0	50	0
3	All	Biodiversity Monitoring	BOPRC and MOWS to undertake bird counts, lizards and photopoint monitoring.	Hours	26	$55.00	1,430	1,073	357	0	0	357
3	All	Project Management	MOWS to manage the project with assistance from BOPRC.	Hours	60	$40.00	2,400	1,800	0	0	0	600
		2017/2018 - Total					**$18,000**	**$9,941**	**$3,579**	**$1,000**	**$3,795**	**$2,292**
Share								55.2%	19.9%	5.6%	21.1%	12.7%

		2018/2019										
Year	Area	Activity	Task details	Unit	Quantity	Rate	Cost	BOPRC	MOWS	F&G	DOC	WBOPDC
4	All	Animal Pest Control Operation - DOC permits	DOC to arrange permits for MOWS to use toxin in the reserve.	Hour	4	$55.00	220	0	0	0	220	0
4	All	Plant Control (ground spraying)	MOWS to conduct follow-up pest plant spraying with a focus on sea couch in Areas 1 & 2, and pampas on the bunds in Areas 4 & 5. Follow-up spraying in Area 3 may also be required.	Hour	40	$55.00	2,200	1,800	400	0	0	0
4	4	Plant Control - Mowing	Fish and Game to continue mowing bunds - east and west, to keep them clear of weeds.	Hour	10	$100.00	1,000	0	0	1,000	0	0
4	4	Estuarine Margin Protection Planting	MOWS and BOPRC to organise planting of another 500 plants, continuing on from previous plantings. The aim is to supress weeds and provide some natural riparian habitat.	Plant	500	$4.50	2,250	1,125	1,125	0	1,125	1,125
4	4	Releasing - x2	MOWS to undertake maintenance releasing of the 1000 plants planted in 2016/17.	Plant	1,000	$0.50	500	250	250	0	0	0
4	All	Animal Pest Control Operation - D-Blocks		kg	40	$11.00	440	0	440	0	0	0
4	All	Animal Pest Control Operation - Eggs	13 checks x 12 traps	doz	13	$6.50	85	0	85	0	0	0
4	All	Animal Pest Control Operation - Tracking cards	BOPRC to purchase tracking cards for all 40 tracking tunnels - 2 lots of monitoring.	Cards	80	$1.50	120	0	90	0	0	30
4	All	Animal Pest Control Operation - DOC 200 + possum trap setup and checks	MOWS to check stoat traps every 2 - 3 weeks for 6 months of the year (13 times between September & April). Allow 5hrs for both sides of site. Traps may be removed afterwards and deployed again the next spring.	Hours	65	$45.00	2,925	2,925	0	0	0	0
4	All	Animal Pest Control Operation - rat bait station checks	Place bait stations approximately according to the pest control map and fill with 6 D-blocks per station (6hrs). Check again after a week or 10 days and re-fill (6hrs).	Hours	28	$45.00	1,260	1,260	0	0	0	0
4	All	Animal Pest Monitoring Operation	BOPRC and MOWS to arrange placement of 20 tracking tunnels and undertake monitoring of rats over one night prior to spring control. Repeat after control.	Hours	16	$45.00	720	0	0	0	0	180
4	All	Animal Pest Control Operation - Warning signs	DOC to provide toxin warning signs for pest control operation.	total	1	$50.00	50	0	0	0	50	0
4	All	Biodiversity Monitoring	BOPRC and MOWS to undertake bird counts, lizards and photopoint monitoring.	Hours	20	$55.00	1,100	825	275	0	0	275
4	All	Project Management	MOWS to manage the project with assistance from BOPRC.	Hours	60	$40.00	2,400	1,800	0	0	0	600
		2018/2019 - Total					**$15,270**	**$9,985**	**$2,665**	**$1,000**	**$1,395**	**$2,210**
Share								65.4%	17.5%	6.5%	9.1%	14.5%

