FARMING WITH NATIVE BIODIVERSITY

Whāma Station

Biodiversity Management Plan

Please note: This farm plan has had farm, family and place names anonymised by the pilot team for the purpose of the pilot, but other than that this is an example of an actual working farm

Prepared with assistance from Farming with Native Biodiversity.

Contents

Whāma Station

Introduction

Whāma Station falls has been farmed by the Smith Family for six generations, with the seventh generation currently growing up on the farm. The farm operates as a grass-feed sheep and beef system, with breeding and finishing occurring on the farm. The total area of the farm is 1440 ha total, 1120 ha effective, and consists of rolling hills. The farm falls within the Central Hawke's Bay District Council, Hawke's Bay Regional Council, and within the takiwā (district) of Heretaunga Tamatea.

Biodiversity vision statement

"One day we would like our kids to have the opportunity to take over the farm, so ensuring that the farm is profitable and sustainable is important to us. We want to continue to work with nature rather than against it, allowing native plants and animals to thrive within our successful sheep and beef farming operation.

To do this we will continue to be open-minded and explore new income revenue such as carbon and eco-tourism to help fund protection efforts. We have already taken steps to protect and enhance native biodiversity through the exclusion of livestock from multiple bush blocks across the farm and beginning to restore our wetlands."

Whāma StationA stocktake of biodiversity assets.

Indigenous Vegetation

Before human settlement

The land which Whāma Station is on now, would have been covered in a podocarp-broadleaved forest with emergent rimu, miro and tōtara with less frequent kahikatea and mataī, emergent over a canopy dominated by tawa and kāmahi with

widespread hīnau, rewarewa, tītoki and māhoe. Pukatea would have been common, particularly in valley bottoms.

Present

Although much of the vegetation was likely felled in the mid-1800s for timber and to clear the land for farming, there are still large areas of remnant vegetation on the farm. Today there is ~ 117 ha of indigenous woody vegetation across the farm. Mostof the indigenous woody vegetation is currently fenced to exclude stock (98 ha). And much of the remnant vegetation has been untouched and the canopy is still dominated by rimu, miro, tōtara kahikatea, and mataī. Although livestock has been excluded from multi areas of remnant vegetation in recent years, the understorey is still recovering. The regeneration process is further suppressed by the deer population in the wider landscape. The recovering understory has a wide range of vegetation including māhoe, red matipo, rangiora, marbleleaf, kōhūhū, poataniwha, mingimingi, and soft tree fern. Along the forest floor, multiple fern species such as kiwakiwa, button fern, hen and chicken fern, and tree nettle were seen. Multiple native climbers were seen including bushman lawyer, climbing rata, white climbing rata, pōhuehue, and New Zealand passion vine.

Around the wetland ponds, an assortment of carex, sedges and raupō were found. The woody vegetation around wetlands is mostly comprised of kahikatea and tōtara.

Miro

Mataī and drooping spleenwort

kiwakiwa

Exotic Woody Vegetation

Across the farm, there is 5.5 ha of exotic woodlots and shelterbelts. Plantations can provide habitat for some native plants and can be used as corridors for native birds to get around the landscape

Native fauna

A diverse range of birdlife occupies the bush blocks across the farm. Kererū were seen flying amongst the canopy with tūī, korimako/bellbirds and riroriro/grey warblers calling from the treetops. Both pīwakawaka/fantails and kōtare/kingfishers were seen in flight in multiple areas across the farm. Around the wetlands, pūkeko, pūtangitangi/Paradise shelduck, and Spur-winged plover were seen.

It has been noted that the ruru/morepork population has been increasing but their population fluctuates with the season. Although not seen, kārearea/flacon, koekoeā/long-tailed cuckoos, pīpīwharauroa/shining cuckoo, tītitipounamu/riflemen, tauhou/silver eye, and miromiro/tomtit would likely be present on the farm. No lizard species were seen on the farm, but a population of New Zealand Forest Geckos has been identified a couple of kilometres to the north, so it is possible they could be found at Whāma Station.

In the Awa Stream and Wai River, both shortfin and longfin eels, kōura, Crans bully, Dwarf galaxias, and Torrentfish have been identified. Upland bully has also been seen in the Awa Stream. Whereas Bluegill, Common, and Redfin bullies were found in the Wai River.

Grey warbler | Riroriro

Kererū | New Zealand pigeon

Sacred kingfisher | Kōtare

Freshwater Crayfish | Kōura

Shortfin eel | Tuna

Cran's bully | Tītarakura

Mahinga Kai Values

Mahinga kai is about the value of natural resources – our birds, plants, fish, and other animals and resources that sustain life, including the life of people. It is a culturally important practice as it connects people with the land, allows for customary traditions to be passed down through generations, and provides a vital food source. These things are the essence of kaitiakitanga, or what many people today call guardianship. Below are just some examples of mahinga kai species that are found on Whāma Station:

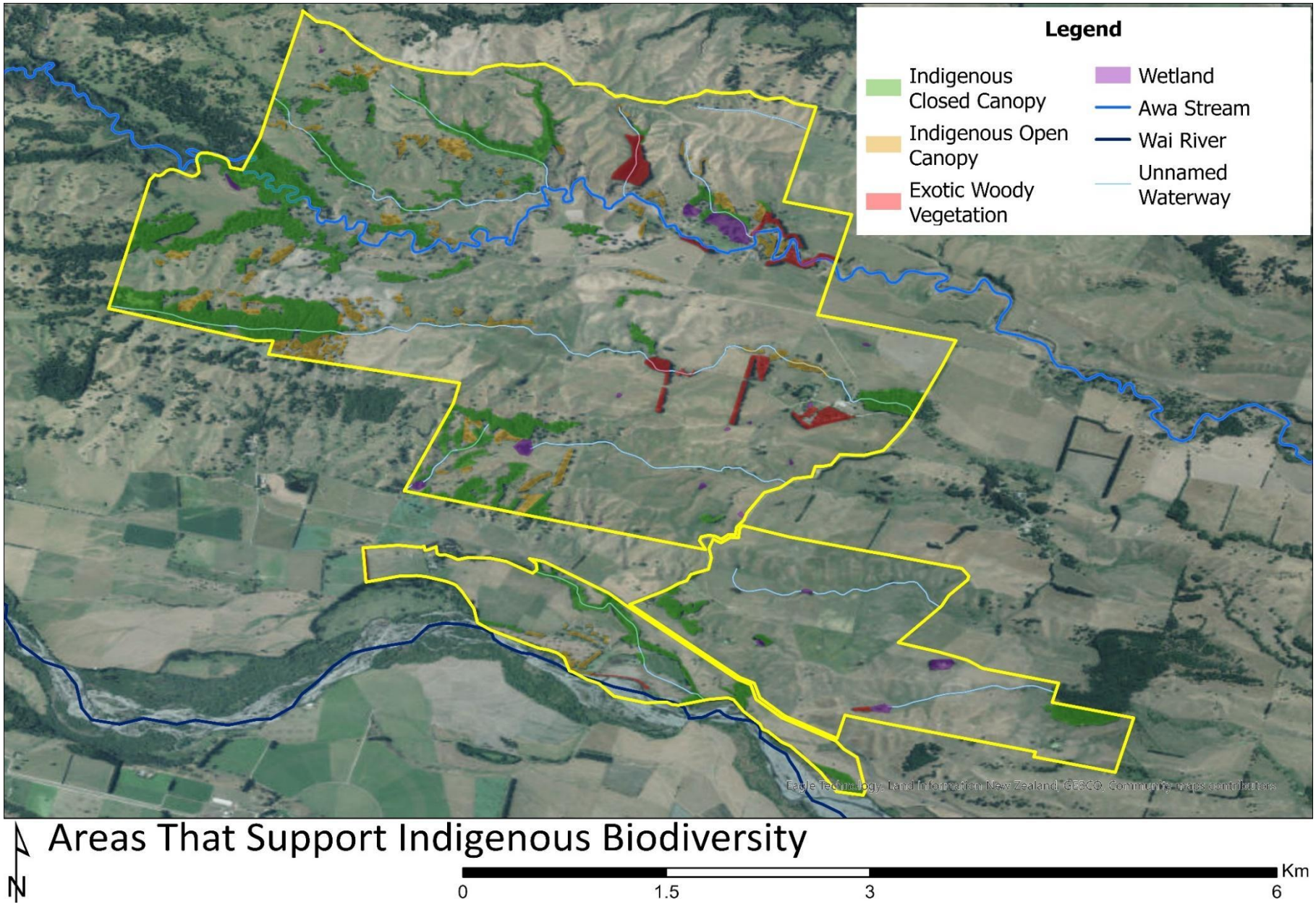
- Tī kōuka | Cabbage tree
- Harakeke | NZ Flax
- Raupō | Bullrush
- Karamū | Coprosma robusta
- Pūtakitaki | Paradise Duck
- Kāhu | Harrier Hawk
- Kōtare | Kingfisher
- Pūkeko | Swamp Hen
- Tuna | Longfin eel + Shortfin eel
- Kōura | Freshwater Crayfish
- Koukoupara | Upland Bully

