ASSESSMENT OF WETLANDS AT THE REMARKABLES SKI AREA, QUEENSTOWN

MARCH 2011

Report No. 2662

Prepared for:

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PROJECT TEAM

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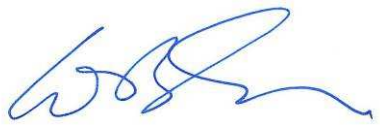

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1. INTRODUCTION

The Remarkables Ski Area, administered by NZSki, is located near the head of the Rastus Burn, in the Remarkables Range, inland Otago. Ongoing development and maintenance of the ski field facilities includes improvements to buildings, access and maintenance roads, terrain parks, and ski runs. Currently, work is being undertaken to install 12 new snow guns, modify two trails, and create two new trails before the 2011 winter season.

The Ski Area is located within the Rastus Burn Recreation Reserve, which is administered by the Department of Conservation. The Department is concerned that wetlands within the Ski Area may be adversely affected by the proposed development. Fahey and Wardle (1998) previously identified the impacts of ski field activities on "fragile alpine wetland communities" as the main area of concern on the ski field. As part of the consent application process for the current development, DOC requires a study of wetlands on the mountain.

This interim report describes the work undertaken by Wildland Consultants Ltd for the Department to assess wetlands within the Remarkables Ski Area and in a nearby catchment (Wye Creek). The goals of the study were to:

- Describe and map the wetland types and dominant plant communities within the Ski Area;
- Assess the importance of Ski Area wetlands in a local and regional context.

2. METHODS

2.1 Desktop assessment

A literature search was undertaken to assess the context of the wetlands in the Ski Area. The literature search was restricted to Lakes Ecological Region, which includes Remarkables Ecological District. Several pastoral lease tenure review conservation resources reports were available for areas close to the Remarkables Range and within Lakes Ecological Region. Protected natural area programme (PNAP) survey reports were not consulted as few surveys have been undertaken in the Queenstown Lakes area (Wildland Consultants 2004), and none in Lakes Ecological Region.

2.2 Remarkables Ski Area wetlands

The Remarkables Ski Area was traversed on foot on 9-10 March 2011. Likely sites for wetlands were identified on topographical maps and aerial photographs. Vantage points were also gained to ensure the majority of the ski field was viewed. All wetlands encountered were described and all but one were mapped. The wetland descriptions include determination of the wetland class, form, and type (Johnson & Gerbeaux 2004), and dominant plant species. All vascular plant species that could be identified were recorded. Other information such as landform, elevation, and aspect was also collected for each wetland.

2.3 Wye Creek wetlands

To determine whether wetland types and plant communities similar to those present in the ski field area were present in nearby areas, the upper Wye Creek catchment was surveyed on foot on 10 March 2011. The location of all wetlands assessed was recorded by a GPS unit, the extent of several wetlands was mapped, and wetland descriptions and environmental factors were recorded, as for the Ski Area wetlands. Most, but not all, wetlands in the upper catchment were surveyed.

3. WETLAND DESCRIPTIONS

Remarkables Ski Area

Twenty-six wetlands were surveyed, mapped (Appendix 1), and described within the Ski Area. Wetlands within the Ski Area are associated with the margins of tarns and streams, areas of gentle topography, and seepages on steeper slopes (Appendix 3). Most wetlands were seepages, although bogs, and two moderately-large string mires, were also recorded. The wetlands were located at altitudes between *c*.1,500 m and 1,880 m asl (mean 1,725 m). There were few wetlands with an easterly aspect, reflecting their location within the northwest-facing Rastus Burn catchment. Most of wetlands are dominated by comb sedge (*Oreobolus pectinatus*) cushionfield, with scattered *Gentianella bellidioides* and *Euchiton traversii* (Appendix 3). Comb sedge cushionfield occurs in a mosaic with areas of mossfield, sedgeland (most often dominated by *Isolepis aucklandica*), shallow water (tarns, streams, slower flowing streams with algae), and herbfield (where *Psychrophila obtusa* is usually a major component). Other common species include *Epilobium komarovianum*, *Abrotanella caespitosa*, and *Kelleria paludosa*. Seepages dominated by *Schoenus pauciflorus* are also present within the Ski Area. The majority of plant species recorded were indigenous, with only single occurrences of the exotic species lotus (*Lotus pedunculatus* - in Wetland 16) and mouse-ear chickweed (*Cerastium fontanum* - in Wetland 14) seen in wetlands near ski field roads, and *Juncus articulatus* seen in one wetland (also in Wetland 14). *Carex berggrenii*, which is classified as 'At Risk-Naturally Uncommon' in de Lange *et al*. (2009), was present in several wetlands.

Wye Creek Catchment

Fourteen wetlands were surveyed, mapped, and described (Appendix 2) within the upper Wye Creek catchment (Appendix 2), located at altitudes between *c*.1,690 m and 1,830 m asl (mean 1,747 m). Wetlands were generally associated with the margins of tarns and streams, gentle topography, and seepages on open faces (Appendix 3). One small string mire was present at the northern end of Wetland 40 and a fen-like wetland (possibly with a peaty substrate) was present in part of Wetland 44. Most wetlands had a southerly aspect, reflecting their location within the south-facing upper Wye Creek catchment, although the southernmost wetlands had a northerly aspect. Comb sedge was recorded in only two of the north-facing wetlands (Wetlands 43 and 45). Most wetlands were seepages dominated by *Schoenus pauciflorus*, *Isolepis aucklandica*, bryophytes, *Kelleria paludosa*, and *Carex* spp. *Oreobolus pectinatus* was notably absent from all but two wetlands in the southern part of the catchment. No exotic plant species were recorded.

4. FAUNA

A single New Zealand falcon (*Falco novaeseelandiae* 'eastern') was seen on the ridge between Wye Creek and Doolans Creek.

Aquatic fauna were not surveyed as part of this study. However, a previous study by Patrick *et al*. (1992) found that the caddisfly (Tricoptera) and stonefly (Plecoptera) fauna collected in the upper Rastus Burn are indicative of a relatively rich freshwater fauna. Of the alpine caddisflies collected, *Tiphobiosis childi*, *T. montana*, *Hydrobiosis kiddi*, and *Costachorema hebdomon* were rarely collected local species.

5. WETLAND CONTEXT

At a national level, wetlands have been markedly reduced from their former extent, with only *c*.10% of the original area remaining. Cushion bog, string mire, tarn, seepage, and snow bank wetland classes, all of which were observed during the survey, are recognised as originally rare wetland types within New Zealand (Williams *et al*. 2007). Within the *c*.86,690 ha Remarkables Ecological District, there is an estimated *c*.11,380 ha (13% of total area) of ponds and lakes and only *c*.180 ha (0.2% of total area) of freshwater wetland vegetation (Landcover Database v2).

Wetlands in the alpine zone have different characteristics than those at lower altitudes. For example, Lake Luna wetlands within the Mt Creighton pastoral lease (*c*.810 m asl) and lower altitude wetlands in Coronet pastoral lease have *Carex coriacea* as an important constituent (LINZ 2006), but this species was absent from wetlands in the Remarkables survey area. Seepages can be present at low elevation, but the composition of the seepage wetland vegetation is likely to be very different from higher elevation sites. For example, a seepage at 100 m asl on the Lake Wakatipu faces of Mt Creighton pastoral lease is dominated by silver tussock (*Poa cita*), which does not occur in alpine habitats. A greater number of exotic species occur in wetlands at lower elevation, and exotic dominance also tends to be higher (e.g. below 1,000 m asl in Glen Nevis Pastoral Lease) whereas exotic species were few in number and never dominant in the Remarkables survey site.

