Monitoring of Waituna Lagoon Shoreline Changes 2026 Survey

Contract Report No. 7967

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Project Team:

Sarah Wright – Field survey and report author
Michael Stuart – Field survey and report author

Prepared for:

Department of Conservation
Murihiku/Invercargill Office,
7th Floor, CUE on Don,
33 Don Street,
Invercargill 9840

Reviewed and approved for release by:

Justyna Giejsztowt
Principal Ecologist – Biodiversity and Modelling Specialist
Wildland Consultants Ltd
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Queenstown Office
Unit 3, 189 Glenda Drive, Frankton, Ph 021 199 8853, Email queenstownlakes@wildlands.co.nz

Head Office
99 Sala Street, P.O. Box 7137, Te Ngae, Rotorua, Ph 07 343 9017, Email rotorua@wildlands.co.nz

www.wildlands.co.nz

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1.0 Introduction

Te Rūnanga o Awarua, the Department of Conservation (DOC), and Environment Southland have jointly applied for a new resource consent to periodically open Waituna Lagoon, with the primary purpose of establishing an opening regime focused on ecological health and cultural values.

Waituna Lagoon is one of New Zealand's most intact coastal lagoons and is internationally recognised as a Ramsar Wetland of International Importance. The lagoon covers approximately 1,350 hectares and is Southland's largest coastal lake. It holds notable ecological and cultural values, including as a site of importance to Kāi Tahu.

In its natural state, the lagoon bar was breached when rising water levels overtopped it, naturally opening the lagoon to the sea. Over the past century, this process has been replaced by human-managed openings, occurring on average once a year when water levels exceed approximately 2 metres. This frequency of opening has created more saline conditions than would occur naturally and has altered the character of fringing wetland communities. Johnson and Partridge (1998) observed that the dominance of oioi/wire rush (*Apodasmia similis*) reedland around the lagoon shore reflects a response to the earliest artificial opening events, accelerated by increased sediment and nutrient availability. More frequent openings cause fringing wetland communities to shift toward drier community types or expand oioi reedland at the expense of other communities.

Fringing, or shoreline, wetlands are recognised as a key ecological value of Waituna Lagoon (Robertson *et al.* 2024), supporting important flora and fauna, including threatened species. Wetland plant communities vary in their tolerance of inundation and dry conditions. Fringing wetland vegetation within the influence of lagoon water levels (below approximately 2.5 metres elevation) is currently dominated, in terms of extent, by oioi reedland. Persistent low water levels and very high water levels both alter indigenous plant communities, with some species and community types benefiting at the expense of others. Sustained higher water levels may also offer some protection to wetland vegetation from invasive species.

The nine original transects were first established and measured by Johnson and Partridge in 1995. Bythell (2013) subsequently remeasured the nine transects and established seven additional ones in 2012 and 2013.

This survey has been designed to establish a baseline against which the ecological effects of the proposed new opening regime can be assessed over time. This report describes the methods used and provides the baseline survey data. It also makes recommendations for future surveys.

2.0 Project Scope

The objective of this project is to design and undertake a baseline survey that allows for assessment of the effect of inundation/water level variation on the extent, type, and health of plant communities, and to provide a report that outlines the methods, accompanied by the data from the baseline survey. The outputs of this project are intended to satisfy the requirements of the s42a report requested during the consenting process.

The scope of this project includes:

- Designing a baseline survey of fringing wetland plant communities, as they relate to elevation and inundation frequency. This largely follows Bythell (2013).
- Undertaking the baseline survey.

- The preparation of a report that describes the methodology used, with sufficient detail that it can be repeated.
- Provision of baseline survey data.

3.0 Methods

Methods were designed to establish a repeatable baseline of fringing wetland plant communities and their relationship to lagoon water level, allowing future surveys to detect changes in community type, extent, and condition.

Methods have been adapted predominantly from Bythell (2013).

3.1 Desktop assessment

Previous reports and monitoring data relating to Waituna Lagoon, and wetland coastal monitoring methods were reviewed to confirm the methods and assist with fieldwork preparation. Key references reviewed included Bythell (2013), Johnson and Partridge (1998), Brownstein *et al.* (2022), Clarkson *et al.* (2003), Robertson *et al.* 2024 and Boffa Miskell and Urtica (2010).

Historical transect data were reviewed in preparation for fieldwork. This included checking transect bearings and lengths, and confirming transect locations on Google Earth aerial imagery. Waypoint data from Bythell (2013) were loaded into Google Earth to verify transect locations. Inconsistencies, including missing data, waypoints and a different numbering system, meant that the transects had to be checked and renumbered. Transects 14 and 15 had no waypoints or data.

