C06110

PORTERS

PROPOSED Ski Area Expansion

Ecology Report and Assessment of Effects

Prepared for Porters Ski Area Limited
By Boffa Miskell Limited • July 2010

EXECUTIVE SUMMARY

The Porters Ski Area and its proposed expansion are located in a sensitive alpine environment that is characterised by:

- Modification of mountain beech forest and low altitude grasslands by pre-human and early European fires, followed by extensive grazing
- Induced secondary indigenous vegetation cover at lower altitudes dominated by shrublands and tussock grasslands.
- High altitude habitats with limited but specialised vegetation cover supporting native invertebrates, lizards and birds
- Climatic extremes of temperature, rainfall and aspect which limit biological activity
- Fragile soils which support limited vegetation types and are prone to erosion when vegetation cover is absent
- High level of indigenousness in flora and fauna
- High water quality at the head of the large Waimakariri River catchment

When assessed against the criteria in Selwyn District Plan, the significant ecological values on the proposed Plan Change area are:

Management Area	**Significance assessment**
A Porter Basin	Not significant
B Porters Stream Valley, C Porters Stream	Significant
D Lower Porter River, E Porter Porter River Valley, F Porter hillslopes	Not significant
G Southern Terrace	Not significant
H Crystal Basin	Significant
I Crystal Stream Valley, J Crystal Stream	Significant
K Northern Terrace	Not significant

Potential adverse effects on ecological values during construction are considered to be:

a. Loss or further fragmentation of vegetation
b. Loss or fragmentation of habitat
c. Weed invasion and spread
d. Soil compaction by vehicles
e. Kea/humans interactions
f. Reduction water quality through sedimentation or contamination
g. Reduction flows through temporary takes

Potential adverse effects on ecological values during operation are considered to be:

a. Loss/fragmentation of terrestrial habitats or vegetation
b. Loss/reduced quality of aquatic habitat due to reduced flows
c. Reduced water quality
d. Weed invasion and spread
e. Pest incursion and spread
f. Kea/human interactions
g. Trampling /ski damage to fragile soils
h. Disturbance of invertebrate life-cycles through effects of lighting

Proposed actions to address significant adverse effects on ecological values comprise:

a. Ensure a process to refine routes, towers, and building site selection on-site with ecologist's input at construction stage
b. Adopt best practice methods for earthworks, sediment control, stormwater and waste water management.
c. Prepare Erosion control and Sediment Management Plan.
d. Prepare an Environmental Management Plan for part or all of the site.
e. Prepare management plan(s) to address methods to deal with weeds, pests, and habitats and vegetation protection and restoration.
f. Remove pines, willows, silver birch and other invasive weed plants currently found on the site.
g. Refine bridge/culvert design and construction methods with ecologist's input.
h. Mark and/or fence areas of valued habitat or vegetation in the vicinity of construction areas.
i. Retain, covenant and enhance red tussock gully wetland within Village area.
j. Minimise vegetation removal throughout ski area, but especially the Village area.
k. Use helicopters where practicable to place towers or other isolated structures.
l. Fence off a 5m wide buffer alongside all waterways during construction
m. Revegetate all disturbed areas within or close to Village with appropriate native species if not to be built on within 6 months of disturbance.
n. Prohibit introduced animals except working dogs
o. Prohibit development of private gardens and limit curtilage area.
p. Use low level, low intensity lighting near waterways.
q. Place covenants on private property titles to address vegetation clearance, garden and animal issues.
r. Place covenants on area of high ecological value in Crystal Basin.
s. Carry out pre-construction surveys for lizards and invertebrates in Crystal Basin and implement trap and transfer programme if needed.
t. Adopt Crystal Stream Enhancement Programme to remove trout, enhance native fish population and initiate weed control.
u. Plant waste water irrigation area with *Dracophyllum acerosum,* kanuka, red tussock, and other appropriate local species to absorb nutrients.
v. Carry out water monitoring to establish baseline, detect changes and implement construction, management or operational changes.

The array of spatially small and varied adverse effects can largely be remedied and mitigated (where they cannot be avoided) by actions proposed, the majority of which are on-site. Often specific management actions will address specific effects.

However, there are residual, significant adverse effects that are not avoided and for which there are currently no remedy or mitigation proposals. The large-scale disturbance of Crystal Basin is a significant adverse effect and represents a large-scale negative outcome for the project in ecological terms. Analysis of off-site options for biodiversity protection/ enhancement or management should be considered to address this situation.

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1.0 Introduction

1.1 Background

Porters is applying for a Plan Change to the Selwyn District Plan and associated resource consents, as a step in the expansion and development of the Porters Ski Area. The key features of the development are shown on the Outline Development Plan, Figure 1-1:

- A discrete "village" with a range of types of permanent and visitor accommodation, a commercial centre, alpine recreational activities; known as the Village Base Area (as shown on the Master Plan, Figure 1-2)
- An expanded Ski Area encompassing the existing Porters Ski Area and a new Crystal Basin Ski Area adjacent to it
- Upgraded road link to SH 73
- New roads within village
- New and upgraded trails in the ski area
- New lifts (including gondola)
- New water takes for, and discharges from, buildings and structures
- Ski Area management activities including maintenance, snow making, snow grooming

This Ecology Report is a technical report providing a description of the existing ecological values in the area, and an assessment of the potential and actual effects of the activities proposed under the Plan Change/resource consents. An "Interim Ecology Report"[1] was prepared for Porters in March 2007, in which recommendations to assist in master planning and preparation of the Plan Change were made. This current Report describes the wider ecological context as well as providing a detailed site description of the Plan Change area. Ecological values are set out in terms of the Selwyn District Plan significance criteria. The potential positive and adverse effects of activities provided for by the Plan Change/ resource consents are assessed and a range of options to avoid, remedy, or mitigate the significant adverse effects is described. A programme to monitor the ecological values and anticipated effects on them is outlined.

This Report should be read in conjunction with the following Technical Reports which have been prepared for Porters to assist in project development and assessment of effects:

Boffa Miskell Ltd (BML) 2010: *Assessment of Landscape Effects.*
CPG 2010: *Porters Ski Area. Wastewater, Stormwater, and Water Supply Infrastructural Options Assessment Report.*
Eliot Sinclair and Ptnrs Ltd (ES) 2010: *Preliminary Engineering Report for Proposed Expansion of Porters Ski Area.*
Mahaanui Kurataiao Ltd (MKT) 2010: *Cultural Values Report (draft)*
URS 2010a: *Geotechnical Draft Summary Report (draft, April 2010)*
URS 2010b: *Technical Report. Crystal Basin Landform Assessment*
Watson, K 2009: *Porters Ski Area: An Archaeological Assessment*

The Plan Change Area encompassed by this report (and shown on Figure 1-3) is the result of a series of proposed changes in land status and iterations to design for the development.

[1] BML (2007): *Porter Heights: Interim Ecological Report.* Prepared for Porters JV by Boffa Miskell Ltd.

In 2009, Porters applied to the Department of Conservation to obtain the freehold of the site for the proposed Village. The application was made in terms of the Department's statutory ability to transfer ownership of land from the conservation estate, if the Department was satisfied there was a "net gain to the conservation estate". The proposed "net gain" to the conservation estate was the proposed gifting to the Department of 15 hectares of land adjoining Lords Bush Reserve near Kowai Bush, Springfield.

These 15 hectares contain the only high-plains remnant of Canterbury's original lowland beech and podocarp hardwood forest. Riccarton Bush in Christchurch is the only low-plains remnant. Porters also proposed a 10 year, $422,000 in total commitment with the Department to ecologically restore this land as well as the adjoining Lords Bush Reserve.

The enlarged reserve would be over 27 hectares and is considered to have sufficient area for a viable ecological restoration of the forest including indigenous bird and insect life.

The ecological values of the proposed Plan Change area are assessed against the Selwyn District Plan.

1.2 Ecological context

The existing environment is described and evaluated in the context of the Craigieburn Ecological District (ED)[2]. The general descriptive material used here for the ED is taken from the PNA report (Shanks *et al* 1990)[3]. Other references are cited when they have been used. Most of the area subject to the Plan Change lies in Craigieburn ED, although the Porter River was placed in the Torlesse by Shanks *et al.* Figure1-4 shows the location of the site in relation to Ecological District boundaries.

The land environments found within the site are assessed using LENZ[4]

Reference is also made to the NZ Biodiversity Strategy[5], the Canterbury Conservancy CMS[6] and the National Vegetation Survey records for the area[7].

Unless stated otherwise, the classifications used to assess threat to species in this report are:

Plants: PJ de Lange, DA Norton, SP Courtney, PB Heenan, JW Barkla, EK Cameron, R Hitchmough, AJ Townsend (2009): *Threatened and uncommon plants of New Zealand (2008 revision). New Zealand Journal of Botany, 2009, Vol. 47:61–96*

Birds: CM Miskelly, JE Dowding, GP Elliott, RA Hitchmough, RG Powlesland, RG Robertson, PM Sagar,

[2]MW McEwen (ed) (1987). *Ecological Regions and Districts of New Zealand.* New Zealand Biological Resources Centre Publication No 5. Department of Conservation, Wellington.
[3] A Shanks, D Glenny, R Gibson, K Rosser, D Roozen, S Phillipson, J Stecen & J Arand (1990): *Coleridge, Craigieburn and Cass Ecological Districts. Survey Report for the Protected Natural Areas Programme.* NZ Protected Natural Areas Programme No 10, Department of Conservation, Wellington.
[4]Leathwick, J.; Wilson, G.; Rutledge, D.; Wardle, P.; Morgan, F.; Johnston, K.; McLeod, M.; Kirkpatrick, R. 2003. *Land environments of New Zealand.* David Bateman. 184p.
[5] Department of Conservation , Ministry for the Environment (2000): *The New Zealand Biodiversity Strategy.* DOC, MfE, Wellington
[6]Department of Conservation (2002): *Canterbury Conservation Management Strategy.* Canterbury Conservation Management Planning Series No. 10, DOC Christchurch
[7]www. Landcareresearch.co.nz

RP Scofield, GA Taylor (2008). *Conservation Status of New Zealand birds.* Notornis 55, 117-135.

Other animals: Hitchmough, R., Bull, L., Cromarty, P. (comps) (2007). *New Zealand Threat Classification System lists—2005*. Department of Conservation, Wellington. 194 p

Porters has been, and continues to be, in discussions with the Department of Conservation in relation to this project. Accordingly there has been no consultation with DOC on technical /ecological matters.

2.0 Existing environmental context

2.1 Craigieburn Ecological District.

The Craigieburn Ecological District (see Figure 1-4) covers 42,700 ha of mountain ranges including the entire Craigieburn Range. (Shanks *et al* loc cit). Vegetation is generally mountain beech forest at lower altitudes with alpine shrublands, snow tussocklands and scree at higher levels. There are many cirque basins which are in-filled by rock-fall scree, moraine and occasional rock glacier deposits (URS 2010a).

The original (pre-human) vegetation of Craigieburn ED comprised mountain beech forest, alpine tussockland and scree (Harding 2009).[8] Mountain beech dominated the montane zone, while tussockland, rockland and scree dominated the alpine zone.

