Appendix C:
EIANZ guideline tables.

Impact Assessment tables (EIANZ 2015).

Table 9 Criteria for describing magnitude of effect

Adapted from Regini (2000) and Boffa Miskell (2011)

Magnitude	Description
Very high/severe	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally change and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
Moderate/medium	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature
Low/minor	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

Table 10 Assigning value to species for assessment purposes

Determining factors	Value
Nationally threatened – critical or vulnerable	Very high
Nationally at risk – declining	High
Nationally at risk – recovering, relict or naturally uncommon	Moderate–high
Locally uncommon/rare, not nationally threatened or at risk	Moderate
Not threatened nationally, common locally	Low

Table 11 Assigning value to vegetation or habitat for assessment purposes

Determining factors	Value
Supporting more than one national priority type[27]	Very high
Supporting one national priority type or naturally uncommon ecosystem (Holdaway, Wiser, & Williams, 2012)	High
Locally rare or threatened, supporting no threatened or at risk species	Moderate
Nationally and locally common, supporting no threatened or at risk species	Low

Table 12 Criteria for describing level of effects

Ecological Value → Magnitude ↓	Very high	High	Moderate	Low
Very high	**Very high**	**Very high**	**High**	Moderate
High	**Very high**	**Very high**	**Moderate**	Low
Moderate	**Very high**	**High**	Low	Very low
Low	**Moderate**	Low	Low	Very low
Negligible	Low	Very low	Very low	Very low

ASSESSMENT OF WETLANDS AT THE REMARKABLES SKI AREA, QUEENSTOWN

MARCH 2011

Report No. 2662

Prepared for:

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CONTENTS

PROJECT TEAM

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Kelvin Lloyd - Report review.

Reviewed and approved for release by:

_____
W.B. Shaw
Director
Wildland Consultants

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.

REFERENCES

de Lange P.J., Norton D.A., Courtney S.P., Heenan P.B., Barkla J.W., Cameron E.K., Hitchmough R., and Townsend A.J. 2009: Threatened and uncommon plants of New Zealand (2008 revision). *New Zealand Journal of Botany 47*: 61-96.

Fahey B. and Wardle K. 1998: Likely impacts of snow grooming and related activities in the West Otago ski fields. *Science for Conservation: 85*. Department of Conservation, Wellington.

LINZ 2002: Crown Pastoral Land Tenure Review. Lease name: Wyuna. Lease Number: P0 299. Conservation Resources Report.

LINZ 2003a: Crown Pastoral Land Tenure Review. Lease name: Mt Creighton. Lease Number: Pc 107. Conservation Resources Report.

LINZ 2003b: Crown Pastoral Land Tenure Review. Lease name: Temple Peak Station. Lease Number: Po 94. Conservation Resources Report.

LINZ 2004: Crown Pastoral Land Tenure Review. Lease name: Ben Nevis. Lease Number: P0 241. Conservation Resources Report.

LINZ 2005: Crown Pastoral Land Tenure Review. Lease name : Glen Nevis. Lease number: PO 201. Conservation Resources Report - Part 1.

LINZ 2006: Crown Pastoral Land Tenure Review. Lease name : Coronet Peak. Lease number: PO 195. Conservation Resources Report - Part 1.

LINZ 2007: Crown Pastoral Land Tenure Review. Lease name : Loch Linnhe. Lease number: PO230. Conservation Resources Report - Part 1.

Mark A.F and Bliss L.C. 1970: The high-alpine vegetation of Central Otago, New Zealand. *New Zealand Journal of Botany 8*: 381-451.

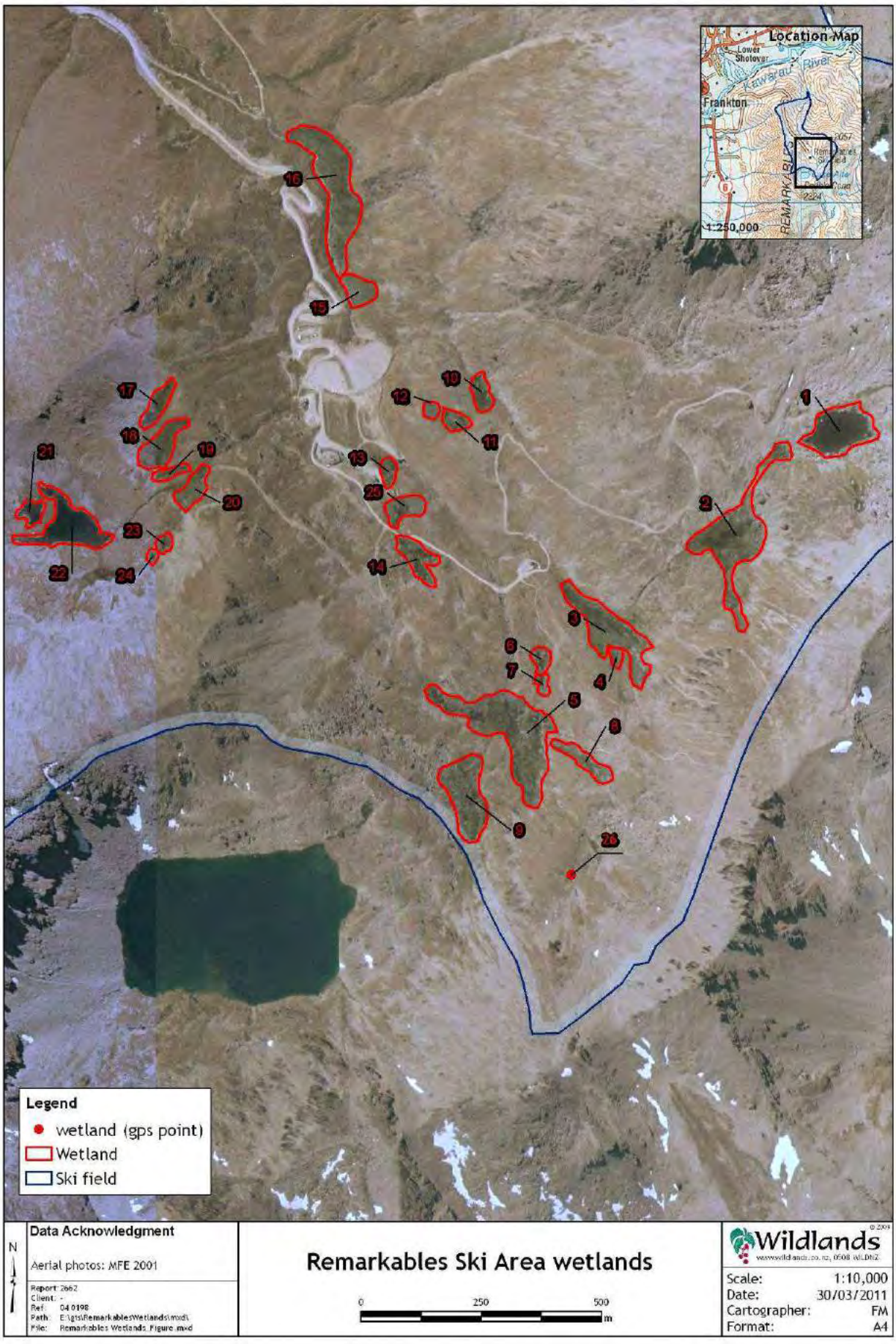
Patrick B.H., Lyford B. M., Ward J.B. and Barratt B.I.P. 1992: Lepidoptera and other insects of the Rastus Burn Basin, The Remarkables, Otago. *Journal of the Royal Society of New Zealand 22*: 265-278.

QLDC 2007: Queenstown-Lakes District Plan. Queenstown-Lakes District Council.

Williams P.A., Wiser S., Clarkson B. and Stanley M.C. 2007: New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology 31*: 119-128.

Wildland Consultants 2004: A Review of the use and management of Protected Natural Area Programme (PNAP) survey reports. *Wildland Consultants Ltd Contract Report No. 674*. Prepared for Department of Conservation, Wellington.

REMARKABLES SKI AREA
WETLANDS (MAP)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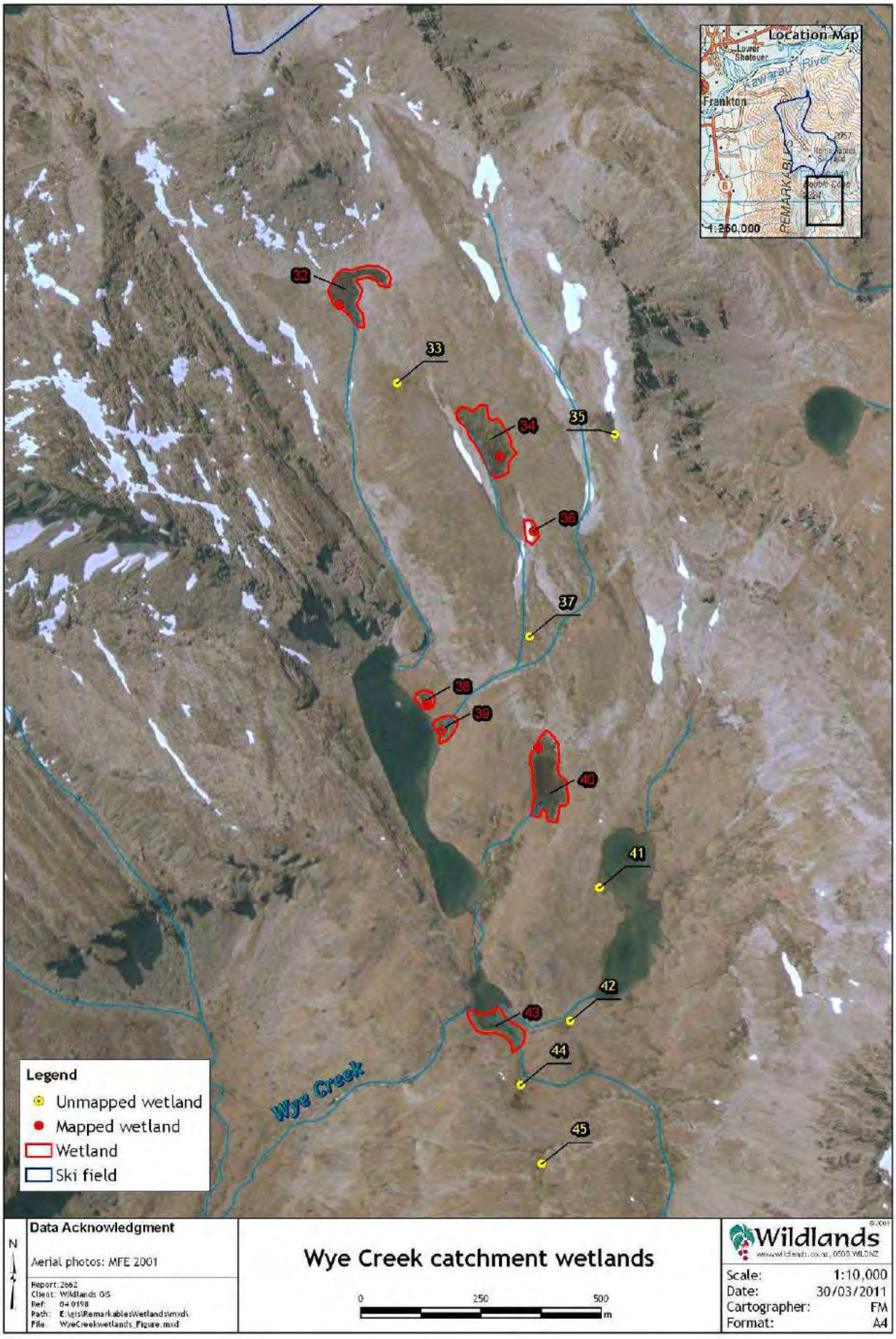
WYE CREEK CATCHMENT
WETLANDS (MAP)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Legend
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DETAILS RECORDED OF WETLANDS SURVEYED

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.

SUGAR BOWL LIFT REPLACEMENT
NATURAL HAZARDS ASSESSMENT

PREPARED FOR NZSKI LIMITED

July 2018

Stantec

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Grant Kluyts	Derek Chinn

PREPARED BY		
Derek Chinn		06/07/2018
CHECKED BY		
Lee Paterson		06/07/2018
REVIEWED BY		
Grant Kluyts		06/07/2018
APPROVED FOR ISSUE BY		
Grant Kluyts	 .	06/07/2018

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by

Executive Summary

A new lift is proposed to be constructed in the Sugar Bowl cirque. This report assesses potential natural hazards to the lift structure.

- The foundation materials are considered to be ideal for the lift. Foundations conditions are anticipated to be either over consolidated glacial till or rock. High allowable bearing capacity is anticipated from these materials
- No signs of instability at the foundation locations has been identified. One area of instability was detected in the cirque, but this is not in the lift line.
- The lift line crosses two areas of existing rock fall debris fans which are below potentially unstable features where further rock fall may originate.
  - It is practical to move the towers in the lower (smaller) debris fan area to mitigate the risk of rock fall damage to the towers. There remains a risk of further rock fall from the source area. This change has been made to the design and the towers have been moved out of the existing debris fans.
  - The upper rock fall debris fan covers a significant area. A potentially unstable rock tower remains in the source area. The return period of rock fall from this area appears to be in the order of hundreds of years and is return period is consistent with the design return period for other natural phenomena such as wind and earthquake loading given in the loadings standard NZS 1170.0. The most likely conditions for rock fall are earthquake, seasonal freeze/thaw or heavy rainfall. . This is a risk that will need to be understood and accepted with the proposed alignment
    - The avalanche paths in the area are mapped and well understood. The Remarkables operate a robust avalanche control programme and the avalanche risks are managed. The avalanche risk is not allowed to build up sufficiently to cause damage to structures and avalanches are triggered by bombing.
    - The lift structure has been designed appropriately for loads calculated in accordance with the relevant New Zealand Standards. In particular wind and snow loads have been assessed using the relevant standard from the 1170 suite of loading standards.
    - No evidence of risks of erosion, debris flow and flooding to the lift structure was detected
    - The assessment was undertaken in July 2018, when the site was largely covered with snow. The assessment relied extensively on existing photographs and reports. Thus an inspection of the ground surface was not possible and evidence of some risks may not have been detected.