Shortfin eel | Tuna

Paradise shelduck | Pūtangitangi

Assessment of Biodiversity Assets

Map showing identified habitat that would support indigenous terrestrial and indigenous aquatic biodiversity.



Asset 1: Multiple fenced-off indigenous bush remnants.

Across the farm, there are multiple patches of fenced-off remnant bush, mostly on the western end of the farm. The two largest bush blocks (Bush 2 and Bush 4) were assessed. Both have a closed canopy dominated by tōtara, tawa, mataī, miro and pukatea, with the occasional rewarewa and rimu. Although excluded from livestock, feral deer are causing a lot of damage to the understory and slowing down the regenerative process. The removal of livestock however has allowed for some regeneration of the understorey with mingimingi, māhoe, red matipo, rangiora, and marbleleaf beginning to fill in. There were fern species on the forest floor, but due to the presence of deer, they kept being trampled.

Neither bush block has any evidence of dieback and there were saplings of canopy species coming through. Therefore, it is unlikely that the canopy will collapse in the short term, but increased control of deer will need to be implemented to lower the risk of this occurring in the future. There are long-term plans to fence off other remnant bush areas, but due to costs, this is currently not practical and will be addressed in the next 5-year plan.

Throughout both areas, there was a continuous chorus of birds. Although the possum population is being controlled by a contractor employed by the farmers, mustelids and rodents are likely to still be harming bird life.

The Awa stream cuts through the Bush 4 block. In this section of the river, there is a healthy population of kōura and eels. Historic records do not have trout listed as present; however, these records are outdated. If present, trout pose a risk to aquatic biodiversity through competition for both food resources and habitat. Conducting an eDNA test of this waterway will likely confirm if they are present.

The Awa stream in Bush 4. Rimu is dominant along the waterway, but there is little understory due to the movement and grazing of deer.

With livestock removed there is some recovery of the understory and forest floor. However, this regeneration is being suppressed by grazing deer.

Rubbing damage against miro trunk, possibly from livestock as they have only been recently removed from the area.

The recovering understory of Bush 2. There is noticeable difference in vegetation as you move deeper into the forest on the (left) compared to the pasture on the (right).

Asset 2: Multiple fenced wetlands.

In addition to the multiple remnant bush blocks, there are numerous wetlands and dams across the farm. Currently, only wetlands and dams greater than 0.5 ha have been fenced off, as many of the smaller dams are the water source for livestock in those paddocks. Further improvements to the reticulated water system will be implemented over the next 10 years creating the opportunity to fence off some of these areas.

The largest wetland (4.6 ha) was fenced off five years ago and multiple small ponds have formed and filled. As the deer and hare numbers were high, the area received no enrichment planting to expand the ~1.2 ha of indigenous vegetation within the fenced-off area. The canopy consists of kahikatea, tawa, tītoki, and tōtara, with the occasional rimu and mataī. Whereas the understory was dominated by māhoe, with an abundance of red matipo, kōhūhū, and poataniwha. In the wetter areas, there were some cabbage trees and sedges. There is some single stand-alone silver pine throughout the area, due to their exposure to the elements there is some dieback occurring for this species.

Most of the ponds had algae blooms and there were tall stems of raupō present. This indicated that the ponds within the wetland are high in nitrates, which are creating a hostile environment for aquatic life. There were some pūkeko, paradise shelduck and spur-winged plover present, but in relatively low numbers given the size of the area. Amongst the woody vegetation along the bank of the wetland, there were many kingfishers, fantail, and grey warblers. Sitting on top of a silver pine a white-faced heron was seen drying out. There were also numerous kererū and tūī heard and seen.

This area would greatly benefit from enrichment planting and nitrate control.

Asset 3: Awa Stream and Wai River.

The Awa Stream cuts through the centre of the main farm block, and the Wai River defines the southern boundary of the farm. Both waterways have a rich diversity of native species including but not limited to shortfin and longfin tuna, kōura and an assortment of bullies and galaxias. Further investigation is required to determine if trout are present.

Although the Wai river is currently fenced to exclude livestock, the Awa stream has not been. Fencing off the entire Awa stream is impractical due to the flooding each year and the need to retire over 70 ha of productive land to do so. Therefore, it is recommended to exclude cattle from the area along the Awa stream, but still have sheep grazing. To reduce damage to the streambed by cattle, it is recommended to select two points to cross stock across the stream so that damage to the streambed is localised to two small areas. These crossing points should be fenced using two-wire fencing to meet regulatory requirements of moving stock across the waterway but minimise costs to repairs if flooding damage occurs.

Risks to Biodiversity

The main risks to native biodiversity identified on Whāma Station are from pest animals and plants such as:

- Pest plants: Blackberry.
- Mammalian Herbivores: Deer, Hares, and Rabbits.
- Mammalian predators: Possums & Mustelids.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Deer will destroy the forest understory as well as cause mortality in young seedlings by herbivory and older saplings by rubbing their antlers and stripping the bark.</td><td>Rabbits and hares can cause damage by overgrazing native and sown pastures, leading to loss of plant biodiversity and reduced crop yields</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Blackberry invades natural ecosystems, smothering native vegetation. It is also a problem in pasture and plantation forests</td><td>Stoats often catch large numbers of animals and cache them in their burrows</td></tr>
</table>

Biodiversity Objectives and Action Plan.

Goal 1: Deer and hare control.

Feral deer are a problem on the farm and in the wider landscape. These deer are often coming down from Ruahine Forest Park. Although the family, staff and friends control their population through recreational hunting, the quantity being culled is not sufficient to prevent degradation of the vegetation. Therefore, an increase in the quantity being culled will need to occur to reduce the damage being caused, especially in the remnant forest blocks.

Deer will be the greatest risk to regenerating native forests and scrub due to their habit of browsing seedlings, saplings and low-growing vegetation in the forest understory eliminating the trees' ability to replace themselves as they age and die. Monitoring the amount of damage deer, goats, and pigs are causing will be addressed in **Goal 4: Establish biodiversity monitoring**.

The incursion of pest herbivores will likely be a continuous threat to biodiversity on the farm, if control is not implemented by the government in Ruahine Forest Park (which is unlikely in the short term) and without the installation of a deer-proof fence around the boundary of the farm, which would be impractical due to the costs.