The District has a cool, wet, mountain climate with a precipitation gradient from west to east influenced by the Main Divide. 25% of the precipitation above 1000m falls as snow – the snow pack develops from mid-May to late June, peaks in September then rapidly thaws any time between September and mid-January. There is no permanent snow in the Ecological District, and the depth and duration of the snowpack varies according to wind and local topography. Frosts can occur throughout the year, and frost heave effects on soil are common.

In summer the District experiences frequent strong, dry north-west winds which cause low humidity and high evapo-transpiration rates. The winds and temperatures have a high diurnal range.

Shanks *et al* identified 18 vegetation groups in Craigieburn Ecological District – these are listed in Table 2-1.

Table 2-1: Main vegetation types in Craigieburn Ecological District (adapted from Shanks *et al 1990)*

Code no	Name	Abundance /distribution	Sites	Present in Study area?
CRA01	Alpine watercourse flush	In some cirque basins, throughout District	Fertile sites	✓
CRA02	High alpine	Not common	Covered by late snow; constantly damp	

[8] M A Harding (2009): *Canterbury Land Protection Strategy.* Nature Heritage Fund, Wellington

	seepage zone			
CRA03	Snow-patch grass late snowbank tussockland	Common	Upper alpine zone moraine hollows and nivation hollows; late snow.	
CRA04	*Dracophyllum pronum* on low-angled fell-field	Frequent in suitable habitats	Front lip of high cirque basins; low angled fellfield on summit ridges.	✓
CRA05	Upper alpine zone slim snow tussockland	Frequent in suitable habitats	Upper alpine- sub-nival; cirque basin headslopes on eastern faces; also Ryton Basin.	✓
CRA06	Blue tussock, snow patch grass late snowbank tussockland		Margins of moraine depressions; lee of some ridges with late snow. SE facing slopes.	
CRA07	Snow totara tussock shrubland	Localised – Harper catchment/ eastern side Craigieburns	Disturbed sites, with establishing snow totara	✓
CRA08	Mid-ribbed snow tussockland	Abundant in northern (wetter) end of ED; east side Craigieburns	Wetter, more fertile sites.	
CRA09	Lower alpine zone dense slim snow tussockland	Not common – scattered sites inc Porter Heights ski area	Moderate slope, all aspects, just above subalpine scrub and forest.	✓
CRA10	*Schoenus pauciflorus* sedgeland		Flush zones within alpine tussocklands	✓
CRA11	Rock bluff community	Common throughout	Top half of alpine and sub-nival zones.	✓
CRA12	Bog pine-red tussock shrub tussockland	Only Lagoon Saddle	Bog	
CRA13	Snow totara scrub	Common throughout	Scree margins, above treeline; sometimes steep	✓
CRA14	Fire-induced shrublands and short tussocklands	Common but most extensive in Harper and Hamilton Ck	Where beech forest removed by fire in upper montane, subalpine and lower alpine zones.	✓
CRA15	Montane *Schoenus pauciflorus* shrubland	Harper River catchment only	Riverflats	
CRA16	*Oreobolus-Gaimardia* sub-alpine cushion bog	Only Lagoon Saddle	Bog margin	
CRA17	Mountain beech forest	Common throughout	Subalpine zone (reduced considerably from former extent.	
CRA18	Scree vegetation	Common throughout	Screes from subnival down to 1000m. In south, only vegetation above sub-alpine.	✓

The characteristic native montane-alpine fauna of the District includes:

- Kea (*Nestor notabilis*): mountain beech forest and open areas above the tree-line. Threatened: Nationally endangered
- NZ falcon (*Falco novaezeelandiae*): open montane areas, rocky outcrops; Threatened: Nationally vulnerable- habitat induced rarity, but data poor
- Common skink (*Leiolopisma nigriplantare = Oligosoma nigriplantare)* : common
- Long-toed skink (*Leiolopisma* "long-toes" now known as *Oligosoma longipes*) has been recorded on the screes on a rock avalanche adjacent to the Porters Ski Area /study area. Rare and has a sparse distribution- data poor.
- Common gecko (*Hoplodactylus maculatus*): common
- Invertebrates including alpine grasshopper species, weta, and black mountain ringlet butterfly throughout the District.

Introduced mammals including red deer, chamois, feral stock (cattle from nearby stations), rabbits, hares and possum are common in the Ecological District. Hares are reported to be abundant in the tussocklands around Porters Ski Area.

Aquatic habitats in the ED include lakes and tarns, small rivers and alpine seepages or flushes. Across the ED, the most common native fish species are:

- alpine galaxiid (*Galaxias paucispondylus*) – above 650m
- common river/Canterbury galaxiid (*Galaxias vulgaris*) - throughout
- long-finned eel (*Anguilla dieffenbachii*)
- upland bullies (*Gobiomorphus breviceps*)

Introduced brown trout, rainbow trout and quinnat salmon were recorded as present in most of the lakes and rivers of the Ecological District. Brown trout dominate many of the rivers and the highest numbers of galaxiids are found in rivers where trout are uncommon or absent (Shanks *et al, McIntosh* pers com*.).*

There are currently three Protected Natural Areas in Craigieburn Ecological District:

- Craigieburn Conservation Park (formerly Craigieburn Forest Park)
- Korowai/Torlesse Tussocklands Park
- Lagoon Saddle Ecological area

The PNA Survey Report (Shanks *et al, loc cit*) recommended a further 15,000 ha of land for protection (RAPs) with some sites extending into adjacent EDs. The four RAPs were:

- *RAP1: Craigieburn Rock Avalanche*: extensive scree slope and deposit west of Blue Hill (including the area referred to in this report as Ryton Basin)

- *RAP2: Harper Valley*: catchment at western end of Ecological District

- *RAP3: Mt Cheeseman*: Mt Cheeseman, Mt Cloudesley and upper Ryton basin – cirques and alpine tussockland.

- *RAP 4*: Mt Manson: Forest to alpine vegetation sequence near Flock Hill.

There are a number of areas of conservation value close to the study area. The study area itself is in the Porter Heights Conservation Area (S62 Conservation Act), an area of stewardship land managed by the Department of Conservation.

Immediately adjacent to the north-east lies Castle Hill Station. The process of Tenure Review for this station will identify areas of conservation value.

To the south-east, bounded by the Porter River, is the extensive Korowai/Torlesse Tussocklands Park (S19 Conservation Act).

These areas are shown on Figure 1-4. A fifth site (CAS14) is also shown on the figure since it overlaps the boundary between Craigieburn and Cass Ecological Districts.

Harding (2009) notes that 51% of the ED is protected, but that wetlands are least well-protected of the plant communities found there (19% wetland area protected).

2.2 Torlesse Ecological District

Following the PNA survey work by Shanks *et al* (1990) the boundary lines of Ecological Districts were adjusted slightly in this area, so that part of the upper Porter River Valley is now considered to lie within Torlesse Ecological District. This is a long, thin District running along the Canterbury foothills from the Hurunui River to just north of the Rakaia River. It is characterised by mountains with broad flat summits, with extensive areas of rock pavement and scree. Generally the mountains are slightly lower (1600m to 2000m) than those of the Craigieburn ED to the north-west.

The study/ODP area is entirely within the Craigieburn ED; however, the Porter River system lies at the boundary between Craigieburn and Torlesse EDs.

2.3 Land and land use history in the Craigieburn Ranges.

Prior to human arrival the area would have been covered in mountain beech forest up to an altitude of 1300m to 1400m. Some of the very dry sites may have had kanuka shrubland or low forest, while kowhai and broadleaved shrubs would have grown along the river banks with matagouri on river flats and fans. Eroding, steep or frosty hollows would have supported a mixed shrubland in which *Coprosma propinqua, Dracophyllum* sp, tauhinu and korokio would have formed the main components. (Shanks *et al*)

Above the tree-line there would have been a mosaic of scrub, tussocklands, herbfields, scree and fellfield vegetation depending on aspect, altitude, exposure and ground stability.

In this pre-human landscape, native fish and birds (including kakapo, kaka, kiwi and moa) would have been common.

Fires some 500-700 years ago removed most of forest throughout the area, and burnt the subalpine and alpine tussock grasslands. The forest was replaced with tall tussock species - *Chionochloa flavescens* (broadleaved snow tussock) on rubbly hillslopes and *C. macra* (slim snow tussock) on hill summits or areas of fine soils on hillslope. *C. rubra* (red tussock) filled the basins where there was more moisture.

Following European settlement, continued fires to control weeds and stimulate grass growth, and the introduction of deer in the 1940s, had a major effect on alpine herbaceous

vegetation and palatable shrub and forest species. Indigenous biodiversity was reduced and species which were more tolerant of fires, grazing and browsing became dominant.

In the 1970s, controls reduced deer numbers, but the natural ecological patterns and plant and animal communities continued to be modified by the introduction of pasture grasses, *Lotus,* gorse, sweet brier and broom, as well as the spread of self sown conifers from neighbouring NZ Forest Service forests.

A few men with picks, shovels and a government grant of 500 pounds, made the first track over Porters Pass in 1858-9. The original road is still visible within the Korowai/Torlesse Tussocklands Park. Porters Ski Area is part of the former Castle Hill Station lease – the Porter brothers were early lease holders.

Porter Heights Ski Area was opened in 1968, and is the oldest commercial field in Canterbury. The area has been retired from grazing for a number of years, although occasionally cattle have been seen on the site, having wandered in from neighbouring stations.

Other club ski areas in the Craigieburn Range are at Broken River, Craigieburn and Mt Cheeseman. Mt Olympus ski area lies in the Ryton valley. Ski touring is popular along the Range ridges and in basins.

In summer there is some tramping, although the high summer temperatures and lack of forest cover make it a less popular area than Arthurs Pass National Park and the Korowai/Torlesse Tussocklands Park. There is an annual horse trek through the Upper Porter Valley and over Coleridge Pass. Hunting for deer, pigs and chamois takes place.

Nearby Castle Hill/Kura Tawhiti limestone rocks attract rock climbers and botanists, while Cave Stream is a popular attraction further along the State Highway. Mountain biking is very popular in Craigieburn Conservation Park an there is a proposal to link tracks here to Mt Cheeseman. Fly fishing is popular on the rivers and lakes in the area. Occasionally there is water skiing on Lake Lyndon, rowing and sailing on Lake Pearson and ice skating on Lake Lyndon.

Sheep and cattle grazing continues on nearby Brooksdale, Castle Hill and Flock Hill Stations.

3.0 The Study Area

3.1 Introduction

The site subject to the Plan Change and development proposals lies at the southern end of the Craigieburn Range, at the edge of the Craigieburn Ecological District. The study area comprises the Plan Change area in which the proposed developments will occur, and some adjacent areas which may be affected by some proposed activities. Figure 3-1 shows the study area boundary.

The Plan Change area is the existing Porters Ski Area and, to the north-east, Crystal Basin, together with an area of 18.3 ha, immediately to the north-east of Crystal Valley (the Northern Terrace). The study area also includes the Porter River Valley. The adjacent Ryton Basin and land in the current Porters ski lease (as at 15 June 2010) on the true left of the upper Porter River were included in the study area during initial stages of investigation.

The Plan Change area ranges in altitude from 900m at the Ski Area access road bridge across the Porter River to 2000m above Crystal Basin.

Staff at the Porters Ski Area report that the snow pack typically develops from mid-May to late June, peaks in September then rapidly thaws any time between September and mid-January.