CONTENTS

LIST OF FIGURES

1. Introduction

NZSki Limited intend to construct a new ski lift at the Remarkables ski area to replace the existing Sugar Bowl lift during the 2018/19 summer season. This document reports our findings regarding the potential Natural Hazards along and adjacent to the proposed route. The purpose of this report is to record our observations and conclusions. We understand that this report will be used in support of NZSki's submissions to the following Statutory Authorities;

- The Queenstown Lakes District Council for Land Use Consent for lift, and associated ancillary building
- The Department of Conservation for approval relating to NZSki's Concession to Operate within the conservation estate.

The following natural hazards are addressed within this document:

- Foundation stability and bearing capacity for the lift base station, tower foundations and top station.
- Rock fall potential hazard
- Snow avalanche hazard
- Wind
- Flood risk, erosion or debris flow

2. Proposed Lift Description

2.1 The proposed lift

The proposed lift is a six seat detachable chair lift and is being supplied by Doppelmayr Lifts NZ Limited.

- The lift is approximately 1.05 km long and rises approximately 264m.
- The base station is to be located in the existing drop off area adjacent to the base building at an altitude of approximately 1,606m.
- The top station is located within the 'Sugar Bowl' crique, below the cirque headwall. The ground level at the top station is at an altitude of 1,870m.
- The lift has ten towers independent of the top and bottom station structures

2.2 Lift Alignment

The lift is located along the northern side of the basin floor. The alignment of the lift is shown on the figure below;

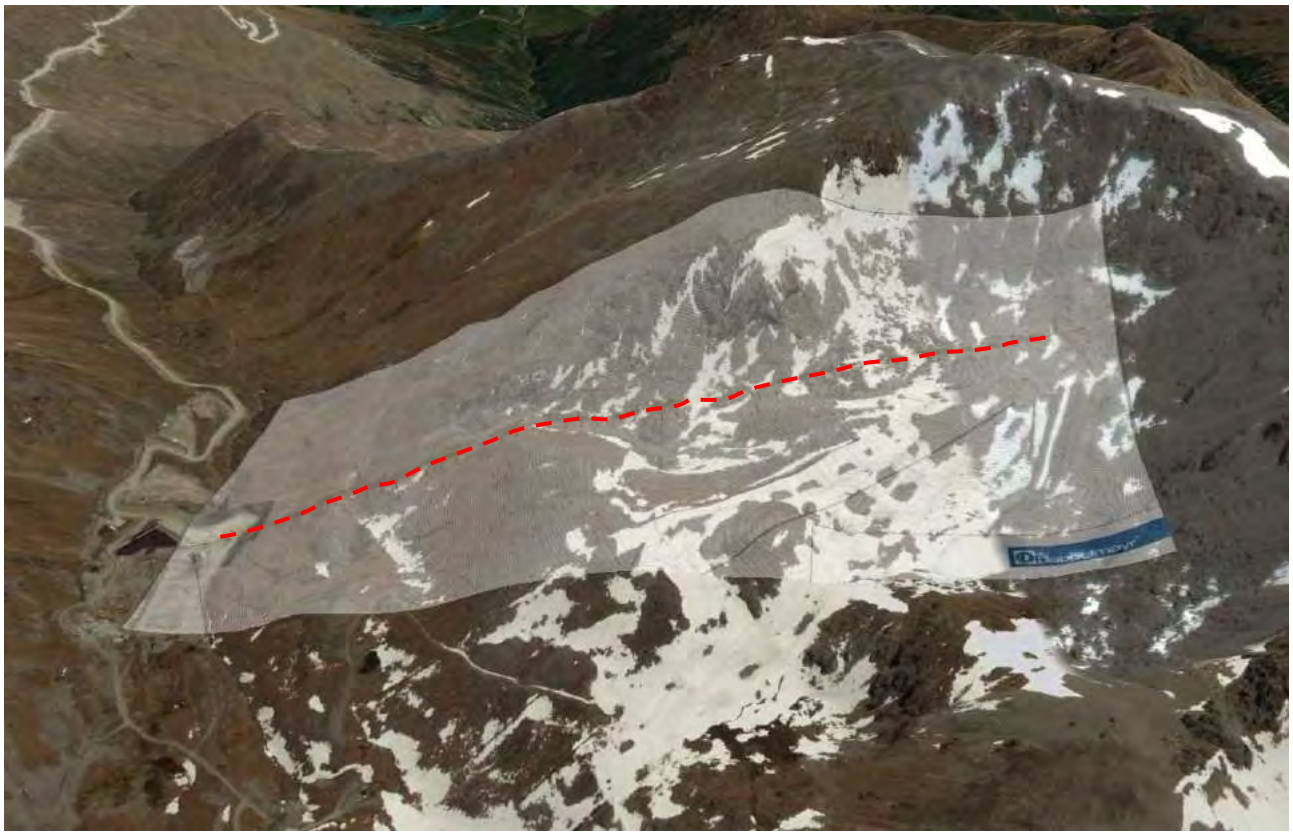

Figure 2-1: Nominal alignment of the new Sugar Bowl lift

3. Site Description

3.1 Glacial History

The Sugar Bowl Crique has been shaped by successive periods of glaciation. The Southern Alps glaciers advanced to their last glacial maximum between 22,300 and 18,000 years before present (BP). At this time the Wakatipu Basin was nearly completely glaciated and various rôche moutonnée features of glacier shaped bed rock visible in the Wakatipu Basin were formed. Various subsequent lesser glacier advances have occurred since 18,000 years BP with the last significant glacial advance occurred approximately 10,000 years BP.

3.2 Geology

The underlying bedrock at this site consists of chlorite schist which is visible in outcrops around the perimeter of the crique and in locations in the on the basin floor. The bedrock is overlaid by glacial till in turn overlaid in part by colluvium and specific areas of rock fall debris fans. There have been numerous areas of excavation within the area and these excavations have exposed dense glacial till deposits.

3.3 Ground Water

A number of glacial tarns are present within the Sugar Bowl Cirque and also around the wider area. The most notable being Lake Alta below Single and Double Cone peaks. Ground water movement is understood to be primarily along the horizon between the underlying bedrock and the glacial till.

4. Investigation Methodology

This investigation into natural hazards for the lift was commissioned in June 2018. A specific site inspection was undertaken in early July 2018. Snow cover prevented an inspection of the ground surface, but rocky out crops and large-scale landforms were still visible. Thus, the investigation has relied significantly on previous records and photography.

Sources of information used for this report include the following:

- Google Earth aerial photography
- The previous site investigation report for the new base building foundations and the results of the test pits undertaken as part of this work
- The previous site investigation report undertaken for the construction of the recently completed Curvey Basin lift, and the test pits excavated as part of this investigation
- Site risk report prepared for the construction of the Curvey Basin lift and, in particular, the rock fall and stability elements of this report
- Site visit reports from the construction of the Curvey Basin lift foundations
- Site visit records for the previous earthworks undertaken in the learner's area associated with the relocation of the Rastus Burn creek
- Site visit records for the earthworks undertaken on the cat track to Shadow Basin
- Site visit records for the construction of the Curvey Basin lift

5. Foundation stability and bearing capacity

5.1 Foundation Bearing Capacity

This section addresses the risk of settlement of the individual lift tower or station foundations as a result of compaction of the underlying soil.

During previous excavation the existing glacial till deposits have been found to be very dense and over consolidated, potentially as a result of compaction from overlying ice. The depth of the till deposits over the underlying rock will vary with location, but due to the visible rock outcrops the depths of the site soil is not anticipated to be significant and is likely to be only a maximum of 20 to 30m, and in many locations the soil depth is likely to be significantly less than this figure.

Areas of overlying colluvium consist of dense chaotic debris with numerous large boulders, many of these in excess of 1m maximum dimension. Very large erratic blocks may be present within this material. Test pit excavation for the base building, undertaken during 2013 in undisturbed natural ground, is shown in the figure below;

Figure 5-1: test pit excavation at the base building site in undisturbed dense glacial till

Our recommendations for foundations for both the base building and the Curvey Basin chair lift in both till and colluvium was that the material had an allowable bearing capacity of at least 300 kPa and an ultimate bearing capacity of 900 kPa. These are inferred values and the capacity of the foundation is likely to be governed by crushing of the aggregate rather than densification of the material. The actual confined capacity of the foundation platform before crushing occurs is likely to be greater than 900 kPa.

However, our previous recommendations were that 300 kPa allowable bearing is an appropriately conservative design figure.
Published literature contains recommendations for allowable foundation bearing capacity, Foundation Design and Construction, MJ Tomlinson includes the following recommendations for allowable bearing capacity:

Description of soil	*N-value in SPT*	*Presumed bearing value* (kN/m²) *for foundation of width*		
		1 m	*2 m*	*4 m*
Very dense sands and gravels	>50	800	600	500
Dense sands and gravels	30–50	500–800	400–600	300–500
Medium-dense sands and gravels	10–30	150–500	100–400	100–300
Loose sands and gravels	5–10	50–150	50–100	30–100

Experience with the local schist rock indicates a safe figure to use for allowable bearing capacity is 300 kPa.

5.2 Level of Ground Water table

The location of the water table is assumed to be significantly below the level of the foundation and is not expected to have any detrimental effect on the foundation bearing capacity. The site is composed of free draining granular material and the slopes below the terrace are not expected to hold water in a way that will adversely affect the allowable foundation bearing capacity.

5.3 Foundation Stability

This section addresses the risk of slip failures of the soil or rock beneath of the individual lift tower or station foundations.

5.3.1 Foundation Stability Summary

- Inspection of the ground surface and of existing photographs has not identified evidence of slip failures along the route of the lift.
- Solifluction lobes are visible along the lower half of the lift route, these features do not threaten the structure as these are shallow seated
- An isolated circular slip failure feature exists above the lift top station. The top station is not founded on this feature and it is likely that movement of this feature has already occurred, and the feature may have reached a stable position. This feature does not pose a risk of rapid or catastrophic failure.

5.3.2 Solifluction Lobes along the lower half of the route

Figure 5.2 below shows the lift line viewed from Shadow basin. In this figure it can be seen that the lower half of the lift line traverses rolling scree covered terrain. Surface solifluction lobes are visible on the surface in this area. These lobes are associated with seasonal migration of saturated surficial material. Such solifluction lobes are not a risk to a structure such as a lift as the lift towers are founded below the movement. Solifluction is a gradual and cyclic process and is not associated with rapid failure. Thus, these lobes do not pose a risk to the structure.

Because of the smooth landforms in the lower half of the structure any deep-seated instability and resulting movement would be expected to be evident. No such signs if circular slip movement are visible.

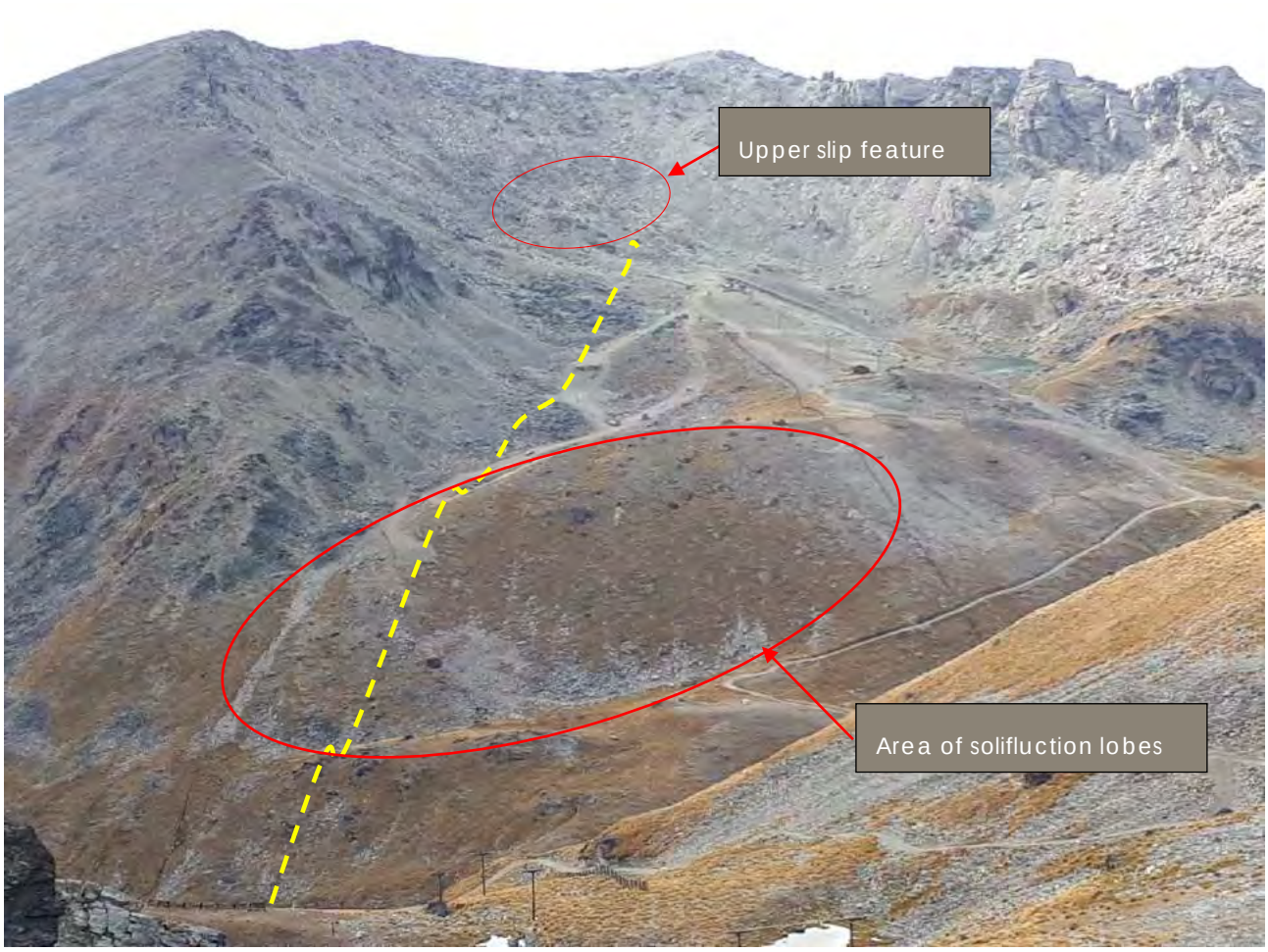

Figure 5-2: the proposed lift line marked with the area of slip marked in the circle

5.3.3 Upper Slip Feature

Above the top of the lift, within the talus slopes below the ridge, is feature indicating a circular slip failure of the upper cirque wall. This feature is marked in Figure 5-2 above and in Figures 5-3 and 5-4 below.