Wetland types in the Remarkables Ski Area do not appear to be unique, as comb-sedge-dominated bogs and *Schoenus pauciflorus*-dominated seepages are relatively common in the alpine zone of the Queenstown Lakes area (Table 1). String mires appear to be less common, with only one example (in Loch Linnhe Pastoral Lease) mentioned in pastoral lease tenure review conservation resources reports from nearby areas (Table 2). However, this string mire appears to have a vegetation composition similar to wetlands present within the Remarkables Ski Area and the upper Wye Creek catchment: common taxa are *Psychrophila obtusa*, *Carex* sp., *Abrotanella caespitosa*, *Kelleria paludosa*, *Euchiton traversii*, *Gentianella* sp., *Epilobium komarovianum*, and mosses.

Based on information currently available, the distribution of comb sedge-dominated wetlands on the Remarkable Range appears to be discontinuous. Wetlands within the

Ski Area may, therefore, be distinctive within the context of the Remarkables Range. The concentration of several examples of this wetland type in a relatively small area may also be of significance. At a wider spatial scale, within the Lakes Ecological Region, comb sedge-dominated wetlands appear to be relatively common.

Of the notable plant species recorded during the survey, *Carex berggrenii* is mainly a montane to subalpine wetland species inhabiting lake, tarn, pond, and stream side margins. In the South Island, it is present in the east south of Lake Tennyson (www.nzpcn.org.nz). It is present in other wetlands in Lakes Ecological Region (c.f. LINZ 2003 and 2007). No plant species are known to be restricted to the Remarkables Range/Ecological District (Mark and Bliss 1970).

Table 1: Wetland types in Lakes Ecological Region, as described in conservation resources reports of pastoral lease tenure reviews.

Ecological District	Pastoral Lease	*Oreobolus pectinatus*-dominant	*Schoenus pauciflorus*-dominant	Types of Wetlands Present
Remarkables	Loch Linnhe	✓	✓	Seepage, rivulet, wet terrace, string mire, turf
	Glen Nevis	✓	✓	Bog, flush, 'wet areas'
	Ben Nevis	N/A	N/A	Tarn, snowbank
Richardson	Wyuna	?		'Wetlands'
	Temple Peak	✓		Tarn, bog, seepage, swamp
Richardson/ Shotover	Coronet Peak	✓	✓	Seepage, bog, fen, shallow water (tarn), ephemeral
	Mt Creighton	✓	✓	Seepage, bog

6. WETLAND SIGNIFICANCE

Wetlands in the Remarkables Ski Area were assessed against the ecological significance criteria in Appendix 5 'Areas of Significant Indigenous Vegetation' in the Queenstown Lakes District Plan (QLDC 2007). This assessment is presented in Table 3. Remarkables Ski Area wetlands are ecologically significant because they are the largest in the immediate area, are in good condition, and are representative of wetlands in the wider Remarkables Ecological District. Several different forms and vegetation types are present. The wetlands are performing important hydrological functions and support an uncommon plant species and uncommon indigenous invertebrates. In the absence of further disturbance, these wetlands are likely to remain viable in the long-term.

Table 3: Ecological significance assessment of wetlands at the Remarkables Ski Area.

		Criteria	H	M	L	Justification
Primary Criteria	**A** The Ecological Values of the Area - the values of the place itself	(i) Representativeness	✓			Good quality, large examples of alpine comb sedge-dominated wetlands on the Remarkables Range
		(ii) Rarity	✓			Cushion bogs, string mires, tarns, seepages, and snow banks are originally rare wetland types (Williams *et al*. 2007). Wetlands comprise only *c*.10% of their former extent in the South Island. *Carex berggrenii* (classified nationally as At Risk-Naturally Uncommon) is present.
		(iii) Diversity and Pattern		✓		Riparian, cushion mire, and string mire wetland forms, and sedgeland, herbfield, mossfield, and cushionfield vegetation types present. Likely to include a moderate to high diversity of indigenous plant species.
		(iv) Distinctiveness/Special ecological character			✓	No distinctive wetlands were observed.
Other Criteria	**B** The Ecological Context of the Area including its relationship with its surroundings	(v) Size and Shape	✓			A range of sizes and shapes. Existing wetlands appear to represent most of their original extent. The Remarkables Ski Area contains the greatest number and largest areas of comb sedge-dominated wetland vegetation seen during the survey.
		(vi) Connectivity		✓		Part of a network of wetlands and waterways within indigenous alpine habitats, which perform important hydrological functions and support populations of indigenous flora and invertebrate fauna. Several wetlands have been bisected by roads/culverts.
	C The Future Ecological Value of the Area	(vii) Long Term Sustainability	✓			Located within a protected area. Exotic species rare. Likely to remain viable in the long term in the absence of disturbance.

Are the wetlands significant? **Yes**

Justification: Wetlands on the Remarkables ski field are the largest in the immediate area, are in good condition, and are representative of wetlands in Remarkables Ecological District. Several different wetland forms and vegetation types are present. The wetlands are performing important hydrological functions and support an uncommon plant species and indigenous invertebrates. In the absence of further disturbance, these wetlands are likely to be viable in the long-term.

7. DISCUSSION

Wetlands in the Remarkables Ski Area are mostly dominated by comb sedge cushionfield although there are also wetlands dominated by *Schoenus pauciflorus* sedgeland. In the larger wetlands, comb sedge cushionfield forms a mosaic with areas dominated by bryophytes, *Isolepis aucklandica*, and *Kelleria paludosa*. Several wetland forms are also present, with shore, riparian, seepage, string mire, and cushion wetlands recorded. None of the wetland types surveyed appear to be restricted to the ski field, but the ski field contains the largest examples of comb sedge-dominated wetland and string mires seen during the field survey, as well as a clustering of comb-sedge-dominated wetlands within a relatively small area.

The predominance of comb sedge-dominated wetlands in the Remarkables Ski Area compared to the Wye Creek catchment may be related to aspect. Only a few wetlands in the Wye Creek were northerly-facing, and these were where the only wetlands where comb sedge was recorded in this catchment. Aspect may be related to local climatic conditions, with (for example) north-facing slopes having less snow-lie. The altitudinal range for wetlands in the Ski Area and Wye Creek was similar, and is unlikely to be the reason for the differences observed.

Wetlands within the Ski Area are performing several important ecological functions. These include protection of water quality through moderation of flows and entrapment of sediment, providing habitat for indigenous alpine flora including the uncommon *Carex berggrenii*, and providing habitat for aquatic invertebrates. Other threatened and uncommon species may also be present in these wetlands, as wetlands in nearby ecological districts within the Lakes Ecological Region provide habitat for species such as *Lobelia perpusilla* and *Epilobium angustum* (regionally uncommon), *Carex rubicunda* (Acutely Threatened-Nationally Vulnerable), *Plantago obconica* (At Risk-Naturally Uncommon), and *Myosotis* aff. *tenericaulis*.