Transects have been numbered W1–W14 (Figure 1), based on the mapping presented in Appendix 1 of Bythell (2013).

Field surveys were undertaken over seven days during mid to late May 2026. Four transects were accessed on foot; the remaining ten were accessed by boat. Because most transects were boat-accessible only, fieldwork could be scheduled only when weather and water conditions allowed.

Transect access details, bearing information, and GPS waypoints are recorded in an accompanying Microsoft Excel data file.

3.2 Transect establishment

A total of fourteen transects were measured, based on the transect locations established in Bythell (2013). Transects were re-established by locating permanent marker posts (warratahs) using GPS waypoints from the 2013 survey, loaded onto a Garmin eTrex 22x. Some transects had additional warratahs at 50, 100, 150, 200 and 250 metres. Where more than one warratah was located, a measuring tape was run between them, and the bearing was confirmed. This bearing was then used to extend the transect in both directions as required. Where warratahs were missing, the transect was re-established using the bearing and available waypoints as guides, with triangulation between located warratahs where possible. Previous subplot waypoints were used as a guide. Replacement warratahs were installed when a warratah was missing. A magnetic compass bearing was recorded for each transect.

All transects were measured from their established start points, which are at or close to the water's edge (Figure 1). Transects were extended to their full previously measured length, including any subplots that had been previously measured as a wetland community type, but at this measure could possibly be a dryland community.

The number of subplots on Transect W10 differs from the 2013 dataset (24 subplots in 2026 versus 30 in 2013). Following realignment of the transect to the warratahs, the revised subplot count was 24. The difference is likely due to recording errors in the 2013 dataset. Transect W14 was re-established using the transect length recorded in Bythell (2013) after the original start-point warratah was located during fieldwork.

The following data were recorded for each transect:

- Date and ecologist names.
- Access information.
- Start, end, subplot and additional warratah waypoints.
- Magnetic compass bearing.

Data Acknowledgment

Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0

Report: 7967
Ref: 12741
Client: Department of Conservation
Name: Figure_Transects.aprx
Path: E:\gis\WaitunaLagoon\2026\mxd\

N

0 500 1,000 m

Figure 1. Location of monitoring transects at Waituna Lagoon

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Scale: 1:21,000
Date: 23/06/2026
Cartographer: FM
Format: A3R

3.3 Subplot measurement

Subplots measuring 2 × 2 metres were placed along the true right side of each transect, allowing movement along the true left without trampling vegetation within subplots. Subplots were established using four bamboo stakes and a 30-metre tape. Subplot spacing along each transect followed the intervals used by Bythell (2013), which vary with transect length (as shown in the accompanying Excel sheet).

Data collected for each subplot has been summarised in Table 1. All vascular plant species observed in subplots were collated into a species list (Appendix 1). National Vegetation Survey (NVS) six-letter codes were used in the field and for data entry.

For the 2026 measure, the vegetation height recording was simplified. Rather than recording the mean and maximum height for every individual species, the mean height of all vegetation in the subplot was recorded, along with the height and identity of the tallest species present. This change was made to reduce field time without material loss of information and to align with current vegetation monitoring methods.

Table 1 – Data collected for each subplot.

Variable	Protocol
GPS waypoints	A new GPS waypoint was recorded where possible; where the subplot was inaccessible due to water depth, historical waypoints from Bythell (2013) were used.
Vascular plant NVS code	All vascular plant species present in the subplot. Aquatic species were not recorded. Species were only counted if they had live vegetation extending out of water.
Percentage cover (species)	Estimated to the nearest 1% per species. Species with less than 1% cover were assigned a nominal value of 0.5%. The total may exceed 100% where layers overlap.
Percentage cover (substrate)	Estimated to the nearest 1% for: gravel, soil, silt, litter, moss, algae, and water. The total may exceed 100% when substrate categories overlap. If a subplot could not be reached because it was inundated, it was recorded as 100% water.
Mean vegetation height	Mean height of all vegetation in the subplot, recorded to the nearest 5 cm.
Maximum height (tallest species)	Height of the tallest individual recorded to the nearest 5 cm.
Canopy cover %	Where vegetation exceeded 135 cm, species in that tier were recorded a second time as 'canopy', with an estimated canopy cover percentage.
Vegetation and habitat type	Each subplot was rapidly assigned a vegetation type from Table 2

Vegetation and habitat types

The vegetation community descriptions from Bythell (2013) were reviewed and cross-referenced against the community types in Singers and Rogers (2014). A vegetation community type was assigned to each subplot based on this review.

