Wetland Management Plan for Homestead Bay, Queenstown

Contract Report No. 7522a

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Wildlands

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Contract Report No. 7522a

September 2025

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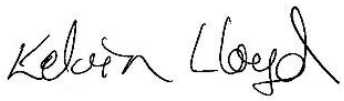

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Contents

1.0 Introduction

RCL Homestead Bay Limited, is developing a residential subdivision on approximately 200 hectares of rural land at Homestead Bay, just south of Jacks Point in Queenstown. The subdivision plan will involve the development of residential units, commercial land, schools, roading infrastructure, recreational parks, and indigenous plantings.

An existing ephemeral wetland is proposed as part of the development to be retained and enhanced (as partial compensation) and a Wetland Management Plan is being prepared to ensure that the wetland is not affected by the development occurring within 100 metres.

This management plan takes in account the unique nature of the ephemeral wetland. However, ephemeral wetland management information is limited and suggestions have been carefully considered. The wetland condition monitoring will help identify any potential wetland change that could occur from the restoration plantings and/or development activities.

2.0 Management Goals

The purpose of this Wetland Management Plan is to:

- Manage the activities and maintenance within and adjacent to the wetland to ensure that there is no loss of extent or loss of any value of the natural inland wetland and to ensure that the hydrological wetland characteristics are maintained.
- Monitor wetland condition to ensure the residential development does not affect the hydrology of the wetland during works or as a result of permanent changes to wetland hydrology inputs resulting from the residential development.
- Enhance wetland through indigenous plantings and other actions, to achieve no net loss and ideally a net gain of natural inland wetland extent within Lot 9002 and values within the site as compared with the pre-residential development environment

3.0 Ecological Value

3.1 Vegetation and habitat

Four vegetation and habitat types were identified within the wetland area and are mapped in Figure 1, with descriptions provided below. The wetland has been observed in its dry state in summer and its wet state during winter (Plate 1 and 2). The wetland present contains two classes of wetlands (ephemeral and marsh) within it.

Ephemeral wetlands are typically in closed depressions and contain low statue plant species that are often arranged in a zonation pattern. This type of wetland has unique hydrology characteristics by being intermittently inundated throughout the year. Typical hydrology of an ephemeral wetland is usually ponded during winter/spring, with the water level gradually lowering in summer (Johnson & Rogers, 2003). Ephemeral wetlands are ecologically valuable as they can contain a diverse range of plant species, host a high proportion of uncommon and threatened plants (Johnson & Rogers, 2003) and provide habitat for wading indigenous birds. Ephemeral wetlands threatened by many factors including human-induced modifications, sedimentation, nutrient enrichment, pollutants, trampling impacts from mammals, weed invasions and introduced fish (Johnson & Rogers, 2003).

Ephemeral wetlands are a unique and uncommon habitat and has been listed as a critically endangered ecosystem (Holdaway *et al*., 2012).

1. Exotic pasture grassland

This exotic dominated grassland contains various grasses at various abundances with ryegrass (*Lolium perenne*) being the most common in the main paddocks. This grassland is mostly grazed by sheep and/or cattle, except for the areas that are fenced off to exclude stock. Exotic herbs such as white clover (*Trifolium repens*) are common in the grassland.

2. Soft rush rushland (0.039 hectares)

North of the ephemeral wetland is a rushland dominated with soft rush (*Juncus effusus*), exotic grasses and the occasional track rush (*Juncus tenuis* subsp. *dichotomus).* A linear drain has been dug in the middle of this rushland that runs towards the northern end of the ephemeral wetland.

3. Kneed foxtail *Lobelia perpusilla* grassland ephemeral wetland (0.036 hectares)

The ephemeral wetland is located in the middle of the rushlands and is a concave hollow that is lined with soft rush on the northern end and leafless/wīwī (*Juncus australis*) rush on the southern end. The ephemeral wetland contains abundant kneed foxtail (*Alopercurus geniculatus*) with common patches of the indigenous herb *Lobelia perpusilla*.

4. Wīwī rushland marsh (0.051 hectares)

The marsh wetland at the southern end of the ephemeral wetland is dominated by leafless/wīwī, exotic grasses, including some patches of kneed foxtail. The exotic rush, track rush is occasionally scattered within.

Plate 1 – Ephemeral wetland with rushland marsh edges at the end of summer. 5 February 2025.

Plate 2 – Ephemeral wetland with rushland marsh edges at the end of winter. Rushes have been heavily grazed. 9 September 2025.