The greatest potential adverse effects on wetlands at the Ski Area are likely to arise as a result of earth-moving activities which destroy or modify wetlands or their hydrology. Substantial removal of rock and other excavations are currently being undertaken within the Ski Area, including the excavation of several large ditches located near wetlands. These activities were not directly affecting wetlands, although there is the potential for indirect effects resulting from changes to flow patterns or water levels, or effects related to sedimentation of streams and/or wetlands downstream of works. The rehabilitation of worked areas that has been carried out by the transplanting of snow tussocks (*Chionochloa* spp.), e.g. near Wetland 14, is likely to be successful in the long term. There are also existing modifications to wetlands (roads, walking tracks, and culverts), but these do not appear to be having major adverse effects on wetland viability.

Fahey and Wardle (1998) identified five main wetland areas that were at risk of damage: Alta Green wetland (probably Wetlands 14 and 25), Easy Out/Gotham City (probably Wetlands 3 and 4), Water Race wetland (probably Wetland 2), Left branch of Rastus Burn wetland (probably Wetland 5), and Mid Station Shadow Chairlift wetland (probably Wetlands 17-20). However, apart from existing roads and walking tracks, no additional threats were identified for any of these wetlands, and they

appeared to be in excellent condition. The walking track to Lake Alta passes through Wetland 5 and there is some localised damage to wetland vegetation.

There is a proposal to extend ski field operations (cat skiing) to the head of the Doolans Creek Right Branch. This area contains additional wetlands that were not visited as part of the current survey. Viewed from a distance, these wetlands appeared to comprise tarns and their margins, with a cluster of wetlands associated with areas of shallow water.

It should be noted the comparisons between the ski field and other nearby areas were only undertaken at a broad level (i.e. wetland type), and it is possible that there are finer scale differences (e.g. species composition) between wetlands within the Ski Area and wetlands in nearby catchments and ranges.

This report should be considered to be a preliminary assessment as the survey period was relatively brief, some species could not be identified due to the seasonal timing of the survey, and the Doolans catchment wetlands were not surveyed.

8. CONCLUSIONS

A survey should be undertaken of wetlands in the Doolans Creek catchment. More data on aquatic invertebrates within the Ski Area is also required. One uncommon plant species was recorded in Ski Area wetlands, but other uncommon or threatened species may also be present.

In order to obtain more information on the wider context of wetlands in the Ski Area, additional surveys could be undertaken of north-facing wetlands. From assessment of topographical maps, the most likely areas where these may be present are slopes north of Mt Cruachan (although no tarns are marked on topographical maps) or at the head of the Doolans Creek Left Branch, near Lake Hope. Assessment of areas near Lake Hope would require at least two days. Additional desktop comparisons could also be made between Ski Area wetlands and wetlands in other ecological districts (outside Lakes Ecological Region).

Any loss of, or disturbance to, wetlands within the Remarkables Ski Area should be avoided, to protect ecological values and functions. In order for this to be achieved, these wetlands will need to be monitored. Fahey and Wardle (1998) recommended that transects be established in wetlands for monitoring the effects of snow grooming and other activities. At a minimum, the percentage cover of live vegetation, dead vegetation, bare ground, rock, litter, and of individual plant species would need to be recorded. 'Control' wetlands, not subject to ski field activities, would also need to be identified and included in the monitoring programme. Simple measures, such as photopoints, could be used to monitor changes in wetland extent. The abundance of uncommon species, such as *Carex bergrennii*, could be monitored by recording its current locations and/or undertaking counts of individuals within sites.

The following further work is therefore suggested:

- A field survey of Doolans Creek wetlands should be undertaken in the summer of 2011-2012.
- Sampling of aquatic fauna in seepages should be undertaken in summer 2011-2012.
- A search for threatened and uncommon species should be undertaken in summer 2011-2012.
- Extend desktop assessment of wetlands to include nearby ecological districts.
- A monitoring programme for wetland condition and threatened and uncommon species should be established in places where skifield development and operation could potentially affect these features.

ACKNOWLEDGEMENTS

Barry Lawrence (Department of Conservation) provided project liaison.

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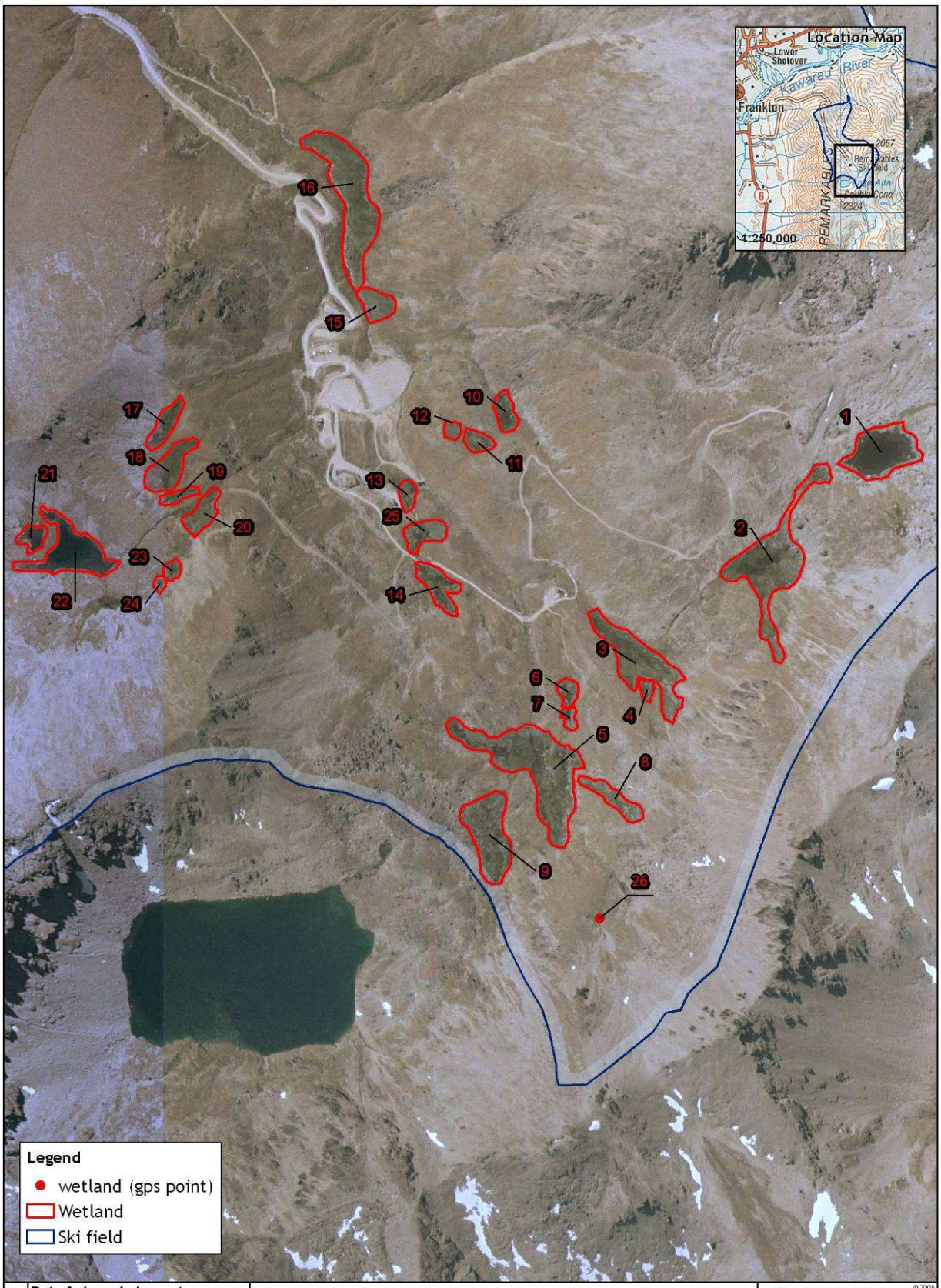
REMARKABLES SKI AREA
WETLANDS (MAP)