Geology/geomorphology

The Craigieburn Range comprises greywacke and argillite of the Torlesse group. The study area is situated in the southern most spur of the range with Blue Hill and "Powder Bowl" slopes at the southern end and two alpine basins (Crystal Basin and Porters Basin) within the Plan Change area.

The slopes are steep and weathered as a result of glacial and postglacial erosion. These formations underwent complex faulting during their uplift and are highly prone to frost shattering which results in the extensive talus and scree slopes characteristic of this region. On this site, above 1200m the terrain is largely bare rock screes of various sizes and the two more-stable alpine basins.

A number of fault lines cross the study area and there are examples of rock glacier features – high level basins with glacial debris. URS (2010a) describes the geology and geomorphology of the area.

Waterways

Numerous tributaries or small waterways drain from Porters and Crystal Basins to the Porter River. Several are well formed and permanent streams (for example Porter Stream), many are intermittent or ephemeral. Waterways are shown on Figure 3-1 and described further in Section 5.3.

The source of the Porter River is a small headwater system at the Coleridge Pass and the river flows into Broken River downstream of the study area.

Soils

High Country Yellow Brown Earths of the Kaikoura set are found on slopes above approx 1065m, while newer surfaces have recent soils (e.g. in areas of erosion)
Figure 3-2 shows the major soil types across the site and these are listed in Table 3-1

Table 3-1: Soil types in the Porters study area

Soil type	Terrain
Kaikoura steepland and Alpine steepland soils	Highest altitude, ridges, scree slopes
Kaikoura steepland soils	Higher altitude slopes
Tekoa steepland Hurunui Hill soils	Less steep slopes around and generally to northwest of Porter River
Tekoa steepland soils	Small areas on southeast side of Porter River
Tekoa hill soils	Very small area downstream on Porter River flood plain.

Description management units

The study area has been divided into 11 relatively distinct areas or management units for description and assessment purposes, based on a combination of topography and proposed activities. They are areas with similar ecological characteristics in which similar activities are proposed and there are eight terrestrial units and three aquatic units. These are shown on Figure 3-1 and are:

Porters Ski area:

A Porters Basin
B Porters Stream Valley
C Porter Stream (aquatic)
D Porter River main stem (aquatic)
E Porter River Valley
F Porter hillslopes
G Southern terraces/Village

Crystal

H Crystal Basin
I Crystal Stream Valley
J Crystal Stream (aquatic)
K Northern terrace

The ecological descriptions, evaluation and assessments are based on site visits, helicopter fly-overs and brief visits into less accessible areas, literature review, and consultation with Dr Angus McIntosh (University of Canterbury). Full methodologies are provided in Section 4.

4.0 Methods

4.1 Project development

Porters started investigations and project development in 2006 and preliminary ecological site work was carried out in 2007. Over the period up to lodging the application an iterative process of design and planning has been undertaken. During this time, ecological factors were considered alongside others to develop the project.

The Interim Ecological Report (March 2007) outlined the major ecological issues, and potential effects of activities. Ryton Basin was excluded from further consideration for development as a result of ecological investigations among other factors. Further work was commissioned to investigate the potentially high ecological values in Crystal Basin/Crystal Stream.

During late 2009-early 2010 these investigations identified significant botanical values in Crystal Basin, and the importance of the aquatic habitat in Crystal Stream as part of the Porter River system. These findings prompted refinement of proposals for tracking and snow management including options for covenanting area of high value.

Ecological values have also been integrated into development of the design, construction and proposed operation of the stormwater, potable water takes, waste water and Village Base area.

The project for which the Plan Change and resource consents are being applied has thus avoided some areas of high ecological value through design. Residual design, construction and operational effects and their mitigation are discussed in this report.

4.2 Site surveys and laboratory work

Prior to any site work, aerial photographs were analysed to identify apparently different vegetation types and distinct habitat types (e.g. waterways, rock outcrops).

Field investigations were used to verify or add to existing information. The field work was conducted by an ecologist and/or botanist. Field days were:

12, 14-16, 19 February 2007 – terrestrial and aquatic habitats
13 March 2007 – general survey
9 March 2010 – Crystal Basin
1, 2 April 2010 – aquatic habitats in Crystal Basin
22 April 2010 – Porter Stream, Porter River, upper Porter River valley (vegetation and aquatic sampling)
5 May 2010 – Northern Terrace and red tussock gully vegetation

Terrestrial vegetation, habitats and species
In the field, vegetation types, species composition and distributions were assessed and mapped by walking representative lines through the various landforms and by targeting the potentially different types.

Plant species were listed through traversing these alignments; at points along the transect the dominant species forming the canopy or ground cover were estimated by eye. Historic transects and plots were accessed and used as a reference for the field work data. Using the aerials and field data, vegetation types were mapped over the site. The surveys also allowed recognition of special species and their locations. Areas of high value were surveyed in more detail.

The reptiles and terrestrial invertebrates were actively sought by examination of particular habitats during the vegetation survey. However, specific methodologies were also employed to refine the surveys. Reptiles were sampled using fruit baited pit fall traps run over 5 days and by using the standard reptile "hotel" tile system (also run over 5 days in February 2007). Areas of scree and snow totara[9] in particular were targeted for sampling in an effort to confirm the presence of *Leiolopisma* "longtoes"[10] which was reported in the PNA survey (Shanks *et al, loc cit*).

Invertebrates were sampled actively using a standard butterfly net during vegetation survey and via pitfall traps laid in the same places as the reptile traps. Nocturnal Lepidoptera were sampled by light trapping in three locations, each for 40 minutes.

Figure 4-1 shows the location of all faunal ecological sampling carried out 2007-2010

Aquatic habitats and species

Aquatic sampling involved making measurements of the physical habitat based on observations of substrate, flow, depth, cross sections, bank condition and riparian condition[11].

Macroinvertebrates were sampled using one or three standard 25cm by 25cm kick net samples in each of the main tributaries and in two locations on the main (Porter) River. Samples were collected, preserved and sent to Ryder Consulting Limited for processing (see Appendices 2 and 3 for details). The samples were identified to the lowest taxonomic resolution necessary for MCI biometrics.

Fish sampling was carried out with a backpack 300 electric fishing machine. A standard approach was adopted of utilising a chained stop-net as the "catcher" and passing the electric wand down through the water column 3 times, starting 5m up stream of the net (3 passes). Fish stunned in this way were collected, identified, measured and then released. Specific habitats were targeted (pools and runs) and a sampling station involved 5 samples working from 5m downstream upwards, with each having three passes. Nine stations were utilised in the Crystal Stream, one station in the Porter Stream, and around 10 stations in the Porter River up stream of the Ski Area access road crossing, covering some 300m of waterway.

Hand netting was carried out in the upper middle reaches of the Porter River in specific habitats and in the western-most tributary in which pools were small enough to successfully sample by hand net. Most western tributaries of the Porter River had insufficient depth of water to sample or contain fish.

[9] A full species list with common and Latin names is in Appendix 1.
[10] Skinks formerly known as *Leiolopisma nigriplantare* and *Leiolopisma* "long-toes" are now known as O*ligosoma nigriplantare* and *Oligosoma* "long-toes" respectively.
[11] ARC Physical Habitat system: J Maxted, B Evans, C Keenan (2002): *Quality control report for habitat data, summer 2002.* Auckland Regional Council unpublished technical report 3 September 2002.

Bird data comes from existing reports and from observations of the field work team while undertaking vegetation or faunal surveys and is therefore not exhaustive; however, permanent resident birds are likely to have been recorded.

4.3 Analysis

The biometrics used are standard, and focus on taxanomic richness, area (m^2 or ha), macroinvertebrate community indices (MCI), quantitative MCI as well as the EPT (Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly)) ratios. The aquatic bio-assessment protocols have been tested, synthesised and modified for use in New Zealand by NIWA (eg. Quinn *et al*, 1992[12]) and Environment Waikato (Edgar *et al*. 1994[13]) and updated by Maxted and Stark 2004[14]. (See Appendix 2 for details)

No analysis protocol was employed for the reptile or invertebrate samples other than to examine the results for threatened species presence.

[12] J Quinn *et al*. (1992): *Harvest Effects on Stream Habitat and Invertebrates in Whangapoua Forest : Report on Spring 1992 Survey.* NIWA Research Consultancy Report # ERNOO1/1.
[13] N Edgar *et al*. (1994): *Regional Ecological Monitoring of Streams in the Waikato (REMS).*Environment Waikato, Environmental Quality Section.
[14] J Stark and J Maxted (2004): *Macroinvertebrate community indices for Auckland's soft-bottomed streams.* Report prepared by Cawthron Institute for ARC (TP303).

5.0 Ecosystems – description and evaluation

5.1 Introduction

In this section the ecosystems, habitats and species within the study area are described, based largely on site survey work and sampling carried out specifically for this Plan Change and resource consents applications. The ecological significance of the features is assessed, using published and accepted criteria in a range of planning and environmental contexts (e.g. Selwyn District Plan). The areas and values are described in a way that facilitates the assessment of potential and actual effects of the proposal in Section 6.

The description and evaluation also form the basis of mitigation proposals.

The eight terrestrial management units (A, B, E, F, G, H, I, and K) and three aquatic management units (C, D, and J) listed in Section 3.1 are addressed in Sections 5.2 and 5.3 respectively. Overall ecological values are assessed in Section 5.4.

5.2 Terrestrial vegetation, habitats and species

A general description of vegetation types and non-vegetated areas/ habitat types found across the study area is given here, using terms developed for this site, followed by details of their occurrence in the eight sub-areas. Following the descriptive sections is a summary of significant terrestrial species and areas.

While a large proportion of the upper slopes are bare or sparsely vegetated screes, rocks and boulder fields, the lower slopes of the study area are characterised by a mosaic of shrublands and tussocklands, with localised wetter flushes or wetlands and waterways. Often there is not a distinct boundary between types, but rather a gradual zone of change in which one or more species becomes less dominant and others increase in cover. This is especially the case in the merging of *Dracophyllum* shrubland[15] into tall snow tussock (*Chionochloa* spp) grassland. The distributions of snow tussock species also overlap although broad-leaved snow tussock (*Chionochloa flavescens)* is more common at lower altitudes and slim snow tussock (*Chionochloa macra*) more common higher.

Figure 5-1 gives an over view of the vegetation pattern over the eight sub-areas, while Figures 5-2, 5-3, 5-4 and 5-5 show management unit cover. The vegetation maps are compiled from aerial photography and site survey. Appendix 1 gives a list of plant species recorded from the study area in the course of investigations 2007-2010. Photographs referred to are in Appendix 8.

5.2.1 General Vegetation types

This section provides a general description of the vegetation communities throughout the plan change area noting those species that characterise the community and / or are in some way of greater note than the majority of the composition.

Table 5-1 summarises descriptions of the distribution of those vegetation types across the character areas A-K.