This slip feature is isolated in a defined area and does not propagate as far as the lift top station. Because a terrace area has formed at the top of the feature and no signs of recent shoving at the toe were detected on the photography available, we consider it likely that this feature is likely to have reached, or be close to reaching, a stable position. We consider that significant future moment of this feature is unlikely.

Circular slip failures such as this are not generally associated with rapid or catastrophic failure. The movement of such features is often episodic in response to rainfall.

Figure 5-3: Google Earth view showing the slip above the top of the lift

Figure 5-4: 150 ˚ panorama showing the bulge of the slip area above the top of the lift

6. Rock fall potential hazard

The lift route traverses two areas of rock fall fans. Debris from these fans has originated from bluffs along the ridgeline to the north of the lift. These bluffs are jagged features, the sharp nature of these features indicates that the rock falls are geologically recent and have not yet eroded to stable slopes. These features are certainly post glacial (i.e. within the last 10,000 years) and potentially within hundreds of years. The rock fall debris is un-weathered which supports the belief that these are recent features.

The upper most rock fall debris fan is a significant feature and the rock fall event which caused this fan would have been a substantial rock avalanche.

The rock fall zones are shown in figure below:

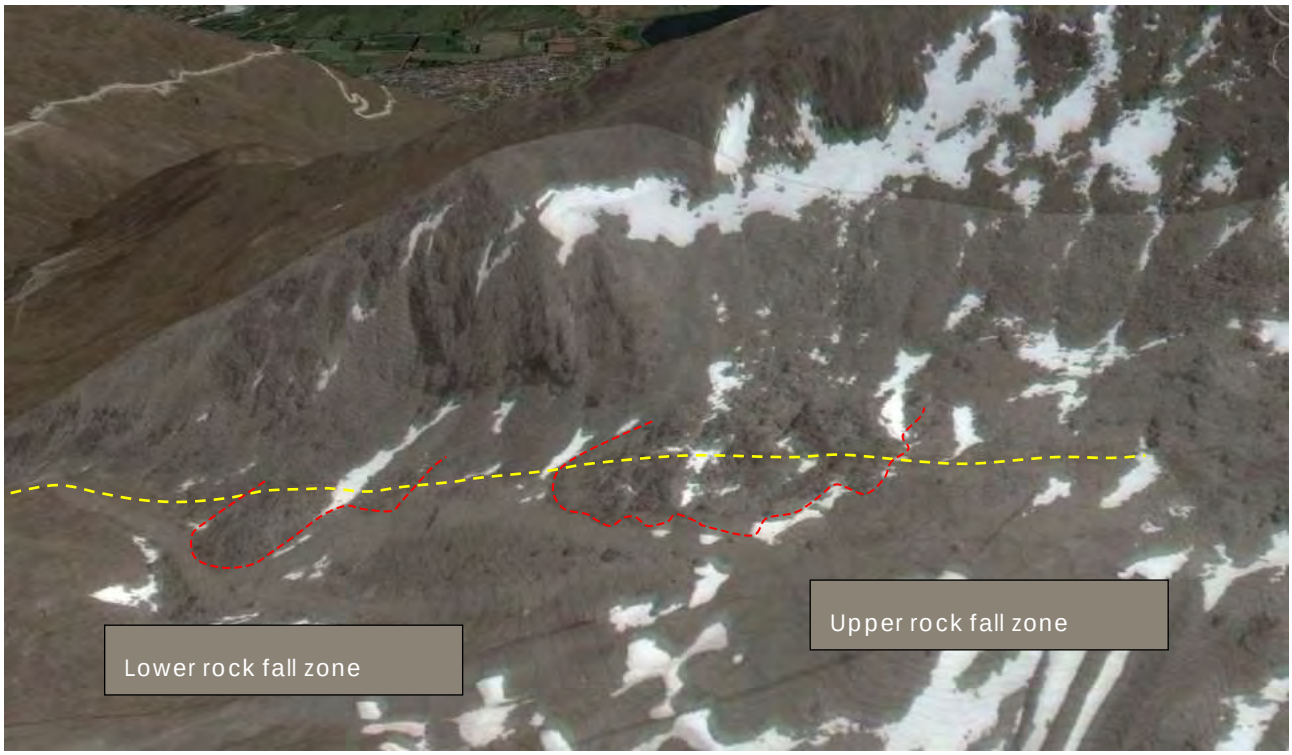

Figure 6-1: Lift Line and rock fall debris fans

6.1 Rock Fall Risk Summary

- Rock fall risk in the lower rock fall zone remains due to the potentially unstable nature of the bluff above. Previous rock fall debris identifies the nominal area of this risk and the towers of the lift have been moved out from this area to partially manage the risk

- Rock fall risk in the upper rock fall remains from the existing feature on the skyline. A potentially unstable rock tower remains in the source area and further rock fall from this feature will occur eventually as the mountain weathers. The upper rock fall debris fan covers a significant area and further rock fall from the remaining feature may result in debris within the existing debris field. Thus it is considered impractical to relocate towers in this area to mitigate the risk because the span of the cable would be impractically far. The most likely conditions for rock fall are earthquake, seasonal freeze/thaw or heavy rainfall. The previous rock fall in this area appears to have been between 200 and 300 years ago, judging from the level of weathering on the debris. The approximate return period of rock fall from this area appears to be in the order of hundreds of years. A return period of 200 to 300 years and is consistent with the design return period for other natural phenomena such as wind and earthquake loading given in the loadings standard NZS 1170.0. Rock striking the tower could conceivably buckle and collapse a tower. This is a risk that will need to be understood and accepted with the proposed alignment. The relevant

section from NZS1170.0 relating to the accepted return periods of these events is reproduced below. The lift is a 'normal building' with an importance level of 2;

AS/NZS 1170.0:2002 14

TABLE 3.3

ANNUAL PROBABILITY OF EXCEEDANCE

Design working life	Importance level	Annual probability of exceedance for ultimate limit states			Annual probability of exceedance for serviceability limit states	
		Wind	Snow	Earthquake	SLS1	SLS2 Importance level 4 only
Construction equipment, e.g., props, scaffolding, braces and similar	2	1/100	1/50	1/100	1/25	
Less than 6 months	1	1/25	1/25	1/25	—	
	2	1/100	1/50	1/100	1/25	
	3	1/250	1/100	1/250	1/25	
	4	1/1000	1/250	1/1000	1/25	
5 years	1	1/25	1/25	1/25	—	—
	2	1/250	1/50	1/250	1/25	—
	3	1/500	1/100	1/500	1/25	—
	4	1/1000	1/250	1/1000	1/25	1/250
25 years	1	1/50	1/25	1/50	—	—
	2	1/250	1/50	1/250	1/25	—
	3	1/500	1/100	1/500	1/25	—
	4	1/1000	1/250	1/1000	1/25	1/250
50 years	1	1/100	1/50	1/100	—	—
	2	1/500	1/150	1/500	1/25	—
	3	1/1000	1/250	1/1000	1/25	—
	4	1/2500	1/500	1/2500	1/25	1/500

Figure 6-2: Risk return period for natural phenome for a 25 year design life structure from NZS 1170.0

6.2 Lower Rock Fall Zone 'Little Witch' & 'Snake Gully'

The lift crosses over rock fall debris in an area known as Little Witch and snake gully. This debris has originated from the bluffs above. This is shown in figure 6-2 below;

Figure 6-3: panoramic view of lower rock fall debris cone in the Little Witch and Snake Gully area

Figure 6-4: the feature where the little witch debris fan originated, adverse joint sets can be seen dipping to the west

Figure 6-3 shows a number of adverse joint sets which dip towards the west and the lift location. No specific significant hung blocks were detected during the inspection, but a rock fall risk remains. Rock fall in this area may be both seasonal and event related. Seismic events, heavy rainfall and seasonal freeze thaw action are likely to be the primary triggers of rock fall in this location.

6.2.1 Little witch and snake gully rock fall risk mitigation

The tower locations have been moved from the existing debris fans. Tower 6 has been moved to below the existing fan and tower 7 moved approximately 40m up slope and off the debris fan. This movement reduces the risk of the towers being struck should a rock fall from the bluff occur.

There remains a risk of rock fall from this future reaching the lift line. It is conceivable that debris reaching the lift line may have sufficient energy to cause damage.

6.3 Upper Rock Fall Zone

The upper rock fall fan is a significant feature. This was clearly a high energy event involving the collapse of a significant quantity of material from the ridgeline. This is evident in the two figures below;

Figure 6-5: the upper rock fall area. The debris fan on the left and the margins of the rock fall are visible on the slope above

Figure 6-6: Upper rock fall area with the existing debris fan on the right and the source area on the skyline

There remains a jagged feature on the ridgeline, which did not collapse with the earlier rock fall. This feature includes steep rock towers and this feature has not yet eroded to a stable condition. This feature is shown in the figure below;

Figure 6-7: Remaining feature above the top rock fall debris fan

Rock fall from this feature is likely to be precipitated by either a sufficiently large earthquake, heavy rainfall or seasonal freeze thaw action. This feature is sufficiently far from the debris run out zone that the debris may spread out in a wide area and thus it is not practical to move the towers sufficiently to defensibly reduce the risk. The fall from the feature is sufficiently high that rocks falling from this location may be travelling fast enough to cause damage to the towers.

7. Snow avalanche hazard

The lift crosses a number of understood, named and managed avalanche paths. These paths are shown in the figure below:

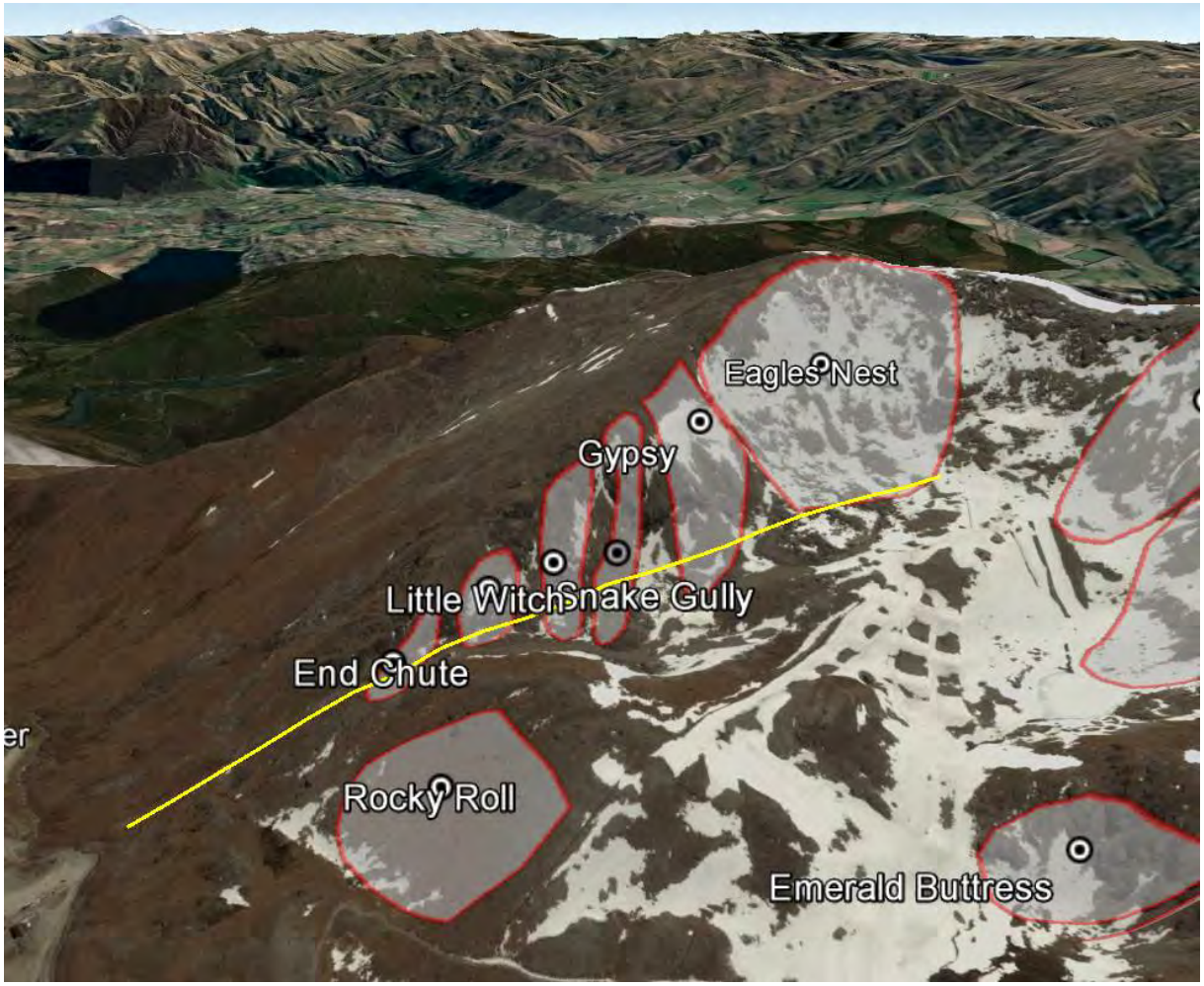

Figure 7-1: mapped avalanche paths and the lift route

The Remarkables maintain a robust avalanche control programme. We have discussed the avalanche control measures specifically relating to the new lift with the head of the Remarkables ski patrol. The avalanche control measures in place include the following:

- Identification of the avalanche paths
- Identification of the weather risks, including precipitation and wind direction
- A robust programme of snow pack monitoring
- Onsite monitoring
- A programme of bombing to prevent risks from building up to significant levels
- Access to site for bombing either by foot or by helicopter
- The potential to shut the runs or the lift should the risk become too great

Thus, we are satisfied that, while the lift does cross known avalanche paths, the risk of avalanche building up sufficiently to threaten the lift is both low and appropriately managed.