Data Acknowledgment

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Remarkables Ski Area wetlands

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Wildlands
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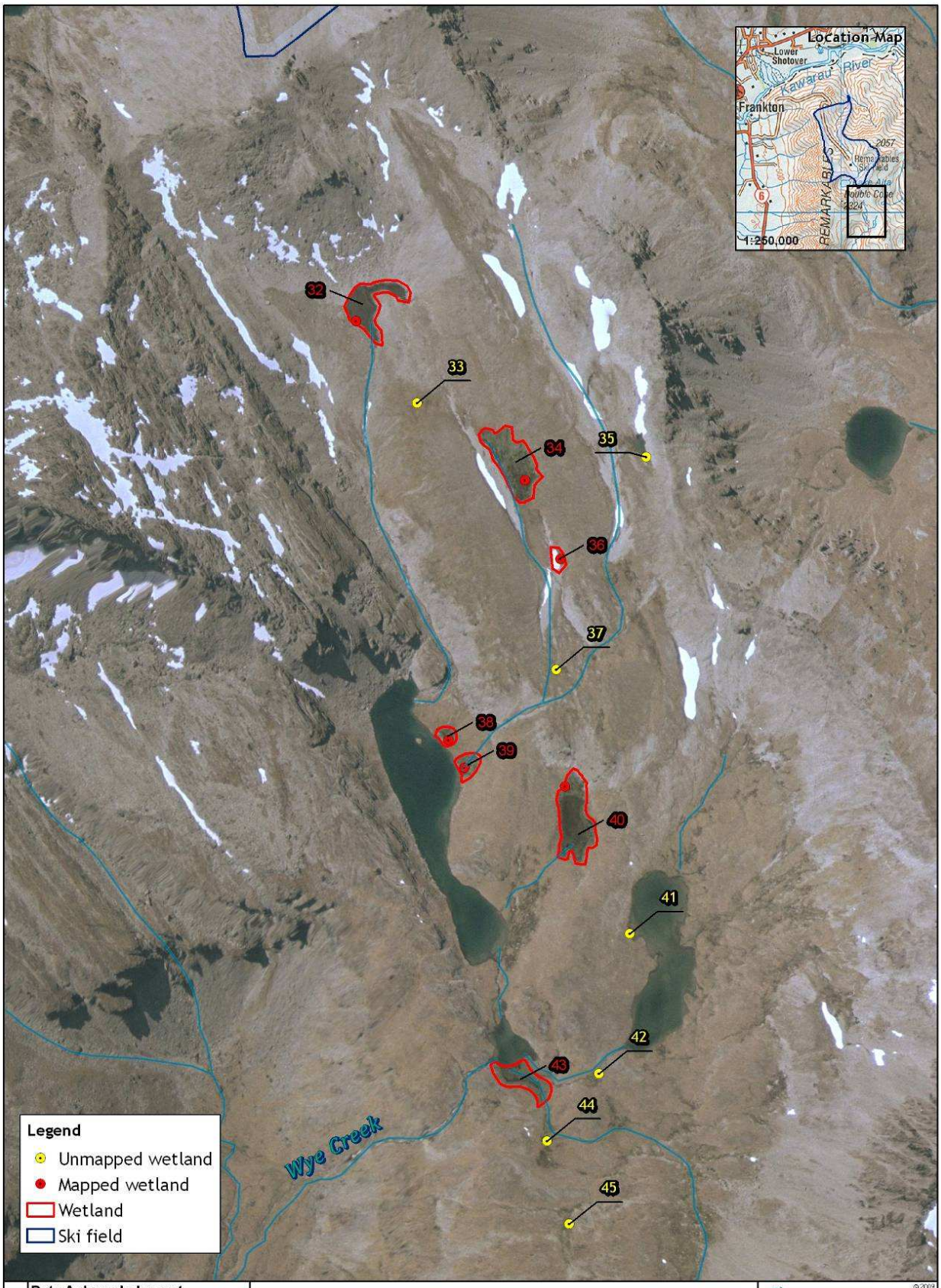
WYE CREEK CATCHMENT
WETLANDS (MAP)



Data Acknowledgment

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Wye Creek catchment wetlands

0 250 500 m

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Scale:	1:10,000
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DETAILS RECORDED OF WETLANDS SURVEYED

ID	Mapped Area (ha)	Altitude (m asl)	Slope	Aspect	Wetland Class	Wetland Type	Dominant Taxa	Easting	Northing
Ski Area									
1	0.98	1810	Flat	Flat, SW	Seepage Shallow water	Mossfield	Bryophytes	1271456	5002459
2	1.49	1800	Flat-steep	Flat, SW, N	Bog Seepage Shallow water	Cushionfield Mossfield Algalfield	*Oreobolus pectinatus* Bryophytes *Kelleria paludosa* *Euchiton traversii* *Abrotenella caespitosa*	1271239	5002238
3	1.06	1720	Gentle - steep	NW	Bog Seepage Shallow water	Cushionfield	*Oreobolus pectinatus* Bryophytes	1270976	5002042
4	0.06	1730	Steep	N	Seepage	Cushionfield		1270989	5001991
5	2.14	1750	Gentle	N, E	Bog Seepage Shallow water	Cushionfield Mossfield Sedgeland Herbfield	*Oreobolus pectinatus* Bryophytes *Psychrophila obtusa* *Epilobium komarovianum* *Euchiton traversii* *Abrotenella caespitosa* *Kelleria paludosa* *Isolepis aucklandica* *Coprosma perpusilla* *Celmisia sessiliflora* *Celmisia verbascifolia* *Gentianella bellidifolia*	1270766	5001832
6	0.12	1710	Gentle	N	Bog Seepage	Cushionfield	*Oreobolus pectinatus*	1270833	5001984
7	0.06	1720	Gentle	N	Bog Seepage	Cushionfield		1270836	5001933
8	0.27	1770	Steep	NW	Seepage	Cushionfield	*Oreobolus pectinatus*	1270926	5001772
9	0.98	1750	Gentle - Moderate	N, NE	Seepage Shallow water	Cushionfield Herbfield	*Oreobolus pectinatus* *Psychrophila obtusa*	1270677	5001702
10	0.19	1680	Gentle	W	Seepage Shallow water	Cushionfield	*Oreobolus pectinatus* *Gentianella bellidifolia*	1270708	5002536