[15] See Appendix 1 for plant names; * indicates exotic/introduced species

Table 5-1 Distribution of vegetation types in core area

No	Management unit → Vegetation /habitat type ↓	A	B	E	F	G	H	I	K
1	Scree	✓	✓				✓	✓	
2	Scree chutes/ loose rock	✓					✓	✓	
3	Rock outcrops	✓					✓	✓	
4	Boulder field/fellfield/rock glacier						✓		
5	Spring flushes						✓		
6	*Celmisia* herbfield	✓					✓		
7	Tall tussock – snow totara		✓					✓	
8	Tall tussock-*Dracophyllum* and *Dracophyllum* – tall tussock		✓		✓	✓		✓	✓
9	Wetland (red tussock)		✓			✓			
10	Slim snow tussock grassland	✓					✓	✓	
11	Riparian		✓	✓				✓	
12	Valley floor		✓	✓			✓		
13	Short tussock grassland			✓					

Management units

A Porters Basin
B Porter Stream Valley
C Porter Stream (aquatic)
D Porter River (aquatic)
E Porter River Valley
F Porter hill slopes
G Southern Terrace/Village
H Crystal Basin
I Crystal Stream Valley
J Crystal Stream (aquatic)
K Northern Terrace
G Southern Terrace/Village

Vegetation types/Habitat types

1 Scree. (Photo 1) Large areas of the higher altitude parts of the study area are unstable scree and have no higher plant cover. There are localised patches of more stable scree where a red coloured alga is established and in other places, for example in the Ryton Basin, conditions have allowed small areas of alpine vegetation to establish.

The highly specialised scree plants that are present on many of the scree slopes, but especially the eastern faces, include *Stellaria roughii, Lignocarpa carnosula, Epilobium pynchnostachynum, Cotula atrata, Ranunculus haastii* and *Hebe epacridea. S*ome penwiper plants *(Notothlaspi rosulatum)* were occasionally seen during investigations. (Photo 2)

2 Scree chutes/ loose rock. (Photo 3) Along the western slopes of Crystal Stream below Crystal Basin, amongst the vegetated communities and screes, are chutes and areas which are characterised by variously-sized loose rocks that are neither scree nor rock outcrop. Few plant species grow on this surface although various species of the snow-totara or slim tussock communities are established there.

3 Rock outcrops. (Photo 4) Frost-shattered rock outcrops occur locally (for example, along the steep eroded slopes and in some of the upper scree slope areas around the

Crystal Basin.) A few plants cling to the exposed rock. They include *Helichrysum intermedium, Hebe tetrasticha, H pinguifolia, Raoulia mammillaris, Aciphylla monroi, Dracophyllum pronum, Blechnum penna marina* and *Koeleria cheesemanii*. At other sites (on Powder Bowl slopes) additional species recorded include: *Helichrysum epacridea, Chionohebe pulvinaris, Colobanthus acicularis, Leucogenes grandiceps, Phyllachne colensoi* and *Poa novae-zelandiae.*

4 Boulder field/fellfield/rock glacier. (Photo 5) The upper basin and western edge of Crystal Basin are dominated by fields of large round boulders forming mounds and depressions amongst which grow (on flatter pockets) a small number of prostrate plants that give a defining colour to the boulder field. The common species of this habitat include: *Dracophyllum pronum, Raoulia australis, R. glabra, Anisotome aromatica, Phyllachne colensoi, Aciphylla monroi*, *Leucopogon fraseri, Celmisia lyallii, C viscosa* and *Poa buchananii*. The areas are subject to extreme snow and frost conditions and plants here are adapted to their micro-environment. Rock glaciers are described in URS 2010b[16]

5 Spring flushes. (Photo 6) Permanent alpine waterways are uncommon in the study area, but two small, steep, cascading streams in Crystal Basin support lush riparian margins with a dense cover of *Poa dipsacea, Neopaxia australasica* and *Epilobium macropus.* On damp shady banks along the length of, and adjacent to, the streams are dense covers of alpine herbs including *Schizeilema pallidum, Ourisia caespitosa, Brachyglottis bellidioides, Anaphalioides bellidiodes, Geum leiospermum, Leptinella pyrethrifolia* and *Viola cunninghamii.* This bank community is the most diverse of all the vegetation communities identified within the Crystal Basin area. *Schizeilema pallidum* is a threatened species in the 'naturally uncommon' category of de Lange (2009) and was recorded on one of the damp shady bank edges alongside one of the streams.

The headwaters of these streams are also the highest altitude at which exotic species were recorded in the study area:*Trifolium repens, Hieracium lepidulum* and *Anthoxanthum odoratum* were recorded. This is thought to be because of the greater moisture of the soils.

***6 Celmisia* herb field.** (Photo 7) In the middle-upper Basins above, and mixing into the tussock grasslands, *Celmisia*-dominated herbfields locally form rough, somewhat scattered, and relatively narrow bands. Typically, relatively large sheets of *Celmisia spectabilis* (sometimes with *C viscosa*) characterise this community. Species which are also found in the lower tussock lands (such as *Celmisia lyallii, Poa buchananii, Wahlenbergia albomarginata, Raoulia mammillaris, Poa colensoi*, *Chionochloa* spp and *Elymus solandri)* occur in this community.

Over 30 species have been recorded in this community in the study area.

7 Tall tussock - snow totara. (Photo 8) Stable areas above about 1250m are dominated by either tall/snow tussock in which snow totara may also be found (such as above the car park on southern aspect slopes) or snow totara (such as on the upper slopes of Big Mama above the main Ski Area road). It was not possible to clearly map these two separate associations in most of the study area.

8 Tall tussock- *Dracophyllum* grassland and *Dracophyllum*- tall tussock shrubland. (Photo 9) The lower toe-slopes of the study area are covered in a mosaic of *Dracophyllum* spp and tall snow tussocks accompanied by scattered herbs and small grasses. At the higher altitudes, snow tussocks dominate. Below about 1250m, the *Dracophyllum* spp become more dominant in the mix with snow tussock so that the areas

[16] URS 2010b. *Technical Report: Crystal Basin Landform Assessment*. Prepared for Blackfish Ltd. May 2010.

become more clearly shrubland. This is the most abundant vegetation cover on the lower toe-slopes and includes a range of densities including a sparse *Dracophyllum*-tussock area on the flat terrace to the north of Crystal Valley stream (Northern Terrace).

Dracophyllum acerosum, Chionochloa flavescens and *C. macra* as well as *Dracophyllum pronum* are the dominant and most frequently encountered species with 91 other species recorded within the study area in this community. The type is also characterised by *Celmisia angustifolia, C. lyallii, C. spectabilis* and *Aciphylla colensoi var. maxima.*

Within these grassland/shrublands there are occasional, localised, wetter areas where species such as *Schoenus pauciflorus* and *Chinonochloa rubra* are prominent associated with seepages or springs. Other common wetland species, such as *Viola cunninghami, Oreobolus pectinatus* and *Hydrocotyle novae-zelandiae* occur.

Although the boundary between the two types is not always clear, they are mapped separately as 8a and 8b on the vegetation Figures.

9 Wetlands. (Photo 10) There are few areas of wetland in the study area due to the porous nature of soils and lack of suitable topography. In the centre lower valley of Porter Stream Valley where the Porter northern ephemeral stream nears the perennial southern Porter Stream is a depression in which the community better reflects a wetland than the drier adjacent slopes. While *Dracophyllum* is still prominent, *Coprosma propinqua* is also common here along with red tussock, *Carex* sp., *Astelia* sp and occasional manuka. The northern "stream" resembles a flush (or seep) with herbaceous wetland species such as *Epilobium macropus*, *Hypsela rivalis, Mentha cunninghamii, Hydrocotyle novae-zelandiae, Gonocarpus micranthus*.

There is a second distinct wetland in the study area, running down through the middle of the Southern Terrace (i.e. that area proposed as the Village Base area). This is a shallow depression or gully which is differentiated from the surrounding *Dracophyllum*-tall tussock by a dense sward of red tussock running down the gully accompanied by herbs adapted to wetter conditions.

Amongst the *Dracophyllum*-tall tussock terraces and lower slopes are a number of depressions and shallow swales/gullies. Most are dry most of the year and support dryland vegetation. Where the soil remains damp for longer, a small range of wetter species are present as well as more clover and exotic grasses (e.g. browntop, sweet vernal, Yorkshire fog). The native species include red tussock, *Schoenus pauciflorus* and *Schizeilema hydrocotyloides Carex coriacea, Drosera arcturi, Gaultheria crassa*.

10 Slim snow tussock (*Chionochloa macra*). (Photo 11) This vegetation community dominates the lower slopes near the Porters Ski Area and also on the more stable slopes in the Crystal Basin proper. *Chionochloa macra* dominates with numerous inter-tussock herbs and grasses including *Poa colensoi, Anisotome flexuosa, Dracophyllum pronum, Celmisia lyallii, Celmisia angustifolia* and *C spectabilis.*

11 Riparian. (Photo 12) Vegetation along the sides of Porter River, Porter Stream and Crystal Stream varies in stature and riparian connectedness. In a few locations on the Porter River and Porter Stream shrubs overhang steep banks – C*oprosma propinqua* and matagouri are most common. For most of their reaches within the Plan Change area, these streams are bounded by tall tussocks or tall ferns (*Polystichum vestitum*)with native or exotic herbs in the ground cover (e.g. *Holcus lanatus, Agrostis capillaris).* The less incised parts of

waterways have a riparian border of grasses and small herbs. Throughout the site the riparian zone is generally a place where exotic species are most commonly found.

12 Valley floor. (Photo 13) The Porter River Valley in total can be divided into a more modified lower valley, a shrubland (matagouri) middle reach and a less modified upper reach (upstream of the Ski Area Access Road bridge) which is strongly native and largely tussock with scattered shrubs. Common native species in the valley floor include – *Discaria toumatou, Aciphylla colensoi* var*. maxima, Carex coriacea, Festuca novae-zelandiae, F rubra*, Poa cita, Bromus diandrus*, Epilobium* sp*, Acaena caesiiglauca, A fissistipula,* and *Muehlenbeckia axillaris*.

In the lower reaches of the Porter River and Crystal Stream, exotic/weed species (for example, Lotus, browntop, sweet vernal grass) are found in abundance.

13 Short tussock grassland. In the lower reaches of the Porter River pastoral species are found in a short tussock grassland cover: *Chionochloa flavescens, Chionochloa macra, Poa cita, P colensoi* and *Festuca novae-zelandiae,* as well as relatively abundant weed species. This vegetation type is largely outside the study area.

5.2.1 Vegetation and habitat descriptions of each management unit

Introduction

In this section, the management units with predominantly terrestrial vegetation communities (A, B, E, F, G, H, I, and K) are described, including the mosaic of similar but subtly different communities present. The management units that are predominantly aquatic (C, D, and J) are described in Section 5.3. Fauna habitats and species are described in sections 5.2.5 and 5.2.6.

Appendix 4 shows the areas of the different vegetation/habitat types within each management unit; the total area of cover for each is given in Table 5-2 below.

A Porters Basin

The vegetation types of this area are mapped on Figure 5-2.

The general upper slopes of ***Porters Basin*** are loose screes and occasional prominent rock outcrops with little vegetation – 141 ha in total (Photo 14). More stable slopes in Porter Basin show extensive lichen development. More isolated screes and rock outcrops have occasional scree and rock specialist plants (*Epilobium pyncnostachyum*, *Lobelia roughii*, *Leucogenes grandicepes*, *Helichrysum intermedium* and *Chionohebe pulvinaris*).

