

ECOLOGICAL MANAGEMENT PLAN FOR THE PROPOSED COMPENSATION SITE AT GLEESON QUARRY, HUNTLY



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South-facing (upstream) view of the proposed compensation site.

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1. INTRODUCTION

Gleeson Quarries Huntly Ltd and Gleeson Managed Fill Ltd are seeking resource consent for the disposal of quarry overburden material and imported clean fill within four new fill areas at the Gleeson Quarries Huntly Ltd landholdings.

Proposed works at the site will result in the loss of approximately 1,530 m² of wetland habitat present within the proposed fill areas. An Ecological Impact Assessment (EIA) of the proposed works (Boffa Miskell 2019) recommended creating or restoring wetland habitat at a ratio of 1:1 as compensation for wetland loss. Given there are no suitable locations at the quarry site to undertake these management actions, a gully on a nearby property also owned by Gleeson Quarries Huntly Ltd has been identified as a suitable compensation location. A preliminary assessment of the proposed compensation location concluded that restoration of this gully will provide sufficient compensation for habitat loss in the proposed fill areas (Wildland Consultants 2020).

The 1:1 restoration ratio recommended in the EIA is only considered appropriate where 'like-for-like' restoration is being undertaken, i.e. restoration of a degraded wetland as compensation for the loss of a degraded wetland. Wetland habitat in the proposed compensation area consists of both indigenous-dominated wetland in relatively good condition and degraded wetland habitat dominated by exotic species. It will be difficult to demonstrate an increase in ecological values by restoring the indigenous-dominated wetland habitats, therefore a larger area for ecological restoration is proposed in order to compensate for loss of values in the proposed fill areas. In order to compensate for loss of wetland function as well as wetland habitat, a holistic approach is provided whereby an entire gully is protected and restored.

The proposed compensation area is approximately four hectares and includes six indigenous and four largely exotic vegetation types. Within this area, five wetland habitat types (two indigenous and three largely exotic) were identified, totalling 5,816 m², resulting in a restoration ratio of 4:1 (gain:loss).

To this end, Paua Planning Ltd, on behalf of Gleeson Quarries Huntly Ltd and Gleeson Managed Fill Ltd, commissioned Wildland Consultants Ltd to develop an Ecological Management Plan (EMP) for the proposed compensation site at Hillside Heights Road, Huntly. This plan provides methods for the management of pest plants, planting, and pest mammal control.

The implementation of this EMP will result in the protection and enhancement of ecological values and an increase in the extent and quality of indigenous wetland and forest habitats within the compensation site.

2. ECOLOGICAL CONTEXT

2.1 Overview

The site is located in the suburb of Huntly within the Meremere Ecological District, which covers an area of *c.*105,300 hectares. Meremere Ecological District is bounded by the Hunua, Manukau and Awhitu Ecological Districts to the north, Raglan Ecological District to the west, Hapuakohe Ecological District to the east and Hamilton Ecological District to the south. It comprises the lower Waikato River floodplains (including many shallow lakes and the Whangamarino wetland) and surrounding hills.

The topography, soils and ecology of the Meremere Ecological District are largely the result of geomorphological and hydrological processes. The steep land around Huntly on the Taupiri and Hakarimata ranges is underlain by greywacke comprised of sandstones and argillites. To the west of Huntly, the greywacke is partly covered by younger marine sediments, which have eroded away in the east. In the cold climate of the last glaciation, post-eruption erosion and floods - including the Taupō eruption in 230 AD - brought debris down the river channels of the Waikato River. In the lower Waikato the debris was deposited alongside the river channel that formed alluvial terraces and trapped drainage from the hills to form extensive lakes including Lake Hakanoa in Huntly (Clarkson *et al.* 2002).

The Taupiri Range in the vicinity of the Gleeson quarry reaches an elevation of 270 metres a.s.l. (Landcare Research 2017). The soils in hill country with hilly and steep slopes are dominantly clay textured, podzolised soils with impeded drainage derived from strongly weathered sedimentary rocks under forest with a high proportion of kauri. There are also some small areas of weakly to moderately leached soils derived from sedimentary rocks on hilly areas. On flattish and rolling slopes, soils are mainly clayey textured, but friable and well drained. On river flats and swamps, soils are poorly drained (McEwen 1987).

The current climate is characterised by warm humid summers with persistent westerly winds, and mild winters; with a rainfall of 1,200-1,400 millimetres per year (McEwen 1987).

2.2 Local context

The proposed compensation site (*c.*3.9 hectares) encompasses a gully and wetlands located on a rural property owned by Gleeson Quarries Huntly Ltd. The property lies approximately one kilometre to the northwest of the quarry; a series of vegetated gullies between the proposed compensation site and the quarry form stepping stone linkages between the sites.

The compensation site includes wetland, gully and treeland habitats that are heavily impacted by grazing of cattle, and is located on the western side of the Waikato River within a highly modified agricultural landscape. Pest plant and animal species are also present at the site.

The stream that flows through the gully has been dammed at the downstream (northern) end of the proposed compensation site to create an irrigation pond. The dam has altered the hydrology of the stream, which has led to the formation of an induced wetland system that extends along most of the gully floor. A wetland is also present north of the dam.

The proposed compensation site has been identified as a Significant Natural Area (SNA_16743) and therefore has legal protection under the Waikato Regional Council Regional Policy Statement 2018.

3. PROJECT GOALS, ACTIONS AND OBJECTIVES

The goal of this plan is to achieve an ecological gain through the restoration of degraded wetland habitats and riparian margins through the exclusion of stock, pest plant control, and indigenous replanting.

Excluding stock and providing vegetated buffers to streams and wetlands will improve water quality by reducing sediment and nutrient runoff into the aquatic habitats, and minimise stream bank erosion. Increased shading of the water surface improves the in-stream environment for aquatic fauna by cooling the water.

These effects continue to have positive impacts downstream, beyond the extent of the restoration. Improving the riparian vegetation also has a positive effect on terrestrial invertebrates, which in turn provide food for indigenous fish such as giant kōkopu (*Galaxias argenteus*; At Risk-Declining), banded kōkopu (*G. fasciatus*; Not Threatened), and shortfin eel (*Anguilla australis*; Not Threatened). Lake Waahi, approximately one kilometre downstream of the restoration, is an important rearing ground for juvenile giant and banded kōkopu (David *et al.* 2019). The fish disperse out of the lake to populate other tributaries in the middle and lower reaches of the Waikato River. The proposed restoration will improve habitat and spawning success for the adult fish in the tributary at the study site.

The restoration actions outlined in this EMP will provide:

- Pest plant control and enrichment planting of 1,857 m² of *Carex* and *Eleocharis* sedgeland.
- Pest plant control and planting in 3,958 m² of degraded exotic wetland vegetation to create WF8 – kahikatea-pukatea swamp forest.
- Planting approximately 620 m² of appropriate indigenous vegetation to provide a 10-metre buffer to the *Carex* and *Eleocharis* sedgeland.
- Planting approximately 2,320 m² appropriate indigenous vegetation to provide a 10-metre buffer to the degraded wetland.
- Pest plant control and riparian planting upstream of the wetland to provide at a minimum 10-metre buffer on both sides of the watercourses that feed the wetland complex.

This mitigation and compensation package will result in the restoration of 0.6 hectares of wetland together with 0.6 hectares of wetland buffer planting. Riparian restoration will be undertaken along 850 metres of stream and a total of 3.3 hectares of terrestrial indigenous habitats will be protected.

The specific objectives of this EMP are to:

- Provide methods to be used to control pest plants within the restoration areas.
- Provide detailed pest animal control methods and recommended control device layouts.
- Provide detailed planting lists for areas of potential revegetation planting.

4. METHODS

4.1 General vegetation survey

Field surveys were carried out on the 17 February and 30 April 2020. Key vegetation and habitat types were described and mapped (Figure 1). In addition, all vascular plant species observed at the site were recorded and are listed in Appendix 1.

