

South Farm

Biodiversity Management Plan



**This plan has been designed to meet and exceed the relevant
industry assurance standards and district and regional council
regulations in place at the time of preparation**

*Please note: All family and farm names in this plan have been anonymised
for the purpose of this pilot project.*

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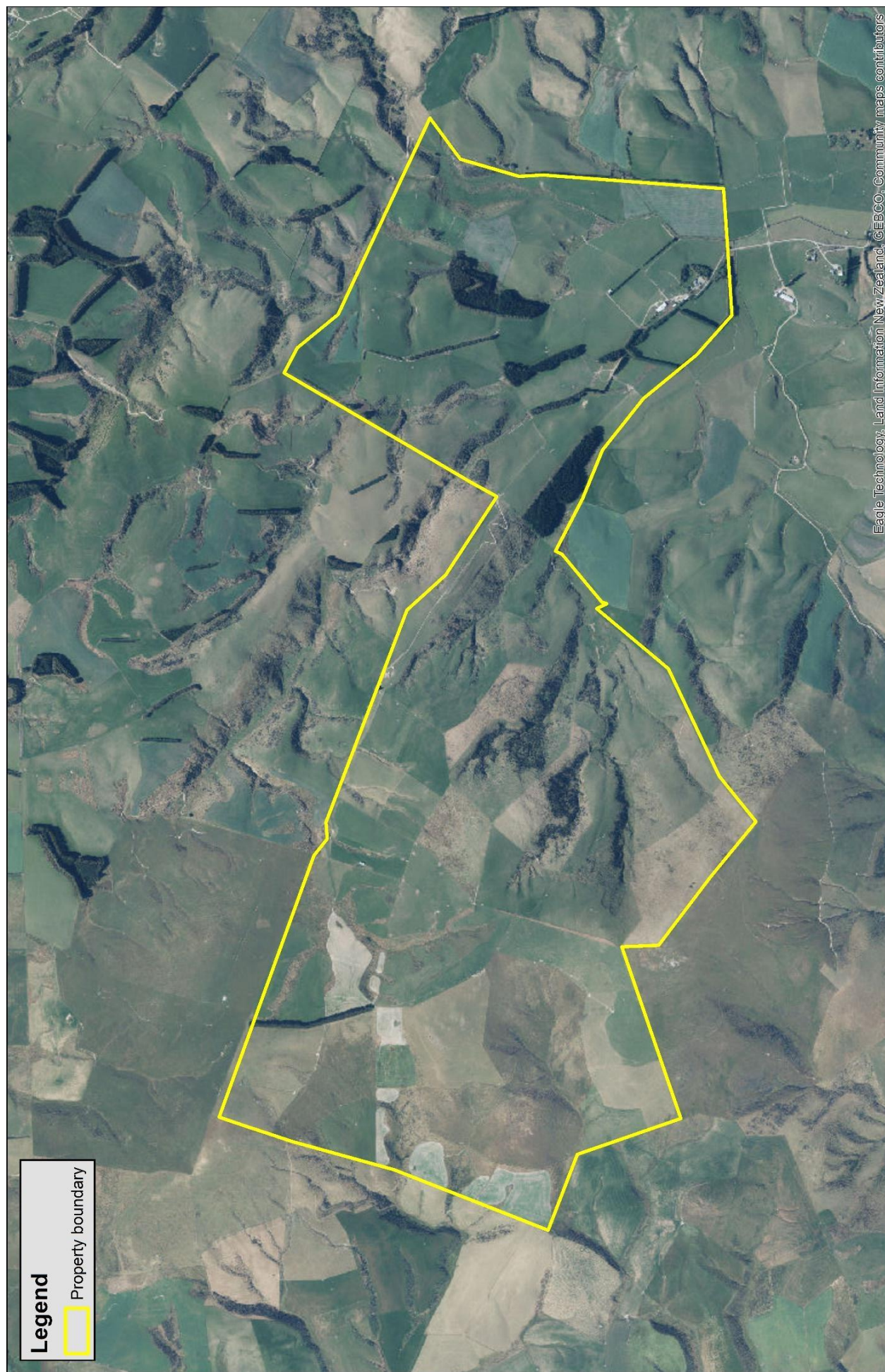
Introduction

South Farm is a 565-ha sheep and beef breeding and finishing operation in West Otago. The owners run 4,700 stock units. They are committed to minimising the farm's impact on the environment and have adapted farming management to safeguard the quality of the water and environment. The topography of the farm is a combination of developed flats, moderately steep hill slopes and gullies with the elevation range being from 300 to 600 m. Their average annual rainfall is 830 ml. South Farm lies within the takiwā (district) of Ngāi Tahu who are mana whenua of this land and were present here for many generations before European settlement. The farm is within the administrative area of Otago Regional Council and Clutha District Council.

Vision statement

In 20 years we will be woken to a dawn chorus of native birds and tūī, korimako and kererū are seen all across the property. Our waterways are healthy and the galaxiids are thriving. Stock have been excluded from the gullies with native bush regenerating and providing

habitat for native birds. As a result of this work, we feel a sense of pride when looking upon the property and what we have achieved.



Stock take of Biodiversity Assets

What is biodiversity?

The diversity of plants and animals relates directly to the health of our environment. A healthy environment means an abundance of native birds, native invertebrates and a diversity of plant life across a range of different habitat types. These plants and animals in turn assist in actively sequestering carbon, creating healthy waterways and soil, and enhancing resilience to droughts and storms. In some parts of New Zealand, our unique plants and animals are still declining in number and diversity. As pastoral farms cover 50% of New Zealand's land, and this land includes ecosystems and climates not found in public conservation land (managed by the Department of Conservation), what happens on pastoral farms is vital to restoring the full spectrum of native biodiversity in New Zealand and indigenous vegetation in the wider landscape

Prior to human settlement

The pre-human vegetation of the wider area would have been predominantly forested, with silver beech likely dominant on steeper sites and a more diverse podocarp- broadleaf forest on more gentle sites, and wetlands in damp valley floors. Podocarps including kahikatea, mataī and tōtara likely occurred as scattered emergent trees in the lower altitude forests, while more dense kahikatea forests probably occurred on valley floors and around wetlands. Broadleaf, tarata, ribbonwood, kōwhai, five-finger, wineberry and fuchsia were likely common in the forests and pōkākā would have been common on poorly drained soils.

Present day vegetation in the wider landscape

The majority of the indigenous forest of the eastern South Island has been cleared through early Polynesian fires and subsequent European settler fires and logging for timber. There are areas of red tussock (*Chionchola rubra*) and indigenous scrub remaining on private land in the area, but the closest substantial area of indigenous forest to South farm is 10 km away at the Leithen Scenic Bush Reserve.

Indigenous vegetation on South Farm:

Today, indigenous broadleaf and grey scrub species are found across the multiple gullies on South Farm and red tussocks have colonised the wetter areas on the farm, but there are no remnants of the original forest present. There is about 12 ha of red tussock that persist

across the paddocks on the higher areas of the property and in some of the back blocks. There are two threatened Olearia tree daisy species present in the gullies, *Olearia lineata* and *O. fimbriata*. Multiple waterways across the property provide habitat for various indigenous fauna and flora.

Table 1.1 Indigenous plant species observed during ecological assessment.

Common name	Scientific name
Pohuehue	<i>Muehlenbeckia australis</i>
Coprosma species	<i>Coprosma spp.</i>
Mingimingi	<i>Coprosma propinqua</i>
Mikimiki (Yellow wood)	<i>Coprosma linariifolia</i>
Matagouri	<i>Discaria toumatou</i>
Olearia lineata	<i>Olearia lineata</i>
Olearia fimbriata	<i>Olearia fimbriata</i>
Common tree daisy	<i>Olearia arborescens</i>
Kōwhai	<i>Sophora microphylla</i>
Tātārāmoa (Bush lawyer)	<i>Rubus cissoides</i>
Common broom	<i>Carmichaelia australis</i>
Tikōuka (Cabbage tree)	<i>Cordyline australis</i>
Korimako	<i>Veronica salicifolia</i>
Inanga	<i>Dracophyllum longifolium</i>
Kānuka	<i>Kunzea ericoides</i>
Porcupine shrub	<i>Melicytus alpinus</i>
Red tussock	<i>Chionochoa rubra</i>

Table 1.2 Indigenous fauna species identified on South Farm.

Common name	Scientific name
Kāhu (Harrier hawk)	<i>Circus approximans</i>
Riroriro (Grey warbler)	<i>Gerygone igata</i>
Water fowl	
Korimako (Bellbird)	<i>Anthornis melanura</i>
Pīwakawaka (Fantail)	<i>Rhipidura fuliginosa</i>
Kōura (freshwater crayfish)	<i>Paranephrops zealandicus</i>
Pomahaka galaxiid	<i>Galaxias 'Pomahaka'</i>

Exotic Vegetation

There are multiple windbreaks of exotic conifers and a few stands of pines that will eventually be harvested. There is also a small area of eucalypts present. The main component of exotic vegetation are the pasture species and crops.

Threats to Biodiversity

The main risks to indigenous biodiversity identified on South Farm are from introduced animal species such as:

- **Feral Deer**

Deer are often seen on the property, though not in large numbers, and are controlled through hunting. 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.

- **Mammalian Predators - Possums, cats, stoats, ferrets, rats**

Evidence of high possum numbers in the scrubby gullies of the property can be seen. Possums are currently controlled through night shooting. Possums can strip a tree of foliage within one night. They also predate on bird eggs and young chicks. Stoats and ferrets are occasionally seen across the property and are currently not being controlled. Stoats often catch large numbers of animals and cache them in their burrows. Feral cats are present on the property as it is likely that people dump their cats nearby. Feral cats pose a large threat to native biodiversity as they predate on lizards, insects, and bird species.

- **Brown Trout**

Brown trout are found in several of the main waterways on the property. This species is an issue as they predate on our native fish species and the threatened Pomahaka galaxiid species is also present in the waterways.