On the other side of Blue Hill and the ridge at the top of Porters Ski Area (and outside of the Plan Change boundary) lies the west-facing ***Ryton Basin*** (Photo 15). This Basin is notable in having only native plant species present. It is characterised by a profusion of *Celmisia* spp in the lower basin, especially *Celmisia viscosa. Dracophyllum pronum* is found on the fellfield together with scattered scree-specialist plants and other rarer species of conservation value including *Lignocarpa carnulosa , Gentiana corymbifera*, *Epilobium pyncnostachyum*, *Haastia recurva*, *Leptinella atrata*, and *L. pyrethrifolia*.

The Porters Basin side slopes within the Ski Area retain several tongues of snow tussock communities, most predominantly on the lower southern faces above the existing Café and parking area. This tall tussock grassland is primarily composed of *Chionochloa flavescens* and *C. macra* but includes *Aciphylla colensoi var. maxima, A. monroi, Agrostis petriei, A.*

muelleriana, Celmisia viscosa, Poa colensoi, Myrsine nummularia, Acrothamnus colensoi and *Hebe pinguifolia*.

The basin bottom now contains very few examples of *Celmisia* fellfield communities; the very upper sub-basin has several small areas and the southern sub-basins have several more typified by matting *Celmisa viscosa* and *Dracophyllum pronum*, as well as including *Anisotome flexuosa, Aciphylla monroi, Celmisia laricifolia, C lyallii, Epilobium pyncnostachyum, Gentianella corymbifera subsp. corymbifera, Haastia recurva* and *Raoulia grandiflora.*

Beneath the looser/small screes of the northern face of Blue Hill ("Big Mama"), at the edge of the basin and valley, lies a zone of snow totara-tussock grasslands (Photo 16). This patchwork of snow totara as a dominant cover, inter-mixed with an assortment of grasses and herbs, is common throughout the study area, but at this site includes species such as *Coprosma petriei*, *Scleranthus uniflorus*, *Rumex acetosella*, *Acaena fissistipula*, *A. caesliiglauca*, *Gaultheria depressa var. novae-zelandaie* and *Chionochloa macra*.

The transition from snow totara-tussock to relatively intact *Dracophyllum* shrubland occurs as a relatively well-defined point around 1250m to 1300m. Below the Porter Basin proper is the Porter Stream Valley with a south and north ridge and slopes emanating from the Basin and with a smaller ridge in the central valley. These are described below. (B Porter Stream Valley)

B Porter Stream Valley

The vegetation and habitat types of this area are mapped on Figure 5-2

There are four basic land forms and related vegetation types down the valley on: the steep scree and loose rock on side slopes (approximately 26 ha or 27% area); the deeper soils of the valley bottom; riparian edges to the water ways; and depressions associated with the wetter soils in valley floor.

The upper valley is located around the existing water storage pond and has been highly modified for the pond and with the additional construction of parking platforms. On the slopes above and to the north of the pond are areas of slim tussock (Photo 17) which are characterised by: *C. macra, Poa colensoi, Agrostis petriei, Rytidospermum pumila, Festuca novae-zelandiae, Lachnagrostis filiformis*, as well as an array of exotic invaders such as *Hieracium pilosella, H praealtum, Hypochoeris radicata, Rumex acetosella, Rytidosperma setifolia,* red clover and Lotus*.* The south side is a continuum of the snow totara-tussock community.

Further down the Valley, on the slopes, *Dracophyllum* is the prominent and characterising vegetation cover and all other communities are generally subtle variations in the dominance between tall tussocks and *Dracophyllum* (Photo 18). While relatively uniform in appearance at least 96 plant species make up this community with various degrees of this species richness found locally. The heath on most slopes is characterised by *Dracophyllum* spp, *Gaultheria* spp, *Chionochloa* spp, *Ozothamnus fulvida*, *Celmisia* spp (in steeper sparser areas) and bidibid; it can also include *Myosotis australis*, and *Leptinella pyrethrifolia*; and in damper side-gullies *Carex geminata*, *C. wakatipu* and red tussock. Generally the central ridge slopes are *Dracophyllym* dominated, the northern valley slopes are a mixture of *Dracophyllum*-tall tussock and the southern slopes are tall tussock-*Dracophyllum*. Approximately 38 ha or 38% area in the valley is covered in shrubland/grassland.

The perennial Porter Stream and the ephemeral northern waterway meet just above the Ski Area Access Road crossing on Porter Stream. In both waterways a narrow riparian terrace runs adjacent to the stream. This expands beyond (down stream) of the confluence of the two waterways to form a wetland. The northern waterway is an ephemeral stream or flush in which spring flush vegetation sits amongst the taller *Dracophyllum* heath. The flush typically contains natives adapted to wet conditions, such as *Epilobium macropus, Luzula rufa, Mentha cunninghamii, Ourisia caespitosa, Ranunculus foliosus, R glabrifolius, Viola cunninghamii and Sphagum sp.* as well as red tussock and *Schoenus pauciflorus* at the edges.

This flush leads down into a depression wetland that sits at the base of the central ridge and in the fork above the confluence of the two waterways (Photo 19). This wetland on its southern branch is a *Schoenus pauciflorus*-red tussock wetland and on its north branch it is a *Coprosma propinqua- Astelia- Polystichum vestitum*- wet shrubland. Both areas also contain species such as *Ranunculus enysii, Pratia angulata, Juncus edgariae* and many of those found in the flushes, described above. The grassy-rush portion of the wetland falls into the management unit G Southern Terrace/Village. The wetland shrubland falls into management unit B Porter Stream Valley proper and the area estimates in Tables 5-2 to 5-9 reflect this division.

The stream riparian vegetation is a variation on the *Dracophyllum* shrubland being visually distinguished by the frequent and large fern cover (*Polystichum vestitum*), tall red tussocks, taller *Dracophyllum* shrubs, *Aciphylla colensoi* var. maxima and occasional *Astelia nervosa* and flax. Near the Ski Area Access Road Bridge and existing dam the edges have a notable exotic component of Lotus, cocksfoot, Yorkshire fog and buttercup.

E Porter River Valley

Most of the **Porter River Valley** is excluded from direct effects of activities associated with the proposed Plan Change. The Porter River Valley unit includes the part of the valley adjacent to the Plan Change area around the point where the Ski Area Access Road crosses the Porter River. Indirectly, proposed changes to the existing water takes in Porter Stream and earthworks for the construction of a new road access on the southern-most western slope (Porters Chalets area) may have an effect – see area F below.

The vegetation in the broader, upper valley (below Coleridge Pass) is a mosaic of *Chionochloa flavescens – C. rubra* grasslands, *Dracophyllum* - matagouri shrublands and *Raoulia* - fescue - lichen stone fields (Photo 20). Throughout are pocket wetlands of *Carex* spp and *Luzula* spp. The immediate riparian edge is intact and largely red tussock and *Dracophyllum* heath, but noticeable features are the abundant and large spaniards (*Aciphylla monroi*).

Moving down the valley, introduced species become more abundant and diverse; and downstream of the Ski Area Access Road crossing, introduced pastoral species are locally dominant.

On the valley floor, just upstream of the Ski Area Access Road crossing, *Coriaria sarmentosa* is prominent along with the exotic *Lotus pedunculatus*. These species become increasingly dominant down the valley along with a wider array of “weed” species including *Hieracium pilosella, H lepidulum, Mimulus moschatus, Anthoxanthum odoratum* and *Agrostis capillaris*. Near the road crossing the valley is still largely tall tussock grass (*Chionochloa flavescens* and *C. rubra*,) with *Coprosma propinqua* and an increasing amount of matagouri (*Discaria toumatou*) (Photograph 21). Between these two native-exotic types, the

grasslands give way to “weed” flats through a *Poa* and *Festuca novae-zelandiae* transition stage. In the lower river valley, the river escarpments are tall and become heavily covered in matagouri while the valley floor becomes open and weedy (Photo 22).

Weeds (all exotic species) throughout the lower valley include brown top, sweet vernal, oxeye daisy, Californian thistle, Scotch thistle, broom, vipers bugloss, cat’s ear, Yorkshire fog, cocksfoot, sheep’s sorrel and white clover. However, the most potentially damaging and/or obvious weeds are *Pinus contorta*, grey willow, sweet brier and *Hieracium* (3 species). Lotus is abundant in the lower valley and gullies wherever disturbance occurs and it is a notable feature of the edge of Porter River and side tributaries below the Ski Area Access Road.

F Porter hillslope

The vegetation and habitat types of this area are mapped on Figure 5-2

The dominant vegetation type on the steep and eroding slopes is *Dracophyllum*-tall tussock shrubland (approximately 6 ha or 82% area) (See Figure 5-2). *Dracophyllum acerosum* with *Chinochloa flavescens* dominate this area (approx 6.5ha, Photo 23). The vegetation cover is sparser than further up the valley and bare soil is common. Amongst the *Dracophyllum* and tussock clustered on soil islands amongst the eroding bare soils are the common herbs and grasses found in other *Dracophyllum*-tall tussock areas. Weeds are relatively common on this slope, particularly pasture grasses, *Hieracium* spp and occasional wilding *Pinus contorta.*

G Southern terraces (the Village Base Area)

The vegetation and habitat types of this area are mapped on Figure 5-3

The dominant vegetation type across this area is the *Dracophyllum*-tall tussock shrubland (17 ha or 82% area). *Dracophyllum acerosum* with *Chinochloa macra* and *C. flavescens* dominate this undulating area (Photo 24). A diverse assemblage of native mosses, herbs and small shrubs occur across the terrace including *Acaena caesiiglauca, Carmichaelia australis, Celmisia* spp*, Gaultheria crassifolia, Ozothamnus leptophyllus* and *Racomitrium pruinosum.* Various ski facilities (lodges, staff quarters and associated tracks) are located here and the exotic component is associated with these and dominated by pasture grasses, *Hieracium* spp and occasional wilding *Pinus contorta.* A small number of mountain beech trees were planted here 30-40 years ago and they remain near the staff accommodation.

There are some areas of bare ground/exposed soil and these areas increase with altitude up the ridge starting west of the proposed village area. Most of the depressions across the terrace are dry throughout most of the year. However, one of the larger ones supports a red tussock gully (which includes *Schoenus pauciflorus,* and *Carex coriacea)*, and appears to arise from a central upper spring, suggesting that soils there are damper. Exotic species are also more common in this damper area.

H Crystal Basin

The vegetation and habitat types of this area are mapped on Figure 5-4.

In Crystal Basin there are steep tussock slopes grading into highly mobile slopes of scree and shattered rock outcrops, large eroded guts and large boulder fields. (Photos 25, 26) The vegetation communities encountered included scree, rock outcrop, *Chionocloa macra*,

Celmisa herbfields, fell fields, alpine watercourse /seepage flushes and boulder/prostrate plant communities.

A major component of Crystal Basin (164 ha or 92%) comprises bare rock and scree (some of which supports scree specialist plants and lichen vegetation). 30 hectares of more-recognisably vegetated habitat exists. The species and habitat are each described below.

Scree
The highly specialised scree plants that are present on many of the scree slopes, but especially the western and southern faces include *Stellaria roughii, Lignocarpa carnosula, Epilobium pynchnostachynum, Cotula atrata, Ranunculus haastii* and *Hebe epacridea.* Although not seen on the March 2010 visit, some penwiper plants *(Notothlaspi rosulatum)* were recorded on scree during the visit in February 2007.