4.2 Environmental pest plant survey

Field surveys for environmental pest plants was undertaken on 17 February and 30 April 2020. Environmental pest plants are introduced species that threaten the ecological processes and values within the site where they are present. The field survey involved walking through the study site identifying and recording the density of all environmental pest plants encountered. All environmental pest plants that will be targeted by this EMP are listed in Appendix 2.

Environmental pest plant distributions and densities were mapped in the field onto hard copy prints of digital aerial photographs (Figure 1). The maps were then used for data input into ArcGIS 10.7 (GIS programme).

Control methodologies were prepared for each pest plant species detected at the site and deemed necessary to control. These were informed by the following factors:

- The classification of the species under the Waikato Regional Pest Management Plan (WRPMP) (Waikato Regional Council 2014).
- The ecological values of the site in which the infestation occurs.
- The relative vulnerability of the vegetation and habitats present.
- The level of threat posed by the environmental pest plant species.
- The size of the infestation.

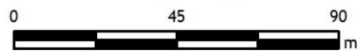


- Legend**
- Compensation area fencing
 - Vegetation and habitat types
 - 1. Kahikatea-pukatea forest
 - 2. Kohekohe forest
 - 3. *Eleocharis* sedgeland
 - 4. *Carex* sedgeland
 - 5. Raupō reedland
 - 6. Grey willow forest
 - 7. Indigenous treeland
 - 8. Gorse shrubland
 - 9. Pasture
 - 10. Exotic rushland and grassland

Data Acknowledgment
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Figure 1: Vegetation types described within the compensation site at Gleenson Quarry, Huntly.



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Scale: 1:1,900
 Date: 18/05/2020
 Cartographer: KM
 Format: A3

4.3 Pest animal presence

While a formal survey of pest animals was not undertaken, any sign of pest animal presence was recorded during the field survey. Pest animals that were not detected but are considered likely to be present were also considered. Effective and efficient control pest animal control methods have been designed that are relevant to the site.

4.4 Planting

Restoration planting sites and areas where planting would improve ecological values were identified during the field survey. These areas include sites where environmental pest plant infestations will be an ongoing problem if planting is not undertaken.

5. VEGETATION AND HABITAT TYPES

5.1 Overview

Vegetation at the property can be divided into ten main types:

- Kahikatea-pukatea forest.
- Kohekohe forest.
- *Eleocharis* rushland.
- *Carex* sedgeland.
- Raupō reedland.
- Grey willow forest.
- Indigenous treeland.
- Gorse shrubland.
- Pasture.
- Exotic rushland and grassland.

These vegetation types are mapped in Figure 1 and described in more detail below:

5.2 Vegetation Type 1: kahikatea-pukatea forest (c.1,890m²)

A kahikatea-pukatea forest remnant is located on the central gully floor and is fenced to exclude stock. The canopy is dominated by kahikatea (*Dacrycarpus dacrydioides*) and pukatea (*Laurelia novae-zelandiae*) with occasional tītoki (*Alectryon excelsus*). The sub-canopy and understorey supports putaputawētā (*Carpodetus serratus*), ponga (*Cyathea dealbata*), kawakawa (*Piper excelsum*), whekī (*Dicksonia squarrosa*), nīkau (*Rhopalostylis sapida*), tī kōuka (*Cordyline australis*), māpou (*Myrsine australis*), hangehange (*Geniostoma ligustrifolium*), and māhoe (*Melicytus ramiflorus*) (Plate 1). Indigenous vines form dense thickets through the gully, including supplejack (*Ripogonum scandens*), kiekie (*Freycinetia banksii*), and aka (*Metrosideros perforata*). Epiphytes such as kahakaha (*Astelia hastata*) and kōwaowao (*Microsorium pustulatum*) are also common throughout the forest, particularly in large canopy trees.



Plate 1: Kahikatea-pukatea forest with sub-canopy and understorey comprising nīkau, whekī, māpou, pukatea, and kiekie. 17 February 2020.

5.3 Vegetation Type 2: kohekohe forest (c.2,110m²)

Mature kohekohe (*Dysoxylum spectabile*) dominates the forest canopy along the western tributary. Karaka (*Corynocarpus laevigatus*) is the only other canopy species in this vegetation type, where it occurs occasionally. Although currently grazed by cattle, several indigenous species persist in the understorey and ground tier, including kawakawa, mātātā (*Paesia scaberula*), nīkau, māhoe, titipo (*Pteris macilenta*), and the indigenous grass species *Oplismenus hirtellus* subsp. *imbecillis* (Plate 2). Supplejack is also common in the larger trees.

5.4 Vegetation Type 3: *Eleocharis* sedgeland (c.700m²)

The stream has been dammed and a water pump shed installed to create an irrigation pond, which will be retained. As a result, the hydrology of the stream has been altered and an induced wetland system extends across most of the gully floor. The wetland vegetation is dominated by giant spike sedge (*Eleocharis sphacelata*) with a localised infestation of grey willow (*Salix cinerea*) (Plate 3). Occasional *Carex secta*, tutunawai (*Persicaria decipiens*) and wī (*Juncus sarophorus*) are also present.



Plate 2: Kohekohe forest understorey and groundcover species featuring mātātā, kawakawa, supplejack and *Oplismenus hirtellus* subsp. *imbecillis*. 17 February 2020.



Plate 3: *Eleocharis* sedgeland on upstream margin of pond. Grey willow is visible behind the sedgeland. 17 February 2020.

5.5 Vegetation Type 4: *Carex* sedgeland (c.1,160m²)

In this vegetation type, *Carex* species are dominant. Rautahi (*Carex geminata*) is most abundant with localised patches of *C. secta* and *C. virgata* (Plate 4). Occasional mānuka (*Leptospermum scoparium*), pukatea, whekī, and tī kōuka are also present.



Plate 4: Rautahi is most abundant species through most of the induced wetland. Pukatea and mānuka are also present on wetland edges.
17 February 2020.

5.6 Vegetation Type 5: Raupō reedland (c.730m²)

Small patches of raupō are present in the wetland north of the dam. Swamp millet (*Isachne globosa*), kikuyu (*Cenchrus clandestinus*), and occasional *Carex secta* grow under the raupō (Plate 5).



Plate 5: Patches of raupō in the northern most point of the wetland with swamp millet, kikuyu, and occasional *Carex secta*. 30 April 2020.

5.7 Vegetation Type 6: grey willow forest (c.1,230m²)

A discrete area grey willow (*Salix cinerea*) forest is present in the northern section of the wetland (Plate 6). The understorey and ground tier support indigenous ferns, shrubs and sedges including karamū (*Coprosma robusta*), *Carex secta*, *C. virgata*, whekī, rautahi, tī kōuka, swamp kiokio (*Parablechnum minus*), and *Machaerina rubiginosa* (Plate 7).



Plate 6: Grey willow canopy covering a large section of the northern wetland.
30 April 2020.



Plate 7: Indigenous ferns and sedges under the canopy of grey willow including whekī, *Carex secta* and swamp kiokio. 30 April 2020.

5.8 Vegetation Type 7: indigenous treeland (c.14,770m²)

Scattered indigenous treeland occupies the mid to lower slopes of the gully (Plate 8). The canopy comprises rimu (*Dacrydium cupressinum*), kahikatea, pukatea, kānuka, rewarewa (*Knightia excelsa*), and occasional tōtara (*Podocarpus totara*). Smaller trees form a sub-canopy including tawa (*Beilschmiedia tawa*), heketara (*Olearia rani*), mānuka, akeake (*Dodonaea viscosa*), and porokaiwhiri (*Hedycarya arborea*). Due to the effects of grazing, woody species are absent and groundcover species are limited to common pasture herbs and grasses such as sweet vernal (*Anthoxanthum odoratum*) cocksfoot (*Dactylis glomerata*), Scotch thistle (*Cirsium vulgare*), soft rush (*Juncus effusus*), paspalum (*Paspalum dilatatum*), Vasey grass (*P. urvillei*), rough stalked meadow grass (*Poa trivialis*), and purple top (*Verbena bonariensis*).