ID	Mapped Area (ha)	Altitude (m asl)	Slope	Aspect	Wetland Class	Wetland Type	Dominant Taxa	Easting	Northing
11	0.14	1670	Gentle	W	Seepage	Cushionfield	*Oreobolus pectinatus* Bryophytes	1270654	5002479
12	0.06	1650	Gentle	W	Seepage	Cushionfield	*Abrotenella caespitosa* *Psychrophila obtusa Euchiton traversii*	1270604	5002501
13	0.11	1630	Gentle	N	Seepage	Cushionfield	*Oreobolus pectinatus* *Nertera balfouriana* *Coprosma perpusilla*	1270515	5002374
14	0.35	1660	Gentle	NW	Seepage	Cushionfield	*Oreobolus pectinatus* *Schoenus pauciflorus*	1270575	5002194
15	0.27	1570	Moderate	W	Seepage Flush	Sedgeland	*Schoenus pauciflorus* *Carex* spp. *Helichrysum filicaule*	1270453	5002749
16	1.61	1530	Moderate	W	Seepage	Cushionfield Sedgeland	*Oreobolus pectinatus* Bryophytes *Abrotanella caespitosa* *Celmisia glandulosa* *Psychrophila obtusa* *Euchiton traversii* *Schoenus pauciflorus*	1270399	5002958
17	0.24	1730	Gentle	NE	Bog Seepage	Cushionfield	*Oreobolus pectinatus*	1270034	5002511
18	0.44	1740	Gentle	NE	Bog Seepage	Cushionfield	*Oreobolus pectinatus*	1270041	5002426
19	0.09	1750	Gentle	NE	Bog Seepage	Cushionfield	*Oreobolus pectinatus*	1270059	5002370
20	0.27	1740	Gentle	NE	Bog Seepage	Cushionfield Sedgeland	*Oreobolus pectinatus* *Schoenus pauciflorus*	1270108	5002337
21	0.15	1820	Flat - Gentle	Flat	Bog Seepage Shallow water	Cushionfield	*Oreobolus pectinatus* *Kelleria paludosa Abrotenella caespitosa*	1269771	5002288
22	0.90	1815	Flat - Gentle	Flat	Bog Seepage Shallow water	Cushionfield	Bryophytes	1269849	5002261
23	0.07	1790	Moderate	NW	Seepage	Cushionfield	*Oreobolus pectinatus*	1270048	5002223
24	0.03	1805	Moderate	NW	Seepage	Cushionfield	*Oreobolus pectinatus*	1270024	5002197

ID	Mapped Area (ha)	Altitude (m asl)	Slope	Aspect	Wetland Class	Wetland Type	Dominant Taxa	Easting	Northing
25	0.27	1640	Gentle	NNW	Bog Seepage	Cushionfield	*Oreobolus pectinatus* *Euchiton traversii* *Kelleria paludosa* *Abrotanella caespitosa* *Drosera arcturi*	1270548	5002298
26	Not mapped	1880	Gentle	NW	Seepage Shallow water	Mossfield	Bryophytes Liverwort Euchiton traversii *Epilobium komarovianum* *Plantago lanigera* *Carex*	1270897	1270897
Wye	**Creek**								
32	0.56	1830	Flat	Flat	Seepage Shallow water	Mossfield	Bryophytes *Carex* spp.	1271065	5000718
33	Not mapped	1820	Moderate	S	Seepage	Sedgeland	*Schoenus pauciflorus*	1271155	1271155
34	0.79	1810	Moderate	SW	Seepage	Sedgeland	*Schoenus pauciflorus* *Kelleria paludosa* *Epilobium brunnescens* *Abrotanella caespitosa* *Isolepis aucklandica* *Carex* spp.	1271345	5000407
35	Not mapped	1820	Gentle	S	Seepage Shallow water	Mossfield	Bryophytes *Carex* spp.	1271609	1271609
36	0.07	1780	Flat	Flat (S)	Seepage	Sedgeland	Bryophytes *Gentianella bellidioides* *Euchiton traversii* *Plantago lanigera*	1271434	5000214
37	Not mapped	1750	Gentle	S	Seepage Bog	Sedgeland	*Kelleria paludosa* *Isolepis aucklandica* Bryophytes *Schoenus pauciflorus*	1271431	1271431
38	0.08	1700	Gentle	SW	Seepage	Mossfield Sedgeland Herbfield	Bryophytes *Schoenus pauciflorus* *Abrotenella caespitosa* *Psychrophila obtusa* *Kelleria paludosa*	1271214	4999865
39	0.13	1700	Gentle	SW	Seepage	Cushionfield Sedgeland Herbfield	*Kelleria paludosa* *Isolepis aucklandica* Bryophytes *Schoenus pauciflorus*	1271257	4999808

ID	Mapped Area (ha)	Altitude (m asl)	Slope	Aspect	Wetland Class	Wetland Type	Dominant Taxa	Easting	Northing
40	0.83	1710	Flat, gentle	Flat, S	Bog Seepage	Mossfield	Bryophytes *Kelleria paludosa* *Abrotanella caespitosa* *Epilobium brunnescens* *Gentianella bellidioides* *Psychrophila obtusa*	1271469	4999701
41	Not mapped	1710	Gentle	NE	Seepage	Mossfield	Bryophytes *Abrotanella caespitosa Kelleria paludosa*	1271577	1271577
42	Not mapped	1700	Gentle	W	Seepage Bog	Mossfield	*Kelleria paludosa* *Schoenus pauciflorus* Bryophytes *Abrotanella caespitosa* *Euchiton traversii* *Gentianella bellidioides*	1271517	1271517
43	0.37	1690	Gentle	NW	Seepage Bog Shallow water	Mossfield Cushionfield Sedgeland	*Oreobolus pectinatus* *Oreobolus strictus* *Psychrophila obtusa* *Euchiton traversii* Bryophytes *Isolepis aucklandica* *Kelleria paludosa*	1271366	4999186
44	Not mapped	1700	Gentle	N	Seepage Shallow water Bog Fen-like (possibly peaty substrate)	Mossfield Sedgeland	*Kelleria paludosa* *Schoenus pauciflorus* Bryophytes *Abrotanella caespitosa* *Euchiton traversii* *Gentianella bellidioides* *Isolepis aucklandica*	1271414	1271414
45	Not mapped	1740	Steep	N	Seepage	Mossfield Herbfield Sedgeland	Bryophytes *Euchiton traversii* *Oreobolus pectinatus* Sedges	1271458	1271458