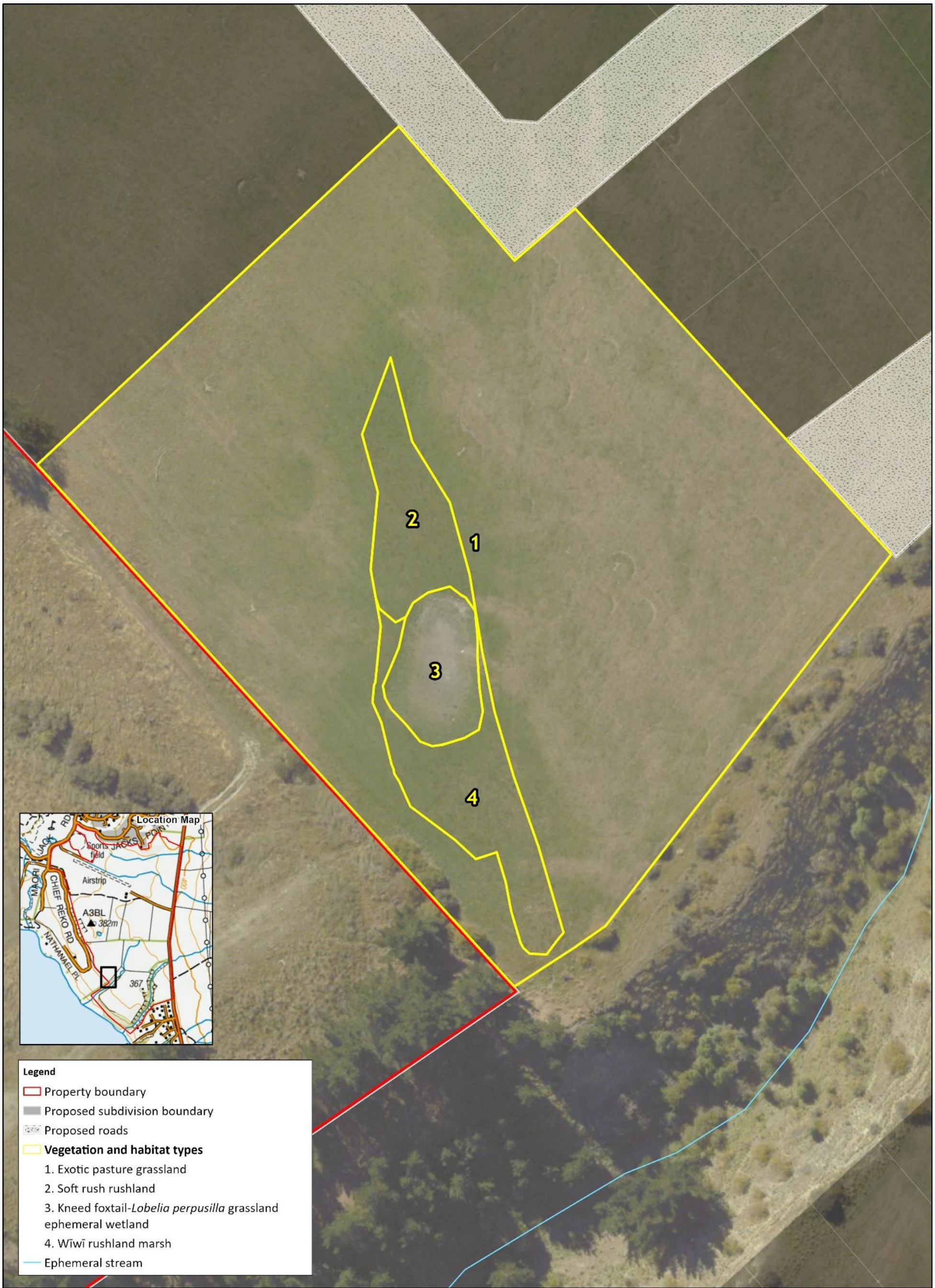

Figure 1. Vegetation types present at Homestead Bay, Queenstown

3.2 Flora

Four indigenous and 15 exotic vascular plant species were recorded during the field survey (Appendix 1).

Environmental weeds and pest plants

One environmental weed, jointed rush (*Juncus articulatus*) is listed in the latest national list published by the Department of Conservation (McAlpine and Howell 2024). Three aggressive weeds that threatened turf vegetation are present and include soft rush, track rush, jointed rush and kneed foxtail (Johnson & Rogers, 2003). Aggressive weeds are those which are able to achieve substantial cover and displace indigenous turf plants, in particular within the upper zone turf ((Johnson & Rogers, 2003).

4.0 Management

4.1 Hydrology and wetland monitoring

Drainage patterns of the wetland catchment have been mapped by the engineer consultant, Stantec (Appendix 2). The current wetland catchment extent is *c.*27,000 m^2. The post-development wetland catchment extent will be *c.*19,300 m^2, meaning that the catchment will be reduced by 28%. One of the unique characteristics of ephemeral wetlands is that they are a sink for water flow, rather than a throughflow or outflow origin (Johnson & Rogers, 2003). The key source of water for this ephemeral wetland will be rain and its related surface-flow. As it is not entirely reliable on surface-flow, the ephemeral wetland may have some resilience to the reduced water catchment due to the development as it can still receive direct rain water. To mitigate any possible drier than normal conditions, it is recommended to plant the surrounding area of the wetlands (and within) to increase surrounding soil moisture retention. This may enable the wetland to be more resilient to drier than normal conditions. Monitoring the wetland will be vital in understanding these possible effects and any additional management actions, such as irrigation or storm water outflow can be addressed at the time.