Plate 8: Indigenous treeland including rimu, pukatea, kānuka and kahikatea. Common pasture grasses and herbs occur the ground tier. 17 February 2020.

5.9 Vegetation Type 8: gorse shrubland (c.6,440m²)

On the upper slopes of the gully, occasionally extending down to the wetland, gorse (*Ulex europaeus*) occurs in dense thickets with small areas of pasture throughout (Plate 9). Woolly nightshade (*Solanum mauritianum*) is occasional amongst the gorse.



Plate 9: Gorse shrubland on the mid-lower slopes of the gully extending down to the gully. 30 April 2020.

5.10 Vegetation Type 9: pasture (c.8,045m²)

Areas of pasture on the upper slopes of the gully are dominated by the same species as the groundcover vegetation in the indigenous treeland described above. It is likely that if left uncontrolled, the gorse shrubland will extend into remaining open pasture.

5.11 Vegetation Type 10: exotic rushland and grassland (c.2,000m²)

The wetland north of the dam is degraded due to stock and comprises exotic rushland and grassland on boggy soils, characterised by Mercer grass (*Paspalum distichum*) with emergent soft rush, occasional rautahi and *Carex virgata*, and frequent exotic herbs such as water pepper (*Persicaria hydropiper*) and creeping buttercup (*Ranunculus repens*) (Plate 10). Occasional juvenile grey willow and blackberry (*Rubus fruticosus* agg.) also occur in the wetland.



Plate 10: Degraded wetland dominated by Mercer grass. 30 April 2020.

6. FENCING

Prior to any restoration works within the site, a stock-proof fence (minimum five-wire post and batten) should be constructed around the gully as shown in Figure 1. Livestock (especially cattle) browse many indigenous plants and trample seedlings, and reduce natural regeneration. Livestock can damage soil through compaction and also weaken or kill small trees by browsing the bark, rubbing against trunks, and trampling roots. Construction of a fence around the gully to exclude stock will allow natural regeneration of an indigenous understorey within the treeland.

7. PEST PLANTS

7.1 Overview

Eleven pest plant species are present at the site and should be controlled, including four that are listed in the WRPMP (Waikato Regional Council 2014). In addition to the control of these species, any other pest plants that may establish at the site will also be controlled. A map of the distribution and abundance of the pest plant species is provided in Figure 2.

The plant species for which control should occur have been assigned to one of the following four categories.

- Progressive containment pest plants, as per the WRPMP (Waikato Regional Council 2014).
- Sustained control pest plants, as per the WRPMP.
- Site led pest plants, as per the WRPMP.
- Pest plants that are not currently included in the WRPMP, but for which control is recommended.

A full list of species for which control should occur is provided in Appendix 2.

7.1.1 Progressive Containment Pest Plant

The WRPMP includes the ‘Progressive Containment Programme’, which aims to contain and reduce the geographic distribution of specific pest plant species over time. One Progressive Containment pest plant species were recorded at the site and are listed in Table 1.

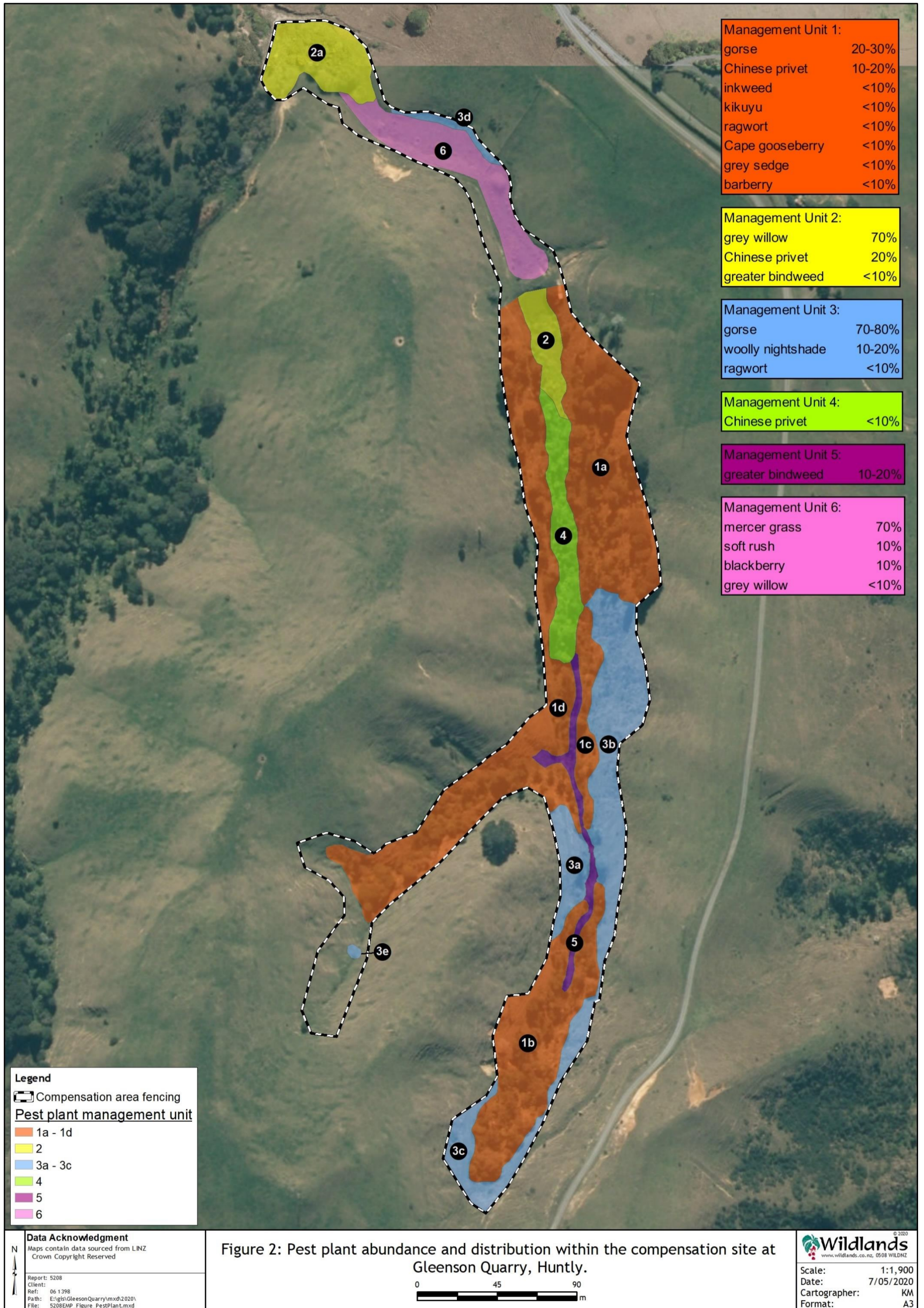
Table 1: Progressive Containment Pest Plants observed at Gleeson Quarry compensation site.

Common Name	Species Name
woolly nightshade	<i>Solanum mauritianum</i>

Woolly nightshade is occasionally present on mid-upper slopes of the gully within gorse shrubland (Plate11).



Plate 11: Woolly nightshade on edge of gorse infestation. 17 February 2020.



Initial control of the Progressive Containment pest plant species will occur as soon as practical. Follow up and maintenance control will also occur to prevent infestations re-establishing.

7.1.2 Sustained Control Pest Plant

The WRPMP also includes the ‘Sustained Control Programme’, which aims to provide for the sustained control of key pest plant species to reduce their effects across the region. Three sustained control pest plant species were identified at the proposed compensation site (Table 2).