Another key invasive animal pest is hares. Bringing them under control will be necessary to reduce browsing pressure on new native saplings being planted. One effective deer and rabbit control d method is night shooting, which involves the use of a spotlight where deer and hares are feeding on pasture or winter crops. For more effective deer control, professional cullers may need to be employed with the use of a helicopter to knock back the deer population. If this option is to be implemented, it is highly recommended to discuss with other adjacent landowners who may be willing to have deer controlled on their land at the same time. This will help spread the costs and have a greater impact on the deer population in the landscape.

Any areas where native seedlings are going to be planted will need a strong feral herbivore control plan as these new seedlings will be very vulnerable to browsing for 5-20 years. Regular intensive hunting and/or poisoning of all feral herbivores in the surrounding area will be necessary, as an unexpected population increase or migration of these pest species can wipe out years of work and investment in a matter of hours.

Benefits for Biodiversity

Reduces browsing pressure and trampling of new saplings and forest understorey.

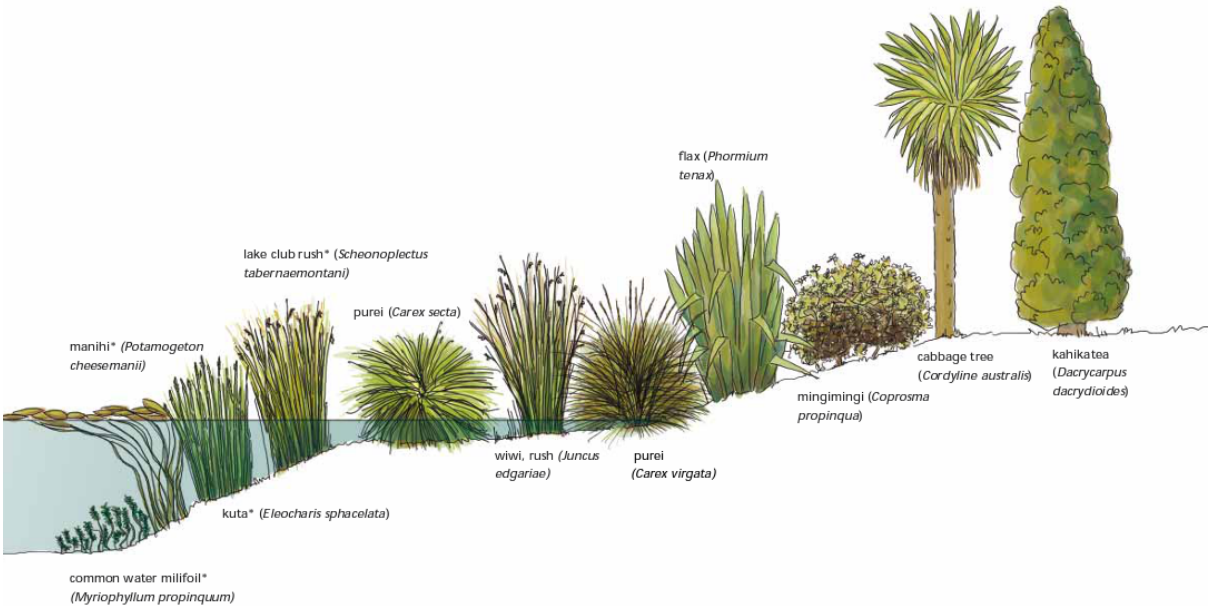
Effects on Farm Business

Reduces the amount of pasture and winter crops being eaten by non-livestock. On average, 7-10 rabbits consume as much as one ewe. By getting feral pests under control, it also reduces the vector of livestock disease such as TB.

Goal 2: Restoration planting of Bottom Bush wetland.

The large wetland was fenced off five years ago and has subsequently been filled with water to make multiple small ponds. Due to the risks of deer and hares grazing on saplings, no recent plantings have occurred.

With the implementation of pest control in goal one and the use of plant guards or rabbit netting around the boundary of the wetland, it will be feasible to plant the remaining 2.4- ha area. It is recommended to plant sedges, and rushes along the water's edge, followed by flaxes, small trees including tī kōuka, and shrubs into the less damp soils. Finally having an assortment of indigenous woody vegetation in the slightly drier areas. An example of what the planting will look like is below. This will create more habitat and food resources for native fauna. A list of recommended species and proportions is provided in appendix 3.



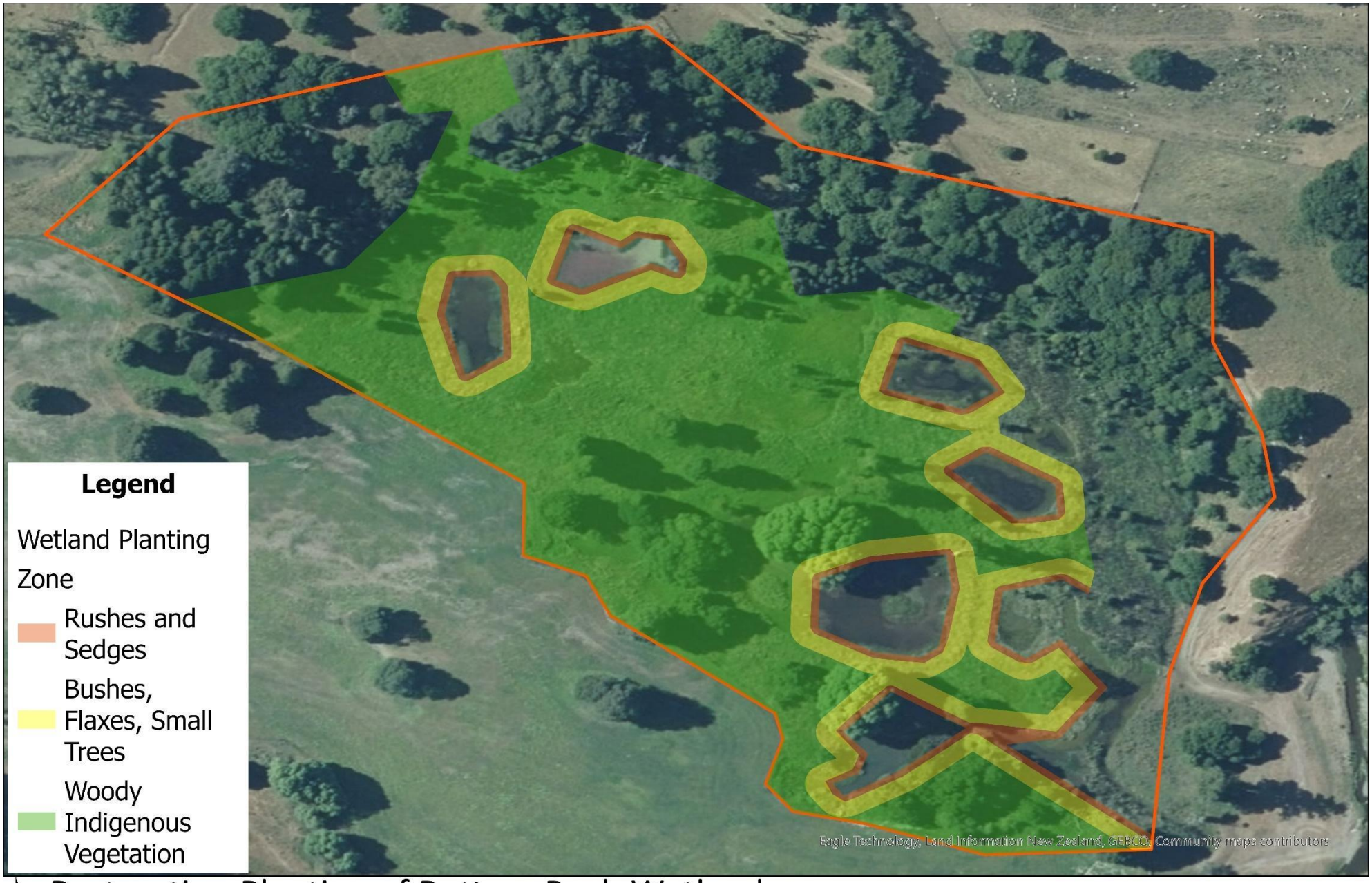
As the wetland is likely to be high in nitrates, the placement of 1-2 large logs in the middle of the ponds will help break down some nitrogen and will also create a roosting spot for waterfowl. Raupō is efficient at water purification because it takes up nitrogen. Therefore, its spread throughout the wetland should be promoted, however if inputs of nitrogen are not minimised, raupō has the potential to become a weed.