The gully's indigenous biodiversity values are also at risk from various native vine species. Pōhuehue (*Muehlenbeckia australis*) and bush lawyer (*Rubus cissoides*) are both native species but in open canopy situations, will smother other native species, as demonstrated in the gullies on this property. Pōhuehue is known to be much more dominant than bush lawyer. The threat but also the potential opportunity these vines pose is further explained in

Goal 2 of this plan.



Figure 1 Pōhuehue and bush lawyer smothering another native tree in a South gully.



Mahinga Kai Values

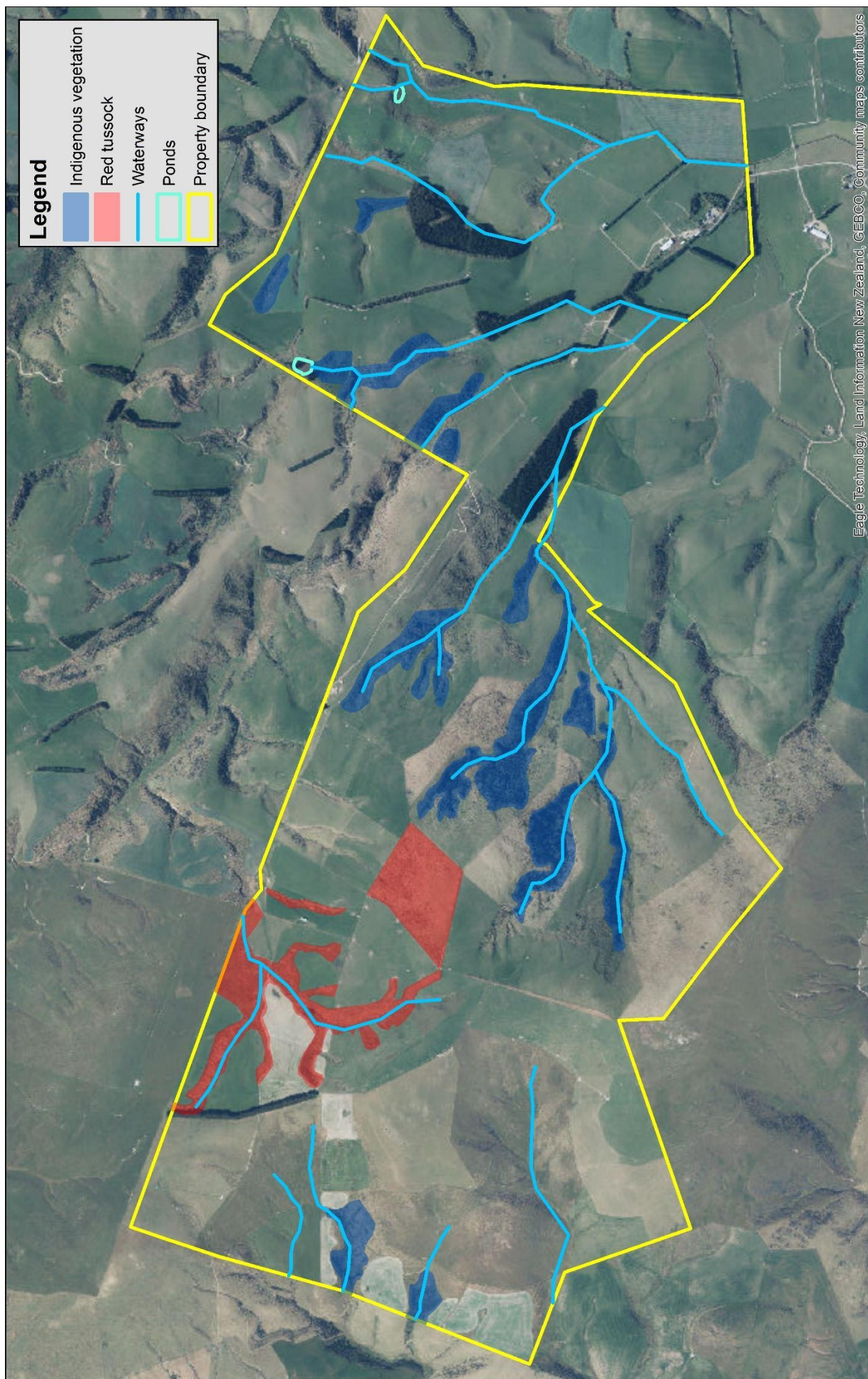
Mahinga kai is about the value of natural resources – our birds, plants, fish, and other animals and resources that sustain life, including the life of people. Mahinga kai encompasses the management and collection of natural resources important to the cultural traditions of Ngāi Tahu. It is a culturally 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. Mahinga kai includes access to healthy kai, and sustainably doing this, with our future generations in mind. Mahinga kai refers to numerous species and inter-relationships rather than something specific. It includes things such as species, natural habitats, materials and practices used for harvesting food, and places where food or resources are, or were, gathered.

Mahinga kai values include the protection of indigenous habitats like the forested gullies, scrubland, and tussock lands that are found on South Farm. Below are some examples of mahinga kai species that are found on South Farm:

- Tī kōuka | Cabbage tree
- Harakeke | NZ Flax
- Karamū | Coprosma robusta
- Tuna | Longfin eel + Shortfin eel
- Kōura | Freshwater Crayfish

The recognition of mahinga kai values does not imply any obligation on the landowner, but this concept is used within the Freshwater Management National Policy Statement as one of

the indicators of freshwater quality.



Habitat Supporting Indigenous Biodiversity

Assessment of Biodiversity Assets

Asset 1: Indigenous Woody Vegetation

There are three main gullies of indigenous woody vegetation on South Farm with smaller stands of indigenous vegetation being found in Rocky paddock, Four Finger paddock and along riparian margins of waterways. The main gullies are characterized by 'grey scrub' species (Coprosma-Matagouri-Olearia) as well as various broadleaved species. A list of species recorded during the ecological assessment is inserted on page 7. Of particular importance is the presence of two Olearia tree daisy species. *Olearia lineata* is ranked as At Risk – Declining under the New Zealand Threat Classification System (NZTCS), and *Olearia fimbriata* is Threatened – Nationally Vulnerable. See Appendix 6 for the NZTCS threat classification diagram.

There are various Coprosma species found in the gullies, including *Coprosma propinqua*, *C. linariifolia* and possibly *C. rigida* and *C. pedicellata*. The biodiversity values these areas provide play an important role in habitat connectivity for mobile bird species such as korimako/bellbirds. Matagouri fixes nitrogen from the air, increasing the amount of available nitrogen in the soil for other plants. The vegetation in these gullies is regenerating and has the potential to be restored back into mature forest, if managed appropriately. The threats that face these areas of indigenous vegetation have been described above.



Asset 2: Waterways

There are multiple waterways across South Farm with two of them named (Wai River and Awa Creek). The waterways on the eastern side of the property are already fenced from cattle as per the current low slope stock exclusion regulations: <https://environment.govt.nz/acts-and-regulations/regulations/stock-exclusion-regulations/>.

A map showing land classified as low slope is attached in Appendix 7. There is a small area amongst the red tussock on the western side of the property that will have to be fenced under the stock exclusion regulations. The waterways on the eastern side of the property are known to provide habitat for kōura/freshwater crayfish (*Paranephrops zealandicus*), and the Pomahaka galaxiid (*Galaxias* 'Pomahaka'). The presence of the Pomahaka galaxiid here is significant as this species have been severely impacted by trout predation and is ranked as Threatened - Nationally Vulnerable.

If further monitoring were undertaken using eDNA, it may show that additional native species are found in these waterways. Work has already been undertaken by the farm owners to improve the quality of water that leaves the farm by fencing off waterways, riparian planting and management of critical source areas. There are also two natural ponds present on the property that provide habitat for waterfowl and kōura. The waterways in the scrubby gullies of the western side of the property are not currently fenced from stock, which is contributing to bank erosion and pugging around the streams. As described in Goal 2, a plan is in place to retire these gullies and thereby restore the health of the waterways in them.

Asset 3: Red Tussock

There is about 12 ha of red tussock grasslands, mainly found on the upper slopes and back side of the farm in wetter areas. Red tussock provides habitat for many indigenous invertebrate species including several moth species. Red tussocks are likely much wider spread than they were before human settlement. After deforestation from fires, red tussocks would have expanded and persisted in areas that would have been historically forested and remained dominant in the landscape as a result of ongoing fires. Tussock lands can also have important value as lambing shelter.



Biodiversity Management Goals

The biodiversity management goals have been developed keeping in mind your vision for South Farm. The biodiversity management goals listed below are ranked in order of priority to be undertaken within a five-year period. Undertaking these tasks will ensure that you achieve high-quality biodiversity management outcomes for South Farm.

The biodiversity management actions undertaken to achieve the goals will need to be recorded and reviewed annually alongside your usual farm management planning so that you can make informed biodiversity management decisions for the coming year. This allows you the flexibility to carry out the work when you have the capacity and make changes in the face of unexpected events.

Biodiversity goals shortlist:

1. Implement biodiversity monitoring
2. Enhance biodiversity values of the gullies
3. Plant mixed species shelterbelts
4. Continue riparian planting of waterways
5. Restoration plantings below Pete's Pond
6. Establish predator control network
7. Review biodiversity management plan

Goal 1 – Implement biodiversity monitoring.

This goal aims to establish a biodiversity management plan for South Farm. All records collected through the below monitoring actions must be kept for at least 5 years although it is recommended that you keep them in perpetuity as their value will be in the long term (including for future generations).

Actions:

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 entails taking photos from the exact same location, in the exact 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 South Farm, your initial photo-points should show a view of areas where management actions such as planting, weed control and stock fencing are planned to occur. Further detail on these methods is found in Appendix 1.

Establish automated acoustic bird monitoring.

One acoustic bird recorder should be purchased from the Cacophony Project (<https://www.2040.co.nz/collections/cacophonometer-bird-monitoring>). This should be set to run for a full year in the homestead garden, but well away from the house and other places where there may be a lot of noise from people and machinery. If there is cellphone coverage where the recorders are located and a monthly cellular data package is purchased, 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. At this stage, the AI can only identify ruru/morepork, and groups all other bird species into "generic bird call". However, it is expected that within the next 3-5 years the AI will be advanced enough to identify all common bird species in Aotearoa. This will allow for records stored on the Cloud to be reanalysed and you will receive a much more detailed record of the birds that you have been recording.