Table 2: Sustained Control pest plants observed at Gleeson Quarry compensation site.

Common Name	Species Name
Chinese privet	<i>Ligustrum sinense</i>
gorse	<i>Ulex europaeus</i>
ragwort	<i>Jacobaea vulgaris</i>

As with the Progressive Containment pest plants, initial control of the sustained control pest plant species will occur prior to planting, and follow up control will be carried out to prevent infestations returning.

7.1.3 Site Led Pest Plants

The WRPMP also includes a ‘Site-Led Programme’, which aims to exclude, eradicate, contain, reduce or control the subject that is capable of causing damage to a place and its values. One site-led pest plant species was identified at the compensation site (Table 3).

Table 3: Site-led pest plants observed at Gleeson Quarry compensation site.

Common Name	Species Name
Grey willow	<i>Salix cinerea</i>

7.1.4 Pest plants not listed in the WRPMP

Five pest plant species were observed that are not identified in the WRPMP (Table 4).

Although these species are not officially recognised as pest plants within the Waikato region, they are having adverse effects on ecological values at the site and may spread further if not controlled. As such, all the non-WRPMP pest plant species should be controlled within the compensation site.

Table 4: Pest plant not listed in the WRPMP observed at Gleeson Quarry compensation site.

Common Name	Species Name
blackberry	<i>Rubus fruticosus</i>
Cape gooseberry	<i>Physalis peruviana</i>
greater bindweed	<i>Calystegia silvatica</i>
grey sedge	<i>Carex divulsa</i>
kikuyu	<i>Cenchrus clandestinus</i>
inkweed	<i>Phytolacca octandra</i>
mercer grass	<i>Paspalum distichum</i>

7.2 Pest Plant Management areas

7.2.1 Overview

All pest plant species identified above should be controlled within the proposed compensation site. The highest priority area for pest plant control is the wetland. This area has low pest plant infestations with the exception of a stand of grey willow near the pond. Areas of treeland and the mid-upper slopes of the gully typically have the highest level of pest plant infestation due to large open areas and minimal understorey.

7.2.2 Management Unit 1a-d

Management Unit 1a-d encompasses indigenous treeland and the kohekohe forest. Inkweed (*Phytolacca octandra*), kikuyu, ragwort (*Jacobaea vulgaris*), cape gooseberry (*Physalis peruviana*), grey sedge (*Carex divulsa*), gorse, barberry (*Berberis glaucocarpa*), and Chinese privet (*Ligustrum sinense*) are frequent throughout. Occasional mature Chinese privet and barberry trees are also present. These species are readily dispersed by birds and can rapidly establish in indigenous habitats. Removal of mature trees will require cut and stumping while seedlings will be controlled through foliar spraying and/or hand-pulling.

7.2.3 Management Unit 2a&b

Management Unit 2 encompasses the pond and surrounding wetland vegetation. Grey willow and Chinese privet are present to the southwest of the pond and at the northernmost point of the wetland. Grey willow produces thousands of wind-dispersed seedlings, which can rapidly establish in high-light conditions. Grey willow can block waterways and modify wetlands. Control of grey willow and Chinese privet is crucial for the health of the wetlands and will require drill and injecting methods as they occur in open water.

7.2.4 Management Unit 3a-e

Gorse shrubland is present throughout much of Management Unit 3, with occasional woolly nightshade located on the mid-upper slopes of the gully and the edge of northern wetland. These species can form dense infestations and exclude indigenous vegetation and may continue to spread into surrounding areas of pasture. Ragwort is toxic to livestock and control is recommended to prevent infestations spreading to nearby pasture through wind dispersal of seeds. Gorse and woolly nightshade can be controlled by cut and stumping or foliar spraying. Where accessible, mulching dense stands of gorse is also recommended.

7.2.5 Management Unit 4

Management Unit 4 encompasses the kahikatea-pukatea forest. Occasional Chinese privet seedlings and saplings occur in the understorey and canopy. These can either be controlled by foliar spraying or hand-pulling.

7.2.6 Management Unit 5

Management Unit 5 includes localised infestations of greater bindweed (*Calystegia silvatica*) within the *Carex* sedgeland. This pest plant has the potential to smother low-growing wetland vegetation as well as indigenous shrubs and small trees. Controlling greater bindweed will require hand releasing and foliar spraying. Extreme caution must be used during foliar spraying to avoid direct spraying of indigenous plants, or damaging indigenous plants through spray drift. If this is a concern bindweed should be removed by hand.

7.2.7 Management Unit 6

The wetland north of the dam (Management Unit 5) comprises exotic grasses, rushes, and herbs growing around patches of raupō. Occasional juvenile grey willow and blackberry are scattered throughout the management unit, and should be controlled. Control of Mercer grass via broadcast spraying is also recommended as site preparation prior to any planting works.

7.3 Planting site preparation

Site preparation work must be carried out in Management Unit 2, 3 and 7 where indigenous revegetation plantings are to be established (refer to Section 9 for details).

7.4 Pest plant control methodologies

Control methods for pest plant species are presented in Appendix 3. All pest plant control operations should be undertaken in line with the Agrichemical Users' Code of Practice, NZS 8409 2004: The Management of Agrichemicals, and any relevant Council Policies and procedures such as herbicide reduction strategies.

Suitable weed hygiene procedures shall be followed at all times. Species that can be spread by seed or fragments (including stems, tubers, bulbs and corms) will not be dispersed from pest plant infested areas.

7.5 Disposal of material

All environmental pest plant infestations can be dealt with *in situ*, removing the need for disposal. Seedlings of woolly nightshade and Chinese privet can be controlled by hand-pulling and may be left to rot on site. It is essential that plant seeds, tubers, and fragments are not dispersed from the current infestation areas as some species can easily be spread by seed or fragments. Where cut vegetation is to be left on site, seed heads should be removed wherever possible and disposed of carefully to avoid new infestations establishing.

7.6 Pest plant control outcomes

No mature, flowering, or fruiting pest plants should be remaining within all Management Units by the end of the first year of control. After this, ongoing maintenance should be carried out in order to keep these areas in a pest plant free state in perpetuity. All newly established pest plants (including species not currently present) or regrowth of unsuccessfully controlled pest plant species should be controlled during regular maintenance visits. See Section 9 for the recommended frequency and timing of maintenance work.

7.7 Agrichemical use, record keeping, and reporting

All environmental pest plant control operations should be undertaken by “Growsafe” certified operators, in line with the Agrichemical Users’ Code of Practice (NZS 8409 2004: The Management of Agrichemicals) and industry best practice. This includes recording and maintaining records of all agrichemical usage on appropriate spray record sheets.

Reports summarising the pest plant control work undertaken during each year of the programme should be presented to Waikato Regional Council on an annual basis. This report should include, but not be limited to:

- The timing of pest plant control rounds.
- Weather conditions during control rounds.
- Pest plant species controlled.
- The results/effectiveness of the control.
- Pest plant control priorities for the following year.

7.8 Banned flora

Potentially invasive exotic species should not be planted at the compensation site. This includes any species listed in the WRPMP, in the National Pest Plant Accord, or on the weedbusters.org.nz website.

8. PEST ANIMALS

8.1 Overview

In order to protect indigenous fauna and revegetation efforts at the proposed compensation site, pest animal control should be undertaken.

Possums (*Trichosurus vulpecula*), ship rats (*Rattus rattus*), Norway rats (*R. norvegicus*), and mice (*Mus musculus*) are likely to be present at the site. Hedgehogs (*Erinaceus europaeus occidentalis*), cats (*Felis catus*; both feral and domestic), and mustelids (stoats - *Mustela erminea*, ferrets - *M. furo*, weasels - *M. nivalis vulgaris*) may also occasionally use the site.