4.2 Fencing marking wetland boundary

Ephemeral wetlands are sensitive to infilling, soil compaction from humans, cattle, and vehicles. During the construction phase of the development the remaining ephemeral wetland is at risk of being driven across by a contractor or infilled. There are several options for protecting the ephemeral wetland, in order of priority.

- A permanent stock fence around the entire wetland complex could be constructed. This would allow indigenous restoration of terrestrial and wetland indigenous plants. A surround of dense shrubs would restrict weeds, and the wetlands could be enhanced with indigenous wetland plants.
- A surround of big boulders is alternatively suggested for the ephemeral wetland. It will restrict vehicles from driving over it on a permanent basis, but allow enhancement staff through.

4.3 Indigenous planting

To enhance the wetland's diversity, and resilience, indigenous restoration plantings are recommended. Many ephemeral wetland turf communities grow exposed to full sunlight and exposed situations. To retain a natural open habitat around the wetland, low-statue indigenous plant species have been carefully selected to create this environment. Indigenous plantings within and adjacent to the wetland will help retain soil moisture and buffer the wetland from future drier conditions potentially caused from the reduced catchment and drought conditions of climate change. The indigenous plantings will also be beneficial as a resource for any indigenous fauna such as birds, lizards and invertebrates that will utilise this habitat.

4.4 Threatened plant management

To ensure the survival of the At Risk – Declining sedge, *Carex resectans*, all plant clusters should be identified and marked with a small flag or marker. This enable any contractors undertaking the restoration planting or weed control to avoid these plants and ensure they are not accidentally dug up during planting or sprayed with herbicide. Locating and marking the *Carex resectans* will need to be undertaken by a suitably qualified botanist.

4.5 Weed control

Kneed foxtail should be controlled at the start of autumn, again when the wetland is in its drier state. A grass specific herbicide will need to be used to ensure the indigenous herb species are not affected. Soft rush is an analogue with indigenous rushes. It provides similar habitat. Jointed rush should be kept monitored and if it becomes too abundant, over 30% of a plot, it should be manually controlled. Follow up control will need to be undertaken 4-12 months later.

4.6 Grazing

It's unknown how the effect of removing stock from the ephemeral wetland will have a negative or positive effect. Removing stock will be beneficial in terms of soil compaction effects caused from pugging. However, grazing can complement the natural turf composition that is characteristic of ephemeral wetlands. There is a possibility that birds will visit the wetland, especially if fenced off, and their grazing will be enough. Grazing is a component of the monitoring and can be addressed each monitoring visit.

5.0 Monitoring

5.1 Wetland condition monitoring

Wetland monitoring is to be undertaken to detect any possible negative changes to the wetland so that remedial actions can be undertaken if necessary. The wetland monitoring will also be beneficial in tracking the benefits of the restoration plantings. Monitoring permanent vegetation plots over time will help identify any degradation or improvements to the wetland. Wetland monitoring will follow the methods in Wildland Consultants (2019) who set up monitoring in the Shotover Confluence Swamp. Three 100 m^2 plots should be set up in wetland complex (one at least should be in the ephemeral wetland) and marked permanently. The cover of each plant species should be estimated, and ground cover of litter, bare soil, rock or gravel, and open water. Wetland indicator scores should be added to species. These methods allow:

- Whole plot presence/absence.
- Abundance scores for each vascular species.
- Changes in ground cover to be assessed.
- Wetland indicator cover scores to be calculated and assessed. These give indications of hydrological change.

The dates of the construction and planting activities should be recorded and provided to the ecologist undertaking the wetland monitoring assessment.

Plot set up

Plot set up should be done before any construction and/or planting is done. Set up three permanent plots. One plot in the northern rushland, one plot in the ephemeral wetland and one in the southern rushland. All plots will be 10 x 10 metres.

- Mark each plot corner with a fibreglass rods.
- Label the South-West plot marker with the plot number label.
- Record the GPS point of the SW corner for every plot (this should be done using a handheld GPS and ideally the point should be averaged to increase accuracy).
- Undertake wetland condition monitoring as above.
- Take a photo of the plot vegetation.

Plot re-measurement

The wetland condition monitoring and plot re-measurement should be done at the same time each year. Monitoring should occur annually in February or March for ten years.

- Undertake wetland condition monitoring as above.
- Take a photo of the plot vegetation.
- Compare results with previous assessment and write an annual report to update landowner.

5.2 Hydrological monitoring

Hydrological monitoring should be set up as soon as possible to gather as much baseline data before development construction begins. Hydrology set up and monitoring has been guided by Chapter 7, from the Landcare Research, Wetland Restoration: A Handbook for New Zealand Freshwater Systems (Peters and Clarkson 2010).