Freshwater monitoring

Take an environmental DNA (eDNA) test of waterways: Water samples should be taken annually from the identified locations on the eDNA monitoring map in Appendix 1. These

sites are at the outflow of the waterways on the farm. 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. To isolate the effects your farming practices are having on water quality on the farm, samples should be taken where water enters (upstream control site) and where it leaves the property. Refer to the SHMAK monitoring map in Appendix 1 for sampling site locations.

If possible, purchase a SHMAK kit within your catchment or community conservation group to share the costs, alternatively, the local and regional councils may have a kit you can borrow. You will likely need someone with freshwater ecology knowledge to undertake the Macroinvertebrate Community Index assessments and fish presence/abundance.

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

SHMAK ordering form:

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

Predator control monitoring: Records should be kept of all trapping data along with hunting and incidental sightings of predators and feral ungulates. You can use <https://trap.nz/> to record trapping data.

Benefits to biodiversity

Understanding what species are on the property and how their presence is changing as a

result of management actions will influence future decisions on how to manage these species to further increase biodiversity on your property.

Effect on farm business

Monitoring changes in biodiversity on farms is expected to become more 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 be reinforced as new regulations come into effect. It is important to have a record of any biodiversity enhancement conducted on your property.

Estimated costs

- Automatic bird recorder = \$419 + annual cloud storage @ \$79.
- SHMAK standard kit with clarity tube = \$600 (some consumables will need to be re-purchased).
- Basic freshwater eDNA package = \$160 per sample.
- Photo-points – cost of metal standards to mark locations.

Goal 2 – Enhance biodiversity values of gullies.

As the main biodiversity assets on the farm, the vegetated gullies should be managed to prevent further degradation by excluding stock where possible, especially cattle. Trampling by stock causes compaction of the soil and restricts plants' ability to uptake nutrients and oxygen, while browse prevents native species from regenerating. Stock also contributes to the erosion of stream banks, and increases sediment and effluent in the waterways. These regenerating gullies are also home to two Nationally Threatened species of *Olearia* tree daisies

Olearia lineata and *Olearia fimbriata* should be protected for their biodiversity values and due to their threatened status (At Risk – Declining and Threatened – Nationally Vulnerable, respectively). Both species are endemic to the South Island and are known only from scattered sites with few individuals. The majority of the known populations are not officially protected and regeneration is often limited. The biggest threat these species face is regeneration failure due to competition with exotic grass swards. Other threats are habitat

fragmentation, animal browsing, and fire.

It is important to take into consideration the limitations of the natural regeneration that will occur within these blocks. As this is a dry and fairly harsh climate, coupled with the presence of wild deer and hares, natural regeneration may be limited. While the competition of pōhuehue and bush lawyer in the gullies may be of concern now, these species are dominant because the ecosystem within these areas is unbalanced due to herbivory from stock and deer. These native vines flourish in highly modified sites such as these gullies. The long-term goal is that with stock and deer exclusion and maintenance of the vines, the natural balance of these areas will be restored and natural regeneration will occur.

Pohuehue (*Muehlenbeckia australis*) and bush lawyer (*Rubus cissoides*) are native plant species and therefore there is little information online on how to control them in situations where they are hindering regeneration. In open canopy habitats and disturbed, such as the gullies on this farm, these species can dominate the vegetation, smothering out other indigenous species. Information on controlling vine species can be found on the Weedbusters website:

<https://www.weedbusters.org.nz/what-are-weeds/controlling-weeds/controlling-pest-vines/>

Options for retirement

In the table below, you will find various options for retiring all or some of the vegetated gullies on South Farm. Included are the cost estimates for 6-wire fencing as well as deer fencing. As deer will hinder natural regeneration and any enrichment planting, deer fencing should be considered. Maps of the four different options can be found on pages 20-23.

Name	Description	Fence length (m)	Fencing cost (\$7/m)	Deer fencing cost (\$18/m)	Area retired (ha)
Option 1	Full retirement of all 3 gullies	866 + 362	\$8,596	\$22,104	36
Option 2	Retirement of top two gullies	866	\$6,062	\$15,588	23
Option 3	Retirement of cabbage tree block	932	\$6,524	\$16,776	10.3
Option 4	Retirement of scrubby paddock gully	455 + 362	\$5,719	\$14,706	8.5

Actions:

Choose which option, or combination of options is going to work best for you while also providing good biodiversity outcomes.

- Create a plan to conduct enrichment planting in the gullies. This should only be done once stock are excluded from the area.
 - One option is to plant clumps of 3-5 plants in the gullies, including *Olearia* tree daisies and using the recommended species list in Appendix 2. Plant 50 of these clumps and fence them from stock if the gullies are not able to be entirely fenced initially.
- Plant following best practice methods as per Appendix 4.
- Consider eco-sourcing especially the *Olearia* trees (see Appendix 3). Maintain plantings following best practice methods (Appendix 4).
- Control 'native weeds' pōhuehue and bush lawyer where necessary.
- Exclude stock (especially cattle) from *Olearia lineata* and *Olearia fimbriata* sites. Light sheep grazing when necessary.
- Control exotic grasses around plantings using glyphosate or other herbicides if necessary.
- Control deer when they are known to be frequenting these gullies.

The presence of native fruit and nectar trees should be increased on the property to encourage native birds and insects. Consider establishing some native plantings around the homestead and other suitable areas coupled with predator control. A recommended species list is provided in Appendix 2.

Benefits to biodiversity

By excluding stock and planting native species you will be assisting the regeneration of these gullies and therefore increasing the overall biodiversity value of your farm. Excluding stock from the streams in the gullies to allow regeneration will provide a healthier habitat for aquatic species living in the streams. And waterway regeneration also provides habitat for indigenous bird and insect species.

Protecting this species is important for conserving the range of endemic species in NZ. *Olearia lineata* is not often commercially cultivated therefore increasing the population size found on South Farms will help this species recover. The fragrant flowers of *Olearia lineata* also attracts many different native pollinating species and is a host to several endemic moth species.

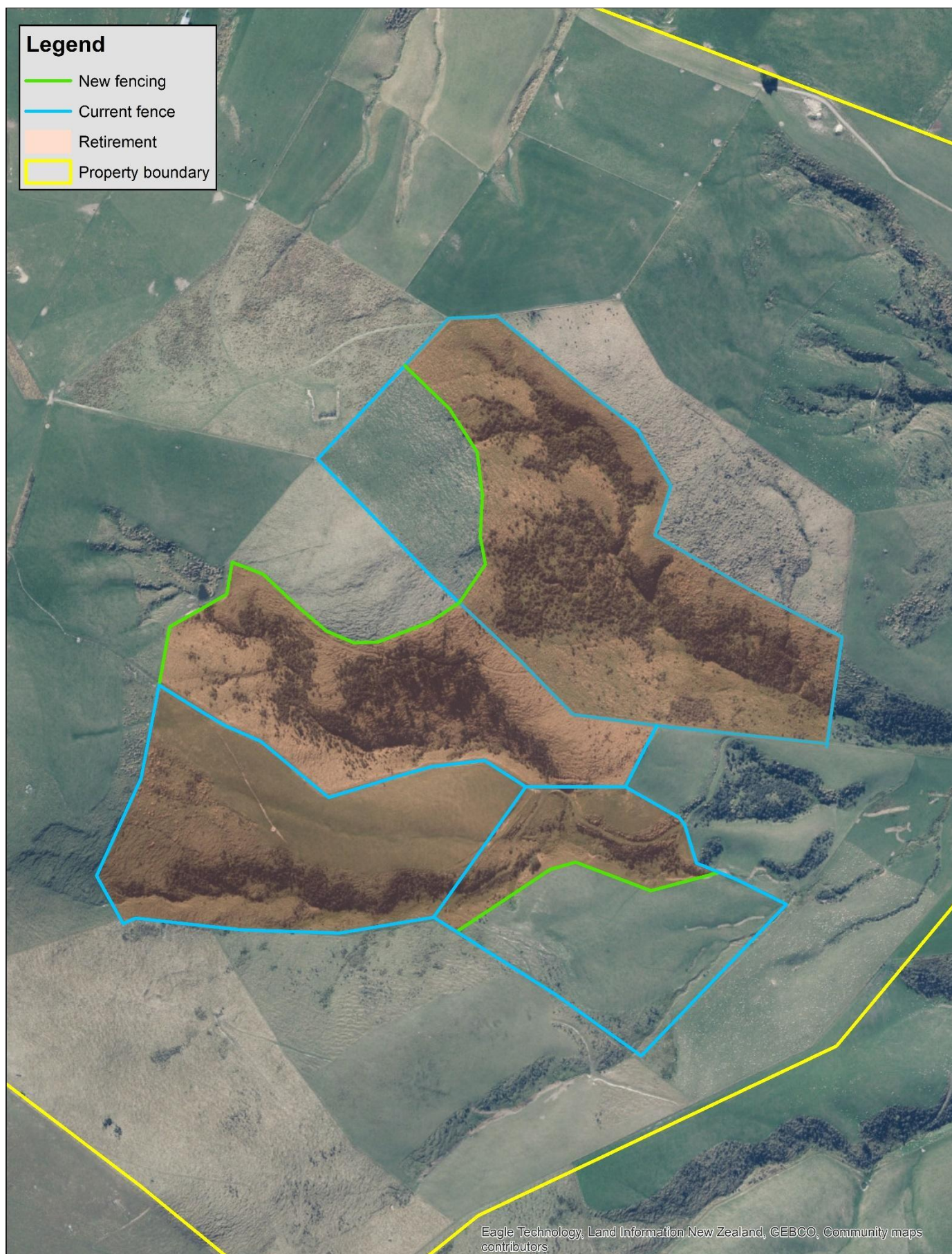
Effect on farm business

Indigenous shrubland like that found in the gullies on this farm provides many ecosystem services. Such as contributing to healthier waterways by reducing runoff and sediment in waterways. It also demonstrates South Farms' commitment to preserving the biodiversity values found on the property and contributing to the conservation of an 'At Risk' endemic plant species.