Possums have adverse effects on vegetation health by browsing foliage and eating the flowers and fruits of indigenous plants. All mammalian pests are also likely to reduce the fauna values of the gully through the predation of birds, lizards, and invertebrates.

Rabbits (*Oryctolagus cuniculus*) and pūkeko (*Porphyrio melanotus melanotus*) may also be present and both of these species have the potential to hinder the establishment of indigenous revegetation plantings. Rabbits browse on the foliage of plants and may damaging the root balls, while pūkeko frequently pull new plants out of the ground soon after planting. If rabbits and/or pūkeko are abundant at the site, control should be undertaken prior to planting. Post-planting monitoring should also be undertaken to determine if these species are having an impact. If rabbits and pūkeko are found to be damaging the plantings, control should be initiated immediately.

8.2 Pest animal control methodologies

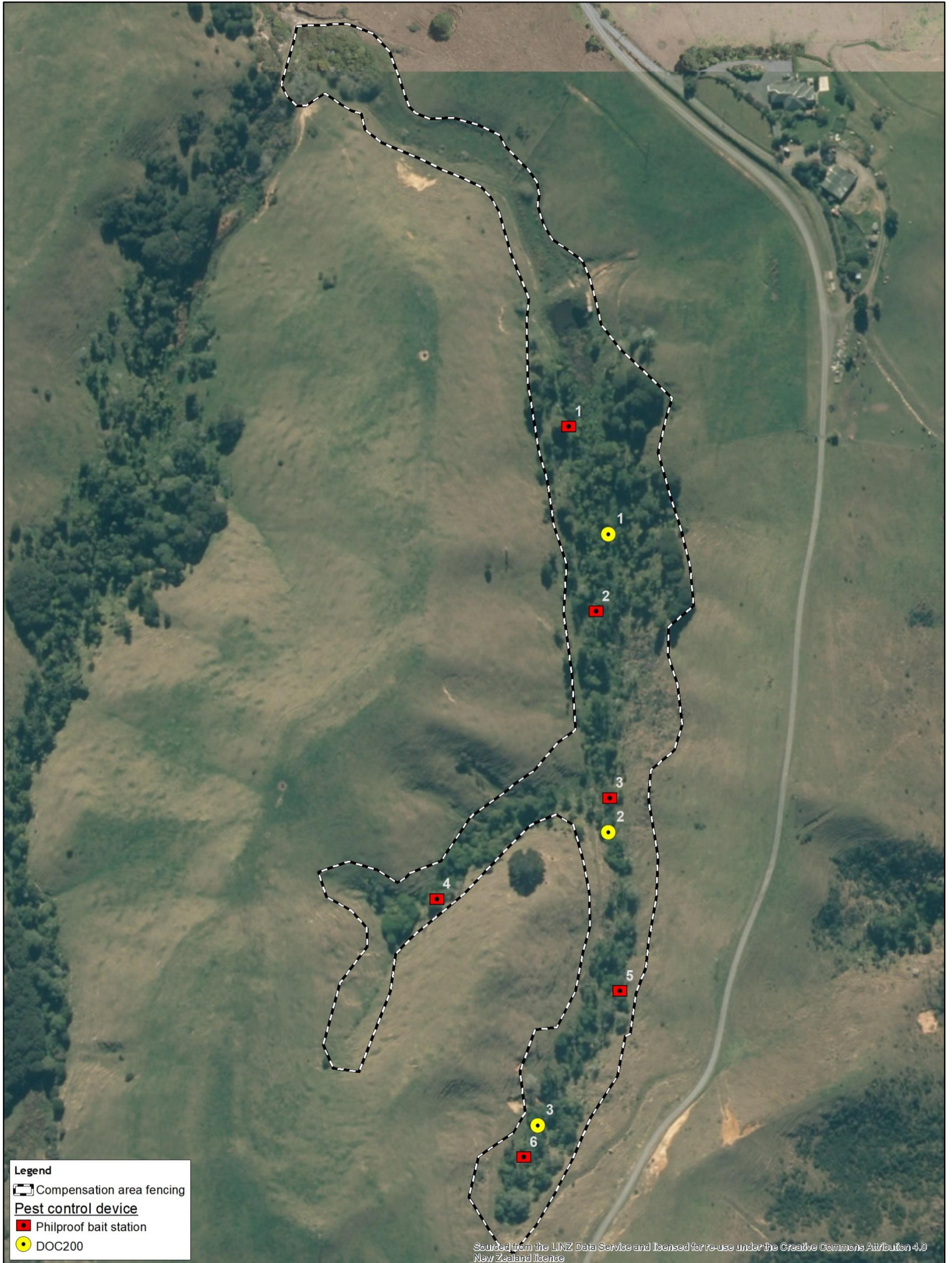
8.2.1 Possum and rat control

Control of possums and rats should be undertaken using Philproof bait stations filled with brodifacoum bait. Bait stations will be deployed at 50-metre spacing in a line along the gully in existing woody terrestrial vegetation types. A map of the suggested lay out is provided in Figure 3.

Four pulses of control should be undertaken each year. Each pulse should consist of three bait station fills at weekly intervals with a fourth visit to remove any uneaten bait. Bait station will be filled with 200 grams of brodifacoum pellet bait.

8.2.2 Mustelid control

DOC200 traps should be used to control mustelids. One trap per hectare is required, equating to three DOC200 traps for the site. These traps can be moved around within the site to areas that stoats are likely to occur. This includes along ridges, tracks and streams, or anywhere that is easy to reach. Each trap should be baited with a chicken egg or dried rabbit meat and should be checked, cleared, re-baited and reset every time the site is visited for pest plant control and/or pest animal control.



Legend

- Compensation area fencing
- Pest control device**
- Philproof bait station
- DOC200

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Figure 3: Pest animal control devices within the compensation site at Gleeson Quarry, Huntly.

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8.3 Monitoring and reporting

Records must be maintained of all pest animal control operations, in line with industry best practice. All control devices should be numbered and their location marked using a hand-held GPS unit. A datasheet listing every control device should be produced and this should be filled in when devices are checked. Bait station data that should be recorded includes:

- Date of check.
- Station ID.
- Amount of bait discarded (if relevant).
- Bait formulation used.
- Amount of new bait placed into the station.

Trap data that should be recorded includes:

- Date of check.
- Station ID.
- Trap status when checked (still set, capture, set off but no capture).
- Species captured.
- Bait used when trap reset.

If required, a short report detailing control effort and results should be prepared annually and submitted to the Waikato Regional Council.

9. PLANTING

9.1 Overview

Four proposed planting areas have been identified within the Gleeson Quarry compensation site. These include areas of gorse and open pasture where natural regeneration is unlikely to occur without restoration planting. The planting will buffer the indigenous vegetation already present in the gully and provide additional habitat for indigenous flora and fauna.

The locations of the planting areas are shown in Figure 4. All planting work within these areas should follow the plant schedules provided below (Tables 5-8) and the timeline presented in Section 10.

9.2 Planting Areas 1-4

These four planting areas are largely characterised by gorse and pasture. Gorse will be controlled prior to planting works. Species selected for these areas are characteristic of regenerating kānuka forest and scrub. Canopy cover is expected to be reached within three to five years, and the shade created will naturally control many of the light-demanding exotic grasses, shrubs, and herbs. The plant schedules for Planting Areas 1-4 are provided in Table 5-8 below.

Table 5: Indicative planting schedule for Planting Area 1 (c.1,500m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Coprosma robusta</i>	karamū	1L	1.4	135
<i>Cordyline australis</i>	tī kōuka	1L	1.4	45
<i>Dacrycarpus dacrydioides*</i>	kahikatea	2L	5	15
<i>Leptospermum scoparium</i>	mānuka	1L	1.4	45
<i>Knightia excelsa</i>	rewarewa	2L	5	15
<i>Kunzea robusta</i>	kānuka	1L	1.4	450
<i>Meliccytus ramiflorus</i>	māhoe	1L	1.4	135
<i>Phormium tenax</i>	harakeke	1L	1	45
<i>Podocarpus totara*</i>	tōtara	2L	5	8
<i>Vitex lucens</i>	pūriri	2L	5	7
Total				900

* Plant in Year 3 when there is sufficient shelter from surrounding plants.