Rainfall should to be measured to help understand external influences on the wetland hydrology. During the construction phase, rainfall data can be collected from the newly established weather station on the property. Pre- and post-construction phase, rainfall data can be collected from a local

source such as the weather station at the Queenstown Airport, where the information can be collected from the Metservice website.

To measure water table elevation, dipwells need to be installed. A dipwell usually consists of a plastic tube (30 – 60 millimetres in diameter) with small holes along the length of the tube and sealed at the base.

Set up

Set up two dipwells for monitoring. One can be placed at the upper/northern end of the wetland and another can be placed near the lower/southern end.

- Use a hand auger or push dipwells into selected locations.
- Install a reference peg (steel rod) next to each dipwell and label.
- Record the GPS point of each dipwell.

Monitoring

Manual measurements will always yield an incomplete record and inevitably the full range of water level fluctuations will not be captured. However, for the purpose of this monitoring, monthly records should be sufficient in recording and noting any change. Monitoring should occur monthly for ten years and as follows:

- Using a tape measure, manually record the water level by measuring the vertical distances between the top of the reference peg and the top of the dipwell, and from the top of the dipwell to the water table inside the tube. Alternatively, a water level indicator (dip meter) can be used to measure the water level in the dipwell.
- Record rainfall data from weather station.
- Compare results with previous assessments and rainfall data and add information to the annual report

5.3 General monitoring of restoration

Surveillance of the restoration area should be undertaken, once per year so that:

- Management is appropriate to ensure the successful survival, growth, and establishment of all planted and regenerating species.
- Monitoring of weather patterns and plant health to determine any extra actions that need to take place. For example, if the area is experiencing a drought the plants may need a planned watering visit. Monitoring can be done in conjunction with maintenance visits.
- Newly established pest plants and/or environmental weeds can be identified and managed.
- Keeping records of the local species used, their source, time of planting and results will be helpful for future restoration projects. This can also be helpful in knowing the source of plants and where to collect seeds for future plantings.

5.4 Photopoints

Photographs, taken at specific points and at set timeframes, are an efficient way to monitor broad changes in vegetation composition and structure within a defined viewpoint. It is suggested that photopoints are established within the wider site. The photopoints should be established at sites

where there are relatively unobstructed views. Each photopoint should be marked with a wooden post and the location recorded with a handheld GPS. A compass should be used to gauge a bearing to the center of the frame of the photopoint. The photographs should then be printed to provide a reference for future revisits. The photopoints should be resampled bi-annually during the same time of year.

5.5 Reporting

After the wetland condition monitoring visit, an annual report will be prepared and submitted to Otago Regional Council (ORC) for their information. If any signs of wetland degradation are noted a meeting will be organized with the RCL Group to discuss potential mitigation actions needed. If the indigenous plantings are not enough to retain appropriate soil moisture levels for functioning wetland hydrology, then an irrigation system for the wetland may need to be installed. Any possible mitigation actions will be discussed with ORC prior to implementation.

6.0 Restoration Planting

Four different planting zones have been identified to support the restoration of the wetland. The key aspect for this restoration planting design is to plant the area with low-statue plants to keep an open habitat that is necessary for the natural functioning ephemeral wetland. Plantings within the ephemeral wetland is not necessary; turf specific indigenous species are already present. However, some species are suggested as an opportunity to diversify the turf community.

Detailed specifications on restoration planting implementation are in Appendix 3.

Planting zones:

- Shrubland.
- Copper tussock grassland.
- Sedgeland and rushland.
- Ephemeral wetland.

Shrubland

Plant 100% of the surrounding dryland area with shrub species such as tūmatakuru/matagouri (*Discaria toumatou*), mingimingi (*Coprosma propinqua*), porcupine shrub (*Melicytus alpinus*), desert broom (*Carmichaelia petriei*) and pōhuehue (*Muehlenbeckia complexa*) and dwarf shrubs such as prostrate snowberry (*Gaultheria antipoda*) snowberry (*Gaultheria depressa*). Short tussock species could fill gaps, silver tussock (*Poa cita*) in damp habitats and hard tussock (*Festuca novae-zelandiae*) in dry habitats. (Table 1).

Copper tussockland

Plant 90% of the area around the wetland with copper tussocks (*Chionochloa rubra* subsp. *cuprea*). Plant 20% of the area with bog rush (*Schoenus pauciflorus),* with many of them being placed closer to the sedge and rush planting zone edge (Table 1).

Sedge and rushland

To create some diversity in the rushland, inter-plant the zone with various indigenous sedges and rushes (Table 1).

Ephemeral wetland

Carex gaudichaudiana, *Epilobium angustum, Euchiton traversii* or *Argyrotegium mackayi* could be planted in the ephemeral wetland. Sourcing these species will be difficult. Discussions with a local nursery to source the seed and the plants would be needed. Alternatively, plants could be transplanted from a healthy source population. The Department of Conservation may have some advice and guidelines around this.