Rock outcrop
Frost-shattered rock outcrops occur along the steep eroded slopes of the proposed (southern side, north facing, western edges and some northern faces). A few plants cling to the exposed rock and habitat cracks. They include *Helichrysum intermedium, Raoulia mammillaris Dracophyllum pronum, Haastia recurva,* and *Koeleria cheesemanii.*

Celmisia herb field
In the middle-upper Crystal Basin above, and fingering into, the tussock grasslands below, approximately 2 ha of *Celmisia* dominant herbfields form a rough, somewhat scattered, and relatively narrow band across the basin Typically intact, relatively large sheets of *Celmisia viscosa with Dracophyllum pronum* characterise this community with numerous other species of lower tussocklands but *notably Celmisia lyallii, Poa buchananii, Wahlenbergia albomarginata, Raoulia mammillaris, Anisotome flexuosa, Celmisia angustifolia, Leptinella pyrethrifolia, Lycopodium fastigiatum, Phyllachne colensoi, Poa spp.* and *Elymus solandri.*

Boulder fields/fellfield/rock glacier
The upper basin and western edge are dominated by fields of large round boulders (rock glacier) forming mounds and depressions amongst which grow (on flatter pockets) a small number of prostrate plants that give a defining colour to the boulder field. The common species of this habitat include: *Dracophyllum pronum, Raoulia australis, R. glabra, Anisotome aromatica, Phyllachne colensoi, Aciphylla monroi*, *Leucopogon fraseri, Celmisia lyallii* and *Poa buchananii*.

Slim snow tussock (Chionochloa macra)
This is the most common vegetation of the lower half of the basin and is characterised by *Chionochloa macra* which dominates with numerous intertussock herbs and grasses including *Poa colensoi, Anisotome flexuosa, Dracophyllum pronum, Celmisia lyallii, Celmisia angustifolia* and *C spectabilis.*

Alpine watercourse flush/Spring flush
Two small steep cascading streams form much of the headwaters of the true right branch of the Crystal Stream (Photo 27). The narrow (1-2m) but lush riparian margins of the stream have a dense cover of *Poa dipsacea, Neopaxia australasica* and *Epilobium macropus.* On damp shady banks along the length of and adjacent to the streams are dense covers of alpine herbs including *Schizeilema pallidum, Ourisia caespitosa, Brachyglottis bellidioides, Anaphalioides bellidiodes, Geum leiospermum, Leptinella pyrethrifolia* and *Viola cunninghamii.*

This bank community is the most diverse of all the vegetation communities identified within the basin area. *Schiezilema pallidum* is a threatened species and was recorded on one of the damp shady bank edges alongside one of the streams. It is approximately 0.5 ha in area.

The headwaters of these streams is also the upper-most location of exotic species and includes, perhaps because of the greater water content of the soils, *Trifolium repens, Hieracium lepidulum* and *Anthoxanthum odoratum*.

The general upper slopes of both the Porter Basin and Upper Crystal Basin are loose screes and occasional prominent rock outcrops with little vegetation.

I Crystal Stream Valley

The vegetation and habitat types of this area are mapped on Figure 5-5. (see Photo 28)

The vegetation of the Crystal Stream Valley has six characteristics: steep scree slopes (30ha), loose rock slopes and steep chutes (6ha); rock outcrops (1ha); vegetated slopes; flat and bare stream terraces; and valley floor. The riparian community is relatively sparse (1.5ha) and extending only 2m from the stream itself. The general vegetation in the valley is either a mix of native grasses and herbs, exotic grasses and herbs (especially Lotus), shrubland or scree vegetation. The vegetated scree slopes are tall tussock, *Dracophyllum*–tall tussock or snow totara communities, although there are a few specialist communities associated with the solid rock outcrops.

Slim snow tussock (Chionochloa macra)

This is very similar to the slim tussock vegetation type in Crystal Basin; however, in the Crystal Stream Valley there is a substantial component of shrubs, especially the *Dracophyllum* species, *Gaultheria* sp and hebe species. *Chionochloa macra* is more prominent than *C. flavescens* at higher altitudes.

Loose rock

Along the western slopes of Crystal Stream below Crystal Basin amongst the vegetated communities, screes and chutes are areas which are characterised by variously sized loose rock that are not scree or rock outcrop. Few plant species grow on this surface although species of the snow-totara community or slim tussock variously establish on this surface.

Snow totara - tussock shrubland

This association occurs only on the upper most and western most part of the Valley. Snow totara *(Podocarpus nivalis)* is found on the margins of screes and rock outcrops and acts as a stabilising influence on the mobile substrate. In a few particular locations the slopes hold a mix of snow totara, *Chionochloa macra, C flavescens,* and *Dracohyllum pronum* with *Hebe pinguifolia, Celmisia lyallii, C spectabilis, C angustifolia, C viscosa, C gracilenta and Gaultheria depressa var. novae-zelandaie*.

Rock outcrop

As with the rock outcrops of Crystal Basin there are numerous “stable” large formations which have developed a distinct vegetation community. The communities of these outcrops are richer and more obvious than those in the higher altitudes of the basin. Clinging to the exposed rock and habitat cracks are *Helichrysum intermedium, Hebe tetrasticha, H. pinguifolia, Raoulia mammillaris, Aciphylla monroi, Dracophyllum pronum, Blechnum penna marina, Haastia recurva,* and *Koeleria cheesemanii.*

In the lower Crystal Valley, both north and south sides are covered in *Dracophyllum*-tall tussock and tall tussock-*Dracophyllum* communities.

K Northern terrace

The vegetation and habitat types of this area are mapped on Figure 5-5. (See Photo 29)

The Northern terrace has vegetation similar to that on the south side of Crystal Stream (G Southern terrace / Village). The majority of the area (40 ha or 97% of area) is a *Dracophyllum*-tall tussock mosaic on drier land with other prominent species including *Celmisia angustifolia, C. lyallii, C. spectabilis and Aciphylla colensoi var. maxima.* Even the depressions and apparent water gullies are so dry as to contain no spring flush or different vegetation. A number of young kanuka are found on this terrace in the upper (western) area and two copses of manuka are present.

Exotic species (particularly pastoral grasses) are found throughout the northern terrace, but generally at low levels of abundance. Wilding *Pinus contorta* and Douglas fir occur here (and need control measures).

There are more areas of bare ground with frost-heaved soil and rubble (especially on the lips of terrace risers) than to the south.

Currently around 85 species are known from this area with patterns characteristic of the Upper Porter River Valley and southern terrace.

5.2.2 Areas of vegetation types.

Based on mapping using field survey and aerial photography polygons of different vegetation types in GIS (ArcMap) it has been possible to estimate the areas (ha) of the different communities in each management unit. The details are given in Appendix 4. Table 5-2 below is a summary of all types across the study area.

Table 5-2: Summary vegetation and habitats mapped in Figure 5-1.

	Vegetation type	Area (ha)	Percentage of total
1	Scree	352.03	60.1
2	Scree chutes/loose rock	8.09	1.4
3	Rock outcrops	2.27	0.4
4	Boulder field/fellfield/rock glacier	25.08	4.3
5	Spring flushes	2.46	0.4
6	*Celmisia* herbfield	4.32	0.7
7	Tall tussock-snow totara	16.26	2.8
8a, 8b	Tall tussock- *Dracophyllum* & *Dracophyllum* – tall tussock	134.1	22.9
9	Wetland (red tussock)	1.63	0.3
10	Slim snow tussock grassland	33.11	5.7
11	Riparian	4.74	0.8
12	Valley floor*	-	-
13	Short tussock grassland	1.33	0.2
	Total	585.42	100.0

*Valley floor vegetation was found in very small areas that could not be mapped in Crystal and Porter Stream valleys, and in the Porter River Valley outside the mapped area.

5.2.3 Vegetation patterns and processes

The vegetation in the study area reflects natural and induced patterns and changes. These include:

- Altitude, climate and soils: indigenous vegetation patterns respond to changes in the physical environment. These are subtle in this alpine environment – for example, the mosaic of snow totara and snow tussocks reflects the slow spread of shrubs onto improving soils and subtle differences in slope stability.

- Wet-dry: permanent watercourses are not common, but there are numerous flushes and seepages across the slopes. These are reflected in localised changes in plant communities.

- Stability and erosion: species and community distribution reflects the stability of rocks (seen for example in the specialised species on the rock outcrops in Crystal Basin) and of scree plants in a habitat with highly variable stability.

- Forest removal: virtually all indigenous vegetation below c. 1200m in this area is secondary growth, induced, following forest removal by burning. This occurred relatively recently, which means that the future changes in existing vegetation are difficult to predict and may not return to forest cover due to other environmental changes that have taken place since burning (e.g. climate change, grazing, introduced species) or since forest last established.

- Historic tracking and use for passage over the Coleridge Pass/Porter Saddle.

- Grazing: although stock have been removed from the study area, occasional wandering stock have been reported.

- Introduced animals/pests: mice, rats, hare, red deer and chamois and other mammalian species in the area will be influencing seed production and the spread of some plants (most particularly exotic ones). The extent of this is unknown.

- Introduced plants: a range of “weeds” have been recorded as common at lower altitudes on the study area, while *Hieracium* species and pasture species, such as white clover, occur higher on the Ski Area and in Crystal Basin. There are apparent altitudinal restrictions on some of the weed species but the current spread is also limited by the current intactness of the existing sub-alpine plant communities. The weed species, where established, are likely to be modifying (restricting) the spread of native species across the site and vice versa.

- The presence of the Ski Area has modified the area subject to skiing and related activities (primarily earthworks) since 1968.

Overall, the area subject to the Plan Change has areas of modification on a gradient from limited historic actions, significant historic actions (forest clearance) to ongoing human activities through to the nearly unmodified. It is considered that only Crystal Basin and the upper Porter River Valley currently have a low degree of modification, intact functioning and hence a high degree of naturalness.

5.2.4 Non-vegetated habitats

While no habitat in the area is completely devoid of life, first impressions of the extensive scree fields, rock out crops and loose rocky terrain on ridge tops and side slopes suggests large areas are unpopulated. However, each of those areas has specialised life forms. On the screes is a surprisingly large number of scree specialist plants whose natural distribution is sparse but nevertheless "cover" much of the scree slopes. The rocky outcrops are rarely without lichens and prostrate herbs and are habitat for weta, lizards and other invertebrates. Even where no plants exist, habitats may exist for a range of invertebrates.

5.2.5 Terrestrial fauna

A range of birds, lizards and invertebrates typical of mountain-alpine tussock and shrublands is known or assumed to form the faunal communities of the Porters area. While no formal bird surveys of the study area have been undertaken, a range of information from reports related to conservation surveys and casual observations during site visits has been used to build up a picture of the terrestrial fauna.

Birds

Bird species typical of the habitats found in the study area, and recorded in Coleridge ED, were observed on the property during field work as listed in Table 5-3.

Table 5-3: Birds likely to occur or observed at Porter Ski Area.

Species	Habitat	Observed on site
Australasian harrier	open country	✓
Kea	open country	>20
NZ Pipit	short shrub	✓
Skylark	open country	✓
Spur - winged plover	open country	
Yellow hammer	shrub	
Black backed gull	open country	
Blackbird	shrub	
Chaffinch	open country	✓
Grey warbler	forest	
NZ falcon	open country	✓
Magpie	open country	
Paradise shelduck	river valley	
Red poll	forest	
Riflemen	forest	
Silvereye	forest	
Song thrush	shrub	
South Island Pied oystercatcher	riverbed	

In addition, fantail, tomtit and brown creeper have been reported in nearby beech forest, and yellow crowned parakeet and South Island robin noted rarely (Shanks *et al* 1990).