APPENDIX 4

PLANT SPECIES RECORDED DURING THE WETLAND SURVEY

*Exotic species

Species	Plant type	Abundance
Abrotanella caespitosa	Dicot herb	Frequent
Acaena saccaticupula	Dicot herb	Occasional
Agrostis muelleriana	Grass	Rare
Agrostis pallescens	Grass	Occasional
Anisotome flexuosa	Dicot herb	Rare
Brachyscome sinclairi	Dicot herb	Rare
Carex berggrenii	Sedge	Rare
Carex lachenalii subsp. parkeri	Sedge	Occasional
Carex petriei	Sedge	Occasional
Carex wakatipu	Sedge	Rare
Carpha alpina	Sedge	Occasional
Celmisia glandulosa	Dicot herb	Occasional
Celmisia gracilenta	Dicot herb	Rare
Celmisia sessiliflora	Dicot herb	Occasional
Celmisia verbascifolia	Dicot herb	Occasional
*Cerastium fontanum**	Dicot herb	Rare
Chionochloa oreophila	Grass	Occasional
Coprosma perpusilla	Dicot herb	Frequent
Deyeuxia aucklandica	Grass	Occasional
Donatia novae-zelandiae	Dicot herb	Occasional
Dracophyllum prostratum	Creeping Shrub	Occasional
Drosera arcturi	Dicot herb	Rare
Eleocharis acuta	Sedge	Occasional
Epilobium komarovianum	Dicot herb	Abundant
Epilobium macropus	Dicot herb	Rare
Euchiton traversii	Dicot herb	Frequent
Gaultheria nubicola	Creeping Shrub	Rare
Gentianella bellidifolia	Dicot herb	Frequent
Glossostigma elatinoides	Dicot herb	Rare
Helichrysum filicaule	Dicot herb	Rare
Isolepis aucklandica	Sedge	Frequent
*Juncus articularis**	Rush	Rare
Kelleria paludosa	Creeping Shrub	Frequent
Lobelia angulata	Dicot herb	Occasional
*Lotus pedunculatus**	Dicot herb	Rare
Melicytus alpinus	Shrub	Rare
Nertera balfouriana	Dicot herb	Occasional
Oreobolus pectinatus	Sedge	Abundant
Oreobolus strictus	Sedge	Rare
Ourisia glandulosa	Dicot herb	Occasional
Plantago lanigera	Dicot herb	Occasional
Poa colensoi	Grass	Rare
Poa sp.	Grass	Rare
Psychrophila obtusa	Dicot herb	Frequent
Ranunculus ?multiscapas	Dicot herb	Occasional
Rytidosperma australe	Grass	Rare
Schoenus pauciflorus	Sedge	Frequent
Uncinia fuscovaginata	Sedge	Occasional
Utricularia dichotoma	Dicot herb	Rare
Viola cunninghamii	Dicot herb	Rare

DESCRIPTIONS OF OTHER WETLANDS IN THE LAKES ECOLOGICAL REGION

These descriptions are sourced from conservation resources reports prepared for tenure review of Crown pastoral leases. Only those reports available for leases near the Remarkables Ski Area are included.

REMARKABLES ECOLOGICAL DISTRICT

Ben Nevis Pastoral Lease (*LINZ 2004*)

Little information is provided for wetlands present in this pastoral lease, except that in high altitude tarns there are extensive wetlands as well as diverse snowbank communities.

Glen Nevis Pastoral Lease (LINZ 2005)

Bogs and flushes and other wet areas

Mosses and sedges are prominent together with comb sedge, bog gentian, bladderwort and marsh marigold. Other plants of note are *Rostkovia magellanica, Gentiana grisebachii, Ranunculus cheesemanii, Lagenifera barkeri,* bog aciphylla and bog dracophyllum. *Euphrasia cf. dyeri* formed small, bright-green cushions raised slightly above the mosses in which it grew. It was covered in tiny mauve and yellow blotched flowers. In places *Schoenus pauciflorus* is the dominant plant with other rushes and sedges. The small shrubs *Hebe pauciramosa* and *Gaultheria parvula* and succulent orange fruited *Nertera balfouriana* are common plants in these places. Sphagnum moss can form large patches. At lower altitudes, below about 1000 m, more exotic species appear including rushes, musk, clover, browntop and Yorkshire fog. But native species still dominate.

Loch Linnhe Pastoral Lease (*LINZ 2007*)

Western Hector Mountains, Staircase Creek Catchment: Above 1,800 m asl, numerous seeps, rivulets and wet gravely terraces provide a wealth of wetland habitats for a suite of species tolerant of poor drainage. These include *Parahebe trifida, Ranunculus pachyrrhizus, R. maculatus, Marsippospermum gracile, Plantago lanigera, Epilobium komarovianum, Carex gaudichaudiana, Poa novae-zelandiae, Ourisia caespitosa* and *O. glandulosa*.

Between 1,700 and 1,800 m asl, Seeps have especially high diversity but conspicuous are bryophytes, *Aciphylla pinnatifida, Psycrophila obtusa, Dolichoglottis lyallii, Ranunculus gracilipes, Euchiton traversii* and *Epilobium macropus*. Nearby snowbank herbfields have *Coprosma niphophila, Gaultheria nubicola, Carex wakatipu, C. hectorii, Celmisia haastii* and *Plantago lanigera*.

At 1,500-1,700 m asl, alluvial terraces alongside streams often have impeded drainage and are dominated by sphagnum moss and other bryophytes. Higher altitude examples have the

uncommon *Plantago obconica*, but lower in the valley they have more widespread bog rush, *Carex gaudichaudiana* and *Oreomyrrhis* "bog". Such sites have also been invaded by introduced grasses, especially browntop (*Agrostis capillaris*) which forms dense swards over small patches.

Western Hector Mountains, Lake Wakatipu Faces: At 900-1,000 m asl, seeps have *Gaultheria parvula*, *Pratia angulata*, *Lagenifera barkerii*, *Acrothamnus colensoi*, bog rush (*Schoenus pauciflorus*), *Carex coriacea*, *Galium propinquum*, alpine hard fern (*Blechnum penna-marina*) and *Anisotome* "bog".

Eastern Hector Mountains, Whittens Creek: At *c*.1,600 m asl there is a small string mire patterned wetland present in an upper basin. Elongated ridges of peat act as dams on slight slopes, creating a sequence of pools in terrace fashion. The distinctive short herbaceous turfs occupying these terraces are areas of high plant diversity with many recognisable communities separated by subtle changes in micro-topography, hydrology and fertility. Common species include *Psychrophila obtusa*, *Plantago lanigera*, *Carex gaudichaudiana*, *Abrotanella caespitosa*, *Kelleria paludosa*, *Euchiton traversii*, *Phyllachne colensoi*, *Gentianella* sp., *Epilobium komarovianum* and a range of bryophytes. This is also habitat for two wetland species of restricted distribution; *Plantago obconica* and *Myosotis* aff. *tenericaulis*.

At *c*.1,350 m asl, small river flats on the valley floor are a mixture of recent well-drained outwash gravels and older terraces with impeded drainage. Sparsely vegetated outwash gravels support *Raoulia tenuicaulis*, *Colobanthus strictus*, *Neopaxia sessiliflorum*, *Coprosma atropurpurea*, *Acaena saccaticupula*, *Epilobium* spp. and occasional orange hawkweed (*Hieracium aurantiacum*). A small comb sedge/sphagnum moss bog is located near the downstream end of these flats. Several species rare elsewhere on the property are present and include sundew (*Drosera arcturi*), *Celmisia glandulosa* and *Dracophyllum prostratum.*

Eastern Hector Mountains, Sproules Creek: Foot slope seepages are common and dominated by *Carex gaudichaudiana*, bog rush, and bryophytes. The uncommon sedge *Carex berggrenii* is occasionally present.

Eastern Hector Mountains, Middle faces between Whittens and Sproules Creeks: There are numerous small flushes and seepages with wetland herbs and sedges including comb sedge (*Oreobolus pectinatus*), *Coprosma perpusilla*, bryophytes, *Carex berggrenii* and *Dracophyllum muscoides.*

Nevis Valley mine tailings and associated wetlands: Ponds associated with past mining also harbour a distinct suite of native and exotic species including *Crassula sinclairii*, *Limosella lineata*, *Elatine gratioloides*, *Myriophyllum propinquum*, *Potamogeton cheesemanii*, *Ranunculus trichophyllus*, water forget-me-not (*Myosotis laxa subsp. caespitosa*) and *Carex echinata.*

SHOTOVER ECOLOGICAL DISTRICT AND RICHARDSON ECOLOGICAL DISTRICT

Mt Creighton Pastoral Lease (*LINZ 2003a*)

Wire Creek: Between 1,500 and 1,700 m asl seepages amongst slim snow tussock grassland are characterised by *Schoenus pauciflorus*, and a range of other species including *Plantago lanigera*, *Celmisia haastii*, *Carex edgariae*, *Trisetum* sp., *Deschampsia chapmanii*, *Rytidosperma nigricans*, *Isolepis aucklandica*, and *Psychrophila obtusa*, *Gaultheria nubicola*, *Coprosma perpusilla*, *Hydrocotyle montana*, and *Euphrasia* sp.