Table 1 – Planting zones species list for the wetland restoration plantings at Homestead Bay, Queenstown.

Scientific Name	Common Name	Spacing (m)	Percentage (%)
Shrubland			
Carmichaelia petrei	Desert broom	1.2	10
Coprosma propinqua	Mikimiki, mingimingi	1.2	10
Discaria toumatou	Tūmatakuru, matagouri	1.2	10
Festuca novae-zelandiae	Fescue tussock, hard tussock	0.2	20
Gaultheria depressa	Snowberry	1.2	10
Gaultheria antipoda	Prostrate snowberry	1	10
Melicytus alpinus	Porcupine shrub	1	15
Muehlenbeckia complexa	Pōhuehue, wire vine	1.2	10
Poa cita	Wī, silver tussock	0.5	20
Copper tussockland			
Chionochloa rubra subsp. *cuprea*	Copper tussock	1	80
Schoenus pauciflorus	Bog rush	0.5	20
Sedge and rushland			
Carex buchananii	Matirewa, cutty grass	0.5	20
Carex gaudichaudiana		0.2	20
Carex virgata	Swamp sedge	0.5	20
Eleocharis acuta	Sharp spike sedge	0.2	20
Schoenus pauciflorus	Bog rush	0.5	20
Ephemeral wetland			
Carex gaudichaudiana	Gaudichaud's sedge	-	-
Epilobium angustum	Willowherb	-	-
Euchiton traversii		-	-
Argyrotegium mackayi		-	-

Figure 2. Indigenous planting zones for the natural inland wetland at Homestead Bay, Queenstown

7.0 Summary

Several management actions can be undertaken to ensure the ephemeral wetland is not affected by the residential development. Key actions include:

- Some kind of fencing around the wetland during construction or rocks around ephemeral wetland.
- Wetland condition monitoring.
- Wetland hydrology monitoring.
- Weed control.
- Indigenous plantings.
- Annual report outlining the previous years monitoring and identify any potential issues.
- Meet with landowner if negative effects are noted during the monitoring.

Acknowledgments

Amanda Leith (Planner/Director of Remarkables Planning) is thanked for providing useful information and site access. Farm Manager, Matt Little is thanked for allowing access to the active farm areas.

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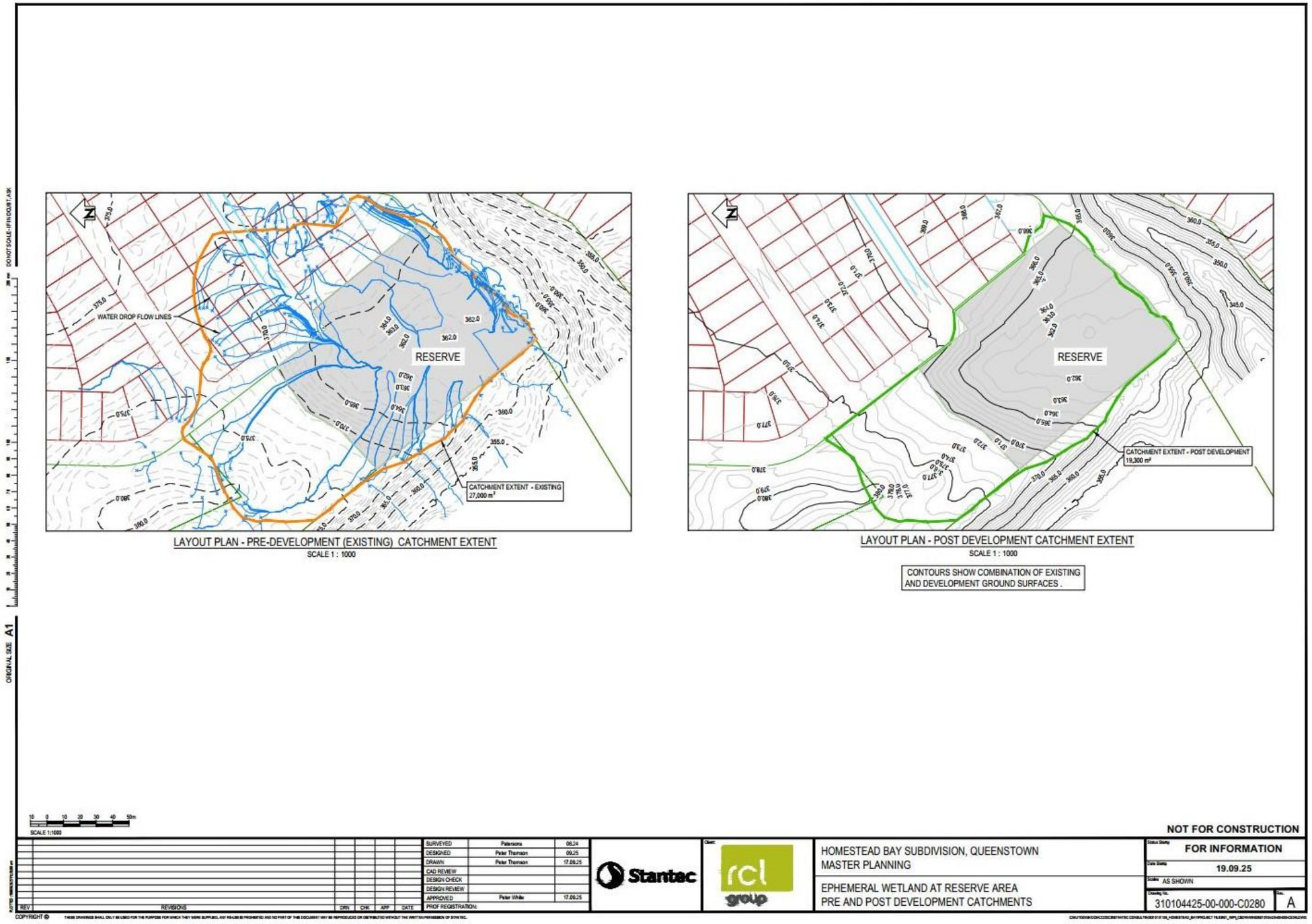
Appendix 1