The Singers and Rogers (2014) framework performs well for indigenous vegetation community types, but, because of its indigenous focus, it cannot be easily applied to modified or exotic-dominant community types. Despite this limitation, the framework is useful for long-term transect monitoring, as it will show changes in community type over time (e.g. wetland to dryland, fernland to scrub).

A full analysis of species composition for each subplot was beyond the scope of this report. Vegetation types were assigned based on a rapid field assessment of dominant species. It is recommended that vegetation and habitat type assignments are reassessed against the subplot species data during analysis.

The classification used in this survey retains the habitat types from Bythell (2013) where these remained appropriate. These are summarised in Table 2. Two habitat types not present in Bythell (2013) were added:

- SA5: Herbfield (coastal turf). Added to capture turf communities on exposed or drier ground that do not meet the criteria for WL15: Herbfield (lakeshore turf). The distinction between these two types relates to inundation regime and exposure: WL15 is a wetland community type, whereas SA5 is considered terrestrial. Rapid field assessment made it difficult to consistently distinguish between the two types. These assignments should be reassessed using the subplot data, particularly for transects W2, W3, and W11.
- YZ1: Lagoon (open water). Added to record subplots that were fully inundated at the time of survey, following the approach of Wildland Consultants (2018). The subplots assigned as YZ1: Lagoon (open water) had 100% water cover.

All vegetation and habitat type assignments are provisional and reflect conditions at the time of survey. Communities dominated by exotic species may be ephemeral, and species composition will vary with lagoon water levels over time. It is recommended that all vegetation and habitat type assignments be reviewed during data analysis.

Table 2 – Vegetation and habitat types for Waituna Lagoon fringing wetlands.

Habitat Type (2026)	Change From 2013	Classification
WL10: Oioi restiad rushland/reedland	No change	Wetland
WL12: Mānuka, tangle fern scrub/ fernland	No change	Wetland
WL15: Herbfield (Lakeshore turf)	No change	Wetland
WL18: Flaxland	WL18: Modified flaxland	Wetland
WL22: *Carex*, *Schoenus pauciflorus* sedgeland	No change	Wetland
YZ1: Lagoon (open water).	New	Wetland
DN5: Oioi, knobby clubrush sedgeland	No change	Wetland or terrestrial
SA4: Shore bindweed, knobby clubrush gravelfield/ stonefield	No change	Terrestrial
SA5: Herbfield (coastal turf)	New	Terrestrial
VS4: Mānuka scrub	F13: Mānuka scrub	Terrestrial
VS10: Bracken fernland	F19: Bracken fernland	Terrestrial
Exotic grassland	No change	Terrestrial
Exotic ruderal beach community	No change	Terrestrial

3.4 Species identification

If a plant could not be identified in the field, it was given a tag name and keyed out to at least the genus level. Some herbs, grasses, and sedges were only identified to genus due to a lack of flowering or vegetative material.

3.5 Elevation

Subplot elevations were measured using a tripod-mounted surveyor's level (dumpy level) and graduated staff. The elevation datum for each transect was the mean water level recorded at the Carran Creek gauge on the day of the survey.

Tall vegetation prevented elevation measurements from being taken at all subplots. Where this occurred, typically at the upper end of transects, no elevation was recorded. It was, however, possible to give an indication of the elevation of those subplots relative to other subplots and the surface of the lagoon. Plots that are inundated are recorded as being lower than the level of the lagoon, and dry plots where no measurement could be taken are recorded as higher than the level of the lagoon. Additionally, where the unmeasurable subplot was obviously higher or lower than the preceding, measurable, subplot, the elevation was recorded as such.

None of the subplots along transects W10 and W11 could be measured during the survey. This was due to high water levels, vegetation obscuring lines of sight and soft ground for W10 and high water levels for W11. Most of the subplots along W10 and all of the W11 subplots would be able to be measured using the same methods at normal or below normal lagoon levels.

3.6 Photopoints

Photopoints were established at the start and end of all transects. Photopoints were established at 50 m intervals on all transects longer than 50 m. Water levels and accessibility impacted the placement of the first photopoints of some transects. Where possible, starting photopoints were at the 0 metre warratah.

Four photos were taken at each photopoint:

1. Along the transect bearing.
2. Approximately 90 degrees clockwise from the transect bearing.
3. Approximately 180 degrees from the transect bearing.
4. Approximately 270 degrees from the transect bearing.

All photos were taken in landscape view with no zoom, at head height (approximately 165 cm) using a 3rd iPhone SE camera with a 12MP sensor, 28mm equivalent focal length, and a f/1.8 aperture.