		2019/2020										
Year	Area	Activity	Task details	Unit	Quantity	Rate	Cost	BOPRC	MOWS	F&G	DOC	WBOPDC
5	All	Animal Pest Control Operation - DOC permits	DOC to arrange permits for MOWS to use toxin in the reserve.	Hour	4	$55.00	220	0	0	0	220	0
5	All	Plant Control (ground spraying)	MOWS to conduct follow-up pest plant spraying with a focus on sea couch in Areas 1 & 2, and pampas on the bunds in Areas 4 & 5. Follow-up spraying in Area 3 may also be required.	Hour	40	$55.00	2,200	1,800	400	0	0	0
5	4	Plant Control - Mowing	Fish and Game to continue mowing bunds - east and west, to keep them clear of weeds.	Hour	10	$100.00	1,000	0	0	1,000	0	
5	4	Estuarine Margin Protection Planting	MOWS and BOPRC to organise planting of another 500 plants, continuing on from previous plantings. The aim is to supress weeds and provide some natural riparian habitat.	Plant	500	$4.50	2,250	1,125	1,125	0	1,125	1,125
5	4	Releasing - x2	MOWS to undertake maintenance releasing of the 1000 plants planted in 2016/17.	Plant	1,000	$0.50	500	250	250	0	0	0
5	All	Animal Pest Control Operation - D-Blocks		kg	40	$11.00	440	0	440	0	0	0
5	All	Animal Pest Control Operation - Eggs	13 checks x 12 traps	doz	13	$6.50	85	0	d	0	0	0
5	All	Animal Pest Control Operation - Tracking cards	BOPRC to purchase tracking cards for all 40 tracking tunnels - 2 lots of monitoring.	Cards	80	$1.50	120	0	90	0	0	30
5	All	Animal Pest Control Operation - DOC 200 + possum trap setup and checks	MOWS to check stoat traps every 2 - 3 weeks for 6 months of the year (13 times between September & April). Allow 5hrs for both sides of site. Traps may be removed afterwards and deployed again the next spring.	Hours	65	$45.00	2,925	2,925	0	0	0	0
5	All	Animal Pest Control Operation - rat bait station checks	Place bait stations approximately according to the pest control map and fill with 6 D blocks per station (6hrs). Check again after a week or 10 days and re-fill (6hrs).	Hours	28	$45.00	1,260	1,260	0	0	0	0
5	All	Animal Pest Monitoring Operation	BOPRC and MOWS to arrange placement of 20 tracking tunnels and undertake monitoring of rats over one night prior to spring control. Repeat after control.	Hours	16	$45.00	720		540	0	0	180
5	All	Animal Pest Control Operation - Warning signs	DOC to provide toxin warning signs for pest control operation.	total	1	$50.00	50	0	0	0	50	0
5	All	Biodiversity Monitoring	BOPRC and MOWS to undertake bird counts, lizards and photopoint monitoring.	Hours	20	$55.00	1,100	825	275	0	0	275
5	All	Project Management	MOWS to manage the project with assistance from BOPRC.	Hours	60	$40.00	2,400	1,800	0	0	0	600
		2019/2020 - Total					$15,270	$9,985	$3,120	$1,000	$1,395	$2,210
Share								65.4%	20.4%	6.5%	9.1%	14.5%
		Total Cost Programme					$115,473	$70,297	$20,924	$4,500	$13,987	$12,797

5.3 Planting

In the first five years planting will be restricted to the bunds (Areas 4 and 5) to replace weed species. Table 4 lists appropriate species to plant on the bunds as well as in saltmarsh and brackish or freshwater wetland parts of the site. These species all occur naturally in the coastal Bay of Plenty. Plants purchased for the project should be grown from seed collected in the local area and should be 1L/PB3 grade and of good quality.

Table 4 Plant schedule.

Botanical name	Common name	Bunds	Saltmarsh	Brackish/ freshwater wetland
Apodasmia similis	oioi		40%	
Austroderia toetoe	toetoe	5%		
Carex sinclairii				5%
Coprosma lucida	shiny karamu	10%		
Coprosma repens	taupata	10%		
Cordyline australis	ti kouka			8%
Dodonaea viscosa	akeake	5%		
Entelea arborescens	whau	5%		
Ficinia nodosa	wiwi	2%		
Hebe stricta	koromiko	5%		
Juncus krausii var. *austaliensis*	sea rush		56%	8%
Kunzea robusta	kanuka	15%		
Leptospermum scoparium	mānuka	5%		15%
Machaerina articulata	jointed twig rush			20%
Machaerina juncea			2%	5%
Melicytus ramiflorus	mahoe	6%		
Muehlenbeckia complexa	small-leaved pohuehue	5%		
Myoporum laetum	ngaio	10%		
Olearia solandri	coastal tree daisy		2%	2%
Phormium tenax	harakeke			35%
Pittosporum crassifolium	karo	5%		
Plagianthus divaricatus	saltmarsh ribbonwood			2%
Pomaderris amoena	tauhinu	5%		
Pseudopanax lessonii	houpara	7%		

5.4 Site compliance monitoring of works (operations)

This section specifies the type and frequency of compliance and operational monitoring which will allow assessment of the efficacy of the Work Programme.