Benefits for Biodiversity

Restores a large wetland area for native biodiversity with plentiful food resources and habitat for nesting and spawning. The placement of logs into the ponds helps break down nitrogen and creates habitat and food resources for native fauna.

Effects on Farm Business

Once larger tree species are established, they will cast shade over adjacent paddocks in the summer months and will dampen wind force in colder months.


Legend
Wetland Planting Zone
Rushes and Sedges
Bushes, Flaxes, Small Trees
Woody Indigenous Vegetation
Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors
Restoration Planting of Bottom Bush Wetland
N
0
0.1
0.2
0.4
Km

Goal 3: Install additional water tanks, a reticulated water system and troughs.

There are numerous waterways throughout the farm which will need to be fenced off to prevent damage to the banks and beds of the streams and this damage ultimately harms freshwater biodiversity. Some waterways are the only access to water for stock, and so fencing them off will have negative impacts on animal welfare and production. Therefore, before these waterways are be fenced off, additional water tanks, reticulated water systems and troughs need to be installed to ensure stock has access to water. Upon completion of this task, plans to fence off the waterways can be drawn up and will likely be part of the next 5-year plan period.

Benefits for Biodiversity

A reduction in stock accessing the waterway will minimise damage to the banks and beds of the waterways. This will allow native biodiversity to be less disrupted and more likely to recover.

Effects on Farm Business

Livestock health generally improves when drinking out of troughs instead of waterways, improved health can result in greater production.

Goal 4: Stock crossing points of the Awa Stream.

Under the current version of low slope stock exclusion regulation, areas along the Awa Stream will need to be retired from cattle grazing (however, sheep can still graze in these areas). During the wettest periods of the year, the Awa Stream flow would be too great for a culvert to be practical, and the installation of a bridge would be too costly. Therefore, to move cattle across the water they will have to be supervised and actively driven across the waterway (this rule does not apply to sheep). Forward-thinking stock rotation planning will need to be implemented as cattle will be limited to being moved a maximum of twice across the waterway each month.

To assist in the mustering of cattle across the waterway and to localise damage to the stream to only a couple of points, it is recommended to install two to three stock crossing points. These points will consist of 2-wire fencing to guide livestock across the waterway.

Benefits for Biodiversity

Keeps damage to the stream bed to be localised to two to three points, reducing the amount of disruption to freshwater species.

Effects on Farm Business

Meets the requirements of the stock exclusion regulation but will require planning of stock rotation due to the restriction of how many times cattle can cross the waterway in a month.

Goal 5: Establish biodiversity monitoring.

Establish automated acoustic bird monitoring:

Two acoustic bird recorders should be purchased from the Cacophony Project https://www.2040.co.nz/collections/cacophonometer-bird-monitoring. One should be placed in Bush 4 and the other should be placed in the Bottom Bush Wetland. The recorder will need to be checked regularly to back up data, every 3-12 months depending on the storage capacity option chosen.

Establish photo point monitoring:

The simplest way to monitor change in your native vegetation (as a proxy for biodiversity generally) over time is to install a photo-point monitoring network. This means taking photos from the same location, in the same direction at the same time every year. The photos should show an area of land where you expect to see a change in vegetation over time. At Whāma Station, initial photo points should show a view of areas where management actions such as planting, weed control and stock fencing have already been applied and where actions will be undertaken for future management plans. Further detail on these methods is found in Appendix 1. Suggestions for where to set up photo points are also found in Appendix 1.

Establish vegetation monitoring plot:

As deer are not able to be excluded from the farm, it is important to note the damage they are causing in stock-excluded areas. The simplest way to monitor the damage pest species have on vegetation is to set up exclusion plots. Two plots should be set up in the main bush, one where livestock have been excluded and the other where they are not, by wrapping deer fencing around trees to make a 10m x 10m plot.

Photo points should also be established to note change in vegetation over time due to pest activity, and where applicable, where stock are excluded. Photo points for both plots should be placed so they are diagonal to the plot and should all face the same bearing if possible. Photo point records will need to be detailed enough to show whether seedlings are surviving and growing beyond deer browse height at a rate that strongly outpaces the death rate of older trees. They will also need to be able to show that the surviving seedlings have a diverse species composition to ensure that highly palatable native species are no longer declining. Suggestions for where to set up vegetation monitoring plots are found in Appendix 1.

Although vegetation plots will be able to give a visual representation of how well the forest will recover with livestock and pest species removed, their true value will come from doing vegetation measurements within the plots. However, to do a vegetation measurement in-depth knowledge and the ability to identify plant species will be required. Therefore, it is likely that an external specialist will need to be employed to do these assessments for you. This will only need to be done once every five years if implemented into your biodiversity management plan.

Take an environmental DNA (eDNA) test of the Awa Stream:

Water samples should be taken from the outflows from the farm of Awa Stream annually. eDNA gives a snapshot of what species are present in your waterways, both native and invasive, and is an important step in identifying what exists within the catchment. The equipment is simple to use, further information and directions can be found at: https://www.wilderlab.co.nz/directions. Although eDNA will give you an indication of native species present in the waterway it can't be used to show how well the population of a species

is doing and how many individuals there are. There are other methods to assess these but require specialists' gear and knowledge to produce robust data.

Freshwater stream monitoring using The Stream Health Monitoring and Assessment Kit (SHMAK):

Stream health is the condition of the whole stream ecosystem, including water quality, physical features of the stream and its banks, and the plants and animals living there. It also includes aspects that affect human health, safety and enjoyment.

SHMAK provides a way to assess whether land-use practices are affecting waters. It also allows stream health to be tracked over time, so you can recognise if stream health is getting better, worse or staying the same.

More details can be found at https://niwa.co.nz/freshwater/management-tools/water-quality-tools/stream-health-monitoring-and-assessment-kit. Local and regional councils may have a kit you can borrow.

Wetland monitoring using a Wetlands Monitoring and Assessment Kit (WETmak):

The use of a WETmak provides advice on useful monitoring techniques and methods of assessing the impact of your restoration work in wetlands. The kit is available in different formats to suit your needs. You can choose to download the entire resource, or you may prefer to focus attention on specific modules. I would recommend doing all the modules. One module is the establishment of photo points in your wetland so can be incorporated into the photo point monitoring stated earlier. More details can be found at:https://www.landcare.org.nz/resource-item/wetmak.

Benefits for Biodiversity

Understanding what species are on the property and how their presence is changing because of management actions will influence future decisions on how to manage these species to further increase biodiversity on your property.

Effects on Farm Business

Monitoring changes in biodiversity on the farm is likely to become important as local and international customers are increasingly looking to source products from farms that operate to environmentally high standards and this is likely to become important as new regulations come into effect. Having a record of any biodiversity enhancement conducted on your property is important.

Goal 6: Review of Biodiversity Management Plan

It is important that this biodiversity plan isn't just a one-off exercise and that it is reviewed regularly and the results from monitoring are used to guide future management. While the whole biodiversity plan will have a substantial review every 5 years, annual reviews and updates to the 5-year operational plan are considered essential and should be undertaken. An annual review is also important because this plan is designed to be able to meet the needs of regulators and market auditors.

Review this biodiversity plan while setting the overall farm work programme and budget for the next year. This review will include:

- Summarising the results of biodiversity monitoring information from the past year.