Due to the level of the lagoon during the survey, it was not possible to reach all of the 0 m marks and some of the 50 m intervals. Thus, the photopoint data set is incomplete. To compensate for the inaccessibility of some of the 0 m subplots, a photopoint was established at the first accessible subplot of every transect where the 0 m subplot was too inundated to access. This should ensure that, should future surveys be carried out at a similar lagoon level, comparable photographs will be able to be taken from an accessible point near the edge of the lagoon.

Some of the photographs may have limited utility due to the sun's low angle during the survey.

3.7 Data management

Data gathered in the field were entered into Excel in a format that is compatible with R (R Core Team 2021). A species list was generated from transect data in R, to check for data entry errors and duplicates (Appendix 1). National Threat classifications rankings were used from de Lange *et al.* 2024.

Wetland indicator ratings from Clarkson *et al.* (2021) were added to plant species within plots, providing an indirect method for monitoring hydrological changes. This will assist in viewing hydrological change over time, as indicated by the cover of obligate and facultative wetland species and terrestrial species. Plant species were assigned a wetland indicator status from the National Wetland Plant List (Clarkson *et al.* 2021).

Each species is rated with one of the following categories:

- OBL: Obligate Wetland. Almost always is a hydrophyte, rarely in uplands (non-wetlands).
- FACW: Facultative Wetland. Usually is a hydrophyte but occasionally found in uplands.
- FAC: Facultative. Commonly occurs as either a hydrophyte or non-hydrophyte.
- FACU: Facultative Upland. Occasionally is a hydrophyte but usually occurs in uplands.
- UPL: Obligate Upland. Rarely is a hydrophyte, almost always in uplands.

4.0 Discussion

Fourteen of the fifteen transects established by Bythell (2013) were re-established and remeasured in May 2026. Transect W15 was not surveyed during this visit, but it is accessible on foot. It is likely that the start warratah could be located and the transect remeasured in a future survey if required.

The methods and data provided in this report establish a repeatable baseline of fringing wetland plant communities at Waituna Lagoon, recording community type, extent, and condition relative to elevation and inundation frequency. This baseline can be used to assess change in response to the proposed new lagoon opening regime.

Water levels were high at the time of the survey, which influenced the distribution of communities and the number of subplots that were fully inundated. Of the 203 subplots measured across the 14 transects, 37 subplots across nine transects were fully inundated and classified as YZ1: Lagoon (open water). A further eight subplots had less than 20% vegetation cover. Transects W5, W12, and W14 had no inundated subplots. Survey duration and community distribution will vary between visits depending on lagoon water levels, and this should be taken into account when planning future fieldwork.

The dominant community type across the transects was WL10: Oioi restiad rushland/reedland. Densely packed oioi (both live and dead) tends to exclude other species, resulting in lower species richness in those subplots and relatively rapid survey times along oioi-dominated transects.

Overall species numbers were similar to the 2013 survey, though composition likely differs. Counts of obligate and facultative wetland species were also comparable to Bythell (2013), though formal analysis has not yet been undertaken. Four threatened plant species were recorded: two At Risk – Naturally Uncommon (*Juncus pusillus* and swamp nettle [*Urtica perconfusa*]) and two At Risk – Declining (*Carex buchananii* and *Deschampsia cespitosa*). *Juncus pusillus* was not recorded in the 2013 survey. Three species recorded in 2013, *Isolepis basilaris, Oxybasis ambigua,* and *Thyridia repens*, were not found in this survey.

Elevation data could not be collected at all subplots due to tall vegetation, unstable ground, and deep water. The elevation measurements provided are not absolute measurements, and although an elevation above the lagoon floor is given for every subplot where a measurement was possible, it is not recommended that the elevations of different transects be compared to one another using this data. The reason for this is that the level of the surface of the lagoon, which was used as the datum for all elevation measurements, cannot be guaranteed to be consistent at all points of the lagoon. The

depth of the lagoon was taken from the Carran Creek gauge for the day of each transect. The gauge is located very near the easternmost extent of the lagoon, and even light winds can cause a significant discrepancy between the true height of the lagoon surface at different points around the lagoon. For this reason, we recommend that the elevation measurements be used only to illustrate the elevation profile of each transect. If absolute measurements of height above the lagoon's surface are necessary for future survey rounds, then a different method will need to be used.

Recommendations for future surveys

Future surveys should ideally be undertaken in late summer or early autumn to maximise identification of sedge and grass species and to capture annual species. Scheduling surveys at consistent water levels, or recording water level at the time of survey, will improve comparability between monitoring events. Another option to consider is the timing of the surveys relative to water depth. Lower water levels will likely show different vegetation community types and species compositions.