8. Wind and Snow

8.1 Wind

The Remarkables is a windy location. The lift has been designed to resist wind loads calculated in accordance with the wind load calculation method described in NZS 1170.2: 2011 Structural design Actions – Wind Actions. Designs conforming to this standard and the relevant material design standards meet the New Zealand building code verification method B1 VM1. I.e. if the wind loads have been calculated in accordance with this standard and the materials designed in accordance with the relevant standard (either steel, concrete or timber) then the verification method is satisfied, and the design complies with the New Zealand Building Code.

8.2 Snow

Similarly to wind, the design of the lift to resist loads imposed by snow has been undertaken using loads calculated in accordance with the snow load calculation method described in NZS 1170.3: 2003 Structural design Actions – Snow and Ice Actions.

9. Flood risk, erosion or debris flow

9.1 Flood Risk

No evidence of there being a flood risk to the lift was detected.

9.2 Debris Flow

The site investigations did not detect any evidence of previous debris flows in the area. Nor were features that could dam water and cause a debris flow detected above the structure. Thus we do not believe that there is any significant debris flow risk.

9.3 Erosion

There are no significant water erosion features adjacent to the lift structures, and we do not believe that there is a significant risk of erosion damage to the lift.

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AFFECTED PERSON'S APPROVAL

FORM 8A

QUEENSTOWN LAKES DISTRICT COUNCIL

Resource Management Act 1991 Section 95

RESOURCE CONSENT APPLICANT'S NAME AND/OR RM

NZSki Limited

AFFECTED PERSON'S DETAILS

I/We Department of Conservation

Are the owners/occupiers of

Administrators of The Rastus Burn Recreation Reserve, Queenstown

DETAILS OF PROPOSAL

I/We hereby give written approval for the proposal to:

Construct a replacement passenger lift system within the Sugar Basin at the Remarkables Ski Area, Queenstown.

The proposal involves associated earthworks for the development of new ski trails and snow making infrastructure. The earthworks and terrain development necessitate the removal of indigenous vegetation, works within water courses and removal of a seepage area.

at the following subject site(s):

The Remarkables Ski Area, Queenstown

☑ PLEASE TICK I/We understand that by signing this form Council, when considering this application, will not consider any effects of the proposal upon me/us.

☑ PLEASE TICK I/We understand that if the consent authority determines the activity is a deemed permitted boundary activity under section 87BA of the Act, written approval cannot be withdrawn if this process is followed instead.

WHAT INFORMATION/PLANS HAVE YOU SIGHTED

☑ PLEASE TICK I/We have sighted and initialled ALL plans dated and approve them. attached

APPROVAL OF AFFECTED PERSON(S)

The written consent of all owners / occupiers who are affected. If the site that is affected is jointly owned, the written consent of all co-owners (names detailed on the title for the site) are required.

A

Name (PRINT)

Contact Phone / Email address

Signature | Date

B

Name (PRINT)

Contact Phone / Email address

Signature | Date

C

Name (PRINT)

Contact Phone / Email address

Signature | Date

D

Name (PRINT)

Contact Phone / Email address

Signature | Date

Note to person signing written approval

Conditional written approvals cannot be accepted.

There is no obligation to sign this form, and no reasons need to be given.

If this form is not signed, the application may be notified with an opportunity for submissions.

If signing on behalf of a trust or company, please provide additional written evidence that you have signing authority.

QUEENSTOWN LAKES DISTRICT COUNCIL

Queenstown Lakes District Council
Private Bag 50072, Queenstown 9348
Gorge Road, Queenstown 9300

P: 03 441 0499
E: resourceconsent@qldc.govt.nz
www.qldc.govt.nz

Written Approvals of Persons Likely to be Adversely Affected

I/We (Please print full name/s) **Department of Conservation**

of (Address) of **1 Arthurs Point Road, Queenstown 9371**

I /we have read the full application for the proposal by (Applicant)

NZSki Limited

for a Resource Consent (Number) **N/A** to **Construct a replacement passenger lift system with associated trail works, snow making infrastructure, stream crossings and removal of a seepage area.**

and give my/our written approval to the proposed activity/activities.

In signing this written approval I/we understand that:

- The consent authority must decide that I/we am/are no longer an affected person, and disregard adverse effects on me/us
- That /we I may withdraw my/our written approval in writing before the hearing, or if no hearing before a decision is made on the application.

Signature/s Date
(or person authorised to sign on behalf of affected party/parties)

Phone Fax Email

Please note: If this application is subsequently notified the above approval does not constitute a submission as required under Section 96 of the Resource Management Act 1991.

Written Approvals of Persons Likely to be Adversely Affected

I/We (Please print full name/s)

of (Address)

I /we have read the full application for the proposal by (Applicant)

for a Resource Consent (Number) to

and give my/our written approval to the proposed activity/activities.

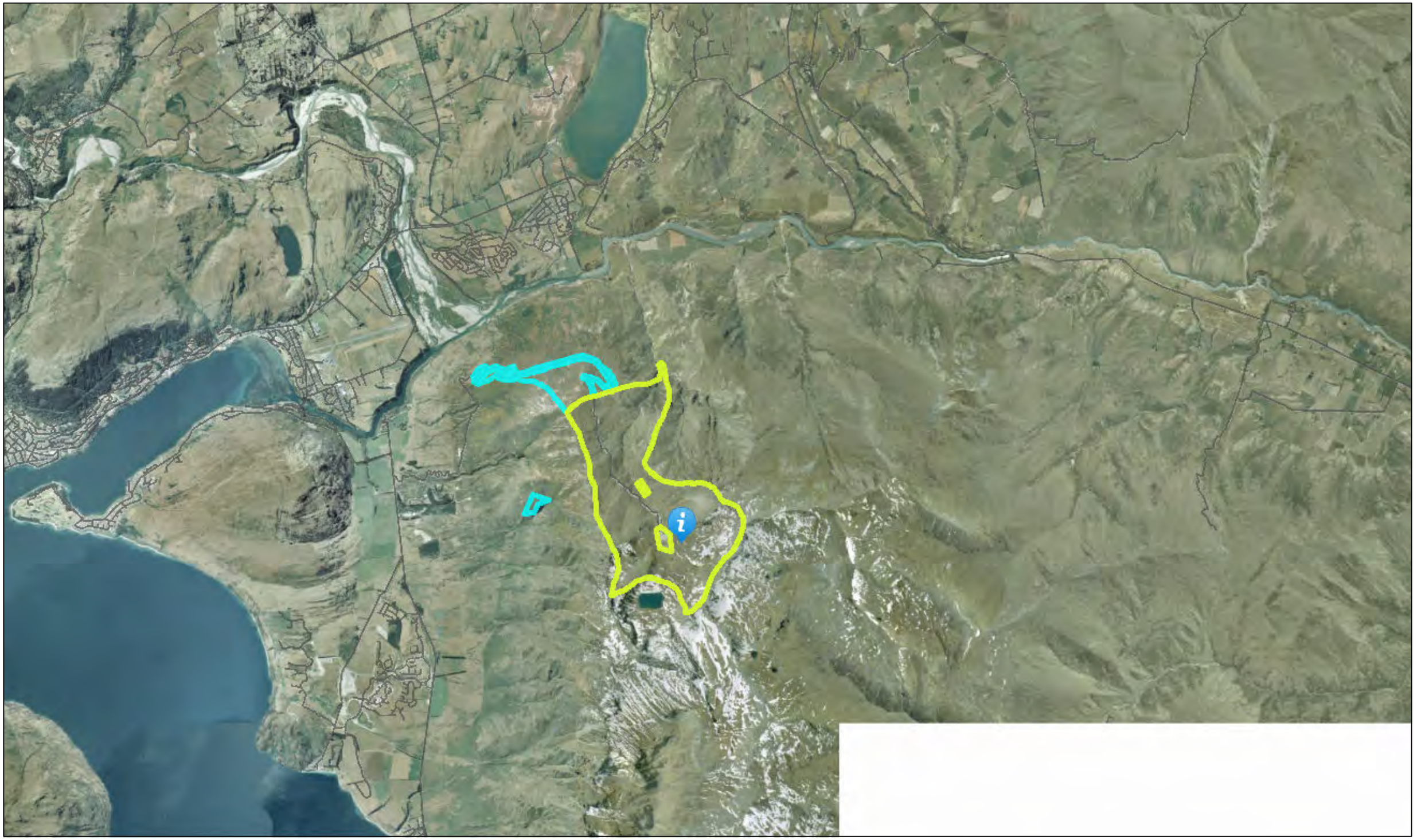
In signing this written approval I/we understand that:

- The consent authority must decide that I/we am/are no longer an affected person, and disregard adverse effects on me/us
- That /we I may withdraw my/our written approval in writing before the hearing, or if no hearing before a decision is made on the application.

Signature/s Date
(or person authorised to sign on behalf of affected party/parties)

Phone Fax Email

Please note: If this application is subsequently notified the above approval does not constitute a submission as required under Section 96 of the Resource Management Act 1991.



Queenstown Lakes District Council

Webmaps your view of your information

Appendix [A] - Overall Site Location Plan

16 July 2018

0 1,000 2,000 3,000 4,000 Metres

N

PRELININARY ENGINEERING DESIGN PLANS

DESIGN PLANS - SUGAR BOWL II
REMARKABLES SKI FIELD, QUEENSTOWN, NZ

EARTHWORKS DESIGN

JOB No. 12650 DWG No.18

FOR

NZ SKI LTD

REV -

For Consent 25.07.18

SHEET INDEX		
DRAWING TITLE	REVISION	SHEET No
OVERALL LAYOUT PLAN	-	01
OVERALL LAYOUT & VOLUME PLAN	-	02
OVERALL LAYOUT & VOLUME PLAN WITH ASBUILT OVERLAY	-	03
LAYOUT & EARTHWORKS PLAN	-	04
LAYOUT & EARTHWORKS PLAN	-	05
LAYOUT & EARTHWORKS PLAN	-	06
LAYOUT & EARTHWORKS PLAN	-	07
LAYOUT & EARTHWORKS PLAN	-	08
OVERALL LAYOUT & VOLUME PLAN WITH IMAGE OVERLAY	-	09
LONGSECTION SUGAR STASH TRAIL	-	20
LONGSECTION SUGAR STASH TRAIL	-	21
LONGSECTION SUGAR STASH TRAIL	-	22
LONGSECTION SUGAR TRAIL	-	23
LONGSECTION SUGAR & SUGAR LINK TRAIL	-	24
TYPICAL SECTION DETAILS	-	40

PREPARED BY

CLARK FORTUNE McDONALD & ASSOCIATES
REGISTERED LAND SURVEYORS, LAND DEVELOPMENT AND PLANNING CONSULTANTS

0 10 20 30 40 50m

NORTH

SUGAR STASH TRAIL

UPPER GALLERY

TOWER LOCATIONS

PROPOSED SUGAR BOWL CHAIR DRAFT LOCATION

SERPENTINE

SUGAR LINK TRAIL

PT SEC 1
BLK X KAWARAU SD
OT8D/636

SECTION 1
SO 22561

CURVEY TRAIL

CASTERWAY

SUGAR BOWL CHAIR

WATERRACE

TWT

water race run

SUGAR TRAIL

CURVEY BASIN CHAIR

ALTA LIFT

FOR CONSENT 25.07.18

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Shop 2, Otago House, 475 Moray Place, P.O. Box 5960
Tel. (03)470-1582, Fax (03)470-1583, Email admin@cfma.co.nz

Rev.	Date	Revision Details	By
-	-	-	-

REMARKABLES SKI FIELD
OVERALL LAYOUT PLAN

Client: NZ SKI LTD

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	EM		11.06.18	1:1500 @ A1 1:3000 @ A3	
	Designed	Signed	Date	Datum & Level	Rev.
	CFM w NZSKI		2018	NZMG & MSL	-

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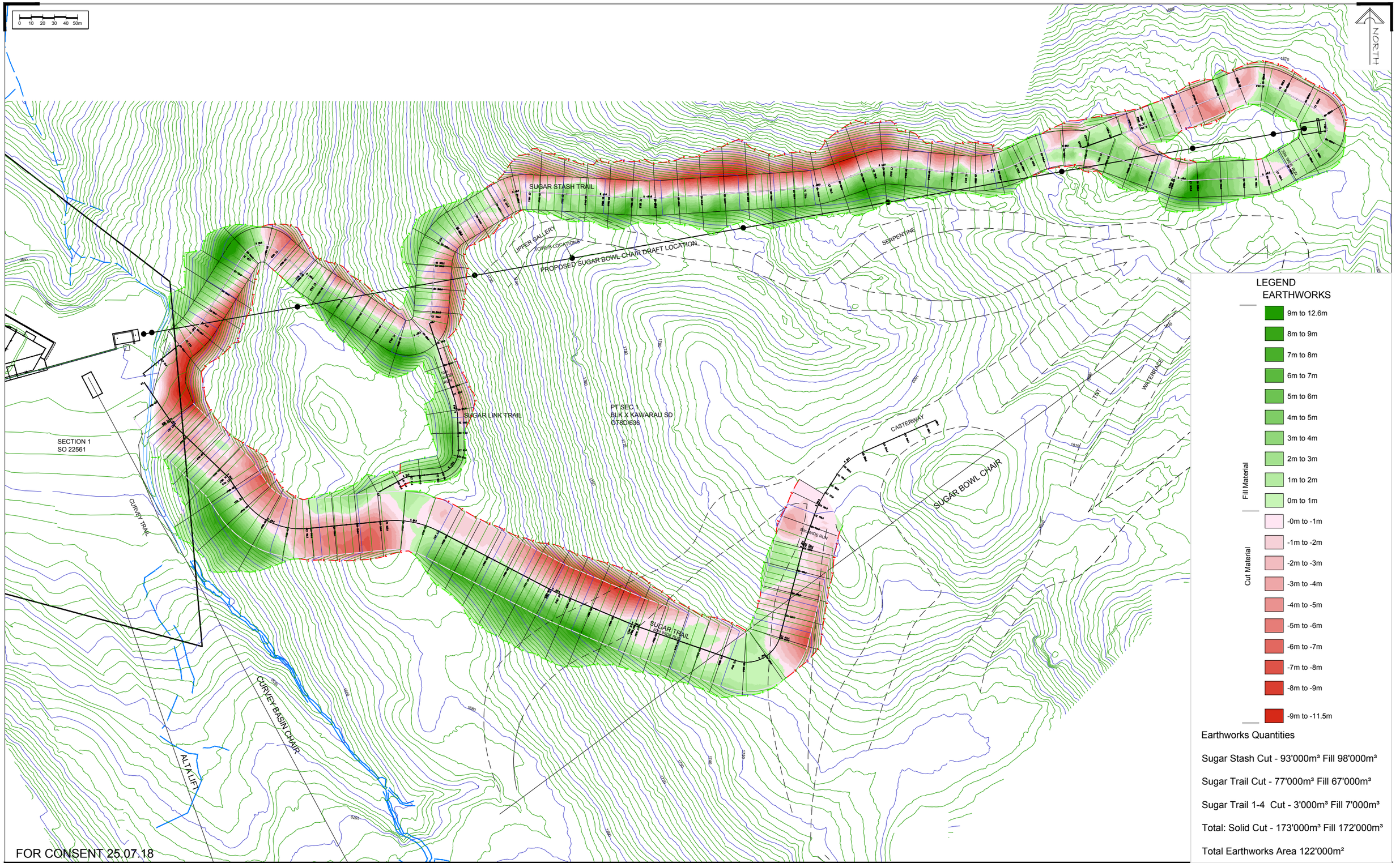