Pest plant control monitoring

The effectiveness of pest plant control work does not need to be formally monitored, but checks on the success of control do need to be carried out so that methods can be altered if required. Simple walk-through assessments of the kill-rate and observations on the effectiveness of the method will be sufficient and should be done once a month for up to three months following control work. Photo-point monitoring and vegetation plots will also be useful for assessing pest plant control effectiveness (see Section 5.4).

Restoration planting

A plant survival rate of >90% should be able to be achieved at this site provided site preparation and post-planting maintenance are done to a good standard. Formal monitoring of survival does not need to be done but casual assessments every few months would be useful. Checking on the health of plants and how well they are doing is best done during maintenance visits.

Pest animal control monitoring

Monitoring pest numbers pre-and post-control gives a valuable measure of the success of control measures. At this site it is recommended that only rats are monitored formally. Rats can be monitored using tracking cards which give an indication of their numbers based on how many cards are marked by their tracks. For this site 20 tracking tunnels in the western part of the site and another 20 in the eastern part would be sufficient. Tracking tunnels should be placed at least 50 m apart and baited with peanut butter. Cards are deployed in the tunnels for a single night and then retrieved. The number of cards that have rat tracks on them is expressed as a percentage of the total. Rat numbers need to be reduced below 5% tracking index to enable successful recovery of biodiversity.

Table 5 Summary of operational monitoring.

Compliance activities	Programme
Pest plant control	**MOWS:** To monitor control of pest plants and new occurrences through simple surveillance. **BOPRC:** Inspection of works takes place annually to check if methods of control are meeting the site objective of progressive control.
Animal pest control	**MOWS and BOPRC**: Tracking tunnels – mammalian predator index, trapping results.
Restoration planting	**MOWS and BOPRC:** Plant survival. Ad-hoc checks of survival and photo-point monitoring as per Section 5.4.

5.5 Biodiversity outcome monitoring

The major restoration actions should be monitored so that the progress of the restoration can be assessed and management can be altered as the project progresses. For this site, monitoring of birds and vegetation should be carried out and survey and monitoring of fish and lizards could be done if time and resources allow.

Bird monitoring

The restoration work will improve habitat for a number of threatened or at-risk indigenous species including bittern, spotless crake, and fernbird as well as for more common species. Bird monitoring aims to detect long-term changes in bird abundance and diversity. Similar pest control work at Nukuhou saltmarsh in the Ōhiwa harbour is monitored using primarily fernbird numbers because these have been found to provide a good indication of the efficacy of predator control. At that site a modified version of DOC's standard five minute bird count is used. Instead of just listening from a single location for five minutes birds are also recorded on the way to the listening stations and their location noted on a map. This makes use of the fernbirds' tendency to sound warning clicks when someone enters their territory. A normal five minute bird count should be done on arriving at the listening station. Ideally bird counts would be done several times per year but as a minimum, monitoring should take place annually and should be done at exactly the same locations each time (at the same time of day) and results can be compared over a number of years. Avoid times when water levels will be very low and cicadas very loud (e.g. February). Ideal monitoring months are September, October and November. Dusk and dawn sampling is more likely to detect crake and fernbird will also be more vocal at these times. Monitoring sites should be at least 200 m apart so the same birds are not being recorded each time. Recordings of spotless and marsh crake calls can be played to elicit a response from these species.

Vegetation monitoring

A network of vegetation plots on transects was set up in Area 3 in 1996 (Beadel *et al.* 1996) prior to re-flooding of the area to provide baseline information on vegetation. Vegetation plots provide high quality information on the composition and structure of wetland vegetation and can be used to monitor vegetation change over time. The existing plots should be re-measured at least once during the project and prior to any further hydrological changes and the data compared to the 1996 data. It may also be useful to upgrade some of the plots to the standard method outlined in Clarkson et al (2014). Vegetation plots should be measured every five years.

Vegetation in the reserve was mapped in the early 1990s by Sarah Beadel and the western part of the site was updated during the preparation of this BMP (2015). Comparison of the two vegetation maps and subsequent updating every four or five years could also be used as a monitoring tool to assess vegetation change.

Photo-point monitoring

Photo-point monitoring involves taking photographs from the same location in subsequent years and allows a visual assessment of vegetation change over time. It is a very effective method for showing coarse changes and is very useful for reporting to stake-holders. Photo-point monitoring was set up as part of the 1996 vegetation monitoring project (Beadel *et al.* 1996) and these should be re-taken during the course of the BMP. Additional photo-points should also be set up in other parts of the site, preferably where significant change is likely to occur, for example where weeds are to be controlled and plantings done. Ideally photo-points should be marked with a stake or a marker attached to a tree and should be GPS marked so they can be easily re-located each year. Information to be recorded includes location, date, time, a description of the view, the compass direction of the view, and the file number of the photo.