The only bird of conservation note, and known to be present regularly, is the kea (Photo 30). This is classified as a threatened species (Naturally uncommon). NZ falcon visits the area from time to time, especially to the outcrops in tussock vegetation and lower valley side slopes. A pair has been reported to Porters staff in the Porters Ski Area, but only one sighting was made during ecological surveys. This is also a threatened species (Nationally endangered, category B (low population), data poor).

There are no significant areas of aquatic or wetland bird habitats in the Plan Change area.

Invertebrates

Within the high altitude habitats of Canterbury, three recognisable and distinct zones with distinct invertebrate faunas are recognised, and this pattern is present in the study area:

- *Chionochloa* tussock grassland,
- rock scree and associated plants (eg. snow totara); and
- bare rock, lichen and specialist plants zone.

Each zone is typified by an associated arthropod fauna. The tussock zone is most diverse and abundant, but also has the most exotic taxa and is least likely to have endemic indigenous taxa. The rock scree zone has many endemic species often restricted in range, but still has most arthropod groups represented. The bare rock zone (generally at highest altitudes) has very few arthropod groups and only a few specialist endemics.

Standard net sweeping, pitfall trapping and light trapping were carried out at a limited number of sites and for a limited time during February 2007. The location of light traps and invertebrate traps is shown on Figure 4-1. These returned a range of common alpine taxa and several specialised species, listed in Table 5-11.

The general pattern described above occurs on this site with the zones forming below 1000masl; between 1000 and 1600masl; and above 1600masl. The various trapping methods recorded a number of indicator or iconic taxa including 12 moth taxa, three butterfly taxa, three grasshopper taxa (Photo 31), two weta taxa and several beetle taxa.

Of particular note in the upper shrub area was the presence of the mountain stone weta (Photo 32), the alpine cicada and the mountain ringlet butterfly. No taxon found is recognised as a threatened species (Hitchmough 2006) or of significant conservation note. However, the above mentioned taxa are iconic of special alpine type habitats. *Brachapsis* 'lowland', located in lower pastoral lease land (Dry Stream, etc.), is a rare grasshopper that may be present on Porters Ski Area.

Given the number of unique or special plant species identified in the rock/scree fields of the upper areas there remains a very good chance of there being rare or special moth and/or weta and/or beetle taxon present in this more isolated, higher and unusual habitat.

Table 5-11 below lists the indicator taxa located in and about the 1000masl shrub-scree boundary.

Table 5-4: Invertebrates recorded during sampling at Porters

Taxa	Common name
Lepidoptera	
Noctuidae	12 species currently unidentified
Orocrambus sp.	grass moths
Aponotareas insignis	white lined moth
Argyrophenga antipodum	tussock butterfly
Percnodaimon pluto	mountain ringlet

Lycaena salustius	common copper
Asterivora sp.	*Raoulia* moth
Beetles	
Cicindela sp.	tiger beetle - very common
Megadromus sp.	carabid beetle
Orthoptera	
Sigaus australus	alpine grasshopper
Sigaus villosus	grey scree grasshopper
Rhapidopheradae	cave weta
*Hemideina/ Hemiandrus**	mountain rock weta
Deinacrida connectens	mountain scree weta
Pelodiaetus sp	*Raoulia* carabid beetle
Other	
Opilione	harvestman
Dolomedes minor	nursery web spider
Chilopoda sp	centipedes
Celetoblatta sp	common cockroach
Petotomid - *Ceramatulus sp.*	shield bug
Uropetula chiltoni	giant dragonfly
Cicadidae - *Melampsalta mangu and Melampsalta nigra*	alpine cicada

*Genus/Species unconfirmed

Reptiles

Five days of skink trapping were undertaken in February 2007 and supplemented by reptile habitat searches made during general vegetation survey work. Figure 4-1 shows the location of lizard traps.

DoC records suggest two skink (*Leiolopisma nigriplantare* and *L."longtoes"*) and one gecko (*Hoplodatylus maculatus*) species were found in the habitats present within the local area (DoC 2002[17] (but records for the “long-toes” were in 1988)). Distribution records also suggest a third skink species (*Leiolopisma "otagense"* form) may also be present. In 1990 the PNAP survey team reported this species in Ryton Basin (Shanks *et al* 1990).

The surveys undertaken for this project confirmed the presence of *L.nigriplantare* but not "long-toes" - this species was only noted from the fell field/rock glacier habitat type in 1988 and is considered rare. It is highly likely that *L."long-toes"* is widespread along the rock avalanche areas in the study area, especially where scree plant and snow totara communities persist. It is also possible *L.otagense* is present, but this is a shy and alert skink and not easily observed.

[17] DOC 2002. *Castle Hill Pastoral Lease Conservation Resources Report.* Released by Land Information New Zealand.

The common gecko (*H maculatus*) is likely to be present, especially in the shrub covered gullies and Porter River Valley where shrubs are thickest and tallest. A less arboreal gecko, it is often found in clear areas on shingle banks and scree-shrub zones.

Of the four species potentially present, only *L."long-toes*" is considered threatened and likely to be found in the habitats of least abundance on the property, i.e. the middle and upper Crystal Basin. Further survey work prior to earthworks starting may provide more information about this species.

Introduced species

Introduced animals have been observed in many parts of the study area, both in the course of ecological surveys 2007 and 2010 and by Ski Area workers and visitors.

Within much of the study area, particularly in the lower basin where the tussock grasslands are flatter and more sparse, are “camp” grounds for red deer, chamois and feral stock. Mice are commonly reported in the existing Ski Area Lodge, staff accommodation and base buildings. Hares are also common but there is no other sign of mammals (such as hedgehogs).

Despite the periodic grazing pressure of ungulates and hares, weed species and induced disturbance are generally absent over most of the study area. The communities of plants and their distributions support this observation.

5.3 Aquatic habitats

5.3.1 Introduction

The Plan Change area includes only two permanently flowing waterways - Crystal Stream and Porter Stream. However, the Porter River and alpine seepages are also discussed within the study area, since they form the receiving environment for most potential discharges and tributary inputs while outside the core activity area. There will be work in the bed of the Porter River in relation to the upgrade of the Ski Area Access Road.

For the purposes of description and assessment, the aquatic habitats are grouped into:

1 Porter River from just upstream of the Ski Area Access Road crossing to its exit from the study area (9.3km upstream of its confluence with Whitewater Stream at the State Highway crossing) (Management unit D)
2 Crystal Stream and its headwaters in Crystal Basin (Management unit J)
3 Porter Stream from its spring source just north of the existing Ski Area Access Road. Includes the ephemeral North Porter waterway, which runs almost parallel to Porter Stream and joins it just upstream of the existing Ski Area Access Road crossing. (Management unit C)
4 Minor (western) tributaries of Porter River – flushes, streams and ephemeral waterways upstream of the Porter Stream confluence (not mapped).

The locations of the array of aquatic sampling carried out (fishing, macroinvertebrate samples, cross sections etc) is depicted on Figure 4-1

Electric fish surveys were undertaken to supplement the NIWA Freshwater Database (FWDB) information. In addition Dr Angus McIntosh of Canterbury University was interviewed to obtain some of the local knowledge that he and his students have in regard to aquatic systems in the area.

The FWDB database shows:

- five records in the Porter River spanning 1963-1997 by NIWA and the University of Otago,
- one record in the Thomas River,
- one in the Whitewater Stream, and
- two in the Dry Stream

These are all tributaries of the Porter River prior to the Porter River joining the Broken River (see Figure 1-4). As reported in the Castle Hill lease report (DoC 2002) seven species of freshwater fish have been reported associated with the Porter River. That data is presented in Table 5-5

Table 5-5: Fish reported from Porter River catchment (DOC 2002)

Fish		Location
Canterbury galaxias	*Galaxias vulgaris*	P, W, T
Alpine galaxias	*G.paucispondylus*	P, D
Upland bully	*Gobiomorphus breviceps*	P, W
Long finned eel	*Anguilla dieffenbachia*	P
Rainbow trout*	*Salmo gairdnerii (Oncorhynchus mykiss)*	P, W
Brown trout*	*Salmo trutta*	P, D
Salmon*	*Oncorhynchus tshawytscha*	P

Key : P = Porter River; W= Whitewater Stream; D= Dry Stream; T= Thomas River; *= introduced species

Canterbury galaxias is considered “not threatened” but subject to “human induced” rarity, while alpine galaxias is considered “not threatened” in the “data poor” category.

Water quality monitoring was carried out by CPG during 2009.

5.3.2 Porter River

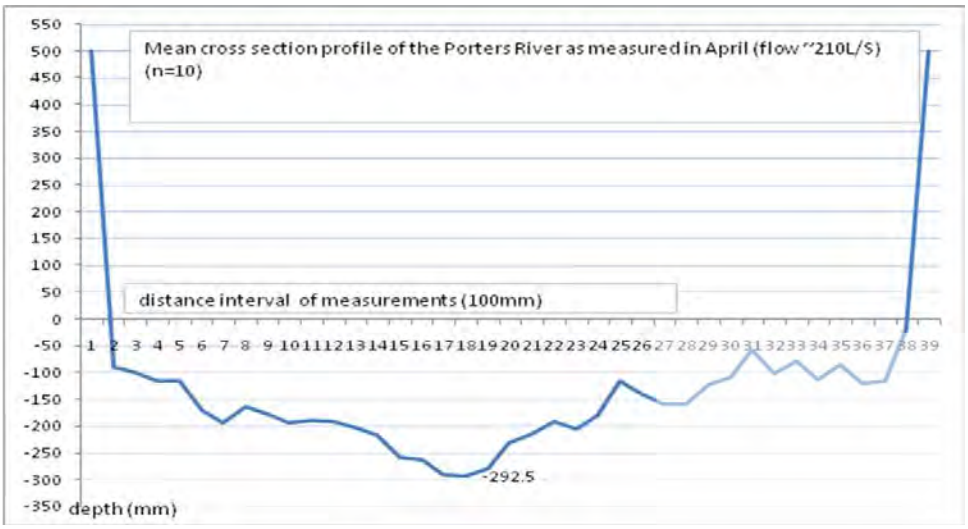
Physical features

From the saddle at Coleridge Pass (1134 masl) down to the State Highway, the Porter River grows in volume and size, and passes through a gradation of valley/ riparian habitat types from predominantly indigenous to exotic and from an enclosed to a relatively open state.

The length of Porter River mainstem aquatic habitat within the study area is approximately 2.0km.

Above the existing Ski Area Access Road crossing (which is a set of large culverts) the river is relatively uniform in width (2-3m wide) and has the form of a run and riffle system varying between 0.2 and 0.4m depth, 0.3 and 0.5ms^{-1} in velocity, and typically between 0.3 and 0.5m deep with a generally half metre high bank (Photo 33). Figure 5-6 shows a mean bed profile (a result of 10 cross-sections measured at 100mm intervals across the stream). Pools are scattered relatively uniformly and increase in size downstream. The last, 300m above the road culverts, has the largest pools at 3-5m diameter and up to 1.5m deep.