- Undertaking a review of biodiversity management achievements against what we have proposed and assessing why the management actions did or did not work.
- Undertake planning for both the next year and the next five-year period, which will include updating the operational plan.

Benefits to biodiversity

Having a structured approach to planning biodiversity restoration work will increase the likelihood of biodiversity management actions being undertaken.

Effects on farm business

Having records of biodiversity work undertaken and the results of monitoring may become important to comply with future regulations.

5-Year Operational Biodiversity Action Plan

This work plan outlines the tasks that will be necessary for achieving high-quality biodiversity management outcomes on Whāma Station that addresses the long-term vision for the property. The plan is written as a 5-year calendar for each goal so that biodiversity management actions can be easily scheduled into the working year with a draft budget included for anticipated costs. Costs are written as estimates only. This calendar should be reviewed and updated annually alongside your normal farm management planning so that you have the flexibility to carry out the work when you have the capability and make changes in the face of unexpected events.

Whāma Station Calendar and Costings for Biodiversity Management Actions.												
		Time of year					Cost per year					Notes
Goal 1: Deer and hare control.												
Action	**Location**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Contact Regional Council for rabbit control	Office	Feb										
Rabbit Control	Farm wide	Year-round	Year-round	Year-round	Year-round	Year-round	$3,000.00	$3,000.00	$3,000.00	$3,000.00	$3,000.00	Costs range from $2-$8/ha. Price estimate at $5/ ha for 600 ha
Talk to neighbours about deer control.	Office	Feb										
Contact Deer Cullers for quotes	Office	Feb										Contact multiple cullers and compare quotes
Deer control	Farm wide	Year-round	Year-round	Year-round	Year-round	Year-round	$6,400.00	$6,400.00	$6,400.00	$6,400.00	$6,400.00	Quotes needed. Price estimate at $20/ha for 320 ha of non-effective land. Costs are likely to be higher than estimated
						Total each year:	**$9,400.00**	**$9,400.00**	**$9,400.00**	**$9,400.00**	**$9,400.00**	**Total cost over 5 years:** **$47,000.00**
Goal 2: Restoration Planting of Bottom Bush Wetland.												
Action	**Location**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Contact nursery	Office	Feb										See the planting list below
(Optional) Install rabbit netting around the wetland	Bottom Bush Wetland	Dec					$5,200.00					Price includes Rabbit Hex Netting @ 5.09 per metre + tying wire. No labour price is included. The alternative is using plant guards at $2.70 each.

Spot Spray	Bottom Bush Wetland		July					$2,000.00					
Buy Plants	Nursery		Aug					$39,790.00				$7,985 plants at $5 each	
Plant	Bottom Bush Wetland		Aug					$5,000.00				~200 hours of labour @$25/hr	
Weed releasing	Bottom Bush Wetland			Dec	Dec	Dec			$700.00	$700.00	$700.00	$700/ha/pa	
						Total each year:	**$5,200.00**	**$46,790.00**	**$700.00**	**$700.00**	**$700.00**	**Total cost over 5 years:**	**$54,090.00**
Goal 3: Install additional water tanks, a reticulated water system and troughs.													
Action	**Location**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**		
Get quotes	Office						insert cost	insert cost	insert cost	insert cost	insert cost	Area outside expertise and therefore cannot give a reliable estimate.	
						Total each year:	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**Total cost over 5 years:**	**$0.00**
Goal 4: Stock crossing points of the Awa Stream.													
Action	**Location**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**		
Plan where crossing points will be	Office	Feb											
Install stock crossing points		May					$2,400.00					~$1,200 per crossing point	
						Total each year:	**$2,400.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**Total cost over 5 years:**	**$2,400.00**
Goal 5: Establish biodiversity monitoring													
Action	**Location**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**		
Establish automated acoustic bird monitoring	Site-specific	Nov					$1,636.00	$79.00	$79.00	$79.00	$79.00	Two bird recorders at $479 each Two solar panels at $339 ea. Cloud storage at $79 each year.	

Establish photo point monitoring	Farm wide	Nov										Suggested photo points locations are provided in appendix 2. Approx. 3 hours of work required to take initial photos and mark locations	
Repeat photo point monitoring	Farm wide		Nov	Nov	Nov	Nov						2 hours of work required to take retake photos	
Establish vegetation exclusion plots	Site-specific	Nov					$480.00					~$240 per plot for 45m of netting	
Photo point of vegetation Plot	Site-specific		Nov	Nov	Nov	Nov							
Perform SHMAK	Awa Stream	April + Oct	April + Oct	April + Oct	April + Oct	April + Oct	$1,250.00	$200.00	$200.00	$200.00	$200.00	SHMAK Plus kit with clarity tube @$1250, ~$100 for water testing x 2 times a year.	
Perform WETMAK	Bottom Bush Wetland	April + Oct	April + Oct	April + Oct	April + Oct	April + Oct						The biggest cost will be time. It is likely equipment required to perform WETMAK is already owned	
Take eDNA samples	Awa Stream	Oct	Oct	Oct	Oct	Oct	$255.00	$255.00	$255.00	$255.00	$255.00	Comprehensive freshwater eDNA packages @$255 ea.	
						Total each year:	**$3,621.00**	**$534.00**	**$534.00**	**$534.00**	**$534.00**	**Total cost over 5 years:**	**$5,757.00**
Goal 5: Annual management plan review													
Action	**Location**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**		
Undertake an annual review the of biodiversity management plan	Office	Nov	Nov	Nov	Nov	Nov						Half-day reading management plan, ticking off completed actions and scheduling actions for the year ahead. Do this in conjunction with farm business planning.	
						Total each year:	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**Total cost over 5 years:**	**$0.00**
												The total cost of biodiversity management actions for 5 years:	**$109,247.00**

Appendix 1 Biodiversity Monitoring

Understanding what species are on the property and how their presence is changing because of management actions will influence future decisions on how to manage these species and increase biodiversity on your property.

Automated Acoustic Bird Monitoring

Forest bird activity can now be monitored with an automated recording device. Installing one of these in a biodiversity area where the vegetation is likely to develop over the next 5-10 years as a result of your management work is a good way to prove your impact on biodiversity. Areas that have been planted with native species or existing forests and wetlands that have a new pest control programme and/or have been fenced from stock are ideal sites to monitor for increases in bird activity.

Automated bird recorders should be installed where they are easy to access but are sheltered from noise created by roads, machinery and stock as this can interfere with your monitoring results.

Recorders run all day and should be set to collect data over the whole year. recorders with solar panels are the best option. It is important to keep detailed records about where the recorders are and if recorders are rotated around the property.

If there is cell phone coverage where the recorders are located, acoustic data will be automatically uploaded to the cloud. If there is no coverage, recorders will need to be checked regularly to back up data, this will need to be done every 3-12 months, depending on the storage capacity option chosen.

To back data up you will need to copy files from the recorder's memory and upload them to a cloud service provided by 2040 Limited. Once uploaded, the data will be analysed and will be made available for you to access.

Currently, only one company in the country manufactures automated bird recorders and offers an analysis of the data. Equipment for automated acoustic bird monitoring can be bought at this link: https://www.2040.co.nz/collections/cacophonometer-bird-monitoring.

Photo point Monitoring

Photo points should show an area of land where you expect to see a change in vegetation over time. Any areas where you are undertaking biodiversity management work (e.g. planting, weed control, stock fencing) should have photo points installed before work commences so that you can demonstrate that you are carrying out biodiversity monitoring and prove the implementation of your plan.

This method entails taking photos from the same location, in the same direction, at the same time every year. Early summer (November-December) is the best time to photograph native vegetation after the flush of growth in spring but before vegetation starts to die back in mid-summer. Installing a waratah is a good way to mark the location of where to take the photos from. Place your photo points near well-travelled tracks or roads so they are not a chore to reach in future.