Table 6: Indicative planting schedule for Planting Area 2 (c.885m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Coprosma robusta</i>	karamū	1L	1.4	80
<i>Cordyline australis</i>	tī kōuka	1L	1.4	27
<i>Dacrycarpus dacrydioides*</i>	kahikatea	2L	5	4
<i>Leptospermum scoparium</i>	mānuka	1L	1.4	27
<i>Knightia excelsa</i>	rewarewa	2L	5	4
<i>Kunzea robusta</i>	kānuka	1L	1.4	266
<i>Meliccytus ramiflorus</i>	māhoe	1L	1.4	72
<i>Phormium tenax</i>	harakeke	1L	1	27
<i>Podocarpus totara*</i>	tōtara	2L	5	4
<i>Vitex lucens</i>	pūriri	2L	5	4
Total				515

* Plant in Year 3 when there is sufficient shelter from surrounding plants.

Table 7: Indicative planting schedule for Planting Area 3 (c.3,600m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Coprosma robusta</i>	karamū	1L	1.4	300
<i>Cordyline australis</i>	tī kōuka	1L	1.4	108
<i>Dacrycarpus dacrydioides</i> *	kahikatea	2L	5	18
<i>Leptospermum scoparium</i>	mānuka	1L	1.4	108
<i>Knightia excelsa</i>	rewarewa	2L	5	18
<i>Kunzea robusta</i>	kānuka	1L	1.4	1,080
<i>Melicytus ramiflorus</i>	māhoe	1L	1.4	324
<i>Phormium tenax</i>	harakeke	1L	1	108
<i>Podocarpus totara</i> *	tōtara	2L	5	18
<i>Vitex lucens</i>	pūriri	2L	5	18
Total				2,100

* Plant in Year 3 when there is sufficient shelter from surrounding plants.

Table 8: Indicative planting schedule for Planting Area 4 (c.540m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Coprosma robusta</i>	karamū	1L	1.4	50
<i>Cordyline australis</i>	tī kōuka	1L	1.4	15
<i>Dacrycarpus dacrydioides</i>	kahikatea	2L	5	3
<i>Leptospermum scoparium</i>	mānuka	1L	1.4	16
<i>Knightia excelsa</i>	rewarewa	2L	5	3
<i>Kunzea robusta</i>	kānuka	1L	1.4	160
<i>Melicytus ramiflorus</i>	māhoe	1L	1.4	46
<i>Phormium tenax</i>	harakeke	1L	1	16
<i>Podocarpus totara</i>	tōtara	2L	5	3
<i>Vitex lucens</i>	pūriri	2L	5	3
Total				315

* Plant in Year 3 when there is sufficient shelter from surrounding plants.

9.2.1 Planting Area 5

Planting Area 5 encompasses the headwaters of the western tributary. One patch of gorse and barberry needs to be controlled prior to planting works. Species selected for this area are characteristic of gully kahikatea-pukatea forest. Canopy cover is expected to be reached within three to five years, and the shade created will naturally control many of the light-dependent exotic grasses, shrubs, and herbs. The plant schedule for Planting Area 5 is provided in Table 9 **Table 8**.

Table 9: Indicative planting schedule for Planting Area 5 (c. 2,644m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Coprosma tenuicaulis</i>	hukihuki,	1L	1.4	230
<i>Cordyline australis</i>	tī kōuka	1L	1.4	220
<i>Dacrycarpus dacrydioides</i> *	kahikatea	2L	5	20
<i>Laurelia novae-zelandiae</i> *	pukatea	2L	5	20
<i>Leptospermum scoparium</i>	mānuka	1L	1.4	330
<i>Kunzea robusta</i>	kānuka	1L	1.4	330
<i>Melicytus ramiflorus</i>	māhoe	1L	1.4	220
<i>Phormium tenax</i>	harakeke	1L	1.4	60
<i>Vitex lucens</i>	pūriri	2L	5	20
Total				1,450

* Plant in Year 3 when there is sufficient shelter from surrounding plants.

9.2.2 Planting Area 6

Planting Area 6 comprises buffer planting around the margins of the northernmost wetland. Control of gorse and blackberry is required prior to planting works. The plant schedule for Planting Area 6 is provided in Table 10.

Table 10: Indicative planting schedule for Planting Area 6 (c.2,320m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Carex virgata</i> ¹	rautahi	0.5L	0.75	90
<i>Coprosma robusta</i> ²	karamū	1L	1.4	150
<i>Cordyline australis</i> ¹	tī kōuka	1L	1.4	140
<i>Dacrycarpus dacrydioides</i> ^{3,*}	kahikatea	2L	5	110
<i>Kunzea robusta</i> ²	kānuka	1L	1.4	230
<i>Melicytus ramiflorus</i> ²	māhoe	1L	1.4	160
<i>Leptospermum scoparium</i> ³	mānuka	1L	1.4	220
<i>Phormium tenax</i> ³	harakeke	1L	1.4	90
<i>Veronica stricta</i> ²	koromiko	1L	1.4	140
<i>Vitex lucens</i>	pūriri	2L	5	20
Total				1,350

1. Plant on the wetter margins of the wetland and standing water
2. Plant on higher, well-drained ground
3. Plant throughout buffer

* Plant in Year 3 when there is sufficient shelter from surrounding plants.

9.2.3 Planting Areas 7 and 8

Planting Areas 7 and 8 requires buffer planting on the western and eastern margins of the pond and *Eleocharis* wetland. Grey willows and Chinese privet should be drilled and injected and left standing prior to planting works. The plant schedule for Planting Areas 7 and 8 is provided in Table 11.

Table 11: Indicative planting schedule for Planting Areas 7 and 8 (c.620m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Carex virgata</i> ¹	rautahi	0.5L	0.75	125
<i>Coprosma robusta</i> ²	karamū	1L	1.4	370
<i>Cordyline australis</i> ¹	tī kōuka	1L	1.5	62
<i>Dacrycarpus dacrydioides</i> ³	kahikatea	PB5	5	31
<i>Kunzea robusta</i> ²	kānuka	1L	3	125
<i>Meliccytus ramiflorus</i> ²	māhoe	1L	3	30
<i>Leptospermum scoparium</i> ³	mānuka	1L	1.4	94
<i>Phormium tenax</i> ³	harakeke	1L	1.4	62
<i>Veronica stricta</i> ²	koromiko	1L	1.4	93
Total				360

1. Plant on the wetter margins of the wetland and standing water
2. Plant on higher, well-drained ground
3. Plant throughout buffer

9.2.4 Planting Area 9

The wetland north of the dam comprises exotic rushland and Mercer grass. Although some re-establishment of indigenous sedges and reeds may occur following stock exclusion, the site would benefit from planting of indigenous species that can tolerate waterlogged conditions to establish complete indigenous cover. The plant schedule for Planting Area 9 is provided in Table 12.

Table 12: Indicative planting schedule for Planting Area 9 (c.1,500m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Carex secta</i>	pūrei	1L	0.75	60
<i>Carex geminata</i>	rautahi	1L	0.75	75
<i>Carex virgata</i>	pūrei	1L	0.75	60
<i>Cordyline australis</i>	tī kōuka, cabbage tree	1L	1.4	45
<i>Cyperus ustulatus</i>	giant umbrella sedge	1L	1.4	60
<i>Phormium tenax</i>	harakeke	1L	1.4	75
Total				1,600



Legend
 [Dashed line] Compensation area fencing
 [Green hatched area] Indigenous revegetation planting

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Figure 4: Indigenous revegetation planting at the compensation site at Gleeson Quarry, Huntly.