Vascular plant species list

Species	Common Name	Plant Type	Status	National Threat Status
Agrostis capillaris	Browntop	Graminoid	Exotic	-
Alopecurus geniculatus	Kneed foxtail	Graminoid	Exotic	-
Capsella bursa-pastoris	Shepherds purse	Forb	Exotic	-
Carex resectans		Graminoid	Indigenous Endemic	At Risk – Declining
Cerastium fontanum	Mouse-ear chickweed	Forb	Exotic	-
Galium perpusillum	Dwarf bedstraw	Forb	Indigenous Endemic	Not Threatened
Glyceria fluitans	Floating sweetgrass	Graminoid	Exotic	-
Juncus articulatus	Jointed rush	Graminoid	Exotic	-
Juncus australis	Wīwī	Graminoid	Indigenous Non-Endemic	Not Threatened
Juncus effusus	Soft rush	Graminoid	Exotic	-
Juncus tenuis subsp. dichotomus		Graminoid	Exotic	-
Leontodon saxatilis		Forb	Exotic	-
Lobelia perpusilla		Forb	Indigenous Endemic	Not Threatened
Lolium perenne	Ryegrass	Graminoid	Exotic	-
Poa annua	Annual poa	Graminoid	Exotic	-
Stellaria alsine	Bog stitchwort	Forb	Exotic	-
Trifolium dubium	Suckling clover	Forb	Exotic	-
Trifolium repens	White clover	Forb	Exotic	-
Veronica persica	Scrambling speedwell	Forb	Exotic	-

Appendix 2

Wetland catchment flow diagram



Appendix 3

Restoration planting guidance

Plant sourcing

Eco-sourcing of indigenous species

Effort is put into protecting and managing indigenous remnants to preserve their ecological history which contains a unique collection of plant communities that has developed over hundreds of years on that particular site and in response to local environmental conditions (Porteous 1993). Using local plants is highly beneficial as they are adapted to local conditions and will persist better than the plants from other areas. Keeping records of the local species used, their source, time of planting and results will be helpful for future restoration projects.

Previously, it has been recommended to source plants from the nearest Ecological District (e.g., Remarkables Ecological District), but new research from Heenan *et al.* (2023), suggests sourcing plants from larger eco-sourcing regions. This means that plants can be sourced from a larger area than originally advised. Sourcing plants from multiple sources with the eco-source region will contribute to a bigger gene pool for the species. This can help, for example, with resilience to climatic change (Heenan *et al.,* 2023). Obtaining plants from the nearest eco-sourcing region, from multiple sites will improve success of the plant species establishment. This property can collect from one eco-sourcing region (Appendix 3). This region overlaps southern/inland Canterbury, Otago, and eastern Southland.