Estimated costs:

- Estimated costs of fencing: Dependent on which option is chosen, costs are detailed in the table on page 18.
- Pre-spray: Estimated average spray contractor price for herbicide spot spraying is \$2/stem.
- Average cost of native seedlings is \$3.
- Plant guards and stakes range between \$1.20 - \$2.80 each.
- Maintenance: Weed release seedlings 12 months after planting @ \$2/stem.
- Vine weed control costs \$69/hr for a contractor to complete the task, or \$68/ha for cut and paste method [1].
- Propagating materials: If done through a nursery, costs may be \$3/plant.

[1] Information retrieved from:
[https://www.mpi.govt.nz/dmsdocument/50209-Review-of-actual-forest-restoration-costs-Contract-Report-Prepared-for-Te-Uru-Rakau-New-Zealand-Forest-Service-November-26-2021#:~:text=Taking%20average%20costs%20for%20seedling,ha%20%3D%20%245%2Fseedling\).](https://www.mpi.govt.nz/dmsdocument/50209-Review-of-actual-forest-restoration-costs-Contract-Report-Prepared-for-Te-Uru-Rakau-New-Zealand-Forest-Service-November-26-2021#:~:text=Taking%20average%20costs%20for%20seedling,ha%20%3D%20%245%2Fseedling).)



Option 1 Retirement

0 50 100 200 300 400 Meters

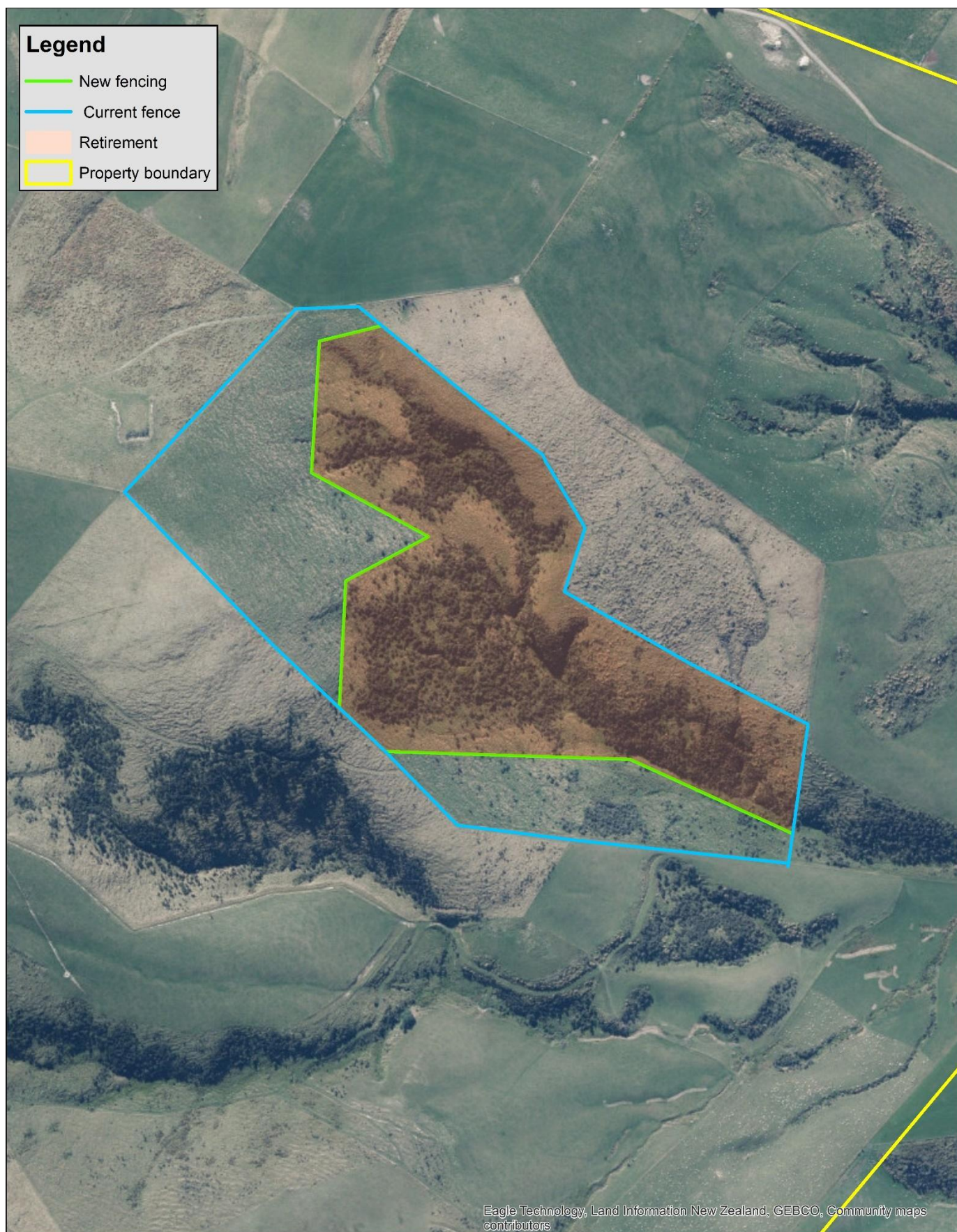




Option 2 Retirement

0 50 100 200 300 400 Meters

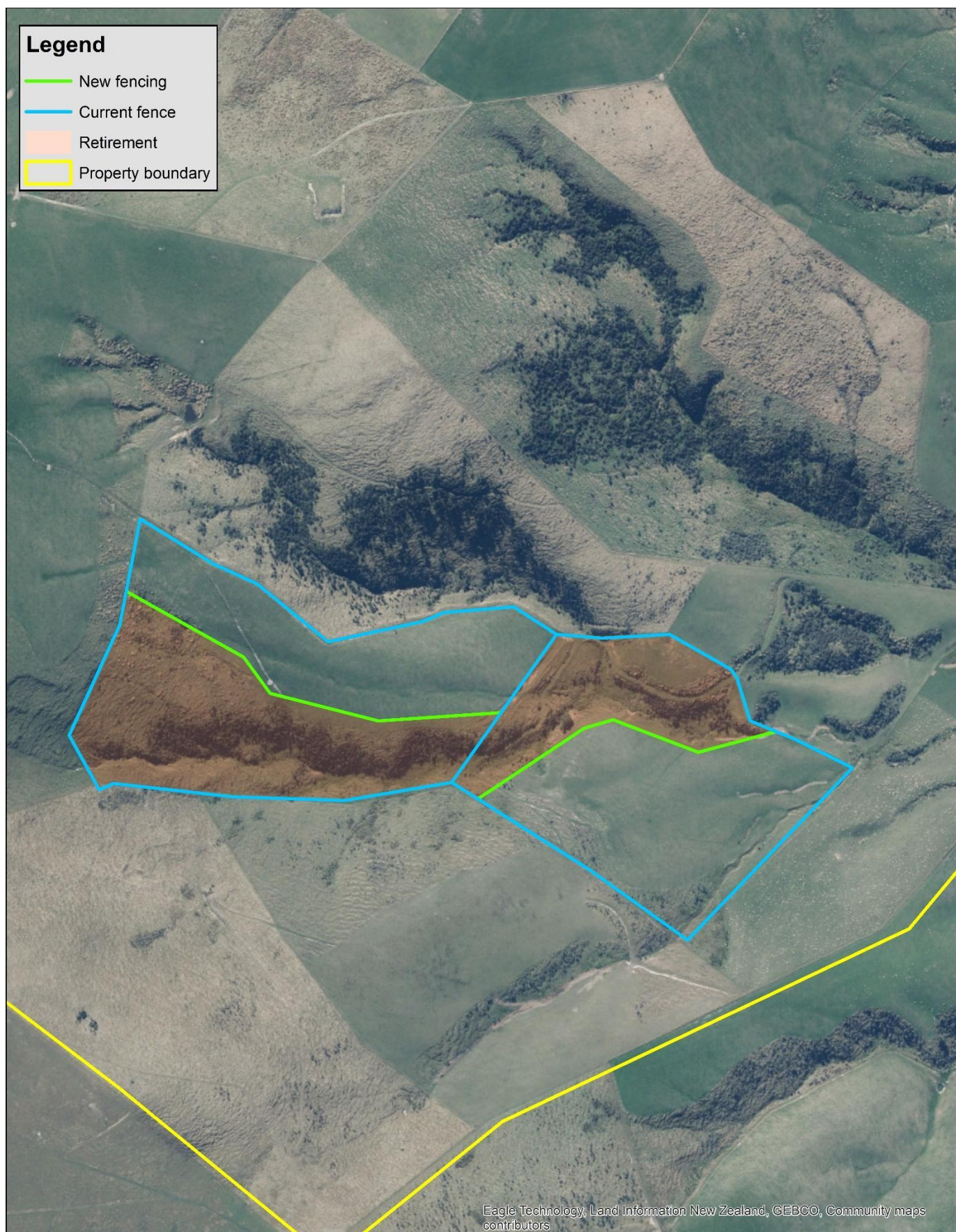




Option 3 Retirement

0 37.5 75 150 225 300 Meters





Option 4 Retirement

0 37.5 75 150 225 300 Meters



Goal 3 - Plant mixed species shelterbelt

This goal aims to provide shelter for stock along the top paddock by planting a mixed native and exotic shelter belt. The fast-growing eucalypts will provide early shelter for stock and a nursery crop for the slower growing natives. It is also recommended to create 'nodes' of indigenous species at paddock corners and around gateways, or, every 350 m along the shelter belt which is 1.1 km long. Further details on species and methodology are found in Appendix 4.

For an indigenous shelterbelt to be ecologically viable long term, the strip should be as wide as possible. This is because weather conditions hinder the growth of the most exposed plants on the outside of the planting, this is called edge effects, read more about this here:

<https://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/bush-restoration/under-stand-the-bush/edge-effects/>

Actions:

- Fence off area from stock. The proposed shelter belt will be approximately 1.1 km long and should be at least 8 m wide.
- Plant and maintain following best practice methods, see Appendix 4.