Finding the transects using the existing warratahs and GPS waypoints is a reliable method to re-establish transects. Because GPS data has been checked and updated, it should be more straightforward to find the transects in the future. However, establishing transects and running tapes through dense vegetation are among the most time-consuming parts of the fieldwork. If conditions change, eg 1) oioi becomes less common and turf species increase, or 2) lagoon water levels are lower, so more subplots are measurable; more time will need to be allocated for field surveys.

Allocating a minimum of four hours for two people per transect is recommended, though time will vary with conditions and community type. An entire day is recommended for each of the three transects, which have over 20 subplots (Transects W10, W11 and W12). A minimum of two people is required for all surveys; elevation measurements cannot be taken with fewer people. If lagoon water levels are higher than those experienced during this survey, boat access will be required for most transects, and waders should be used.

It is recommended that all vegetation and habitat type assignments be analysed against the subplot species data, particularly for turf communities where the distinction between WL15: Herbfield (lakeshore turf) and SA5: Herbfield (coastal turf) was difficult to determine in the field. Turf communities are sometimes monitored using 0.5 × 0.5 metre plots to better capture smaller-statured species; this approach could be considered for future surveys if turf community change is a specific monitoring focus, instead of wetlands.

Acknowledgments

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Appendix 1 Plant Species List

Threat status rankings are from de Lange *et al*. (2024). Wetland rankings from Clarkson *et al.* 2021. OBL: Obligate wetland. Rarely in uplands (drylands). FACW: Facultative Wetland. Usually in wetlands, occ. in uplands. FAC: Facultative. Commonly occurs in wetlands and uplands. FACU: Facultative Upland. Occasionally in wetlands but usually in uplands. UPL: Obligate Upland. Rarely in wetlands, almost always in uplands.