Earthworks Quantities

Sugar Stash Cut - 93'000m³ Fill 98'000m³

Sugar Trail Cut - 77'000m³ Fill 67'000m³

Sugar Trail 1-4 Cut - 3'000m³ Fill 7'000m³

Total: Solid Cut - 173'000m³ Fill 172'000m³

Total Earthworks Area 122'000m²

FOR CONSENT 25.07.18

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REMARKABLES SKI FIELD
OVERALL LAYOUT & VOLUME PLAN

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Designed: CFM w NZSKI		Signed	Date: 2018	Datum & Level: NZMG & MSL	Rev.: -

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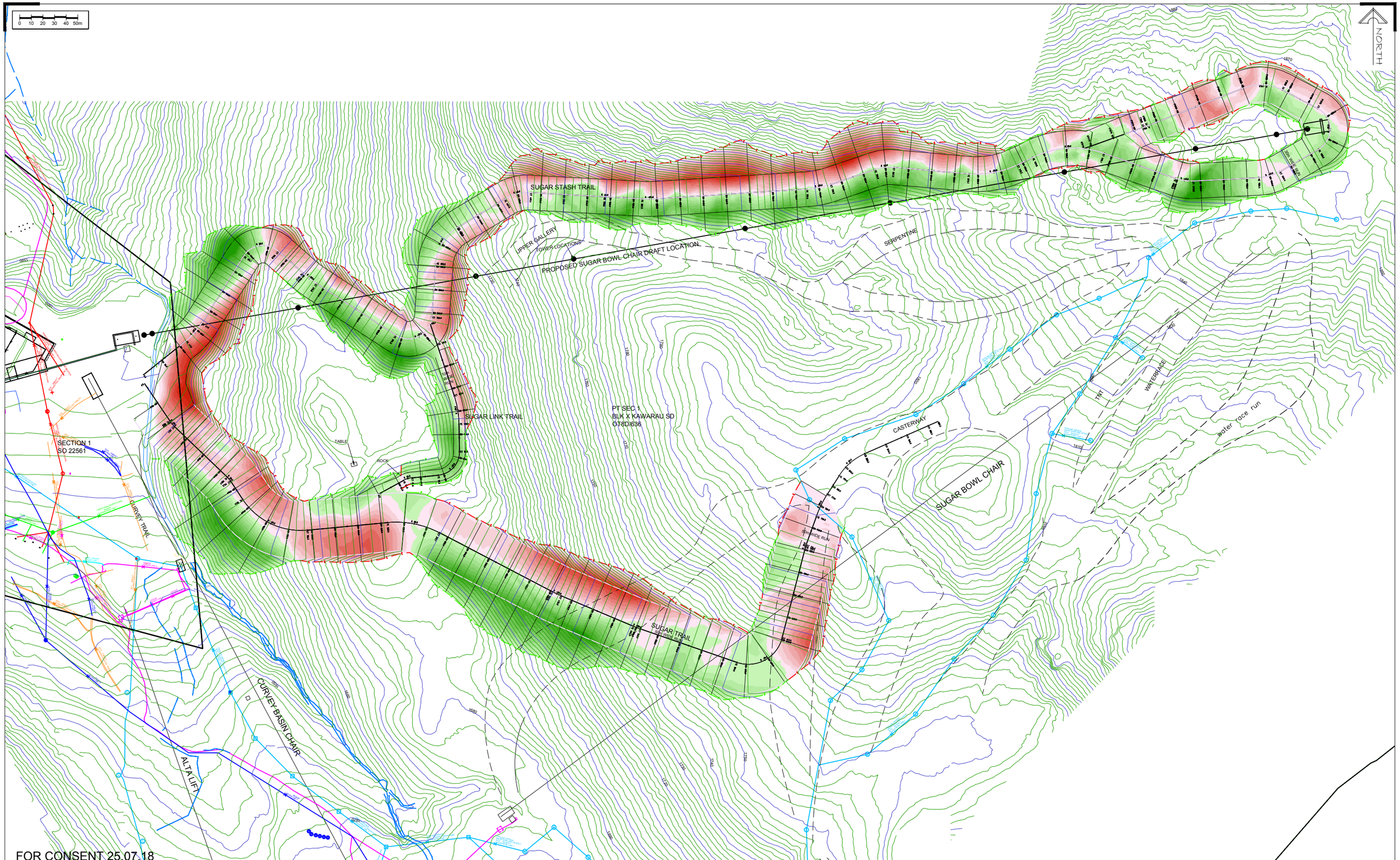

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Rev.	Date	Revision Details	By
-	-	-	-

REMARKABLES SKI FIELD
OVERALL LAYOUT & VOLUME PLAN WITH ASBUILT OVERLAY

Client	Surveyed	Signed	Date	Job No.	Drawing No.
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	Designed	Signed	Date	Datum & Level	Rev.
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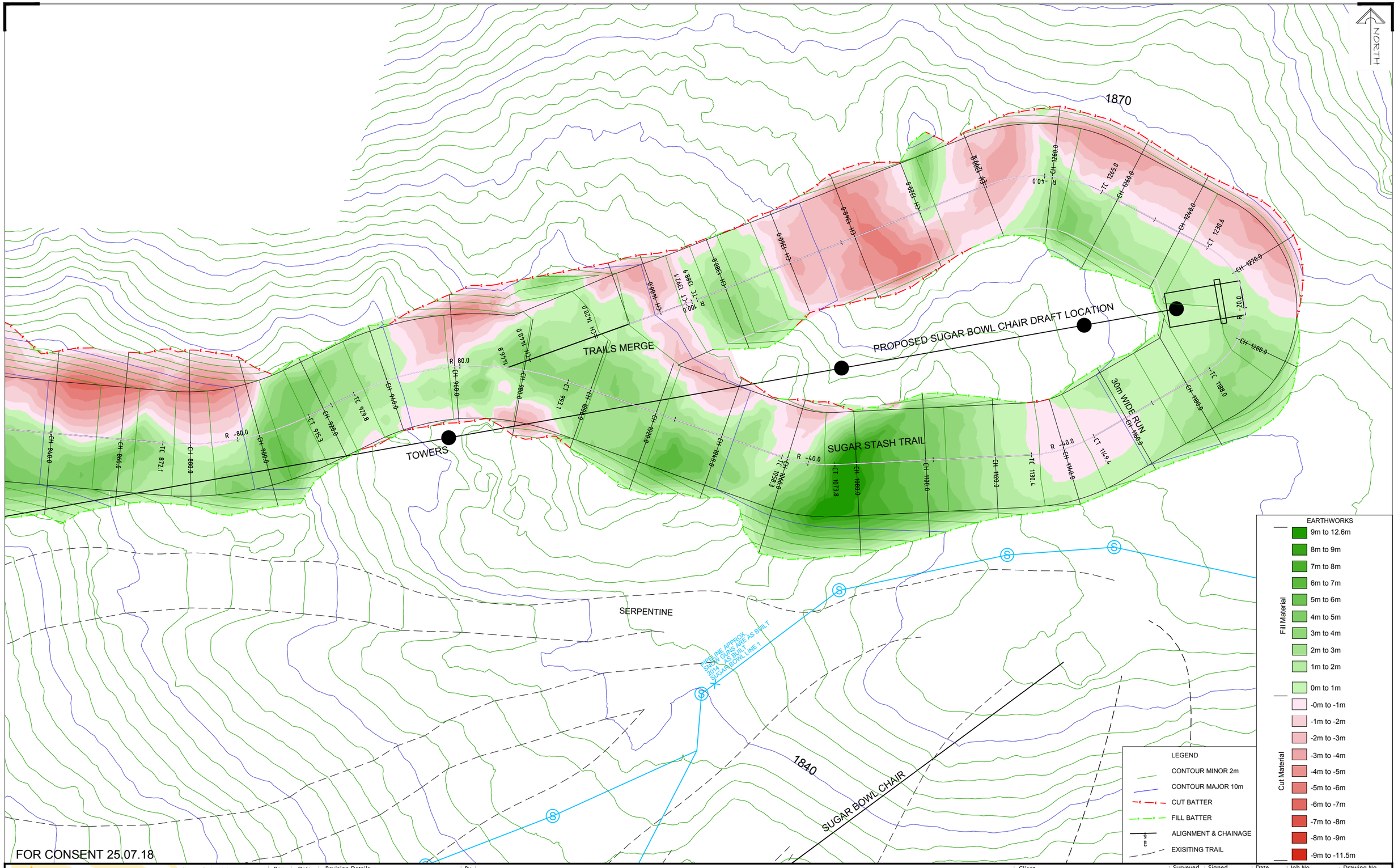

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Rev.	Date	Revision Details	By
-	-	-	-

REMARKABLES SKI FIELD
SUGAR BOWL
LAYOUT & EARTHWORKS

Client: NZ SKI LTD

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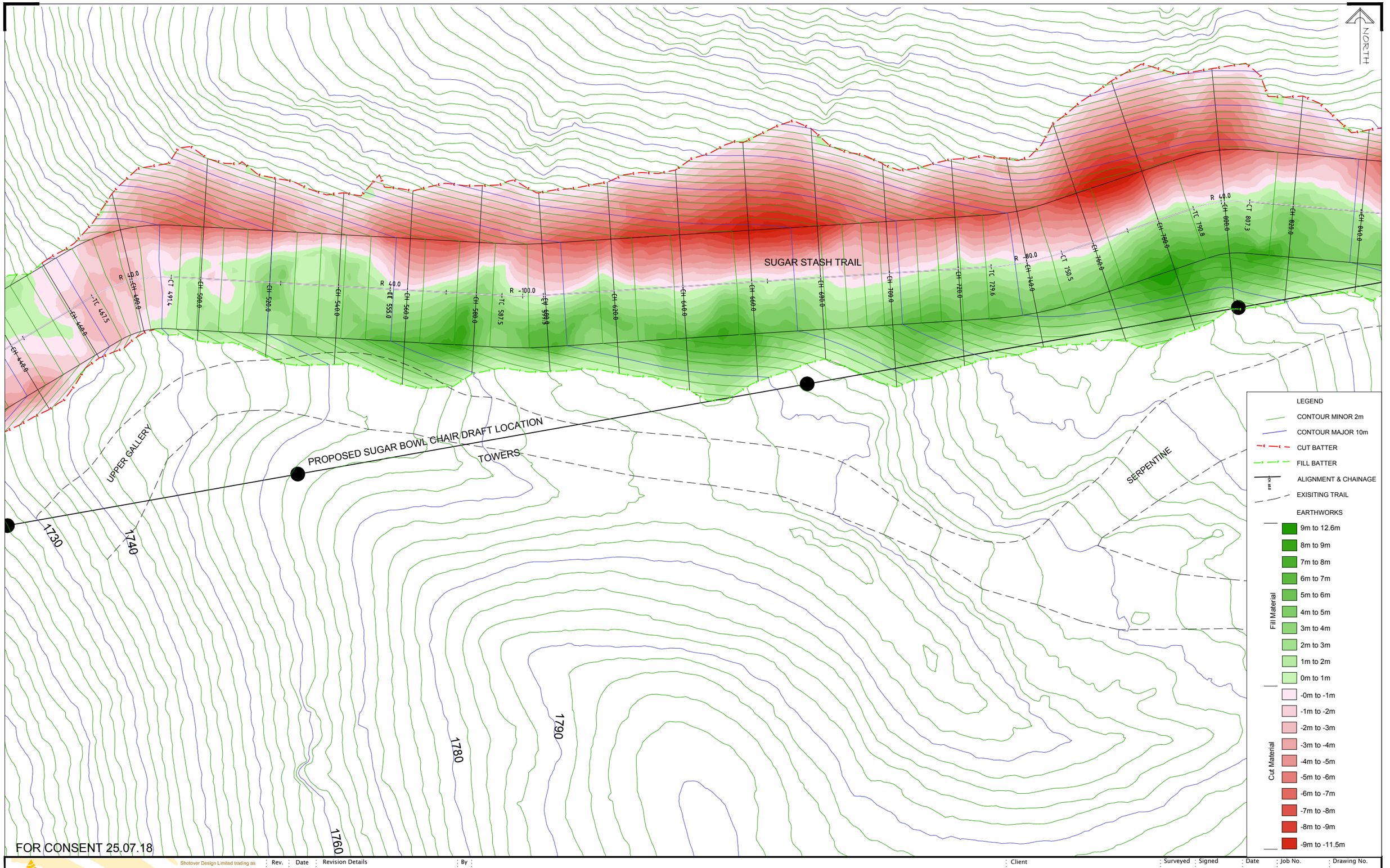
	Surveyed	Signed	Date	Job No.	Drawing No.
			x.x.18	12650	18-04
Drawn: EM		Signed	Date: 11.06.18	Scale: 1:500 @ A1, 1:1000 @ A3	
Designed: CFM w NZSKI		Signed	Date: 2018	Datum & Level: NZMG & MSL	Rev.: -