Aligning the frame of repeated photos is key. It is recommended that you take copies of the original photos out with you when taking follow-up photos to ensure that you are pointing the camera in the same direction (consider using a compass bearing) and showing the same trees year after year. Relying on your memory to aim and frame the picture correctly usually produces poor results.

Panoramas made of multiple pictures taken from the same point may be useful for photographing wide areas of vegetation. The panorama feature on your phone's camera may be effective but it can stretch or compress the scene resulting in degradation in the quality of your biodiversity monitoring data.

More information about photo point monitoring can be found here: https://www.nzpcn.org.nz/conservation/monitoring/photo-points/

Freshwater monitoring:

Environmental DNA (eDNA) can be collected from streams and used to detect the presence of animals and plant species in the catchment above. This monitoring method does not provide any information on the overall health of a catchment's freshwater or terrestrial biodiversity, but it is a cheap and simple way of detecting what species are living there. Repeated sampling over several years will give you information useful for directing future biodiversity management work and may show increases or decreases in a catchment's biodiversity over the long term. This is a new technology that is rapidly improving and we hope this method of measuring biodiversity in freshwater will grow to replace comprehensive monitoring techniques over the next 5-10 years as it could save a considerable amount of time and money. eDNA monitoring works best when the stream is not running high, and the weather is stable so this job has been scheduled for summer.

The only supplier for this service can be found at: https://www.wilderlab.co.nz/order. You will receive a report summarising all the organisms detected in your stream water. Please see an example report here: https://s3.ap-southeast-2.amazonaws.com/wilderlab.openwaters/reports/df3cee2238757344.html.

A more comprehensive freshwater assessment requires the use of a Stream Health Monitoring and Assessment Kit (SHMAK) or Wetland Monitoring and Assessment Kit (WETMAK). These methods provide a much better picture of stream or wetland health but require significantly more training and investment to be used effectively. If possible, purchase a kit within your catchment or community conservation group to share the costs. You may need someone with freshwater ecology knowledge to assist you.

SHMAK and WETMAK manuals and kits:

https://niwa.co.nz/sites/niwa.co.nz/files/SHMAK_orderform_Sept2021.pdf

https://www.landcare.org.nz/resource-item/wetmak

https://niwa.co.nz/our-science/freshwater/tools/shmak/shmak-manual

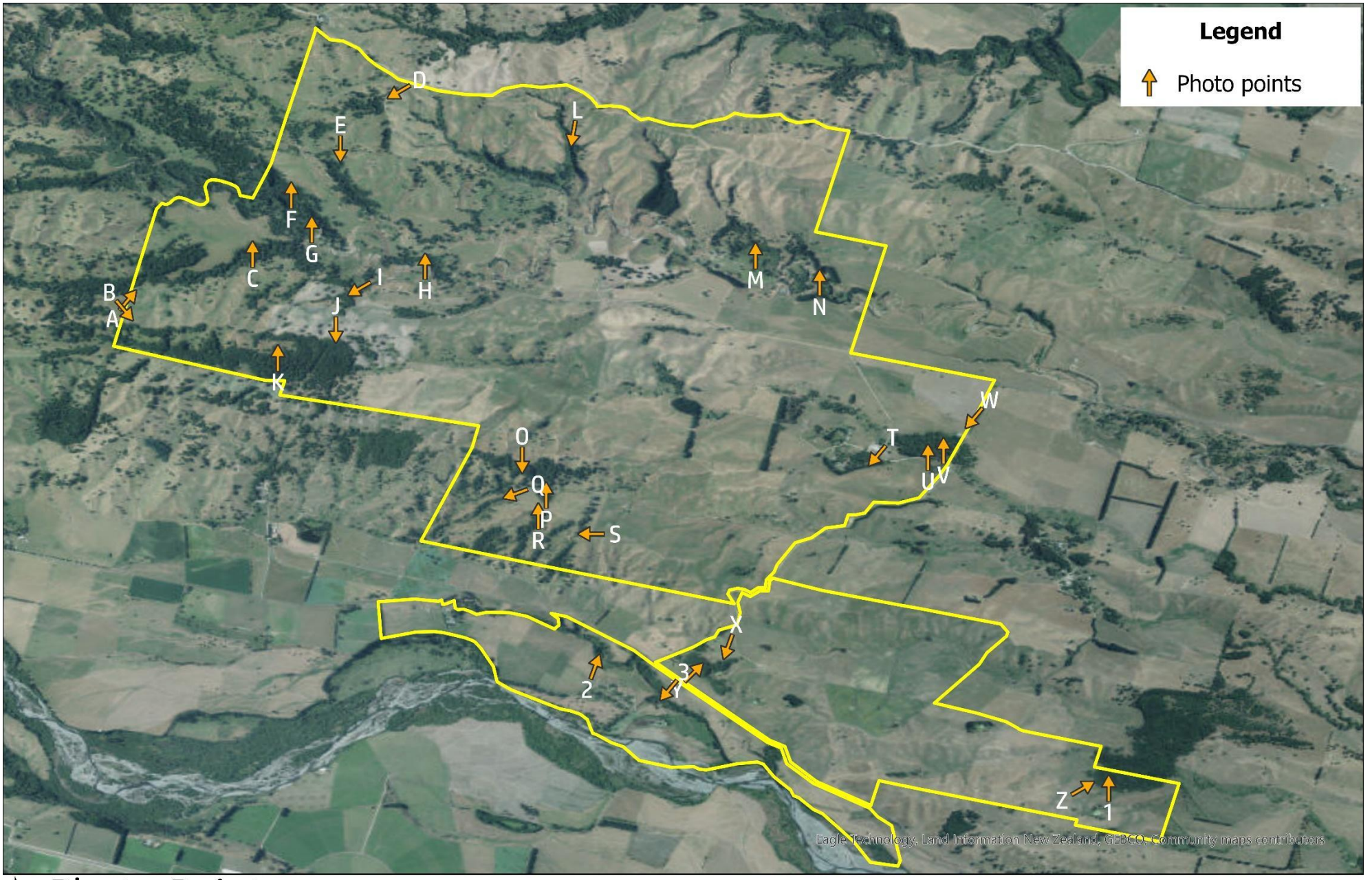
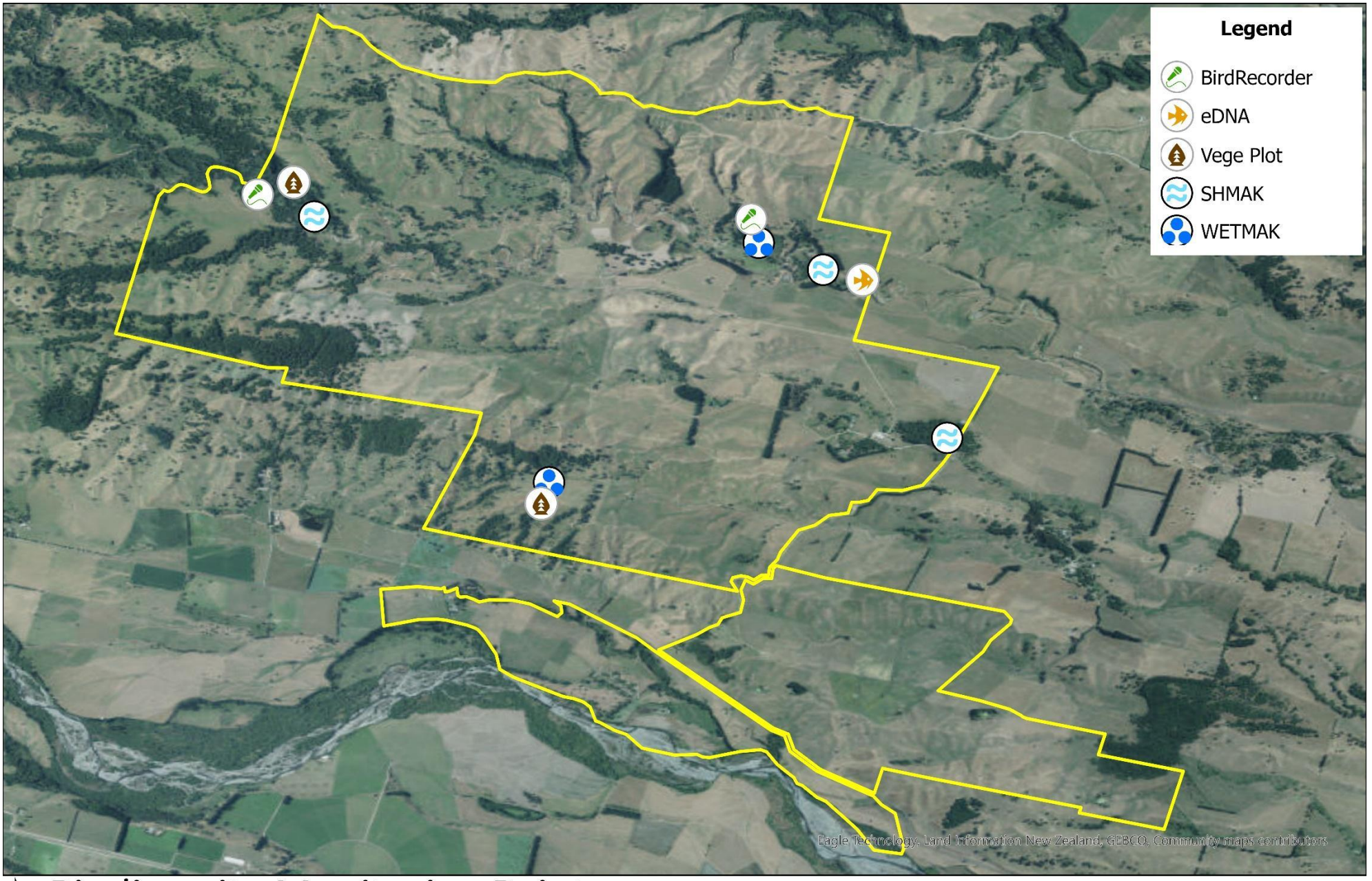