Occasional bogs and wetlands typically contained *Oreobolus pectinatus*, *Nertera balfouriana*, *Gaultheria parvula*, *Ranunculus gracileps*, *Plantago uniflora*, *Schizeilema cockaynei*, *Nertera ciliata*, *Celmisia glandulosa*, *Ranunculus royi*, *Carex gaudichaudiana*, and bryophytes.

Luna Basin and Creek: Above 1,500 m, wetland vegetation is dominated by grazed sweet vernal and browntop, but also present were *Agrostis pallens*, *Euchiton traversii*, *Epilobium komarovianum*, *Colobanthus apetalus*, and *Oreomyrrhis* "bog". There is *Carex coriacea*, *C. kaloides*. *C. petriei*, and *Eleocharis acuta*, *Hydrocotyle sulcata* around Lake Luna (810 m asl).

Lake Luna East Faces, Crush Creek, and Twenty-five Mile Range: A periodically wet hollow at 1,169 m asl amongst narrow-leaved tussock grassland has a central area of moss (*Polystichum* sp.) with *Carex gaudichaudiana*, *Juncus gregiflorus*, *Poa breviculmis*, *Rytidosperma pumulim*, browntop (*Agrostis capillaris*) and sweet vernal (*Anthoxanthum odoratum*). Below 1000 m asl *Oreobolous pectinatus* occurs on damp sites.

Lake Wakatipu faces north of Twenty-five Mile Creek: Snow hollows contain fellfield and cushion plant species with the addition of *Carex pyrenaica*, *Epilobium tasmanicum*, *Neopaxia sessiflora*, and *Ranunculus pachyrrhizus*. A damp seepage at 100 m asl is dominated by silver tussock, with browntop, sweet vernal, Yorkshire fog (*Holcus lanatus*), cats ear (*Hypochaeris radicata*), white clover (*Trifolium repens*), *Viola cunninghamii*, *Elymus solandri*, and *Acaena caesiiglauca*.

Butchers Creek, Dead Horse Creek, and Gill Creek: Narrow, wet, mossy seepages have abundant liverworts, *Gunnera monoica*, *Pratia angulata*, *Plantago triandra*, *Hydocotyle microphylla*, *Ourisia caespitosa*, *Galium perpusillum*, *Viola cunninghamii*, *Anaphallioides bellidioides*, *Carex wakatipu*, and *Oreomyrrhis* "bog". A broad damp tussock face at 1,370 m supports *Schoenus pauciflorus*, *Dracophyllum uniflorum*, *Astelia nervosa*, *Phormium cookianum*, *Oreobolus pectinatus*, *Hebe pauciramosa*, and occasional *Olearia cymbifolia*.

Fan Creek flats: Wetter parts of a floodplain are dominated by rushes and sedges including *Eleocharis acuta*, *Carex gaudichaudiana*, *C. berggrenii*, and *Juncus* spp., along with *Rumex flexuosus* and *Myosotis tenericaulis*.

Coronet Peak Pastoral Lease (LINZ 2006)

Wetlands are not common and occur as small bogs in the alpine zone, seepages in tussockland, ephemeral tarns in the montane zone, and along stream edges. Small seepages in

the tussockland contain several moss species, *Lagenifera barkeri, Uncinia divaricata, Schoenus pauciflorus, Ranunculus foliosus, Gunnera monoica* and *Juncus gregiflorus. Hebe pauciramosa* and *Olearia bullata* occurs in places. A few small upland bogs typically have several moss species that can dominate in places, comb sedge (*Oreobolus pectinatus*), *Carex echinata, Carpha alpina*, marsh marigold (*Psychrophila obtusa*), *Ranunculus gracilipes, Abrotanella caespitosa, Nertera balfouriana, Plantago uniflora* and *Carex gaudichaudiana. Carex coriacea* is common in lowland damp ground. Stream edges contain plants such as *Dolichoglottis lyallii, Acaena fissistipula, Coprosma atropurpurea, Epilobium macropus, Ourisia caespitosa* and *Anaphalioides bellidioides* as well as many of the more common species.

A notable fault-determined basin wetland complex (*c*.800 m above sea level) occurs east of the lower Polnoon Burn, and runs south to nearly Stockyard Creek. This is comprised of several wetland classes (sensu Johnson and Gerbeaux 2004) including bog, fen, shallow water (tarn) and ephemeral wetland. At the top of the complex, a deep tarn has a fringe of *Carex secta, C. gaudichaudiana* and *C. sinclairii*, with an occasional woody element of *Olearia odorata* and *Gaultheria antipoda*. Submerged wood suggests a much greater shrub or tree cover in the past. Its outlet feeds into a *Schoenus pauciflorus* dominated fen at lower elevation. Within this system are areas of slightly raised bog dominated by *Oreobolus pectinatus, Gaultheria parvula, Anisotome* "bog" and sundew (*Drosera arcturi*). Lower still is a small impounded pond with red pondweed (*Potamogeton cheesemanii*), sharp spike rush (*Eleocharis acuta*) and *Myriophyllum triphyllum*.

Between Church Hill Creek and Carmichaels Creek is an ephemeral tarn with an abundant fringing turf of *Galium perpusillum, Hydrocotyle microphylla, Pratia perpusilla*, and *Epilobium angustum*. Other even larger examples occur south of Carmichaels Creek. These too are dominated by the regionally uncommon *Pratia perpusilla* and *Epilobium angustum*. The uncommon sedge *Carex rubicunda* occurs at one location. These tarns rely on periodic filling from downslope wash during heavy rain events.

RICHARDSON ECOLOGICAL DISTRICT

***Temple Peak Pastoral Lease* (*LINZ 2003b*)**

Although wetlands do not feature prominently on the property there are several types of wetland present with distinctive plant assemblages. Wet seepages are the most widely distributed. Typical species include *Oreobolus pectinatus, Gnaphalium laterale, Epilobium komarovianum, Carex gaudichaudiana, Pratia angulata, Juncus antarcticus, Gonocarpus micranthus, Schoenus pauciflorus, Elaeocharis acuta* and *Leptinella mediana*. Small patches of *Sphagnum cristatum* are occasionally present.

A wetland complex on an old glacial terrace at the north end of the Rees Valley faces

(920 m altitude) has elements of peat bog, wet seepages and swamp. Despite the appearance of domination by Yorkshire fog (*Holcus lanatus*), native herb diversity is high reflecting subtle changes in hydrology, chemistry and fertility. Distinctive wetland species include *Nertera balfouriana, Plantago triandra, Microseris scapigera, Drosera arturi, Viola cunninghamii, Oreobolus pectinatus, Gonocarpus micranthus, Celmisia glandulosa, Carex gaudichaudiana* and *Schoenus pauciflorus*. Raised hummocky areas amongst the wetland have a short tussock community with more ubiquitous herbs. Ribbons of *Olearia bullata* shrubland are also common.