NVS Code	Species	Common Name	Plant Type	Status	National Threat Status	Wetland Status
acanov	*Acaena novae-zelandiae*	Bidibidi	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACU
agrsto	*Agrostis stolonifera*	Creeping bent	Grass	Exotic		FACW
ammare	*Ammophila arenaria*	Marram	Grass	Exotic		UPL
antodo	*Anthoxanthum odoratum*	Sweet vernal	Grass	Exotic		FACU
apipro	*Apium prostratum*	Tūtae-kōau, New Zealand celery	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FAC
aposim	*Apodasmia similis*	Oioi	Rush	Indigenous Endemic	Not Threatened	FACW
argans	*Argentina anserinoides*	Kōwhai kura, silver weed.	Herb (Dicot)	Indigenous Endemic	Not Threatened	FACW
atrpro	*Atriplex prostrata*	Orache	Herb (Dicot)	Exotic		FACU
ausric	*Austroderia richardii*	Toetoe	Grass	Indigenous Endemic	Not Threatened	FAC
azorub	*Azolla rubra*	Red azolla	Fern	Indigenous Non-Endemic	Not Threatened	OBL
belvis	*Bellardia viscosa*	Tarweed	Herb (Dicot)	Exotic		FAC
blemin	*Blechnum minus*	Swamp kiokio	Fern	Indigenous Non-Endemic	Not Threatened	FACW
blemon	*Blechnum montanum*	Mountain kiokio	Fern	Indigenous Endemic	Not Threatened	FACU
blechn	*Blechnum* species		Fern	Indigenous Non-Endemic	Not Threatened	UNK
calsta	*Callitriche stagnalis*	Starwort	Herb (Dicot)	Exotic		OBL
calsol	*Calystegia soldanella*	Panahi, shore bindweed	Vine	Indigenous Non-Endemic	Not Threatened	UPL
carapp	*Carex appressa*	Tussock sedge	Sedge	Indigenous Non-Endemic	Not Threatened	OBL
carbuc	*Carex buchananii*	Buchanan’s sedge, cutty grass	Sedge	Indigenous Endemic	At Risk - Declining	FAC
carcor	*Carex coriacea*	Rautahi	Sedge	Indigenous Endemic	Not Threatened	FACW
cardem	*Carex demissa*	Yellow sedge	Sedge	Exotic		FACW
cardip	*Carex dipsacea*	Teasel sedge	Sedge	Indigenous Endemic	Not Threatened	FAC
carfor	*Carex forsteri*	Forster's sedge	Sedge	Indigenous Endemic	Not Threatened	FAC
carles	*Carex lessoniana*	Toetoe rautahi	Sedge	Indigenous Endemic	Not Threatened	FACW
carsec	*Carex secta*	Pūkio	Sedge	Indigenous Endemic	Not Threatened	OBL
carsol	*Carex solandri*	Solander's sedge	Sedge	Indigenous Endemic	Not Threatened	FAC
carex	*Carex* species		Sedge	Indigenous Non-Endemic	Not Threatened	UNK
carvir	*Carex virgata*	Pūrei, swamp sedge	Sedge	Indigenous Endemic	Not Threatened	FACW
cenuni	*Centella uniflora*	Centella	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACW
cerfon	*Cerastium fontanum*	Mouse-ear chickweed	Herb (Dicot)	Exotic		FACU
cirarv	*Cirsium arvense*	Californian thistle	Herb (Dicot)	Exotic		FACU
cirvul	*Cirsium vulgare*	Scotch thistle	Herb (Dicot)	Exotic		FACU
colmue	*Colobanthus muelleri*		Herb (Dicot)	Indigenous Endemic	Not Threatened	UPL
copdmo	*Coprosma dumosa*		Tree	Indigenous Endemic	Not Threatened	FAC
coppro	*Coprosma propinqua*	Mikimiki	Tree	Indigenous Endemic	Not Threatened	FAC
coprig	*Coprosma rigida*		Shrub	Indigenous Endemic	Not Threatened	FAC
cotcor	*Cotula coronopifolia*	Bachelor's buttons	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACW
cramos	*Crassula moschata*		Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FAC
dacglo	*Dactylis glomerata*	Cocksfoot	Grass	Exotic		FACU
desces	*Deschampsia cespitosa*		Grass	Indigenous Non-Endemic	At Risk - Declining	FACW
drobin	*Drosera binata*	Sundew, wahu	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	OBL
eleacu	*Eleocharis acuta*	Spike sedge	Sedge	Indigenous Non-Endemic	Not Threatened	OBL
fesrub	*Festuca rubra*	Red fescue	Grass	Exotic		FACU
ficnod	*Ficinia nodosa*	Wīwī	Sedge	Indigenous Non-Endemic	Not Threatened	FACU
galpro	*Galium propinquum*	Māwe	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACU
glemic	*Gleichenia microphylla*	Tangle fern	Fern	Indigenous Non-Endemic	Not Threatened	FAC
gonmic	*Gonocarpus micranthus*	Piripiri	SubShrub	Indigenous Non-Endemic	Not Threatened	FAC
goorad	*Goodenia radicans*	Remuremu, rekoreko, raumangu	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACW
halese	*Haloragis erecta* subsp. *erecta*	Toatoa, fireweed	SubShrub	Indigenous Endemic	Not Threatened	FACU
hisinc	*Histiopteris incisa*	Mātātā, water fern	Fern	Indigenous Non-Endemic	Not Threatened	FAC
hollan	*Holcus lanatus*	Yorkshire fog	Grass	Exotic		FAC
hydhet	*Hydrocotyle heteromeria*	Waxweed	Herb (Dicot)	Indigenous Endemic	Not Threatened	FACU
hydhyd	*Hydrocotyle hydrophila*		Herb (Dicot)	Indigenous Endemic	Not Threatened	OBL
hydnov	*Hydrocotyle novae-zeelandiae*		Herb (Dicot)	Indigenous Endemic	Not Threatened	FAC
hypper	*Hypericum perforatum*	St Johns wort	SubShrub	Exotic		UPL
hyprad	*Hypochaeris radicata*	Catsear	Herb (Dicot)	Exotic		FACU
isocer	*Isolepis cernua*	Slender clubrush	Sedge	Indigenous Non-Endemic	Not Threatened	OBL
isolep	*Isolepis* species		Sedge	Indigenous Non-Endemic	Not Threatened	UNK
jacvul	*Jacobaea vulgaris*	Ragwort	Herb (Dicot)	Exotic		FACU
junart	*Juncus articulatus*	Jointed rush	Rush	Exotic		FACW
junbuf	*Juncus bufonius*	Toad rush	Rush	Exotic		FACW
junedg	*Juncus edgariae*	Wi, wīwī	Rush	Indigenous Endemic	Not Threatened	FACW
junpal	*Juncus pallidus*	Wīwī, giant rush	Rush	Indigenous Non-Endemic	Not Threatened	FACW
junpro	*Juncus procerus*	Giant rush;	Rush	Exotic		FACW