Photo Points

N

0 1.5 3 6 Km



Biodiversity Monitoring Points

N

0 1.5 3 6 Km

Appendix 2: List of Native species found at Whāma Station

Plant species that are known to be present.

Common name	Māori name	Scientific name	Conservation status
Akatea		*Metrosideros perforata*	Threatened & Nationally Vulnerable
Bamboo Orchid	peka-a-waka	*Earina mucronata*	Not Threatened
Bidibid	piripiri	*Acaena anserinifolia*	Not Threatened
Black Matipo	kōhūhū	*Pittosporum tenuifolium*	Not Threatened
Black Shield Fern		*Polystichum wawranum*	Not Threatened
Black Tree Fern	mamaku	*Cyathea medullaris*	Not Threatened
Blechnum Membranaceum		*Austroblechnum membranaceum*	Not Threatened
Bracken	rarauhe	*Pteridium esculentum*	Not Threatened
Bullrush	raupō	*Typha orientalis*	Not Threatened
Bush Lawyer	tātarāmoa	*Rubus schmidelioides var. schmidelioides*	Not Threatened
Bushman's Friend	rangiora	*Brachyglottis repanda*	Not Threatened
Butterfly Fern		*Asplenium flabellifolium*	Not Threatened
Button Fern		*Pellaea rotundifolia*	Not Threatened
Cabbage Tree	tī kōuka	*Cordyline australis*	Not Threatened
Climbing Convolvulus		*Calystegia tuguriorum*	Not Threatened
Climbing Rātā		*Metrosideros fulgens*	Threatened & Nationally Vulnerable
Common Broom		*Carmichaelia australis*	Not Threatened
Common Duckweed		*Lemna disperma*	Not Threatened
Common Maidenhair		*Adiantum cunninghamii*	Not Threatened
Coprosma Crassifolia		*Coprosma crassifolia*	Not Threatened
Coprosma Rhamnoides		*Coprosma rhamnoides*	Not Threatened
Coprosma Rigida		*Coprosma rigida*	Not Threatened
Coprosma Rotundifolia		*Coprosma rotundifolia*	Not Threatened
Creek Fern	kiwakiwa	*Cranfillia fluviatilis*	Not Threatened
Crêpe Fern	heruheru	*Leptopteris hymenophylloides*	Not Threatened
Drooping Filmy Fern	piripiri	*Hymenophyllum demissum*	Not Threatened
Drooping Spleenwort		*Asplenium flaccidum*	Not Threatened
Fine-Leaved Parsley Fern		*Botrychium biforme*	Not Threatened
Fivefinger	whauwhaupaku	*Pseudopanax arboreus*	Not Threatened
Fragrant Fern	mokimoki	*Dendroconche scandens*	Not Threatened
Glossy Karamū	karamū	*Coprosma robusta*	Not Threatened
Golden Tree Fern	wheki-ponga	*Dicksonia fibrosa*	Not Threatened
Gully Fern	piupiu	*Pakau pennigera*	Not Threatened
Hangehange		*Geniostoma ligustrifolium var. ligustrifolium*	Not Threatened
Hen & Chicken Fern	pikopiko	*Asplenium gracillimum*	Not Threatened
Hook Sedge	kamu	*Carex uncinata*	Not Threatened
Hooker's Spleenwort		*Asplenium hookerianum var. hookerianum*	Not Threatened
Kahikatea		*Dacrycarpus dacrydioides*	Not Threatened
Kaikōmako		*Pennantia corymbosa*	Not Threatened
Koromiko		*Veronica stricta var. stricta*	Not Threatened
Lacebark	houhere	*Hoheria sexstylosa*	Not Threatened
Lance Fern	rereti	*Austroblechnum lanceolatum*	Not Threatened