Lizard monitoring

Baseline lizard survey and monitoring will be done by MOWS using pit-fall traps and will be repeated bi-annually to give an indication of lizard population dynamics. Similar monitoring is undertaken in other MOWS project sites in the Maketū area and will help to provide a bigger picture of lizard populations in the area.

The following table outlines a timetable for each type of monitoring. Monitoring can be done by volunteers with guidance from BOPRC.

Table 6 Outcome monitoring types and timing.

Monitoring type	Year 1 2015/2016 measure	Year 2 2016/2017 measure	Year 3 2017/2018 measure	Year 4 2018/2019 measure	Year 5 2019/2020 measure
Bird counts	✓	✓	✓	✓	✓
Vegetation plots	✓				
Photo-points	✓	✓	✓	✓	✓
Lizard survey	✓		✓		✓

6 Consultation

The Department of Conservation and Eastern Fish and Game have both been involved in the development of this BMP. No other consultation is deemed necessary.

7 Work Programme map GSP-506476

Biodiversity Management Plan

Waihī Estuary Wildlife Management Reserve
Department of Conservation

GSP-506476

Plan Date: 18/11/2015
2011 High Resolution Aerial Photography

Reference

Proposed

Pest Control

Management Area

Existing

Property Boundary

Bay of Plenty Regional Council

PART B

Agreement to partner

This Biodiversity Management Plan has been set up to provide long-term protection for the site, and constitutes an agreement between Council and the landowner to undertake various actions over time to protect the site's biodiversity.

We, the undersigned signatories to this Biodiversity Management Plan, acknowledge a commitment to the concept of partnering and agree to work in a cooperative and constructive manner to achieve the objectives, actions and responsibilities outlined in this Biodiversity Management Plan.

1 Grant money

Will be provided on completion of the works based on actual cost.

Actual costs paid will not exceed estimated costs and percentage grant rate as per the Work Programme unless a prior variation has been reached with Bay of Plenty Regional Council.

2 Monitoring

The Council will at the Council's expense periodically monitor the effectiveness of the works and activities carried out in fulfilling the Work Programme. This monitoring will be based on Section 5.4 of this plan.

3 Review plan

This partnership agreement is for five years, following which a review of the plan and associated objectives and Work Programme will occur, at the end of 2020.

This agreement is made on the day of 2015.

Between:

Date: 18/12/15

Julian Fitter
Chairman
Maketū Ongatoro Wetland Society

Date: 18/12/2015

Eddie Grogan
General Manager Integrated Catchments
Bay of Plenty Regional Council

Date: 16/12/2015

Glenn Ayo
Environmental Development Officer
Western Bay of Plenty District Council

Date: 18/12/15

Jeff Milham
Conservation Services Manager
Department of Conservation (Tauranga/Rotorua)

Date: 16/12/15

John Meikle
Fish and Game Officer
New Zealand Fish and Game – Eastern region

PART C

Appendix 1 – Site information

1 Property details

Legal description:	Sections 1 and 2 SO 57042; Section 43, 44 and 63 Block I Waihī South SD; Part Lot 1 DP 37399
Certificate of title numbers:	SA45C/177 SA1284/70 S257814 SO52031 SA781/230 SA1006/177 SA1059/143
Existing registered legal and or other protection mechanism against the site:	Government Purpose (Wildlife Management) Reserve
Existing relevant legal documents registered:	None known
District Plan status:	Rural
Valuation numbers:	06920 319 02; 06910 308 02

2 Location and land use

Catchment: Waihī Estuary

Land type:

Land type	Area (ha)	Tenure	
Estuary	33.89	☐ Private ☐ Maori ☒ Crown	☐ Local Body ☐ Mixed ☐ Leased
Wetland	21.7	☐ Private ☐ Maori ☒ Crown	☐ Local Body ☐ Mixed ☐ Leased

3 Ecological and archaeological information

Ecological district:	Tauranga
Ecological status of site:	Category 1 Ecological Site
Iwi/hapū information:	Mākino, Pikiao, Tapuika, Whakaue and Waitaha
Archaeological information:	No recorded archaeological sites

Appendix 2 – References

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Appendix 3 – Botanical species list