NVS Code	Species	Common Name	Plant Type	Status	National Threat Status	Wetland Status
junpus	*Juncus pusillus*	Dwarf rush	Rush	Indigenous Non-Endemic	At Risk - Naturally Uncommon	OBL
juncus	*Juncus* species		Rush	Indigenous Non-Endemic	Not Threatened	UNK
lacstr	*Lachnagrostis striata*	Purple wind grass	Grass	Indigenous Endemic	Not Threatened	FACW
lemdis	*Lemna disperma*	Kārearea	Herb (Monocot)	Indigenous Non-Endemic	Not Threatened	OBL
leosax	*Leontodon saxatilis*	Hawkbit	Herb (Dicot)	Exotic		FAC
lepaus	*Lepidosperma australe*	Square sedge	Sedge	Indigenous Endemic	Not Threatened	FAC
lepjun	*Leptecophylla juniperina*	Prickly mingimingi	Shrub	Indigenous Non-Endemic	Not Threatened	UPL
lepdio	*Leptinella dioica*	Shore cotula	Herb (Dicot)	Indigenous Endemic	Not Threatened	FAC
lepsco	*Leptospermum scoparium*	Mānuka	Tree	Indigenous Non-Endemic	Not Threatened	FAC
lilnov	*Lilaeopsis novae-zelandiae*		Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	OBL
limlin	*Limosella lineata*	Mudwort	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	OBL
lobang	*Lobelia angulata*	Pānakenake	Herb (Dicot)	Indigenous Endemic	Not Threatened	FAC
lolaru	*Lolium arundinaceum*	Tall fescue	Grass	Exotic		FAC
lolper	*Lolium perenne*	Ryegrass	Grass	Exotic		FACU
lotped	*Lotus pedunculatus*	Lotus	Herb (Dicot)	Exotic		FAC
luparb	*Lupinus arboreus*	Tree lupin	Shrub	Exotic		UPL
lycvol	*Lycopodium volubile*	Waewae-koukou	Fern	Indigenous Non-Endemic	Not Threatened	FACU
lysarv	*Lysimachia arvensis*	Pimpernel	Herb (Dicot)	Exotic		FACU
macten	*Machaerina tenax*		Sedge	Indigenous Endemic	Not Threatened	FACW
micpus	*Microsorum pustulatum*	Kōwaowao, pāraharaha, hound's tongue fern	Fern	Indigenous Non-Endemic	Not Threatened	UPL
monfsf	*Montia fontana* subsp. *fontana*	Blinks	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	OBL
photen	*Phormium tenax*	Harakeke	Herb (Monocot)	Indigenous Endemic	Not Threatened	FACW
pladiv	*Plagianthus divaricatus*	Mākaka, marsh ribbonwood	Shrub	Indigenous Endemic	Not Threatened	FACW
plaaus	*Plantago australis*	Swamp plantain	Herb (Dicot)	Exotic		FAC
platri	*Plantago triandra*	Glossy plantain	Herb (Dicot)	Indigenous Endemic	Not Threatened	FACW
poaann	*Poa annua*	Annual poa	Grass	Exotic		FACU
poacit	*Poa cita*	Silver tussock	Grass	Indigenous Endemic	Not Threatened	FACU
poapus	*Poa pusilla*		Grass	Indigenous Endemic	Not Threatened	UPL
poa	*Poa* species		Grass	Indigenous Non-Endemic	Not Threatened	UNK
poltet	*Polycarpon tetraphyllum*	Allseed	Herb (Dicot)	Exotic		UPL
pselut	*Pseudognaphalium luteoalbum*	Pukatea, jersey cudweed	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACU
pteesc	*Pteridium esculentum*	Rārahu, bracken	Fern	Indigenous Non-Endemic	Not Threatened	FACU
ranaca	*Ranunculus acaulis*	Shore buttercup	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACW
rangla	*Ranunculus glabrifolius*	Kawariki	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	OBL
ranref	*Ranunculus reflexus*	Mārūrū, hairy buttercup	Herb (Dicot)	Indigenous Endemic	Not Threatened	FACU
ranrep	*Ranunculus repens*	Creeping buttercup	Herb (Dicot)	Exotic		FAC
rorpal	*Rorippa palustris*	Hānea, poniu	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	OBL
rumace	*Rumex acetosella*	Sheep's sorrel	Herb (Dicot)	Exotic		FACU
rumcri	*Rumex crispus*	Curled dock	Herb (Dicot)	Exotic		FAC
rytgra	*Rytidosperma gracile*		Grass	Indigenous Non-Endemic	Not Threatened	FACU
samrep	*Samolus repens*	Sea primrose / shore pimpernel	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACW
schmas	*Schoenus maschalinus*	Dwarf bog rush	Sedge	Indigenous Non-Endemic	Not Threatened	FACW
sedacr	*Sedum acre*	Stonecrop	Herb (Dicot)	Exotic		UPL
senmin	*Senecio minimus*	Native fireweed	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FACU
seneci	*Senecio* species		Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	UNK
sensyl	*Senecio sylvaticus*	Wood groundsel	Herb (Dicot)	Exotic		FAC
soldul	*Solanum dulcamara*	Bittersweet	SubShrub	Exotic		FAC
sonasp	*Sonchus asper*	Prickly puha	Herb (Dicot)	Exotic		FACU
stemed	*Stellaria media*	Chickweed	Herb (Dicot)	Exotic		FACU
stepar	*Stellaria parviflora*	Native chickweed	Herb (Dicot)	Indigenous Non-Endemic	Not Threatened	FAC
tridub	*Trifolium dubium*	Suckling clover	Herb (Dicot)	Exotic		UPL
uleeur	*Ulex europaeus*	Gorse	Shrub	Exotic		FACU
urtdio	*Urtica dioica*	Stinging nettle	Herb (Dicot)	Exotic		FAC
urtper	*Urtica perconfusa*	Swamp nettle	Herb (Dicot)	Indigenous Endemic	At Risk -Naturally Uncommon	FACW