S:\JOBS\12600\12650\acad\12650 18 Design Plans Sugar Bowl II 25.07.18.dwg Plotted: 27.07.2018



FOR CONSENT 25.07.18

Shotover Design Limited trading as
Clark Fortune McDonald & Associates
Licensed Cadastral Surveyors - Land Development - Planning Consultants
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-	-	-	-

REMARKABLES SKI FIELD
SUGAR BOWL
LAYOUT & EARTHWORKS

Client: NZ SKI LTD

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Surveyed	Signed	Date x.x.18	Job No. 12650	Drawing No. 18-05	
Drawn EM	Signed	Date 11.06.18	Scale 1:500 @ A1 1:1000 @ A3		
Designed CFM w NZSKI	Signed	Date 2018	Datum & Level NZMG & MSL	Rev. -	

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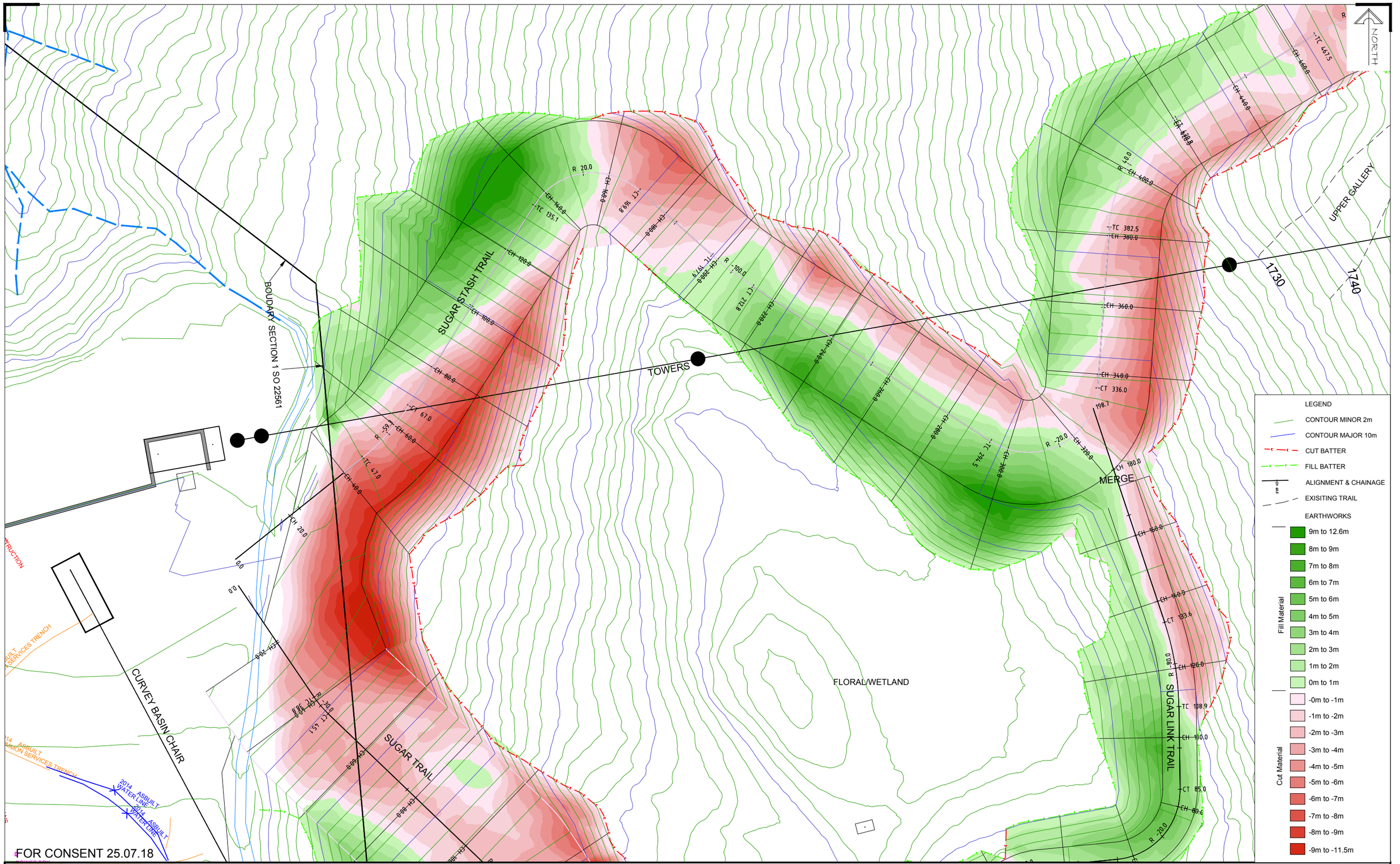

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Rev.	Date	Revision Details	By
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REMARKABLES SKI FIELD
SUGAR BOWL
LAYOUT & EARTHWORKS

Client	Surveyed	Signed	Date	Job No.	Drawing No.
NZ SKI LTD			x.x.18	12650	18-06
	Drawn	Signed	Date	Scale	
	EM		11.06.18	1:500 @ A1 1:1000 @ A3	
	Designed	Signed	Date	Datum & Level	Rev.
	CFM w NZSKI		2018	NZMG & MSL	-

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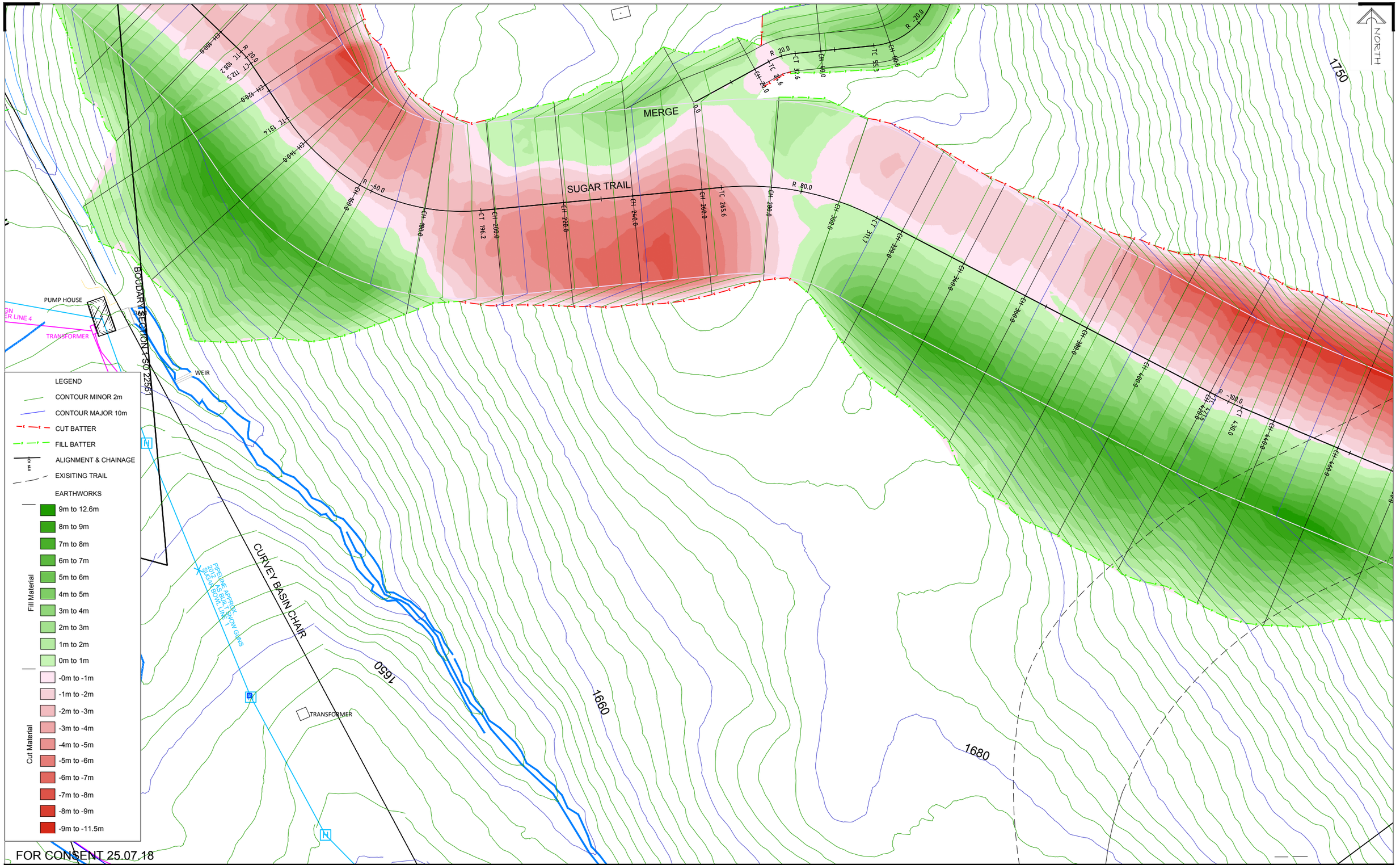

FOR CONSENT 25.07.18

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REMARKABLES SKI FIELD
SUGAR BOWL
LAYOUT & EARTHWORKS

Client	Surveyed	Signed	Date	Job No.	Drawing No.
NZ SKI LTD			x.x.18	12650	18-07
	Drawn	Signed	Date	Scale	
	EM		11.06.18	1:500 @ A1 1:1000 @ A3	
	Designed	Signed	Date	Datum & Level	Rev.
	CFM w NZSKI		2018	NZMG & MSL	-

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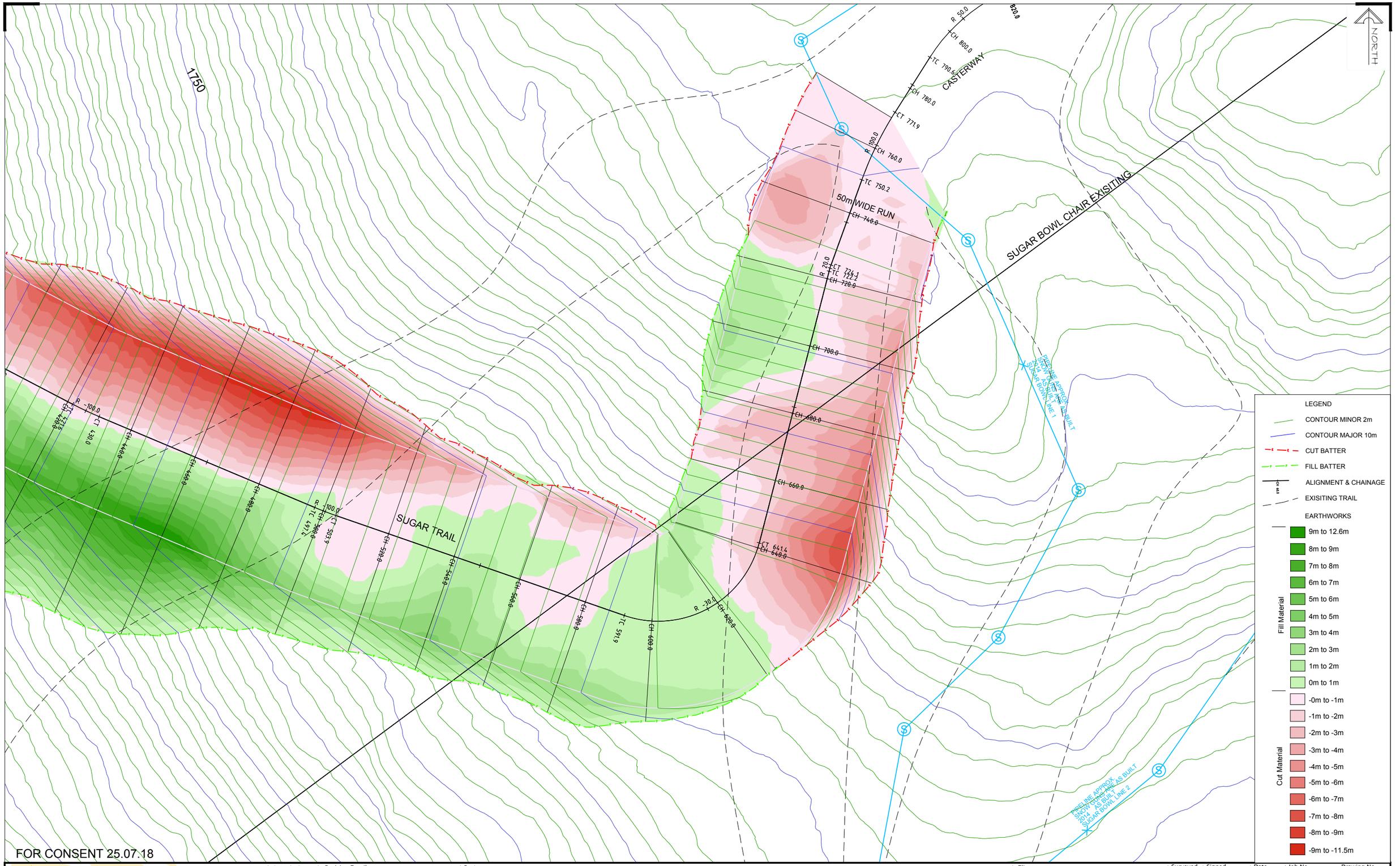

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REMARKABLES SKI FIELD
SUGAR BOWL
LAYOUT & EARTHWORKS

Client	Surveyed	Signed	Date	Job No.	Drawing No.
NZ SKI LTD			x.x.18	12650	18-08
	Drawn	Signed	Date	Scale	
	EM		11.06.18		1:500 @ A1 1:1000 @ A3
	Designed	Signed	Date	Datum & Level	Rev.
	CFM w NZSKI		2018	NZMG & MSL	-