Benefits to biodiversity

The indigenous and exotic plants in the shelterbelt will provide food resources for native birds and insects and promote habitat connectivity for indigenous species. Then these species can provide ecosystem services such as pollination and increased soil health.

Effect on farm business

Shelter is essential for animal welfare and where natural shelter (shrubs, tussocks, topography) isn't available, shelterbelts are important for providing shelter. Unpredictable weather is becoming the new normal so storms affecting spring lambing, wind exacerbating drought effects and excessive summer temperatures are all reasons for making sure there is sufficient shelter on the property. Woodlots (especially made of natives) also have the potential for carbon sequestration and to enhance biodiversity values.

Estimated costs:

- Fencing: Average of \$7/m = ~ \$7,980 for the entire length (1,124 m long, 8 m wide).
- Price of eucalypt: 2 alternating rows with 6 m spacing, 370 seedlings will be required. Average price \$4 each, = \$1,480.
- Price of native species: using 2 m spacing, 1,124 seedlings will be required (2 rows of 562). Average price is \$4 each, = \$4,496.
- Use bark chip on plantings to retain moisture in soil = ~\$79 per cubic meter. Planting site preparation: Spot spraying \$2 per stem.
- Release spraying (annually): ~ \$2 per stem.



Proposed Shelter Belt and Indigenous Nodes

0 50 100 200 300 400 Meters



Goal 4 - Continue riparian planting of waterways.

Water Creek and D Creek on South farm have already been fenced off and riparian planting begun. The long-term goal is to eventually have all waterways on the property fenced and riparian planted. Within the scope of this plan, the priorities should be for Water Creek and D Creek to be fully riparian planted and Rye Creek and Campbell Creek to be fenced and planted as all four waterways are considered low slope land under the new stock exclusion regulations (see map in Appendix 7). A plan should be formulated to target one of these waterways each year.

Actions

- Order 1,000 plants each year for riparian planting.
- Plant riparian zone following best practice methods, see Appendix 4. See Appendix 2 for a recommended species list.
- Maintain plantings following best practice methods, see Appendix 4.

Benefits to biodiversity

Riparian planting reduces the amount of sediment and nutrient runoff into waterways. It also provides habitat for indigenous fauna and shades the waterways, improving the habitat for freshwater species and reduces algae and aquatic weeds.

Effect on farm business

Riparian planting improves the quality of water running through the farm and provides many ecosystem benefits such as pollination and improved soil health. These riparian plantings will also provide shelter for stock.

Estimated costs:

- Estimated lengths and costs of fencing required (\$7/m):
 - Campbell Creek: 310 m (\$2,170)
 - Rye Creek: 270 m (\$1,890)
- Native seedlings are \$4/each on average.
- Planting site preparation: Spot spraying \$2 per stem. Release spraying (annually): \$2 per stem.



Proposed Fencing for Campbell Creek

0 50 100 200 300 400 Meters





Proposed Fencing for Rye Creek

0 25 50 100 150 200 Meters



Goal 5 - Restoration plantings below Pete's Pond

This goal aims to establish restoration plantings surrounding Pete's Pond and the bank that extends below the pond, see map page 32. The area marked out on the map is 0.85 ha. Using plant spacing of 1.8 m in the moist and dry (zones A and B), approximately 2,700 seedlings will be required to plant the 0.85 ha area. Seedlings should be planted at spacings of 1 m in the wet areas surrounding the pond. A recommended species list is attached in Appendix 2.

Actions

- Fence off area before planting.
- Prepare the site for planting following best practice methods, Appendix 4. Conduct plantings following best practice methods, Appendix 4.
- Maintain plantings following best practice methods Appendix 4.

Benefits to biodiversity

Riparian planting reduces the amount of sediment and nutrient runoff into waterways. It also provides habitat for indigenous fauna and shades the waterways, improving the habitat for freshwater species and reduces algae and aquatic weeds.

Effect on farm business

Riparian planting improves the quality of water running through the farm and provides many ecosystem benefits such as pollination and improved soil health. These riparian plantings will also provide shelter for stock. This area is not currently included in the stock exclusion regulations.

Estimated costs:

- Fencing required: approximately 400 m = \$2,800.
- Native seedlings are \$4/each on average. $2,700 \times 4 = \$10,800$. Planting site preparation: Spot spraying \$2 per stem = \$6,172.
- Release spraying (annually): ca \$2 per stem = \$6,172.



Petes' Pond Restoration Area

0 12.5 25 50 75 100 Meters



Goal 6 - Establish predator control network.

This goal aims to establish a trapping network that targets mustelids, possums, cats, and rats. Monitoring the response of birdlife to predator control will be the best indicator of how effective your predator control is.

To begin with, predator control should be focused around the homestead, where there are likely to be more food resources for birds. Possum traplines could later be installed within the fenced riparian zone of waterways and in gullies once they are fenced. There are most likely high numbers of possums in the regenerating gullies as possum sign was seen during this assessment.

Possum behaviour tips:

- They are nocturnal and feed at night.
- Often follow the same track, forming flattened paths about 20 cm wide.
- Have an average home range of 200 m in forest and multiple nest sites.
- Have favourite trees that are visited regularly, leaving extensive scratch marks in their bark and heavy browsing of leaves and fruit.
- Their dislike of wet weather makes control much more successful during fine weather.
- They respond well to visual lures (blue and white in particular) and are attracted to fresh fruit, peanut butter, and a sprinkling of icing sugar over the lure.

Using a long-life lure that is easy to apply and can be kept on a quad bike is the best method to ensure your traps are kept freshly baited. Mayonnaise is used as best practice in the predator control industry as it has a very long shelf life and all target species are attracted to it, but especially mustelids and rodents. Zero Invasive Predators (ZIP) sell an automatic lure dispenser for mayonnaise that can sit on a trap box or be screwed into a fence post or tree <https://zip.org.nz/products-list/motolure>. Peanut butter is a good long-life lure for possums, but they do like mayonnaise too.

Actions:

- Establish monitoring using tracking tunnels and chew cards. Purchase traps:

- DOC200 for mustelids
- Timms trap for possums and cats, alternate bait to target the different species
- T-rex for rats.
- Purchase lure (mayonnaise and peanut butter, fresh rabbit for mustelids during winter).
- Install trapline around the homestead at first, then riparian zones and gullies. See map on page 34 for suggested trapline locations.
- Monitor progress as per Goal 1.

The following link is a good resource for setting up predator control in a bush block:

<https://predatorfreenz.org/toolkits/trapping-baiting-toolkit/farms/bush-blocks/>

This link provides further information on predator control on farmland:

<https://predatorfreenz.org/toolkits/trapping-baiting-toolkit/farms/>

This link provides different options for controlling pests in wetlands and riparian zones on farm:

<https://predatorfreenz.org/toolkits/trapping-baiting-toolkit/farms/wetlands-riparian-zones/>

This link provides some detail around setting up traplines:

<https://predatorfreenz.org/toolkits/trapping-baiting-toolkit/bush-large-areas/how-to-set-traplines/>

Benefits to biodiversity

Controlling mustelids, possums and rats across your farm will greatly increase its biodiversity values as those introduced species predate upon native birds, insects and lizards. Possums also browse on native vegetation and can strip trees of their foliage. Controlling predators on your property contributes to the Government's goal to become predator free by 2050: <https://www.doc.govt.nz/nature/pests-and-threats/predator-free-2050/>.

Effect on farm business

Controlling pests on farm will not only help increase native biodiversity but will also benefit the farm business as possums are TB vectors.

Estimated costs

DOC200 cost: **\$81.50** (trap + wooden box) from Connovation:

<https://www.connovation.co.nz/collections/mustelids-traps/products/doc200-trap-range?variant=34016628244619>

You can save costs by making the trap boxes yourself.

Timms traps cost: **\$80** from

https://store.pggwrightson.co.nz/timms-possum-trap-123680?gclid=Cj0KCQiAyMKbBhD1ARIsANs7rEGouG_P0-Ux6XdlfCN81lt3Qcp1cA_MfUnEQMXCZ0Kb3l3WWMEByTUaAtF_EALw_wcB

T-rex (for rats) cost (3-pack): **\$39**

<https://shop.predatorfreenz.org/products/3-pack-of-t-rex-rat-traps-incl-shipping?variant=35156716552353>