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9.2.1 Planting Area 10

The poisoning of the grey willows forming the main canopy in the northern swamp will open canopy gaps. This area will benefit from enrichment under-planting, including the addition of uncommon swamp forest species in order to increase floristic diversity. The plant schedule for Planting Area 10 is provided in Table 13.

Table 13: Indicative planting schedule for Planting Area 10 (c.900m²).

Species	Common Name	Grade	Spacing (m)	Number of plants
<i>Astelia grandis</i> *	swamp astelia	1.5L	1.4	135
<i>Carex virgata</i>	pūrei	0.5L	0.75	135
<i>Coprosma tenuicaulis</i> *	swamp coprosma	1.5L	1.4	135
<i>Dicksonia squarrosa</i>	whekī	1.5L	3	135
<i>Gahnia setifolia</i> *	giant cutty sedge	1.5L	1.4	135
<i>Dacrycarpus dacrydioides</i>	kahikatea	PB5	10	45
<i>Laurelia novae-zelandiae</i>	pukatea	PB5	10	45
<i>Parablechnum minus</i>	swamp kiokio	1.5L	1.4	135
Total				375

* species subject to availability

9.3 Site Preparation and planting

Site preparation is critical to the successful implementation of this project. All pest plants shall be controlled prior to undertaking planting. In addition, all non-invasive exotic grasses and herbaceous plants should also be blanket sprayed with a Glyphosate-based herbicide before planting work is carried out in any of the management units.

9.4 Plant stock and availability

All plants should be sourced from the Meremere Ecological District, in line with Environment Waikato eco-sourcing recommendations (Environment Waikato 2005). To ensure availability, the plant stock should be ordered as far in advance as possible, especially for slower-growing species required in larger grades (e.g. kahikatea).

9.5 Plant layout and spacing

Plantings shall be spaced at an overall average of 1.4 metre spacing unless otherwise specified. Most species can be planted at these spacings, but larger growing species (e.g. kahikatea, tōtara), should be planted further apart at five to ten metre centres, while maintaining the specified spacing between all plants on the site overall. If plants are spaced too far apart, canopy closure will be slower and maintenance more difficult.

9.6 Maintenance

Timely and effective post-planting maintenance is critical and cannot be deferred or performed in an ad hoc or cursory fashion. Releasing of plants and ongoing pest plant control are particularly important requirements, and infill planting and periodic pest animal control may also be required. Management Unit 2 will also require follow-up control of Mercer grass using Haloxypop (in dry conditions) or Glyphosate Green (in wetter conditions).

Plantings shall be inspected at least three times per year for the first two years following planting to identify any management that may be required. Plantings shall be released from pest plants and exotic grasses and herbs at least three times a year for the first two years, and once or twice a year for the following three years. Some parts of the site may only require releasing for the first year, depending on site conditions and plant growth.

Limited infill planting¹ may be required from the second planting season. Infill planting is required wherever plant failures occur up to year three and may comprise both replacement species, i.e. replacement of dead plants planted in previous years, and planting of enrichment species in existing or created gaps. Infill plants shall be of a bagged grade (PB3/2L) unless otherwise specified in plans. Infill planting requirements shall be identified in the February/March preceding the upcoming planting season.

¹ Infill planting is required on sites where there are gaps in the planting because of plant mortality or where initial stocking rates were too low. Infill should complement any enrichment planting if undertaken after Year 2 of the planting programme.

10. WORK PROGRAMME, RESOURCES AND TIMELINE

The recommended work programmes for pest plant control, pest animal control and planting work is provided below.

Year 1

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Construction of stock-proof fence												
Site Preparation												
Initial pest plant control												
Follow up pest plant control												
Setup of bait stations and traps												
Bait station pulses (four per year)												
DOC200s (monthly)												

Year 2

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Planting												
Infill site preparation (if required)												
Follow up pest plant control												
Monitoring of planting and releasing where necessary												
Bait station pulses (four per year)												
DOC200s (monthly)												

Year 3

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Infill planting (if required)												
Follow up pest plant control												
Monitoring of planting and releasing where necessary												
Bait station pulses (four per year)												
DOC200s (monthly)												

Year 4

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Follow up pest plant control												
Monitoring of planting and releasing where necessary												
Setup of traps and bait stations												
Bait station pulses (four per year)												
DOC200s (monthly)												

Year 5

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Follow up pest plant control												
Monitoring of planting and releasing if necessary												
Bait station pulses (four per year)												
DOC200s (monthly)												

Year 6

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Follow up pest plant control												
Monitoring of planting and releasing if necessary												
Bait station pulses (four per year)												
DOC200s (monthly)												

Ongoing

Task	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Follow up pest plant control												
Monitoring of planting and releasing if necessary												
Bait station pulses (four per year)												
DOC200s (monthly)												

ACKNOWLEDGMENTS

Biance Schoeman and Kate Madsen (Paua Planning Ltd) provided site information and access.

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LIST OF VASCULAR PLANT SPECIES RECORDED AT GLEESON QUARRY COMPENSATION SITE, HUNTLY

INDIGENOUS SPECIES

Gymnosperms

<i>Dacrycarpus dacrydioides</i>	kahikatea
<i>Dacrydium cupressinum</i>	rimu
<i>Podocarpus totara</i>	tōtara

Monocot. trees and shrubs

<i>Cordyline australis</i>	tī kōuka, cabbage tree
<i>Rhopalostylis sapida</i>	nīkau

Dicot. trees and shrubs

<i>Alectryon excelsus</i> subsp. <i>excelsus</i>	tītoki
<i>Beilschmiedia tawa</i>	tawa
<i>Carpodetus serratus</i>	putaputawētā
<i>Coprosma robusta</i>	karamū, kāramuramu
<i>Corynocarpus laevigatus</i>	karaka
<i>Dodonaea viscosa</i>	akeake
<i>Dysoxylum spectabile</i>	kohekohe
<i>Geniostoma ligustrifolium</i>	hangehange
<i>Griselinia lucida</i>	puka
<i>Hedycarya arborea</i>	porokaiwhiri; pigeonwood
<i>Knightia excelsa</i>	rewarewa
<i>Kunzea robusta</i>	kānuka
<i>Laurelia novae-zelandiae</i>	pukatea
<i>Leptospermum scoparium</i> agg.	mānuka
<i>Melicytus ramiflorus</i>	māhoe
<i>Myrsine australis</i>	māpou, matipou, māpau
<i>Olearia rani</i> var. <i>colorata</i>	heketara
<i>Piper excelsum</i> subsp. <i>excelsum</i>	kawakawa
<i>Pseudopanax crassifolius</i>	horoeka, lancewood
<i>Streblus heterophyllus</i>	tūrepo

Monocot. lianes

<i>Freycinetia banksii</i>	kiekie
<i>Ripogonum scandens</i>	supplejack, kareao

Dicot. lianes

<i>Metrosideros fulgens</i>	rātā
<i>Metrosideros perforata</i>	aka
<i>Muehlenbeckia australis</i>	puka

Ferns

<i>Asplenium polyodon</i>	petako
<i>Cyathea dealbata</i>	ponga, silver fern
<i>Dicksonia squarrosa</i>	whekī
<i>Doodia australis</i>	pukupuku
<i>Histiopteris incisa</i>	mātātā, water fern

<i>Icarus filiformis</i>	pānako
<i>Microsorium pustulatum</i>	kōwaowao, hound's tongue fern
<i>Microsorium scandens</i>	mokimoki
<i>Paesia scaberula</i>	mātātā
<i>Parablechnum minus</i>	swamp kiokio
<i>Pteridium esculentum</i>	rārahu, bracken
<i>Pteris macilenta</i>	titipo, sweet fern
<i>Pyrrhosia eleagnifolia</i>	leather-leaf fern