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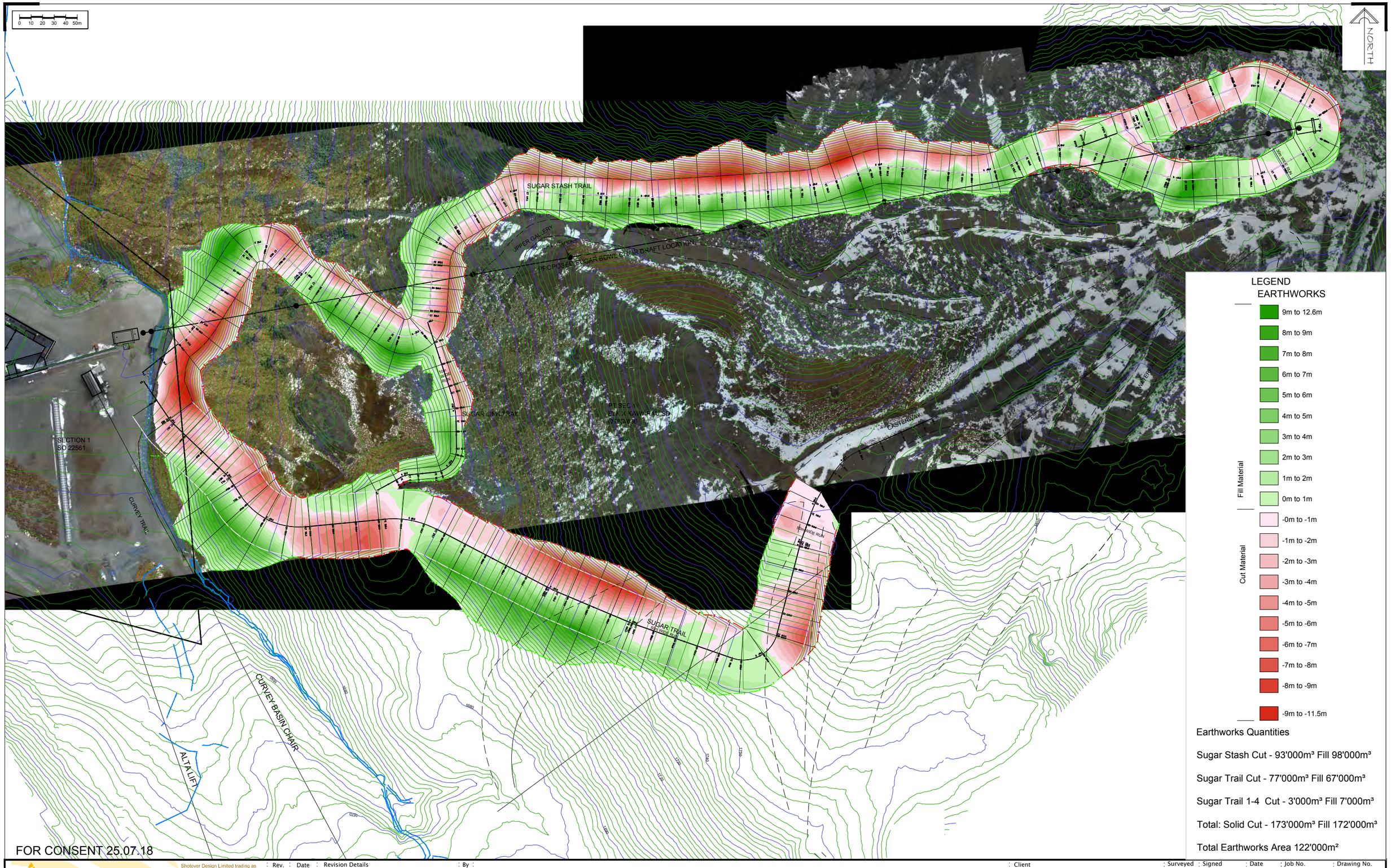

Earthworks Quantities

Sugar Stash Cut - 93'000m³ Fill 98'000m³

Sugar Trail Cut - 77'000m³ Fill 67'000m³

Sugar Trail 1-4 Cut - 3'000m³ Fill 7'000m³

Total: Solid Cut - 173'000m³ Fill 172'000m³

Total Earthworks Area 122'000m²

FOR CONSENT 25.07.18

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Rev.	Date	Revision Details	By
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REMARKABLES SKI FIELD
OVERALL LAYOUT & VOLUME PLAN WITH IMAGE OVERLAY

Client: NZ SKI LTD

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Drawn EM	Signed	Date 11.06.18	Scale 1:1500 @ A1 1:3000 @ A3		
Designed CFM w NZSKI	Signed	Date 2018	Datum & Level NZMG & MSL	Rev. -	

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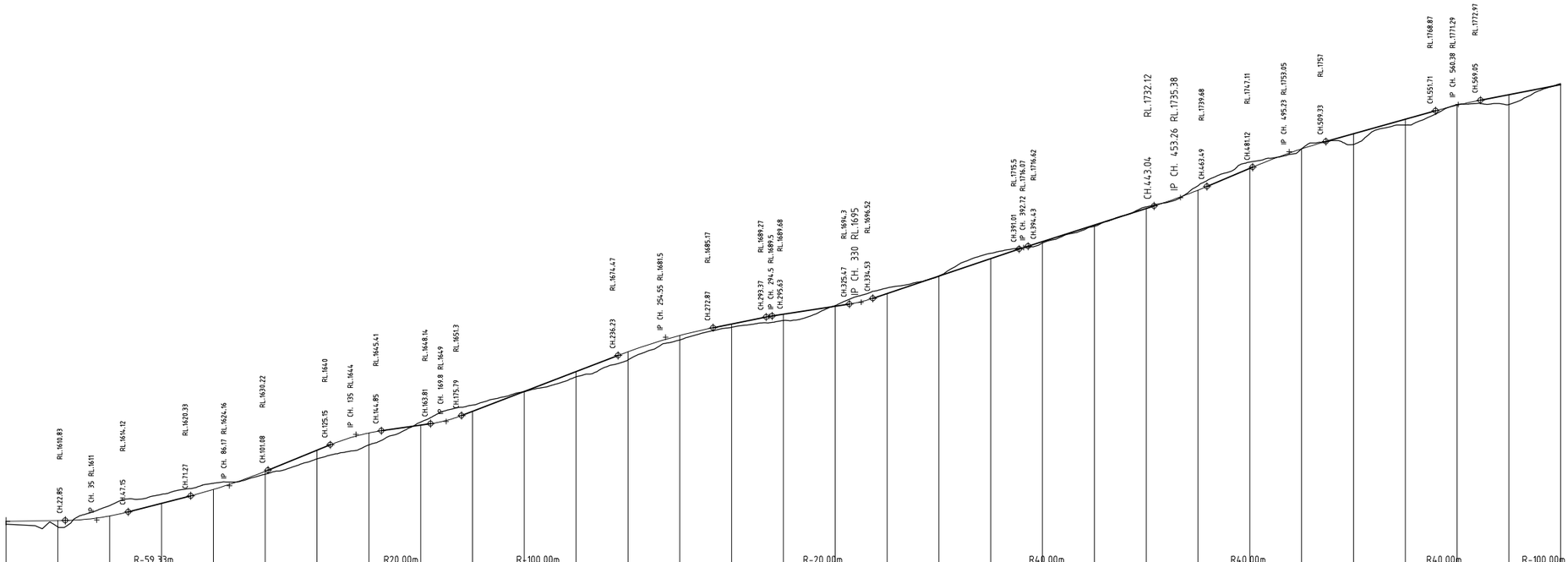

HORIZ CURVE DATA

R-59.33m | R20.00m | R-100.00m | R-20.00m | R40.00m | R40.00m | R40.00m | R-100.00m

VERT GEOMETRY GRADE (%)
VERT GRADE LENGTH (m)

1.43 % 35.00m | 25.72 % 51.17m | 40.63 % 48.83m | 14.37 % 34.80m | 38.35 % 84.75m | 20.03 % 39.95m | 15.49 % 35.50m | 33.60 % 62.72m | 31.89 % 60.54m | 42.11 % 41.97m | 28.01 % 65.15m | 19.33 % 83.30m

VERT CURVE LENGTH (m)

24.30m VC | 29.80m VC | 19.69m VC | 11.99m VC | 36.64m VC | 2.27m VC | 9.05m VC | 3.42m VC | 20.45m VC | 28.21m VC | 17.35m VC

DATUM R.L.1547.00

DEPTH	1.11	2.47	-4.03	-3.45	-2.39	1.12	3.33	4.64	-1.16	-2.40	0.08	2.05	3.14	1.76	1.26	2.40	-0.28	-2.14	0.01	-2.05	0.56	0.49	-0.65	-1.67	-2.46	-0.02	4.13	2.19	-0.20	3.81	-0.43
C.L. FINISHED LEVEL	1610.50	1610.79	1612.54	1617.43	1622.77	1629.78	1637.91	1644.56	1647.59	1652.91	1660.58	1668.25	1675.88	1682.18	1686.60	1690.35	1693.45	1698.36	1705.08	1711.80	1718.39	1724.77	1731.15	1738.24	1746.64	1754.17	1759.99	1765.59	1771.02	1775.09	1778.95
EXISTING G.L.	1609.39	1608.31	1616.57	1620.89	1625.15	1628.67	1634.57	1639.93	1648.75	1655.31	1660.50	1666.20	1672.74	1680.42	1685.34	1687.95	1693.73	1700.50	1705.07	1713.85	1717.83	1724.28	1731.80	1739.92	1749.10	1754.19	1755.86	1763.40	1771.21	1771.28	1779.38
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	600.00

LONGSECTION - 180725 Sugar Stash 1

A1 HORIZ SCALE 1 : 1000

A1 VERT SCALE 1 : 1000

FOR CONSENT 25.07.18

Shotover Design Limited trading as
Clark Fortune McDonald & Associates
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Rev.	Date	Revision Details	By
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REMARKABLES SKI FIELD
LONGSECTION SUGAR STASH TRAIL

Client: NZ SKI LTD

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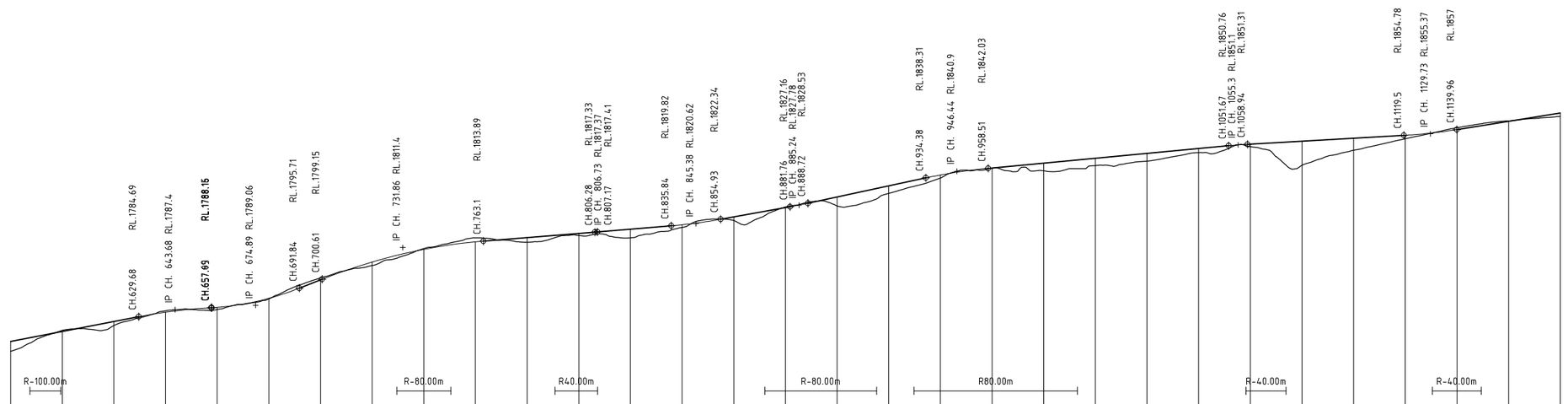
		x.x.18	12650	18-20

Drawn	Signed	Date	Scale
EM		11.06.18	1:1000 @ A1 1:2000 @ A3

Designed	Signed	Date	Datum & Level	Rev.
CFM w NZSKI		2018	NZMG & MSL	-

S:\JOBS\12600\12650\acad\12650 18 Design Plans Sugar Bowl II 25.07.18.dwg Plotted: 27.07.2018



DEPTH	3.81	-0.43	1.56	-0.52	0.83	0.19	-0.78	1.35	-0.29	-1.53	1.82	0.80	3.35	1.03	1.39	-0.24	3.47	2.89	1.20	0.07	3.00	2.81	2.97	1.60	0.99	9.34	4.67	1.38	-0.70	-0.18	1.33
C.L. FINISHED LEVEL	1775.09	1778.95	1782.82	1786.42	1788.29	1791.77	1798.91	1805.81	1810.72	1813.62	1815.24	1816.83	1818.48	1820.21	1823.25	1826.84	1830.94	1835.23	1839.44	1842.17	1844.04	1845.92	1847.79	1849.67	1851.37	1852.52	1853.66	1854.81	1857.01	1860.20	1863.39
EXISTING G.L.	1771.28	1779.38	1781.27	1786.94	1787.46	1791.57	1799.68	1804.46	1811.01	1815.15	1813.42	1816.03	1815.14	1819.18	1821.86	1827.08	1827.48	1832.34	1838.24	1842.10	1841.05	1843.11	1844.83	1848.07	1850.38	1843.17	1849.00	1853.43	1857.71	1860.38	1862.06
CHAINAGE	580.00	600.00	620.00	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00	900.00	920.00	940.00	960.00	980.00	1000.00	1020.00	1040.00	1060.00	1080.00	1100.00	1120.00	1140.00	1160.00	1180.00

LONGSECTION - 180725 Sugar Stash 1

A1 HORIZ SCALE 1 : 1000

A1 VERT SCALE 1 : 1000

FOR CONSENT 25.07.18

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REMARKABLES SKI FIELD
LONGSECTION SUGAR STASH TRAIL

Client: NZ SKI LTD

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			x.x.18	12650	18-21
Drawn: EM		Signed	Date: 11.06.18	Scale: 1:1000 @ A1, 1:2000 @ A3	
Designed: CFM w NZSKI		Signed	Date: 2018	Datum & Level: NZMG & MSL	Rev.: -