Lancewood	horoeka	*Pseudopanax crassifolius*	Not Threatened
Large-Leaved Coprosma	kanono	*Coprosma autumnalis*	Not Threatened
Large-Leaved Kōwhai	kōwhai	*Sophora tetraptera*	Not Threatened
Large-Leaved Muehlenbeckia	pōhuehue	*Muehlenbeckia australis*	Not Threatened
Leafless Lawyer		*Rubus squarrosus*	Not Threatened
Leather-Leaf Fern		*Pyrrosia elaeagnifolia*	Not Threatened
Lemonwood	tarata	*Pittosporum eugenioides*	Not Threatened
Lowland Ribbonwood	mānatu	*Plagianthus regius subsp. regius*	Not Threatened
Māhoe		*Melicytus ramiflorus*	Not Threatened
Mānuka		*Leptospermum scoparium var. scoparium*	At Risk & Declining
Marbleleaf	putaputāwētā	*Carpodetus serratus*	Not Threatened
Mataī		*Prumnopitys taxifolia*	Not Threatened
Mingimingi		*Coprosma propinqua var. propinqua*	Not Threatened
Miro		*Pectinopitys ferruginea*	Not Threatened
Narrow-Leaved Lacebark	houhere	*Hoheria angustifolia*	Not Threatened
Native Nettle		*Urtica sykesii*	Not Threatened
Nz Ash	tītoki	*Alectryon excelsus subsp. excelsus*	Not Threatened
Nz Honeysuckle	rewarewa	*Knightia excelsa*	Not Threatened
Nz Jasmine	kaihua	*Parsonsia heterophylla*	Not Threatened
Nz Passionflower	kohia	*Passiflora tetrandra*	Not Threatened
Pepper Tree	kawakawa	*Piper excelsum subsp. excelsum*	Not Threatened
Pigeonwood	porokaiwhiri	*Hedycarya arborea*	Not Threatened
Poataniwha		*Melicope simplex*	Not Threatened
Pōkākā		*Elaeocarpus hookerianus*	Not Threatened
Prickly Shield Fern	punui	*Polystichum vestitum*	Not Threatened
Pukatea		*Laurelia novae-zelandiae*	Not Threatened
Purei		*Carex secta*	Not Threatened
Rātā		*Metrosideros colensoi*	Threatened & Nationally Vulnerable
Red Horopito		*Pseudowintera colorata*	Not Threatened
Red Matipo		*Myrsine australis*	Not Threatened
Red Pondweed		*Potamogeton cheesemanii*	Not Threatened
Rimu		*Dacrydium cupressinum*	Not Threatened
Rough Tree Fern	wheki	*Dicksonia squarrosa*	Not Threatened
Seven-Finger	patē	*Schefflera digitata*	Not Threatened
Shining Spleenwort	huruhuruwhenua	*Asplenium oblongifolium*	Not Threatened
Sickle Spleenwort		*Asplenium polyodon*	Not Threatened
Small-Leaved Milk Tree	tūrepo	*Streblus heterophyllus*	Not Threatened
Smooth Shield Fern		*Parapolystichum glabellum*	Not Threatened
Speckled Sedge		*Carex testacea*	Not Threatened
Supplejack	kareao	*Ripogonum scandens*	Not Threatened
Swamp Sedge	pukio	*Carex virgata*	Not Threatened
Tawa		*Beilschmiedia tawa*	Not Threatened
Thin-Leaved Coprosma		*Coprosma areolata*	Not Threatened
Tōtara		*Podocarpus totara var. totara*	Not Threatened
Tree fuchsia	kōtukutuku	*Fuchsia excorticata*	Not Threatened
Tree Nettle	ongaonga	*Urtica ferox*	Not Threatened
Waxweed		*Hydrocotyle heteromeria*	Not Threatened
Weeping Kōwhai	kōwhai	*Sophora microphylla*	Not Threatened

Weeping Matipo		*Myrsine divaricata*	Not Threatened
White Climbing Rātā		*Metrosideros diffusa*	Threatened & Nationally Vulnerable
Wineberry	Makomako	*Aristotelia serrata*	Not Threatened

Note: All species listed above that have a higher conservation status than not threatened belong to the Myrtaceae family, this taxon may be prone to Myrtle Rust (*Austropuccinia psidii*). Further information about Myrtle Rust can be found at https://www.myrtlerust.org.nz/.

Bird species known or likely to be present.

Known to be present

Common name	Māori name	Scientific name	Conservation status
Bellbird	korimako	*Fulmarus glacialoides*	Migrant
Grey warbler	riroriro	*Pachyptila desolata*	Relict
Kererū		*Diomedea antipodensis*	Nationally Critical
New Zealand fantail	pīwakawaka	*Cyanoramphus unicolor*	Naturally Uncommon
Morepork	ruru	*Leucocarbo carunculatus*	Nationally Endangered
Paradise shelduck	pūtangitangi	*Stercorarius parasiticus*	Migrant
Pūkeko		*Sterna paradisaea*	Migrant
Sacred kingfisher	kōtare	*Lewinia muelleri*	Naturally Uncommon
Spur-winged plover		*Leucocarbo colensoi*	Nationally Vulnerable
Tūī		*Anas aucklandica*	Nationally Vulnerable

Likely present

Common name	Māori name	Scientific name	Conservation status
Long-tailed cuckoo	koekoeā	*Fulmarus glacialoides*	Migrant
New Zealand falcon	kārearea	*Pachyptila desolata*	Relict
Rifleman	tītitipounamu	*Diomedea antipodensis*	Nationally Critical
Shining cuckoo	pīpīwharauroa	*Cyanoramphus unicolor*	Naturally Uncommon
Silvereye	tauhou	*Stercorarius parasiticus*	Migrant
Tomtit	miromiro	*Sterna paradisaea*	Migrant

Appendix 3: Plants for Bottom Bush Wetland

Zone	Bottom Bush Wetland	Total area 2.4 ha		
Zone 1 (0.15 ha) Rushes and Sedges. 1 m x 1m spacing. 10,000 stems/ha.	**Species**	**Scientific name**	**Number of seedlings**	**Specifics**
	Purei	*Carex secta*	470	Tolerant of damp to wet situations. Prefers full sun but will grow partly shaded.
	Tussock sedge	*Carex virgata*	375	Tolerant of damp to wet situations. Prefers full sun but will grow partly shaded.
	Tussock sedge	*Carex comans*	375	Tolerant of damp to wet situations. Prefers full sun but will grow partly shaded.
	Common rush	*Juncus gregiflorus*	280	Tolerant of damp to wet situations. Prefers full sun but will grow partly shaded.
		Total number of seedlings:	**1500**	
Zone 2 (0.44 ha) Bushes, Flaxes, Small Trees 1.5 m x 1.5 m spacing. 4,444 stems/ha.	**Species**	**Scientific name**	**Number of seedlings**	**Specifics**
	Harakeke (Flax)	*Phormium tenax*	600	Full sunlight or partial shade. Prefers damp soils
	Mingimingi	*Coprosma propinqua*	350	Requires full sun, grows well in damp infertile soils.
	Tī kōuka (Cabbage tree)	*Cordyline australis*	350	Full sun or partial shade. Likes moist soil but can cope with considerable drought once established.
	Weeping matipo	*Myrsine divaricata*	330	Prefers full sun but will grow in partial shade. Grows best in damp soils.
	Manatū (Lowland ribbonwood)	*Plagianthus regius*	330	Grows best in full sun or partial shade on a well-drained site. It is tolerant of frost, cool climates, and periods of dry.
		Total number of seedlings:	**1,960**	
Zone 3 (1.81 ha) Woody Indigenous Vegetation	**Species**	**Scientific name**	**Number of seedlings**	**Specifics**
	Mānuka	*Leptospermum scoparium var. scoparium*	975	Drought resistant. Well-drained, Moist moderate drainage. Tolerates light frost.

	Māhoe	*Melicytus ramiflorus*	900	Prefers full sun and wet soils. Avoid heavy frosts when young.
	Kōtukutuku (Tree fuchsia)	*Fuchsia excorticata*	700	Grows well in well-draining, fertile soil that's kept evenly moist, Prefers part sun, with protection from the strong afternoon sun.
	Tree Lucerne	*Chamaecytisus proliferus var palmensis.*	600	Nitrogen-fixing. Deep-rooted, making it drought tolerant. Nurse crop for natives.
	Karamū	*Coprosma robusta*	300	Does well in wet and dry conditions. Tolerant of frosts
	Tōtara	*Podocarpus totara var. totara*	300	Slow-growing, long lives species. Tolerant of wet and dry conditions. Stands strong to wind
	Kahikatea	*Dacrycarpus dacrydioides*	200	Easy to establish and grow and its relatively fast growth. Grows well in poorly drained soils
	Mataī	*Prumnopitys taxifolia*	150	Tolerates dry periods, partial shade, frosts, and cool climates.
	Lancewood	*Pseudopanax crassifolius*	125	Can grow in wet or dry soils. Frost and wind tolerant. Can grow in partial sun.
	Lacebark	*Hoheria sexstylosa*	100	Wind tolerant. Frost hardy. Prefer damper soils.
	Swamp Marie	*Syzygium maire*	75	Early to mid-succession canopy species that is frost tender and shade intolerant. It requires high light levels
2 m x 2 m spacing.	Pukatea	*Laurelia novae-zelandiae*	50	Grows best in damp soils. Thrives in shaded areas.
2500 stems/ha	Kōwhai	*Sophora microphylla*	50	Can grow in wet or dry soils. Frost and wind tolerant. Prefers full sun but grows well in partial sun.
		Total number of seedlings:	**4525**	