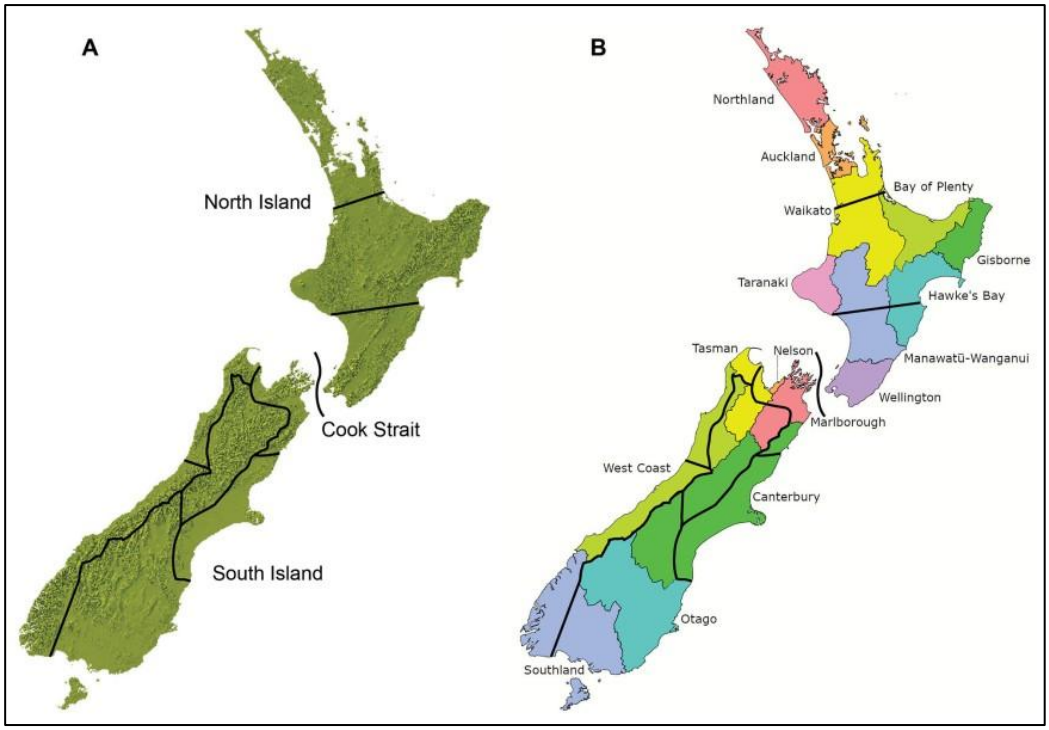


Figure A3-1 – Nine proposed eco-evolutionary regions for eco-sourcing plants. A, Eco-sourcing regions overlaid onto New Zealand topographic map. B, Eco-sourcing regions overlaid onto Regional Council regions. This image has been resourced from Heenan *et al.* (2023).

Garden cultivars are hybrids or are a plant variety that has been selected for amenity traits. Garden cultivars or hybrids are not suitable for restoration projects as they have been propagated to minimize genetic diversity in favour of uniformity. Plant species for restoration projects need to have high genetic variability to enable them to adapt. Garden cultivars can easily be recognized in nursery lists when they do not write out the full scientific name of a species and include a name in single quotation marks. Garden cultivars should be avoided in ecological restoration projects.

If a species is not available on the suggested plant list, order more of another species on that list or consider infill planting with the missing species when it becomes available. Plant orders should be done as soon as possible to ensure plant species and numbers are available for the next planting season. Some nurseries require plant orders two years in advanced to guarantee plant availability.

Plant size and quality

- Planter bag (PB) plant grades (ideally 2/3) should preferably be used for most of the plantings as their stature and robustness reduces their vulnerability to light or incidental browsing from herbivorous animal pests (e.g. rabbits), competition from weeds, and they are more resilient to frosts and other environmental extremes. Larger plant sizes have the disadvantage of making them heavier to transport.
- Where pre-planting site preparation and post-planting monitoring and maintenance are carried out to a high standard, plants in root trainers (RTs or RX90) can be used instead of larger, more costly plants in individual PBs.
- Ensure that all nursery grown shrubs are a minimum of 40 centimetres tall and with a root collar/basal stem diameter of at least two millimetres. This will make sure that the plants are of a sufficient stature to survive the first growing season. Plants that are too young will have a poor root structure, sparse vegetative growth, and are unlikely to survive. Conversely, plant stock that is root bound will also likely result in poor plant growth or survival.
- All plants should be hardened off (exposing them to sun, wind and temperatures that are similar to the climatic conditions at the site) by the nursery prior to planting.
- All plants should be free from pests and diseases.

Care of plants between the nursery and planting

Plants should be kept well-watered from the time of departure from the nursery until the day of planting, and handled with care to reduce plant damage. If planting of a site is to be undertaken over an extended time period (e.g. weeks not days), a temporary nursery for holding and watering the stock prior to planting should be built. Note that plants that undergo drought stress prior to planting have a much higher probability of dying in restoration projects.

Planting

General site preparation and planting guidelines

One month prior to planting the exotic pasture grassland/shrubland planting zone, spot-spraying should be done to reduce exotic grass ready for indigenous species. Care should be taken to check that no lizards are present before spraying. No site preparation is needed for the sedge and rushland planting zone.

The following guidelines will provide general site preparation information:

- An assessment of the area to be planted should be undertaken at least six months prior to planting to identify any problem pest plant species which may require sustained control.
- Herbicide control over water must be undertaken with great care. Only glyphosate can be used over water without a resource consent.

- In areas where threatened or locally important plant species or lizards are present, weed control should be undertaken manually to avoid unwanted damage to threatened plants or lizards.
- Hares and rabbits should be controlled prevent them affecting the plantings.