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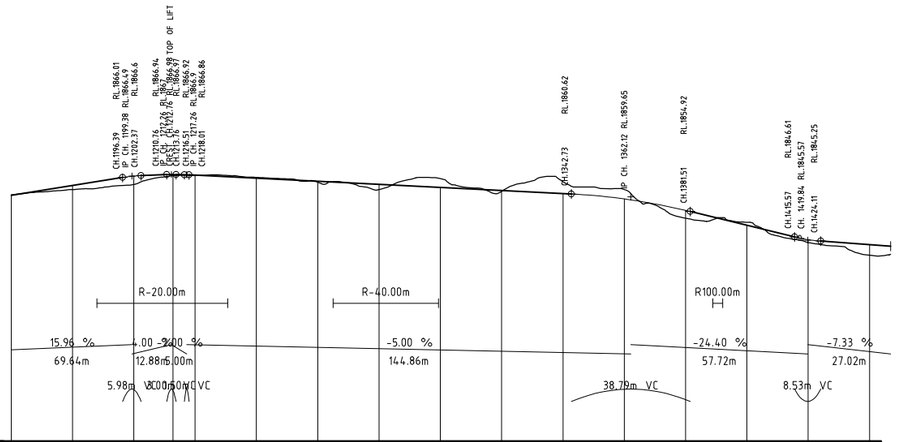

DEPTH	-0.18	1.33	2.72	0.39	0.10	-0.30	0.33	1.70	-2.88	0.27	-3.88	-3.09	2.57	-0.98	0.91	3.42
C.L. FINISHED LEVEL	1860.20	1863.39	1866.45	1866.98	1866.76	1865.76	1864.76	1863.76	1862.76	1861.76	1860.76	1859.01	1855.28	1850.41	1845.72	1844.09
EXISTING G.L.	1860.38	1862.06	1863.74	1866.59	1866.66	1866.06	1864.43	1862.06	1865.64	1861.49	1864.64	1862.10	1852.71	1851.38	1844.81	1840.66
CHAINAGE	1160.00	1180.00	1200.00	1212.76	1220.00	1240.00	1260.00	1280.00	1300.00	1320.00	1340.00	1360.00	1380.00	1400.00	1420.00	1440.00

LONGSECTION - 180725 Sugar Stash 1

A1 HORIZ SCALE 1 : 1000

A1 VERT SCALE 1 : 1000

FOR CONSENT 25.07.18

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Rev.	Date	Revision Details	By
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REMARKABLES SKI FIELD
LONGSECTION SUGAR STASH TRAIL

Client: NZ SKI LTD

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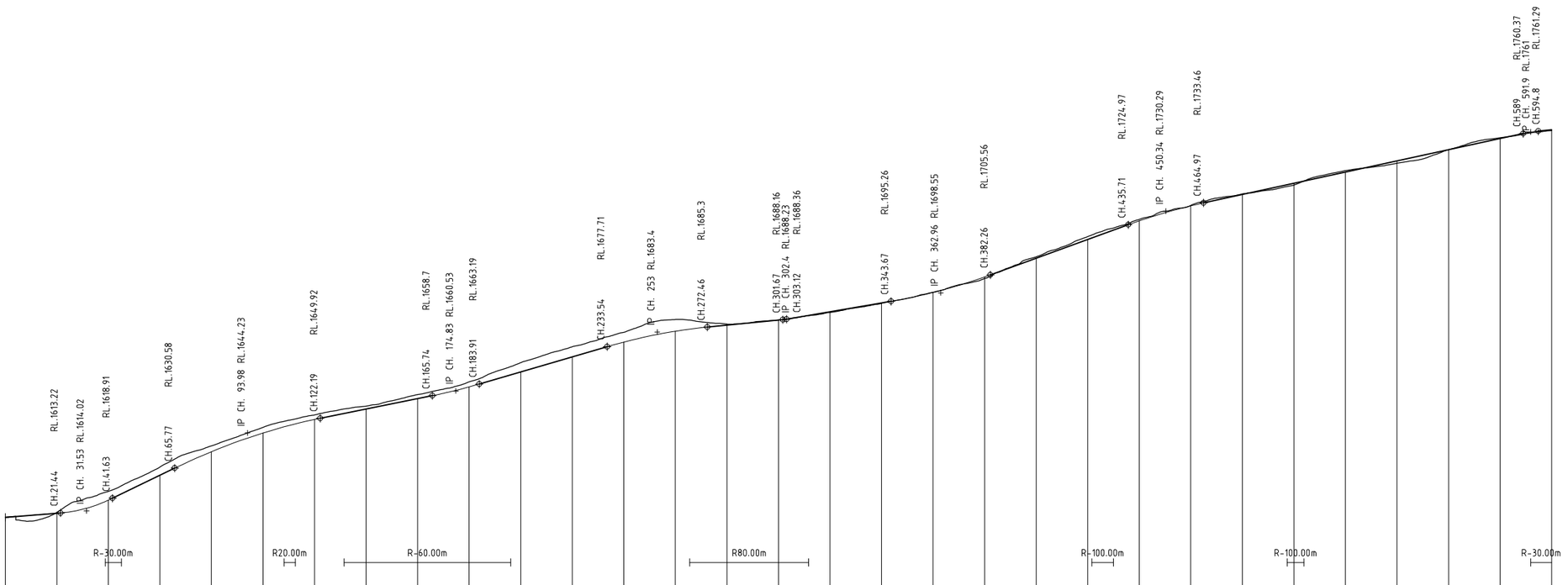
			x.x.18	12650	18-22
	Drawn	Signed	Date	Scale	
	EM		11.06.18	1:1000 @ A1	1:2000 @ A3
	Designed	Signed	Date	Datum & Level	Rev.
	CFM w NZSKI		2018	NZMG & MSL	-



HORIZ CURVE DATA			R-30.00m			R20.00m		R-60.00m						R80.00m							R-100.00m				R-100.00m					R-30.00m	
VERT GEOMETRY GRADE (%)		8.00 %		48.38 %			20.16 %			29.25 %			9.79 %			17.03 %			36.33 %					21.70 %					10.10 %	
VERT GRADE LENGTH (m)		31.53m		62.45m			80.85m			78.17m			49.40m			60.57m			87.38m					141.56m					49.50m	
VERT CURVE LENGTH (m)			20.19m VC			56.43m VC			18.17m VC			38.92m VC			1.45m VC		38.59m VC				29.26m VC								5.80m VC	
DATUM R.L.1549.00																															
DEPTH	-0.06	-0.32		-3.42	-3.24		-2.21	-1.75	-1.13	-1.57	-1.97	-3.59	-3.93	-3.79	-4.54	-0.41	-0.04	0.25	0.14	-0.07	0.57	-0.53	-1.16	-0.57	-0.19	-0.24	0.68	-0.59	0.86	-0.02	-0.35	0.28
C.L. FINISHED LEVEL	1611.50	1613.10		1618.14	1627.79		1644.21	1649.47	1653.51	1657.54	1662.08	1667.90	1673.75	1679.49	1683.69	1686.04	1688.00	1691.23	1694.64	1698.71	1704.75	1712.00	1719.27	1726.49	1732.32	1736.72	1741.06	1745.40	1749.74	1754.08	1758.42	1761.82
EXISTING G.L.	1611.56	1613.42		1621.57	1631.03		1646.43	1651.22	1654.64	1659.12	1664.05	1671.49	1677.67	1683.29	1688.23	1686.45	1688.04	1690.98	1694.49	1698.78	1704.18	1712.53	1720.43	1727.05	1732.51	1736.96	1740.38	1745.99	1748.88	1754.10	1758.77	1761.54
CHAINAGE	0.00	20.00		40.00	60.00		80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	260.00	280.00	300.00	320.00	340.00	360.00	380.00	400.00	420.00	440.00	460.00	480.00	500.00	520.00	540.00	560.00	580.00	600.00

LONGSECTION - 180725 Sugar Stash 4

A1 HORIZ SCALE 1 : 1000

A1 VERT SCALE 1 : 1000

FOR CONSENT 25.07.18

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Rev.	Date	Revision Details	By
-	-	-	-

REMARKABLES SKI FIELD
LONGSECTION SUGAR TRAIL

Client	Surveyed	Signed	Date	Job No.	Drawing No.
NZ SKI LTD			x.x.18	12650	18-22
	Drawn	Signed	Date	Scale	
	EM		11.06.18	1:1000 @ A1	
	Designed	Signed	Date	1:2000 @ A3	
	CFM w NZSKI		2018	Datum & Level: NZMG & MSL	Rev. -

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- Ensuring the information is the most recent issue.

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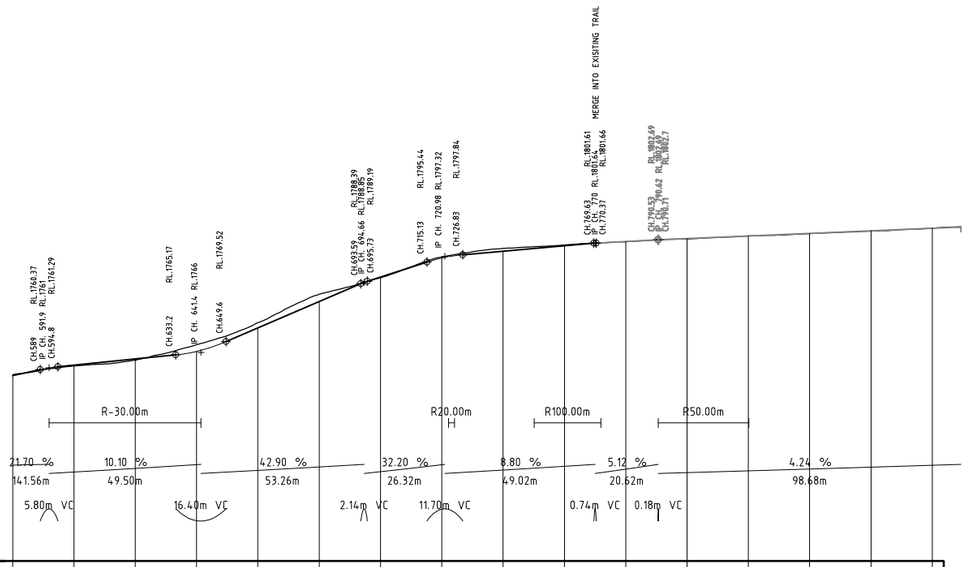


HORIZ CURVE DATA

R-30.00m | R20.00m | R100.00m | R50.00m

VERT GEOMETRY GRADE (%)
VERT GRADE LENGTH (m)

21.70 % / 41.56m | 10.10 % / 49.50m | 42.90 % / 53.26m | 32.20 % / 26.32m | 8.80 % / 49.02m | 5.12 % / 20.62m | 4.24 % / 98.68m

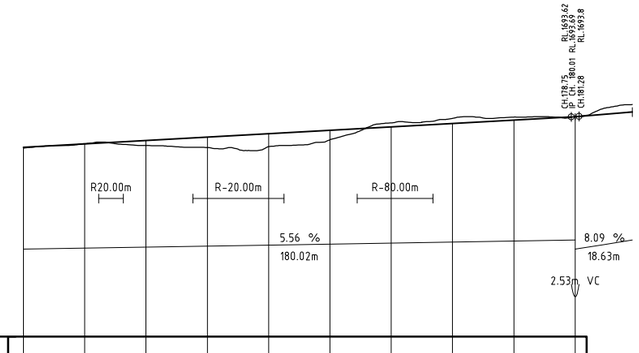
VERT CURVE LENGTH (m)

5.80m VC | 16.40m VC | 2.14m VC | 11.70m VC | 0.74m VC | 0.18m VC

DATUM R.L.1698.00

DEPTH	-0.35	0.28	0.37	-2.17	-1.69	-2.35	0.23	-0.36	-0.90	-0.25						
C.L. FINISHED LEVEL	1758.42	1761.82	1763.84	1766.32	1773.98	1782.56	1790.57	1796.77	1799.00	1800.76	1802.15	1803.09	1803.94	1804.79	1805.64	1806.49
EXISTING G.L.	1758.77	1761.54	1763.47	1768.49	1775.67	1784.91	1790.34	1797.13	1799.90	1801.01	1802.08	1802.98	1803.95	1804.70	1805.55	1806.48
CHAINAGE	580.00	600.00	620.00	640.00	660.00	680.00	700.00	720.00	740.00	760.00	780.00	800.00	820.00	840.00	860.00	880.00

LONGSECTION - 180725 Sugar Stash 4
A1 HORIZ SCALE 1 : 1000
A1 VERT SCALE 1 : 1000



HORIZ CURVE DATA

R20.00m | R-20.00m | R-80.00m

VERT GEOMETRY GRADE (%)
VERT GRADE LENGTH (m)

5.56 % / 180.02m | 8.09 % / 18.63m

VERT CURVE LENGTH (m)

2.53m VC

DATUM R.L.1622.00

DEPTH	0.26	-0.10	1.61	3.40	4.19	3.09	-1.35	-1.66	-0.99	0.05	
C.L. FINISHED LEVEL	1683.69	1684.80	1685.92	1687.03	1688.14	1689.25	1690.36	1691.47	1692.58	1693.70	
EXISTING G.L.	1683.43	1684.90	1684.30	1683.63	1683.95	1686.16	1691.71	1693.13	1693.57	1693.65	1697.66
CHAINAGE	0.00	20.00	40.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	198.65

LONGSECTION - 180725 Sugar Stash 1to4
A1 HORIZ SCALE 1 : 1000
A1 VERT SCALE 1 : 1000

FOR CONSENT 25.07.18

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Rev.	Date	Revision Details	By
-	-	-	-

REMARKABLES SKI FIELD
LONGSECTION SUGAR & SUGAR LINK TRAIL

Client: NZ SKI LTD

Notes:
All dimensions shown are in meters unless shown otherwise.
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- Ensuring the information is the most recent issue.
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	Surveyed	Signed	Date	Job No.	Drawing No.
			x.x.18	12650	18-24
	Drawn	Signed	Date	Scale	
	EM		11.06.18		1:1000 @ A1 1:2000 @ A3
	Designed	Signed	Date	Datum & Level	Rev.
	CFM w NZSKI		2018	NZMG & MSL	-

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