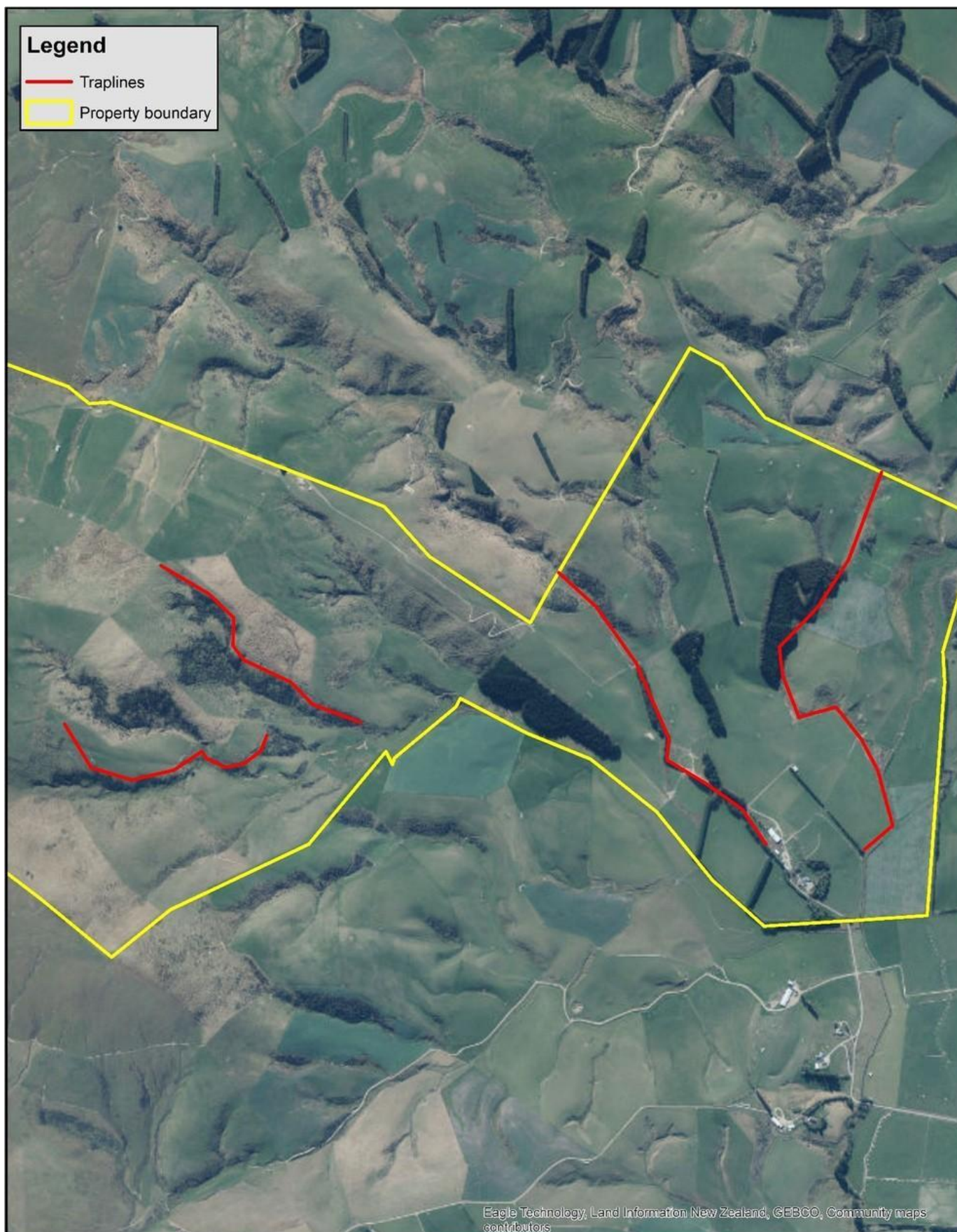
A24 cost: **\$169** from Goodnature:

https://goodnature.co.nz/products/trap-kit?gclid=Cj0KCQiAyMKbBhD1ARIsANs7rEFkjtEEIgbLx2VOMVCy5B9RsXFCrVKPHyDHXZEz4zflWAPFpCg1YuAaAncMEALw_wcB

Best foods mayonnaise: **\$10** per jar

Peanut butter: ca **\$6** per jar





Potential Trapline Locations

0 125 250 500 750 1,000 Meters



Goal 7 - Review biodiversity management plan

It is important that this biodiversity plan is reviewed regularly and the results from monitoring are used to guide future management. The whole biodiversity plan should have a substantial review every 5 years, annual reviews and updates to the 5-year operational plan will also be required.

Actions

- Review this biodiversity plan at the same time as setting the overall farm work programme and budget for the next year. This review will include:
 - Summarise the results of monitoring information from the past year.
 - Undertake a review of biodiversity management achievements against what was proposed and assess 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.

Effect on farm business

Having records of biodiversity work undertaken and results of monitoring is required to show documented evidence of your biodiversity management actions. This is necessary to comply with regulations, and market assurance programmes and will also ensure access to competitive lending terms with some financial institutions

Appendix 1: Biodiversity monitoring

Photo point monitoring technique

Regular repetition of photographs under the same seasonal conditions will be the best way to monitor the actual effect that these management actions are having on vegetation regeneration in the wetlands. 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.

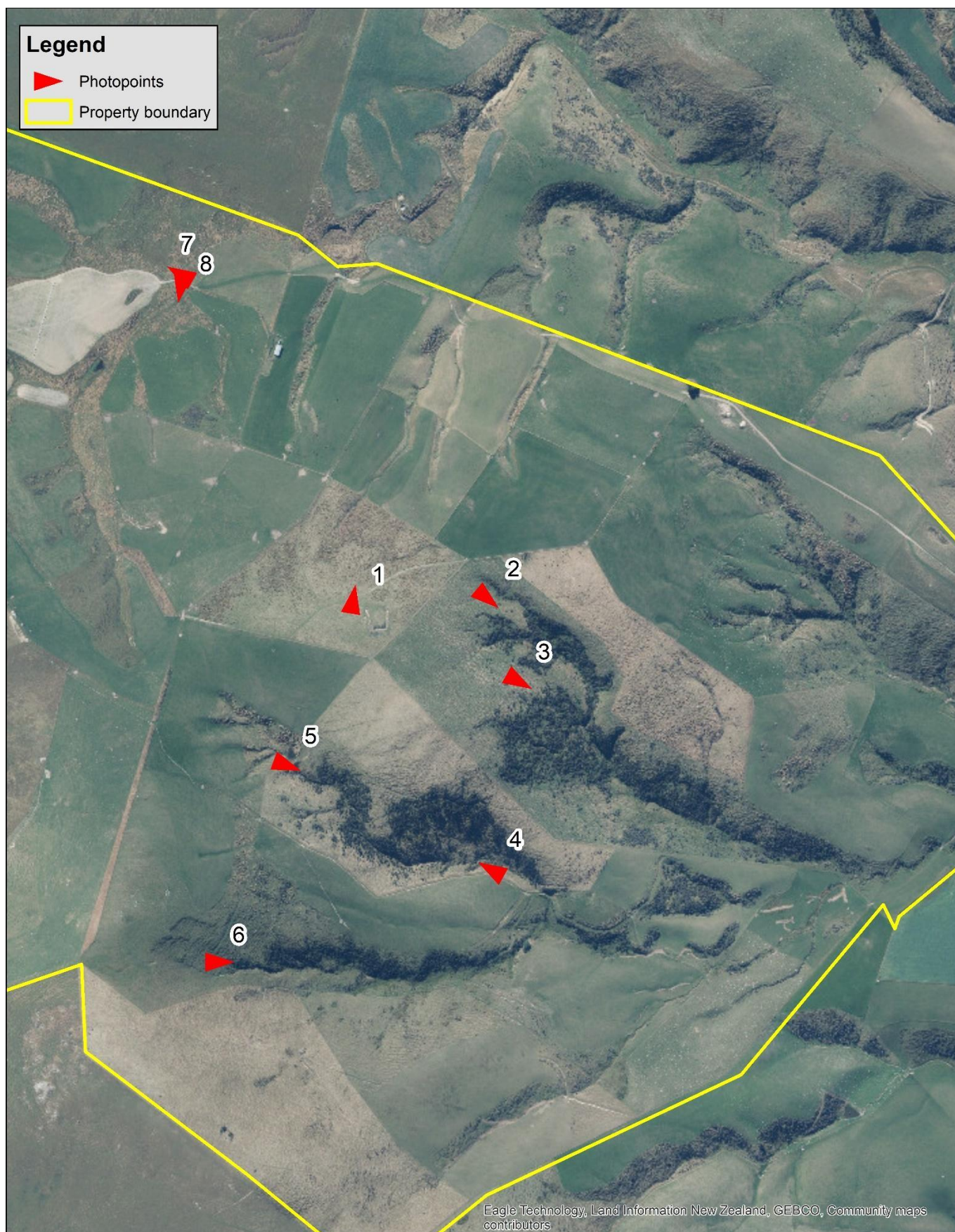
Aligning the frame of repeated photos is key. It is recommended that you take copies of the original photos out with you when taking follow-up photos to ensure that you are pointing the camera in the same direction (consider using a compass bearing) and showing the same trees year on year. Relying on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



Landscape photo-point showing change in vegetation cover on a retired sheep and beef farm over 13-years (2005 left, 2018 right). Note the increase in shrub cover on the hill side in the top right and restoration plantings below this.



Over three years with grazing animal retirement. Note background trees for reference.



Suggested Photopoint locations

0 62.5 125 250 375 500 Meters





eDNA Sample Sites

0 62.5 125 250 375 500 Meters





SHMAK Sample Sites

0 62.5 125 250 375 500 Meters



Appendix 2: Recommended planting list

Species recommendations for the cabbage tree block				
Zone A - Wet and boggy. Zone B - Moist/ Occasionally wet. Zone C - Dry				
The major, moderate, or minor is intended to direct numbers/ mix of plants used in a riparian/ restoration planting. Therefore, the bulk of the plants would compose 'major' species, with some of the 'moderate' species and only a few of 'minor' species. The species mix may be in the order of 10 'major' species to 5 'moderate' to 1 'minor' species.				
Common name	Scientific name	Mix of plants	Zone	Notes
Trees				
Fragrant tree daisy	<i>Olearia fragrantissima</i>	Moderate	C	This species prefers warm, fertile soils with plenty of light. It is suited to rocky outcrops and hill slides.
Hall's tōtara	<i>Podocarpus laetus</i>	Minor	C	A Hardy species that can tolerate a wide range of conditions. Early pioneer species.
Hector's tree daisy	<i>Olearia hectorii</i>	Moderate	B & C	A rare, deciduous tree daisy species that prefers damp, cold valley floors and hill slopes. It requires an open canopy.
Kahikatea	<i>Dacrycarpus dacrydioides</i>	Minor	B	Requires moist, well-drained soils.
Kāpuka (Broadleaf)	<i>Griselinea littoralis</i>	Minor	B & C	Canopy species. Relatively tolerant of harsh temperatures but may struggle to establish. Very palatable to stock.
Kōhūhū (Black matipo)	<i>Pittosporum tenuifolium</i>	Major	C	Early successional species. Hardy. Will grow in any site. Susceptible to myrtle rust.
Linear-leaved tree daisy	<i>Olearia lineata</i>	Moderate	C	This rare species is suited to alluvial flats, terraces, steep hill sides and rocky outcrops.
Mānatu (Lowland Ribbonwood)	<i>Plagianthus regius</i>	Major	B	Fast growing main canopy species. Tolerates wet and some shade and dry. Shelter for tree seedlings. May struggle if pruned.
Mānuka	<i>Leptospermum scoparium</i>	Moderate	C	Fast-growing early successful canopy species. Intolerant of shade. Tolerates damp soils.