Plant layout and spacing

In general, lower growing species (e.g., grasses or sedges) should be planted close together at approximately 0.2-0.5 metre centres. However, copper tussock needs to be planted at one metre spacings as they are a large grass. Shrubs should be planted at 1.0-1.2 metre spacings. Planting at these spacings will ensure that a dense canopy quickly forms, thereby reducing competition with exotic grasses and pest plants.

Timing of planting

Timing of planting will be dictated by the rainfall patterns in the intended planting season but, in general, the site should be planted in autumn (but can also be planted in spring), once soil moisture levels reach field capacity, through to mid-winter or September/October once any standing water has drained. The goal in these areas should be to plant while there is adequate soil moisture to allow the plants to establish before summer droughts.

Planting technique

The importance of good planting technique should not be under-estimated, and the following guidelines should be followed:

- Ideally all planting should be undertaken by experienced workers in accordance with recognised industry best practice. If volunteers are used, they must be briefed and thoroughly supervised to ensure correct planting techniques are used.
- Care should be taken to ensure that the root ball is not excessively disturbed during container removal or planting.
- If the plant is on a slope a 'shelf' will need to be cut into the hillside. The shelf will create a flat zone for the plant to be put into. This will ensure the plant remains upright.
- The planting hole should be two times the size of the root mass and the soil broken up with a spade as it is dug out of the hole.
- Plants should be planted just above the level of the potting mix. This will prevent the potting soil being exposed to the air and drying out.
- The planting hole, when filled in, should form a very shallow depression, to enable rain water to collect and soak in. Once planted, the plant should resist being pulled out of the ground when given a gentle tug.

If plants start to show signs of water stress (e.g., wilting leaves), watering could be carried out to reduce plant losses if practical. However, the timing of planting and the addition of a weed mat will likely help the plants survive potential drought conditions.

Plant protection

Newly-planted shrubs can be decimated by rabbits, so protection against rabbit browse is critical. Individual plant guards should be used to protect each palatable plant from browsing. They also provide shelter, increased humidity, reduction of moisture loss, and help to prevent unintended herbicide damage.

- Mulching/weed mats retain moisture, reduce soil temperature fluctuations, and suppress pest plant growth (Dollery *et al*., 2018). Using weed mats is highly recommended. A second weed mat could be put on the plant again, once the first weed mat has started to degrade.

- Guards are not necessary on rush (*Juncus* spp.), sedge (*Carex* spp.) and grass (*Chionochloa* sp, *Poa* spp. and *Festuca* sp.) or herbaceous plant species.
- We suggest using FiberGuard (300 millimetre) for plant protection in terrestrial habitats. This plant guard is robust and biodegradable. Two bamboo stakes are needed for each guard. Exposed windy sites need three bamboo stakes. Suggested weed mats are Ecowool Mulch Mats (250 millimetre) or TerraFiber Hemp Mulch Mats (300 millimetre).
- Guards should be removed and reused (if plastic guards are used) once the foliage of the plants grows out of the top of the guard. Leave weed mats to biodegrade around the plant. Inspect weed mats every year during the first three years and replace any that have biodegraded too fast.

Planting maintenance

The plantings should be inspected at least three times per year during the first two years following planting, and annually for the next three years. During these visits, plants should be released (weeding around plantings) from exotic vegetation to ensure they receive sufficient sunlight. As the plants become established (once they achieve >75% canopy cover), they will begin to out-compete other exotic species and the amount of maintenance required will decrease. Areas comprising low growing species may require some ongoing maintenance as pest plants will continue to invade from surrounding areas.

Grasses have the greatest impact on the establishment of indigenous plantings and so it is important that they are controlled during Years 1 and 2 by hand releasing or using a glyphosate-based herbicide. Hand-releasing plants by cutting the grass very close to the ground and laying the dead material around the plant can be hugely beneficial for the plant. The dead mulch will temporarily shade out other grasses and weeds and also act as mulch and therefore help with water retention. Hand-releasing can be a hugely time-consuming task, however, it is recommended to use this method as far as possible instead of chemical sprays to avoid adverse effects of chemicals on any lizards that may be present. Care should be taken to make sure lizards are not present before cutting the grass very close to the ground.

The use of a brushcutter between restoration plants can be done but there is a risk of damaging the stems and potentially killing the plant (some brushcutters can cut through guards). The brushcutter should be used by a skilled operator to ensure no plant stems are damaged. Using the brushcutter can be useful if there is intense weed and exotic grass growth in between the plants. The dead material resulting from the brushcutter can again be useful mulch to add around each plant. It is recommended that a brushcutter is not used too close to the ground (i.e., no lower than 10cm above the ground) as lizards may be hiding in the ground cover vegetation.

Once the indigenous plantings have been observed to flower and seed, extra care should be taken next summer during plant maintenance to avoid spraying any indigenous seedlings. If seedlings are found, a stake or weed mat could be added to it, to ensure it does not get accidently sprayed.

Infill planting

Infill planting to replace plants that have died may be required and should be undertaken in years two and three after the original planting, as necessary. The number and species of infill plants should be identified in the February or March proceeding the planting season.

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