Other wetlands include a series of small alpine tarns. These are set amongst hummocky terraces on slump topography in the headwaters of the Ox Burn (1480 m).

Wyuna Pastoral Lease (LINZ 2002)

iv Wetlands

Wetlands are only a minor community occurring on some slopes, in small, shallow gullies and along stream edges. Rushes, sedges, grasses, small herbs and mosses are found here, most are specialised plants of wetlands and include *Oreobolus pectinatus, Utricularia monanthous, Drosera arcturi, Prasophyllum oligantha, Epilobium komarovianum, Gonocarpus micranthus* and others.

SELECTED WETLAND PHOTOGRAPHS

Plate 1: Common cushion bog species: *Oreobolus pectinatus*, *Euchiton traversii*, *Celmisia sessiliflora*, *Gentianella bellidioides*.

Plate 2: Common species alongside a small stream: *Psychrophila obtusa* and *Oreobolus pectinatus*.

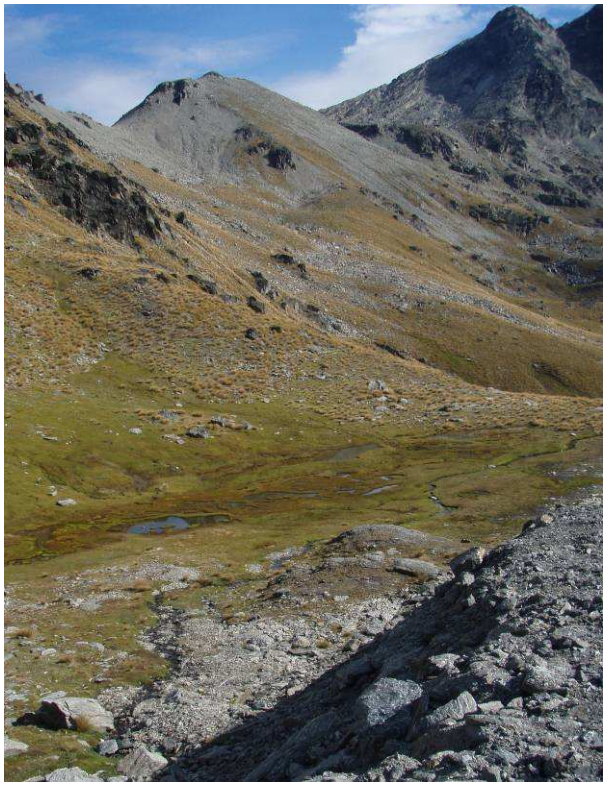

Plate 3: Wetland 2 - String mire in Ski Area.

Plate 4: Wetland 5 - Mossfield in Ski Area.

Plate 5: Wetland 5 - String mire and stream in Ski Area.

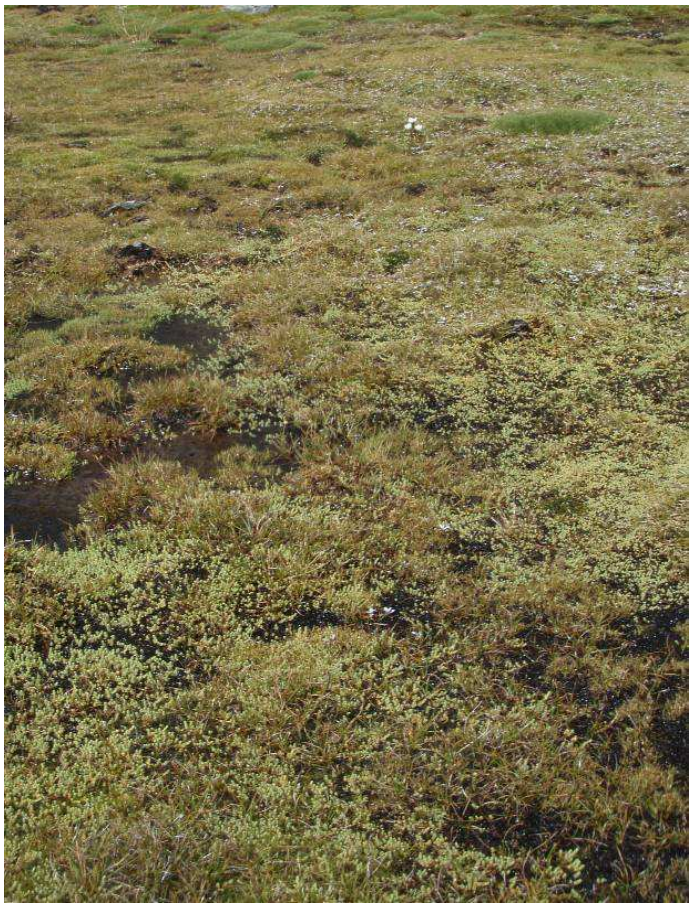

Plate 6: Wetland 5 - Common taxa: *Kelleria paludosa* and bryophytes

Plate 7: Wetland 15 - *Schoenus pauciflorus*-dominated flush/seepage alongside the Rastus Burn, next to the Ski Area access road.

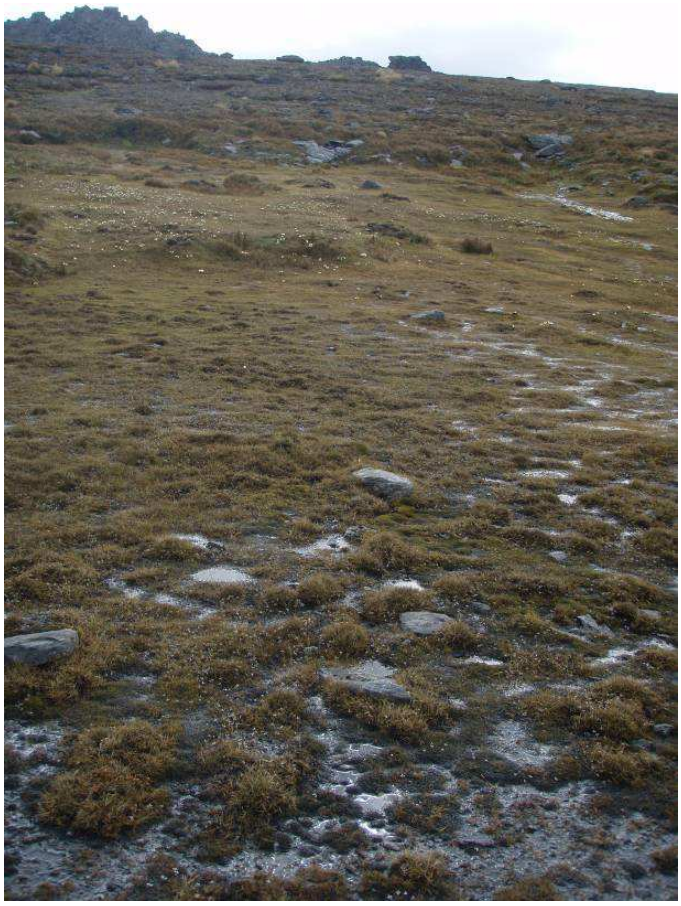

Plate 8: Wetland 34 - Large flush/ seepage in the upper Wye Creek.

Plate 9: Wetland 40 - In the upper Wye Creek catchment.

Plate 10: Wetland 44 - Upper Wye Creek.