Mataī	<i>Prumnopitys taxifolia</i>	Minor	B	Emergent and main canopy component. Requires shelter plants around seedlings. Suitable for slightly drier sites than kahikatea but not as dry tolerant as tōtara.
Narrow-leaved lacebark	<i>Hoheria angustifolia</i>	Major	B	Wetland edges and dryer sites. Fast-growing main canopy species. Similar to lowland ribbonwood but more dry-tolerant.
Putaputāwētā (Marbleleaf)	<i>Carpodetus serratus</i>	Moderate	C	Sub-canopy species that requires shelter trees to grow well. Plant where it will get watered from pivot.
Red beech	<i>Fuscopora fusca</i>	Minor	B & C	Grows fast early. Requires moist, free-draining soil and shelter when young.
Silver beech	<i>Lophozonia menziesii</i>	Minor	B	Requires moist soil and shelter when young. Can be pruned.
Small-leaved tree daisy	<i>Olearia fimbriata</i>	Moderate	C	A rare daisy species that suits dry, exposed sites.
Tarata (lemonwood)	<i>Pittosporum eugenoides</i>	Major	B & C	Fast growing main canopy species. Tolerant of some shade and dry. Frost tender when young.
Ti kōuka (Cabbage tree)	<i>Cordyline australis</i>	Major	B	Important habitat for birds and invertebrates. Shelter for tree seedlings. Plant where no pruning is needed.
Shrubs				
Bloodwood	<i>Coprosma wallii</i>	Moderate	B & C	A hardy shrub that is suitable for most sites.
Coprosma	<i>Coprosma dumosa</i>	Moderate	B & C	A hardy species that is shade tolerant and prefers free-draining soils.
Coprosma	<i>Coprosma rigida</i>	Moderate	B	Prefers a shady site in moist soil.
Koromiko	<i>Veronica salicifolia</i>	Major	B	Hardy shrub, intolerant of dry soil. Will provide shelter for slower growing species.
Mingimingi	<i>Coprosma propinqua</i>	Major	B & C	Very hardy shelter shrub suitable for most sites.

Tauhinu (Cottonwood)	<i>Ozothamnus leptophylla</i>	Moderate	B & C	Suits dry to moist soil. Fast growing hardy shrub.
Teucrium	<i>Teucrium parvifolium</i>	Moderate	B & C	Suitable for river margins, poor soils and exposed sites.
Weeping matipo	<i>Myrsine divaricata</i>	Minor	B	Prefers moist soil and partial shade. 6 m when mature.
Tussocks and tussock-like plants				
Harakeke (Flax)	<i>Phormium tenax</i>	Major	A	Tolerant of permanently wet soil. Shelter for tree seedlings.
Purei	<i>Carex secta</i>	Major	A	Bank stabilising, sediment filtering, habitat-forming. All-purpose wetland plant. Excellent for tree seedlings. Can grow to 5 m tall.
Red tussock	<i>Chionochloa rubra</i>	Moderate	A	Prefers damp soil but can handle dry sites.
Toetoe	<i>Austroderia toetoe</i>	Major	A	Tolerant of permanently wet soil. Shelter for tree seedlings. Use instead of exotic pampas.

Appendix 3: Eco-sourcing

Eco-sourcing benefits native biodiversity by using seeds from plants that naturally occur in the area. They therefore will be genetically adapted to the conditions and more likely to survive. Getting seedlings that have been grown from seed is much better than plants that have been propagated from cuttings, since cuttings are genetically identical to one another and the population will therefore not be robust against the risk of disease and adverse weather. Genetic diversity within a population is needed for survival. When eco-sourcing seeds, you should collect them from a variety of different plants as well as slightly different times in the season.

Resources on propagation of natives and a calendar for seed collection can be found on DOC's website:

<https://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/native-plant-restoration/ecosource-seeds/>

Basic guide to setting up a native nursery:

https://www.whitebaitconnection.co.nz/images/wbc/resources/HK_Resources/He_Kkano_How_to_set_up_a_native_plant_nursery.pdf

Mānuka:

They have seed capsules from September to May, but you can often find capsules most of the year. When the flower petal falls off and a brown capsule remains, collect the capsules before they split open and place them in a paper bag to open and release the seeds. Leave in a dry/warm place for two days, then look at the very bottom of the bag to find the seeds. They look like red eyelashes.

Harakeke:

Harakeke have flowers from September to November and have seeds from November to March. You may notice old empty stalks from past years. Pick the whole 'pod' off of the harakeke stalk and it put straight into a bag or container. Gently open the pod and let the shiny black seeds fall out.

Tī kōuka:

Tī kōuka have berries from December to March. The berries are white with blue speckles. Often you will only find one bunch of berries per 'head' of leaves. Each berry may contain 1-10 seeds inside. Get in quick! Kererū love to eat these berries. Gently squash them

between your fingers, wash in a sieve to get rid of the flesh and find the little black seeds inside.

Kōwhai:

Kōwhai have very small leaves, actually called 'leaflets'. Sometimes you can find kererū eating the new leaves. Kōwhai have seeds from October to May. Seed pods can be picked when the long strands of cases are dry and brown. There is one seed inside each 'bubble'. Kōwhai seeds have a hard-yellow shell that needs to be broken in order for germination to start. Ask an adult to cut an end off with scissors or rub the seed on sandpaper until you can see the pale inside. Caution! Kōwhai seeds can be toxic so keep them away from young children.

Karamū:

You can collect the berries from March to July. The plant will often have berries of all colours, from green to orange, in each bunch. If the flowers are pollinated they will turn into a berry. You can pick the berries when they are bright orange. Wash and sieve the berries to expose two white, hard seeds.

Information above retrieved on 17/06/22 from:

https://www.whitebaitconnection.co.nz/images/wbc/resources/HK_Resources/He_K%C4%81kano_Seed_Collecting_Guide_1.pdf

Purei (*Carex secta* and *Carex virgata*):

These two species of sedge are commonly found in wetlands, both growing in open sunlight or light shade in wet soil, tolerating water to a depth of 300 to 400 mm. The roots of *Carex secta* can form a trunk-like structure, making the individual plant up to 2 metres tall. The seeds are borne on long spikes – upright in *Carex virgata* and more pendulous in *Carex secta*. Seeds ripen in late summer and are dispersed by floating on water. Be careful when stripping seeds from the seed head as leaf margins can be sharp. Sow on firm seed raising mix and cover lightly with mix. Germination can be a few weeks in warmer temperatures but slower in winter.

Information above retrieved on 17/06/22 from:

<https://www.doc.govt.nz/get-involved/run-a-project/restoration-advice/native-plant-restoration/ecosource-seeds/collecting-and-propagation-guide-grasses/>

***Olearia lineata*:**

Easily grown from semi-hardwood cuttings and fresh seed.

Information above retrieved from:

de Lange, P.J. (2022): *Olearia lineata* Fact Sheet (content continuously updated). New Zealand Plant Conservation Network. <https://www.nzpcn.org.nz/flora/species/olearia-lineata/> (1/11/22)

Appendix 4: Planting Instructions

Plant seedlings into the sprayed area 2-6 weeks after spraying to ensure that weed competition is effectively reduced and any herbicide residue has dissipated. Timing of planting will depend on weather conditions and the result of initial blanket spraying.

It is important to source locally appropriate plants and these may already be available commercially or a nursery will need to be contracted to collect seed and propagate them. Nurseries often need a year in advance to prepare the plants.

If purchasing hardened seedlings from a nursery, be sure to ask whether they treat their native seedlings with a mycorrhizal inoculation. It will be important to ensure that seedlings are able to develop healthy populations of mycorrhizal fungi in their roots prior to planting out. These symbiotic fungi help plants to take up nutrients and water more effectively and can make a significant difference in seedling survival rate when planted into a stressful environment.

Using plant guards helps to suppress weeds around the seedlings and make it easier to find and maintain the seedlings afterwards. They help protect against frosts and drying out in exposed sites. Guards can also help to protect against rabbit and hare browse. Guards should be used in combination with matting, as the weeds that grow up inside the plant guard can compete with the native seedling and are difficult to remove. While they improve the success of plantings, plant guards and mats are optional as they do add a significant cost to the restoration project. Maintenance of plantings will need to be carried out every year, this includes release spraying and control of regrowth of woody weeds.

See planting techniques for Natives technical guide by Tane's Tree Trust:

https://www.tanestrees.org.nz/site/assets/files/1069/8_1_planting_techniques_for_natives-1.pdf

Find options for weed mats and plant guards at Advance Landscape Ltd:

<https://www.advancelandscape.co.nz/shop/Plant%2BEstablishment.html>

Appendix 5: Shelter belts

Shelter is essential for animal welfare and where natural shelter (shrubs, tussocks, topography) isn't available, shelter belts are important for providing this. Unpredictable weather is becoming the new normal so storms affecting spring lambing, wind exacerbating drought effects and excessive summer temperatures are all reasons for making sure there is sufficient shelter on the property. Woodlots (especially of natives) have the potential for carbon sequestration and to enhance biodiversity values.

As a general rule when establishing strip plantings or shelterbelts with indigenous species, the planting should be made as wide as practically possible. The issue with strip plantings that are made too narrow is that if there is a combination of taller trees and shrub species, when the trees mature they will shade out the smaller species and the understory of the planting will open up, meaning that this will not be an ecologically viable planting in the long-term. To combat this, shorter, shrub species should be planted on the outside of the strip and trees in the middle. Another option is to not include trees in the planting and only use shrub species. It is also possible to plant your eucalypts on the windy side, with shorter indigenous species on the other side.

Native restoration plantings have the potential to provide income from carbon sequestration. Although slower growing and sequestering carbon at a slower rate than exotics, they provide carbon benefits for much longer than exotic species as well as providing biodiversity benefits.