*denotes a non-native species

Monocotyledonous trees and shrubs	
Cordyline australis	ti, cabbage tree
Dicotyledonous trees and shrubs	
**Acacia dealbata*	silver wattle
Avicennia marina subsp. australasica	Manawa, mangrove
Coprosma propinqua	mingimingi
**Lupinus arborea*	tree lupin
Melicytus ramiflorus	mahoe
Olearia solandri	coastal tree daisy
Plagianthus divaricatus	saltmarsh ribbonwood
**Salix cinerea*	grey willow
**Ulex europaeus*	gorse
Dicotyledonous lianes	
**Calystegia sepium* x. *silvatica*	bindweed
Muehlenbeckia complexa	small-leaved pohuehue
**Rubus fruticosus* agg.	blackberry
Ferns	
Azolla rubra	Pacific Azolla, Azolla, red Azolla
Pteridium esculentum	rarauhe, bracken
Grasses	
**Cortaderia selloana*	pampas grass
**Ehrharta erecta*	veldt grass
**Glyceria maxima*	reed sweetgrass
**Holcus lanatus*	Yorkshire fog
**Paspalum dilatatum*	paspalum
**Paspalum distichum*	mercer grass
**Schedonorus arundinaceus*	tall fescue
Sedges	
Bolboschoenus caldwellii	purua grass
Bolboschoenus fluviatilis	purua grass
**Carex scoparia*	broom sedge
Carex subdola	
Carex virgata	pukio
Cyperus ustulatus	giant umbrella sedge

Isolepis cernua var. *cernua*	slender clubrush
Machaerina articulata	jointed twig rush
Machaerina juncea	
Schoenoplectus tabernaemontani	kuawa

Rushes and allied plants

Apodasmia similis	oioi
**Juncus articulatus*	jointed rush
**Juncus effusus*	soft rush
Juncus kraussii var. australiensis	sea rush
Juncus pallidus	giant rush
Juncus planifolius	grass-leaved rush

Monocotyledonous herbs

**Landoltia punctata*	purple-backed duckweed
Lemna disperma	common duckweed
Phormium tenax	harakeke, flax
Triglochin striata	Triglochin
Typha orientalis	raupō, bullrush

Dicotyledonous herbs (including composites)

**Apium nodiflorum*	water celery
**Callitriche stagnalis*	water starwort
**Cerastium fontanum*	mouse ear chickweed
**Ceratophyllum demersum*	hornwort
**Chenopodium album*	fathen
**Conyza sumatrensis*	broad-leaved flea bane
Cotula coronopifolia	bachelor's buttons
**Foeniculum vulgare*	fennel
**Fumaria muralis subsp. muralis*	scrambling fumitory
**Galium aparine*	cleaver
**Leucanthemum vulgare*	oxeye daisy
**Lotus pedunculatus*	lotus
**Melilotus albus*	sweet clover
**Myosotis arvensis*	field forget-me-not
**Persicaria hydropiper*	water pepper
**Plantago lanceolata*	narrow-leaved plantain
**Ranunculus repens*	creeping buttercup
**Ranunculus sceleratus*	celery buttercup
Sarcocornia quinqueflora subsp. quinqueflora	glasswort
Selliera radicans	remuremu

**Senecio bipinnatisectus*	Australian fireweed
**Solanum chenopodioides*	velvety nightshade
**Sonchus asper*	prickly sow thistle
**Sonchus oleraceus*	sow thistle
**Symphyotrichum subulatum*	sea aster
Thyridia repens	native musk
Trifolium repens	white clover
**Verbena bonariensis*	purple top

Appendix 4 – Times of restricted management activity

It is recognised that the Waihī Estuary Wildlife Management Reserve is a popular duck hunting reserve and that Fish and Game are signatories to this Biodiversity Management Plan.

At certain times of the year it will be necessary to avoid activities that would disturb waterfowl or have an adverse effect on the annual bird banding programme undertaken by Fish and Game in the adjacent reserve.

The table below identifies the periods of time that are subject to restricted management activities:

Period	Event	Restrictions
4 January – 6 February	Duck banding in adjacent Fish and Game reserve.	No chainsaw*, brush cutter or heavy machinery (not including UTV or ATV's) to be used on the western access tracks/causeways, that is likely to cause a disturbance to wildfowl. No fires.
1 May – 30 June	Duck hunting season.	No chainsaw*, brush cutter, heavy machinery and any form of vehicle (including UTV or ATV's) to be used on reserve site two weeks before opening weekend of the duck hunting season (i.e. 20 April) and during opening weekend of the duck hunting season. During the game bird hunting season (after opening weekend) work should be timed to take place between 1,000 and 1,600 hours, with no chainsaw, brush cutter or heavy machinery (not including UTV or ATV's) to be used on reserve site. No fires.

* Chainsaw work only to be undertaken by suitably qualified Department of Conservation staff or approved contractor.