Orchids

<i>Earina mucronata</i>	peka-a-waka
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Grasses

<i>Isachne globosa</i>	swamp millet
<i>Oplismenus hirtellus</i> subsp. <i>imbecillis</i>	

Sedges

<i>Carex geminata</i> agg.	rautahi
<i>Carex secta</i>	pūrei, makura, pūreirei, pūrekireki, pūkio
<i>Carex virgata</i>	pūrei
<i>Eleocharis sphacelata</i>	giant spike sedge, ngāwhā, kuta.kutakuta
<i>Machaerina rubiginosa</i>	

Rushes

<i>Juncus sarophorus</i>	wi, wīwī
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Monocot. herbs (other than orchids, grasses, sedges, and rushes)

<i>Astelia hastata</i>	kahakaha
<i>Typha orientalis</i>	raupō

Dicot. herbs (other than composites)

<i>Haloragis erecta</i> subsp. <i>erecta</i>	toatoa
<i>Persicaria decipiens</i>	tutunawai

NATURALISED AND EXOTIC SPECIES

Dicot. trees and shrubs

<i>Berberis glaucocarpa</i>	barberry
<i>Ligustrum sinense</i>	Chinese privet
<i>Rubus fruticosus</i>	blackberry
<i>Salix cinerea</i>	grey willow
<i>Solanum mauritianum</i>	woolly nightshade
<i>Ulex europaeus</i>	gorse

Dicot. lianes

<i>Calystegia silvatica</i>	greater bindweed
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Grasses

<i>Anthoxanthum odoratum</i>	sweet vernal
<i>Cenchrus clandestinus</i>	kikuyu grass

Dactylis glomerata
Holcus lanatus
Paspalum dilatatum
Paspalum distichum
Paspalum distichum
Paspalum urvillei
Poa trivialis

cocksfoot
Yorkshire fog
paspalum
Mercer grass
Mercer grass
Vasey grass
rough stalked meadow grass

Sedges

Carex divulsa

grey sedge

Rushes

Juncus effusus var. *effusus*

soft rush, leafless rush

Composite herbs

Cirsium vulgare
Jacobaea vulgaris

Scotch thistle
ragwort

Dicot. herbs (other than composites)

Persicaria hydropiper
Physalis peruviana
Phytolacca octandra
Ranunculus repens
Verbena bonariensis
Vicia sp.

water pepper
cape gooseberry
inkweed
creeping buttercup
purple-top

LIST OF ENVIRONMENTAL PEST PLANT SPECIES RECORDED AT
THE GLEESON QUARRY COMPENSATION SITE, HUNTLY

Common name	Species Name
barberry	<i>Berberis glaucocarpa</i>
blackberry	<i>Rubus fruticosus</i>
cape gooseberry	<i>Physalis peruviana</i>
Chinese privet	<i>Ligustrum sinense</i>
gorse	<i>Ulex europaeus</i>
great bindweed	<i>Calystegia silvatica</i>
grey sedge	<i>Carex divulsa</i>
grey willow	<i>Salix cinerea</i>
inkweed	<i>Phytolacca octandra</i>
kikuyu	<i>Cenchrus clandestinus</i>
ragwort	<i>Jacobaea vulgaris</i>
woolly nightshade	<i>Solanum mauritianum</i>

HERBICIDE TREATMENTS FOR PEST PLANT SPECIES AT GLEESON QUARRY COMPENSATION SITE, HUNTLY

Pest Plant	Control Method(s)	Chemical(s)	Application Rate	Timing	Remarks
Barberry (<i>Berberis glaucocarpa</i>)	Hand pull seedlings/small plants	-	-	Year round	
	Cut and treat stumps	Glyphosate gel 120g/KG	Paste with glyphosate gel	October-April	
	Drill and inject, frill and spray	Glyphosate 510g/L	70ml glyphosate + 2ml organosilicone/1L water	October-April	
Bindweed (<i>Calystegia sepium x silvatica</i>)	Knapsack - foliar spray	Triclopyr 600g/L	30ml triclopyr/10L water	October-February	Pull vines away from non-target vegetation before spraying.
Cape gooseberry (<i>Physalis peruviana</i>)	Knapsack - foliar spray	Triclopyr 600g/L	60ml triclopyr/10L water	October-March	Control only in sensitive sites or isolated infestations/plants.
Chinese privet (<i>Ligustrum sinense</i>)	Hand pull seedlings/small plants	-	-	Year round	
	Cut and treat stumps	Glyphosate gel 120g/KG	Paste with glyphosate gel	October-April	
	Drill and inject	Glyphosate 510g/L	70ml glyphosate + 2ml organosilicone/1L water	October-April	
	Knapsack - foliar spray	Glyphosate 510g/L	70ml glyphosate + 10ml organosilicone/10L water	October-April	Seedlings and sapling plants <50cm. Full coverage required.
		Triclopyr 600g/L	60ml triclopyr + 10ml organosilicone/10L water		
Metsulfuron 600g/KG	5g metsulfuron + 10ml organosilicone/10L water				
Gorse (<i>Ulex europaeus</i>)	Cut and treat stumps	Glyphosate gel 120g/KG	Paste with glyphosate gel	October-March	
	Knapsack – foliar spray	Triclopyr 600g/L	60ml triclopyr + 10ml organosilicone/10L water	October-March	
		Metsulfuron 600g/KG	5g metsulfuron + 10ml organosilicone/10L water	October-March	
		Clopyralid 300g/L	125ml Clopyralid/10L water	October-January	
Grey sedge (<i>Carex divulsa</i>)	Dig out small infestations	-	-	Year round	
	Knapsack - foliar spray	Glyphosate 510g/L	100ml glyphosate/10L water	October-April	

Pest Plant	Control Method(s)	Chemical(s)	Application Rate	Timing	Remarks
Grey willow (<i>Salix cinerea</i>),	Cut and treat stumps	Metsulfuron 600g/KG	5g metsulfuron + 2ml organosilicone/1L water	October-April	
		Glyphosate 510g/L	250ml glyphosate/1L water (25% glyphosate)	October-April	
	Drill and inject/Bore and spray	Metsulfuron 600g/KG	5g metsulfuron + 2ml organosilicone/1L water	October-April	Preferred option as leaving the tree standing avoids broken twigs/branches resprouting on ground.
		Glyphosate 510g/L	500ml glyphosate/1L water (50% glyphosate)	October-April	
	Basal bark application	Triclopyr 600g/L	2L triclopyr + 8L Syntol oil	October-April	ONLY on trees with base diameter <30cm
Inkweed (<i>Phytolacca octandra</i>)	Hand pull seedlings/small plants	-	-	Year round	Avoid leaving root in ground
	Cut and treat stumps	Glyphosate gel 120g/KG	Paste with glyphosate gel	Year round	
	Knapsack - foliar spray	Glyphosate 510g/L	70ml glyphosate + 20ml organosilicone/10L water	October-March	Control only in sensitive sites or isolated infestations/plants.
		Metsulfuron 600g/KG	5g metsulfuron + 10ml organosilicone/10L water	October-March	
Kikuyu (<i>Cenchrus clandestinus</i>)	Knapsack – foliar spray	Glyphosate 510g/L	70ml glyphosate/10L water	Year round	Good for initial control
	Knapsack – foliar spray	Haloxypop 100g/L	70ml haloxypop/10L water	Year round	Grass specific herbicide. Useful for releasing around indigenous plantings to minimise non-target damage.
Ragwort (<i>Senecio jacobaea</i>)	Knapsack - foliar spray	Metsulfuron 600g/KG	5g metsulfuron /10L water	October-March	
Woolly nightshade (<i>Solanum mauritianum</i>)	Hand pull seedlings/small plants	-	-	Year round	
	Saplings - cut and treat stump	Glyphosate gel 120g/KG	Paste with glyphosate gel	Year round	



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