Appendix 2 Vegetation and Habitat Type Photos

Plate 1 – WL10: Oioi restiad rushland/reedland. Alive and dead oioi form dense patches along many of the transects.

Plate 2 – The end of transect W5, showing the margins of WL12: Mānuka, tangle fern scrub/fernland.

Plate 3 – WL18: flaxland on transect W12. This wetland type is rare over the transects.

Plate 4 – Mudwort (*Limosella lineata*) and *Lilaeopsis novae-zelandiae* are both features of WL15: Herbfield (lakeshore turf) at the site.

Plate 5 – VS4: Mānuka scrub regenerating after fire.

Plate 6 – The start of transect W3 was inundated with water.

Plate 7 – VS10: Bracken fernland is present in Transects W6 and W12.

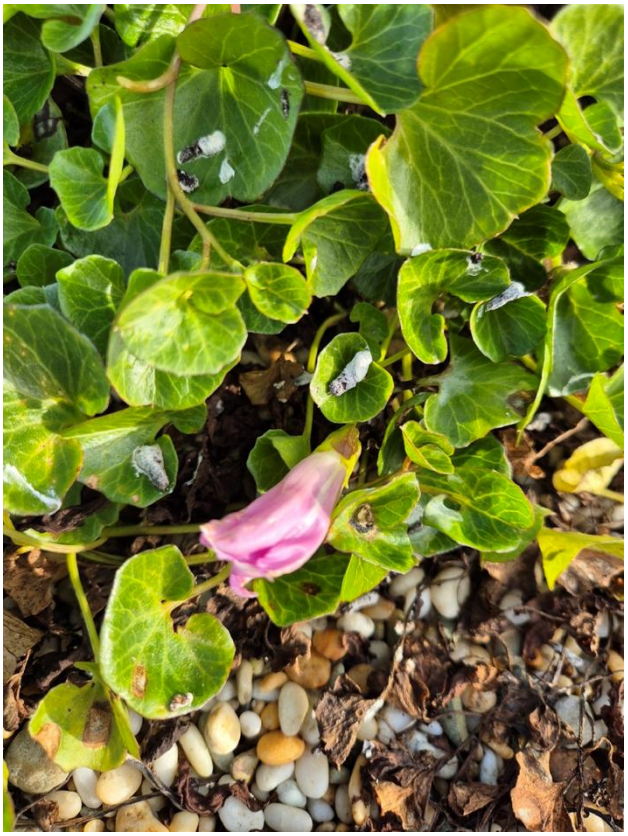

Plate 8 – SA4: Shore bindweed, knobby clubrush gravelfield/ stonefield was common in transect W8 and present in W6.

Plate 9 – Swamp nettle (At Risk – Naturally Uncommon) was found occasionally across the transects.

Plate 10 – SA4: Shore bindweed, knobby clubrush gravelfield/ stonefield at the end of Transect W8.

Plate 11 – Exotic grassland at the end of Transect W4.

Call Free 0508 WILDNZ
Ph +64 7 343 9017
ecology@wildlands.co.nz

99 Sala Street, Whakarewarewa, Rotorua 3010
P.O. Box 7137, Te Ngae, Rotorua 3042
New Zealand

Regional Offices located in Auckland, Christchurch, Dunedin, Hamilton, Invercargill, Queenstown, Tauranga, Wānaka, Wellington, Whangārei.

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