The choice of exotic species used for shelter belts should focus on species that are not prone to spread. The Otago Regional Council pest management plan includes a list of species that are prone to spread, and these should not be included.



Eucalyptus subcrenulata with flax providing lower shelter.

Tree species listed as pests in Otago Regional plan (not to be used in shelter belt):

Contorta (lodgepole) pine (*Pinus contorta*), Corsican pine (*Pinus nigra*), Larch (*Larix decidua*) (excluding sterile hybrids), Mountain pine and dwarf mountain pine (*Pinus uncinata* and *Pinus mugo*), Scotts pine (*Pinus sylvestris*), Sycamore (*Acer pseudoplatanus*), Bishops pine (*Pinus muricata*), Douglas fir (*Pseudotsuga menziesii*), Maritime pine (*Pinus pinaster*), Ponderosa pine (*Pinus ponderosa*), Radiata pine (*Pinus radiata*).

Potential exotic species for shelter:

Hybrid pine (*Pinus radiata* x *Pinus attenuata*), cypress species (e.g. Leyland cypress) and eucalypts, all are fast growing and provide good shelter. Silver Dollar Gum, (*Eucalyptus cinerea*) and Heart leaved silver gum (*Eucalyptus cordata*) make for good shelter trees as they are hardy and retain their lower branches whilst also providing food for bees and birds. *Eucalyptus subcrenulata* is a taller eucalypt and drops its lower branches and indigenous shrub species such as flax can be planted in between each tree. Tree Lucerne (*Chamaecytisus palmensis*) is another option that also provides nectar and pollen.

A few examples of shelterbelts with eucalypts and natives can be found here:

<https://www.es.govt.nz/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/community/farming/good-management-practice/documents/Land%20sustainability%20guides%20and%20factsheets/A%20guide%20to%20shelter%20planting%20and%20costs.pdf>



Silver Dollar Gum (*Eucalyptus cinerea*).

All plantings will require exclusion of herbivores including hares. Irrigation will also increase the chance of establishment and early growth.

The following principles underpin shelterbelt and woodlot management:

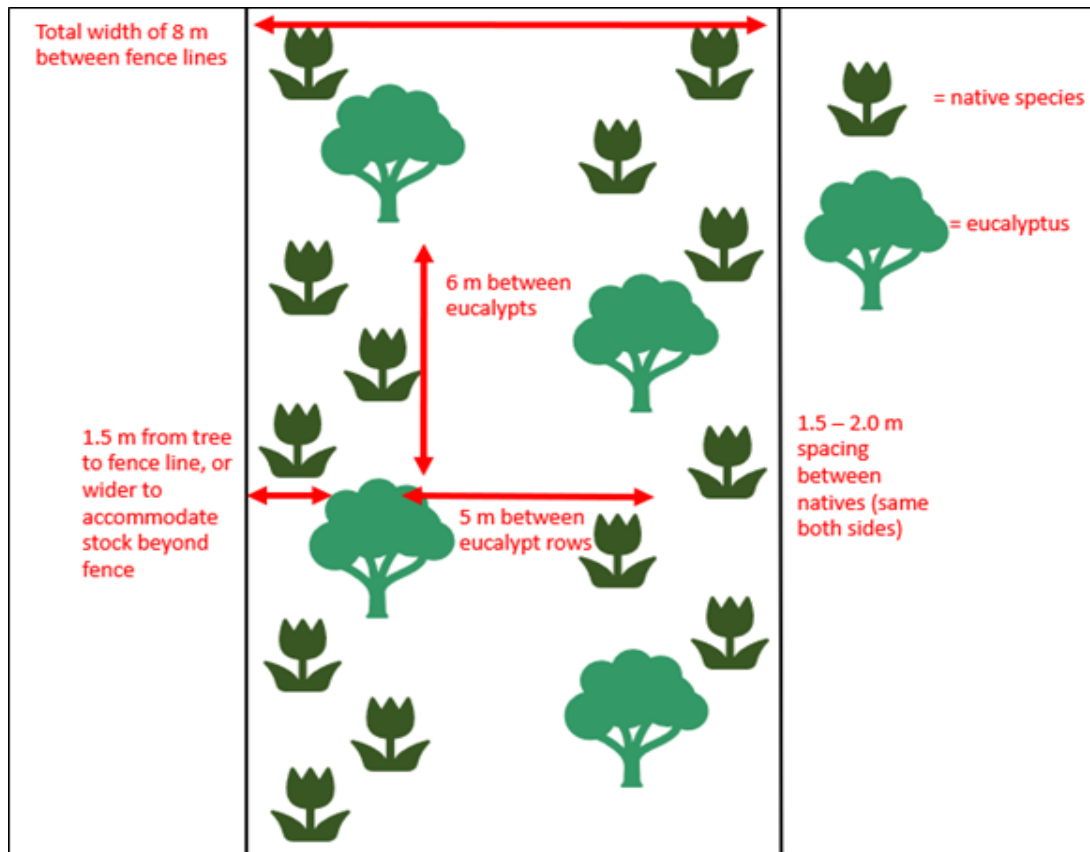
- Shelter is important for animal welfare and sufficient shelter needs to be available for livestock across the whole farm.
- Where possible new shelter should involve native species as well as exotic species that are not prone to spreading.
- Native species used in shelter belts should include those that also provide biodiversity benefits such as fruit and nectar for native birds.
- Native species choice for plantings should reflect species present on South Farm or likely to have been present.
- While eco-sourcing is important to ensure that native plants are adapted to local conditions, sourcing just from the farm isn't a prerequisite and plants from similar environments in the West Otago region are likely to grow well here and can introduce a greater genetic base into plantings.

Trees that are good for bees in Otago:

<https://static1.squarespace.com/static/5c354d3031d4df3e72d75662/t/5cb6e2ca971a18525983d877/1555489483781/New-S5-Otago.pdf>

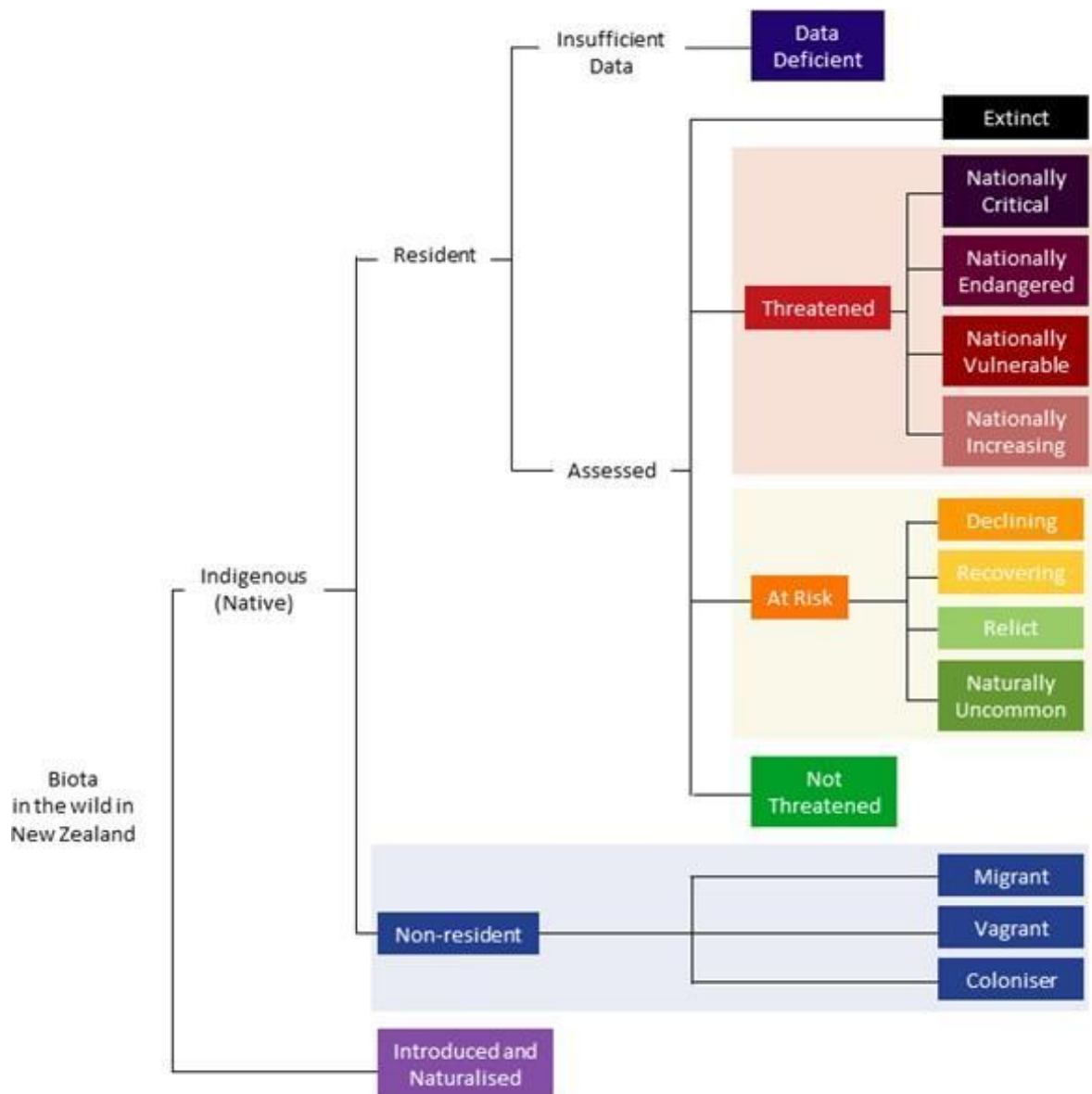
Below is a suggested design for the mixed species shelter belt on South Farm. Native plant species that could be used in this situation should be chosen for their lack of palatability to

stock. Use the suggested species list in Appendix 2.



To further increase indigenous biodiversity and stock shelter, nodes of native species could be created in paddock corners along the ridge where the mixed species shelter is going. See the map on page 27, Goal 3, for suggested locations.

Appendix 6: NZTCS Diagram



Appendix 7: Low slope stock exclusion map