The substrate is 65% large cobble (15-25cm diameter), 30% small cobble and 10% boulder (the boulders are emergent); gravel lies between the cobble and is plentiful, but not visually obvious except in the larger pools. The banks are relatively stable and have overhangs and other fish habitat features, including potential salmonid spawning areas.



Flow at cross section was measured at 240L/S by CPG in May 2010.

Figure 5-6: Mean cross-section profile of Porter River (April 2010)

Approximately 500m upstream of the confluence of the unnamed stream flowing down from Mt Lyndon on the true right bank, the main stem has a deeper-set, narrower section in which the riparian vegetation provides more shade (40%) and (related to a gradient increase) the stream changes to a small cascade and pool system. Here the pools are larger and deeper with more edge habitat than the main reach area. This area is of note as an area of greater potential to support adult galaxiids than other parts of the river.

Below the Ski Area Access Road crossing, the main stem increases in size but not velocity as additional tributaries enter. The stream banks reduce in height and the lower valley widens to create a long riffle/run system with small boulder weir steps. Riparian influence decreases with stream widening and there is an increase in bank instability and an increasing predominance of Lotus and exotic grasses.

Three areas on the Porter River have been scored for physical habitat condition using the ARC index system (Maxted *et al* 2004). The sampling locations (Figure 4-1) were below and above the road culvert and in the upper valley. Their scores are recorded as 99 (82%), 106 (88%) and 112 (93%) respectively. These are very high scores and strongly indicate the natural condition of the morphology, bank and riparian systems.

Water Quality

No instrument recordings of water quality have been taken as part of BML ecological investigations. General observations of clarity, sediment condition, algal quality and type, and any obvious oils, sheens, foams and odours were made. These observations, together with data from CPG (2010b[18]) suggest that water quality is very good. The Porter River exhibits many traits assigned to the upper mountain class of Meredith and Hayward (2002)[19] – low nutrient status, high clarity and low (undetectable) hydrocarbon levels. However, it is noted that in late summer in some of the small tributaries long green filamentous algae and

[18] CPG 2010b. *AEE accompanying resource consent applications to Environment Canterbury.* Prepared for Porters Ski Area Expansion project.
[19] AS Meredith & SA Hayward (2002): *An overview of the water quality of the rivers and streams of the Canterbury Region*. ECan Report no RO2/25

clarity suggest water quality, through natural processes, may degrade. It is also of note, that no events of high sediment loading were captured by monitoring.

Riparian vegetation

Riparian vegetation is generally 100% intact providing good edge cover (20% stream shade) and is comprised of *Chionochloa* sp, *Aciphylla* spp, *Carex* spp, *Dracophyllum* sp, *Ozothamnus fulvida*, *Carmichaelia* sp and (in the section immediately above the road culvert) matagouri. Lotus and exotic grasses, bidibid and herbs are common throughout. The abundance of spaniards (*Aciphylla* spp) especially is a feature of the riparian zone of the Porter River

Periphyton

Algal cover varies through the seasons and has been recorded as "present in low to moderate abundance" up to a periphyton covering of 90% cover on boulders and larger cobbles. Liverwort and mosses cover approximately 5%. A level of 90% cover is considered unhealthy. Recent sampling (April 2010) confirmed thick periphyton growth (see Table 5-6) although a heavy rainfall event was reported during March 2010 (M Sleigh pers comm).

Table 5-6: Periphyton sampling results, Porter River (April 2010)

Sample	Cover %	Average thickness (mm)	Type
1	90	3	Matting browns
2	90	3	Matting browns and occasional Long green filamentous
3	50	1	Scattered matting browns
4	70	4	Matting browns

Fish

Sampling sites in the Porter River are shown on Figure 4-1.

Approximately 300m of the Porter River main stem was fished above the Ski Area Access Road culvert, with the uniform runs, deeper pools and bank side hollows being targeted. However, from 20 x 5m reaches sampled, the only fish found were small brown trout ranging in size from 8 to 25cm. It is possible some of the smallest specimens could have been rainbow trout.

Hand netting nearer Coleridge Pass (above the Mt Lyndon tributary confluence) only caught small brown trout. Brown trout appear to dominate the upper Porter River, perhaps to the exclusion of native fish. Sampling by McIntosh (McIntosh pers comm.) supports this conclusion.

Macroinvertebrates

The full aquatic survey results are set out in Appendix 3.

Aquatic macroinvertebrate communities are relatively simple but have a strong EPT[20] component. In the small side tributaries sampled, the mayflies *Nesameletus* and *Deleatidium,* and the stonefly *Acroperla* were abundant and numerically dominant. The

[20] EPT = Ephemeroptera, Plecoptera and Trichoptera (mayfly, stonefly and caddisfly)

samples from the main stem of the Porter River have very similar taxa but include the presence of Elmid beetle larvae and Chironomid larvae, which are associated with the increased long green filamentous algae, and fewer stoneflies.

Quality indicator biometrics (Table 5-7 below) show that the main stem has faunal communities indicative of excellent habitat and water quality.

Table 5-7: Summary of macroinvertebrates in Porter River system (March 2007 & April 2010)

	Lower Main Stem	Middle Main Stem
Species riches	17	20
EPT taxa %	70%	50%
MCI	132.9	116
QMCI	6.5	6.1
EPT% abundance	92%	70%

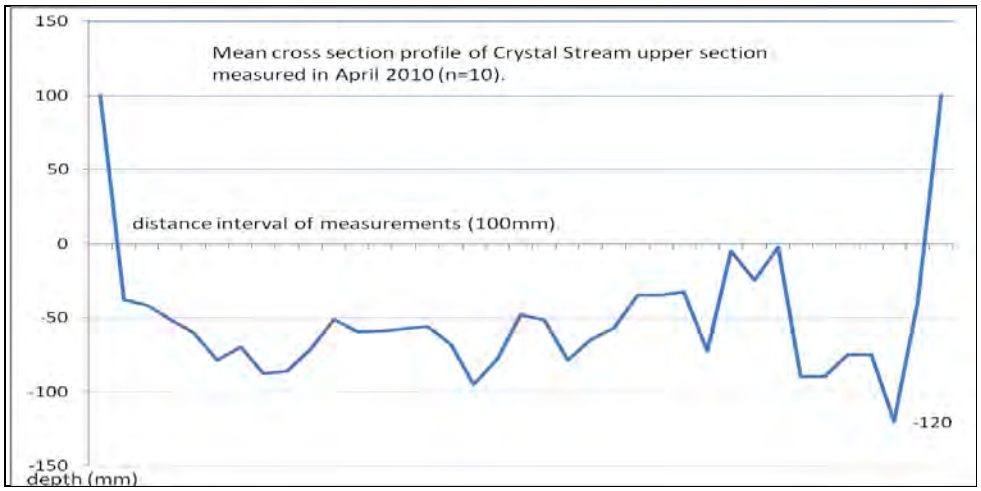
Common, very sensitive species (MCI score of 10) included the caddis *Zelolessica* species and the Stonefly *Zelandoperla* species and more rarely the stonefly *Stenoperla* species.

5.3.3 Crystal Stream and its headwaters

Physical features.

There are approximately 1.8 km of waterway in Crystal Basin. Crystal Stream is a permanent waterway that rises from spring flushes in the upper Crystal Basin and flows to a confluence with the Porter River. In the upper basin this stream has two branches (named True Left and True Right for purposes of these investigations). Sampling was carried out in Crystal Stream on three occasions: March 2007, March 2010 and April 2010. The locations of sampling points are shown on Figure 4-1.

The main stream is a single stem except where the gradient is very steep. In two places the single stem is broken into 2-4 smaller channels. At the 2007 survey, flow was estimated at around 40 L/sec (that is, a 1-1.5m wide stream, around 0.3m deep, flowing at 0.1-0.3m/s). The majority of the stream is relatively unconfined in a bare gravel-cobble-boulder valley without distinctive banks. (Photo 34) Flow estimates were repeated in 2010.



Combined flow in upper TR branch estimated to be around 150 L/sec

Figure 5-7: Mean cross-section profile of Crystal Stream upper section (April 2010)

An estimated 100 L/sec is contributed by the TL branch in Crystal Basin, giving the lower Crystal Stream an estimated flow of 250 L/sec.

Water quality

Only basic instrument recordings of water quality have been taken as part of the BML ecological investigations. The BML one-off measures (see Table 5-8) show a clear waterway with low conductivity, typical pH and cold waters (even for April). The dissolved oxygen at below 1mg/L is severely oxygen depleted. This may be a result of the abundance and total covering of algae and periphyton in shallow water. General observations together with data from CPG (2010b[21]) suggest that water quality is very good. Crystal Stream exhibits many traits assigned to the upper mountain class of Meredith and Hayward (2002)[22] – low nutrient status, high clarity and low (undetectable) hydrocarbon levels. In the late summer, long green filamentous algae were prominent in the upper catchment and there was heavy matting of brown algae in the flush zones.

It is also of note, that no events of high sediment loading were captured by monitoring.

Table 5-8: Water quality data, upper Crystal Stream, April 2010

Metric	Average
pH	6.94
Conductivity (ms/cm)	0.42
Turbidity	0.00
Dissolved oxygen (mg)	0.10*
Temperature (°C)	6.37

** 0.10 mg is a very low reading for dissolved oxygen; however no apparent cause was noted during site survey*

[21] CPG 2010b. *AEE accompanying resource consent applications to Environment Canterbury.* Prepared for Porters Ski Area Expansion project.
[22] AS Meredith & SA Hayward (2002): *An overview of the water quality of the rivers and streams of the Canterbury Region*. ECan Report no RO2/25

Furthermore, while it is acknowledged that heavy rain events can result in very turbid waters over short periods in this environment, generally water clarity is excellent and there is no evidence of sediments amongst the gravel lays in pools or quiet backwaters. Crystal Stream can be considered a moderately stable system with very low nutrient base, and typically clean and clear good quality water and little embeddedness.

The physical habitat was ranked using the accepted ARC rapid assessment technique[23] and scored 97 out of a maximum 120, or 80%.

Riparian vegetation

A narrow band (1m wide on average) of short riparian vegetation lines the stream up from the confluence with Porter River for much but not all of its length. Only in the lower valley are there distinct banks and these are vegetated in exotics: Lotus, cocksfoot, oxeye daisy, Yorkshire fog, *Festuca rubra*, and brown-top, and native *Festuca novae-zelandiae*, *Poa cita*, tutu and mosses. The riparian vegetation in the lower valley is largely exotic and offers little shade and has little value as a source of organic matter.

The upper valley, below the steep headwater flushes is less well vegetated. Centrally the riparian vegetation passes through a short tussock vegetation community before giving way to a largely barren rocky edge. The short tussock band includes *Poa cita, Acaena fissistipula, Epilobium macropus, Rumex acetosella, Hieracium lepidulum and Festuca rubra.*

Periphyton

Periphyton cover varies through the year. In 2007 sampling, periphyton was visible as a thin film over 30-40% of larger cobbles and boulder surfaces (indicating a healthy quantity, in late summer). This score represents a good quality physical habitat in a mountain stream. In late April 2010 however, cover was as high as 100% in parts of the stream.

Table 5-9: Periphyton sampling results, Crystal Stream (April 2010)

Location	Cover %	Average thickness (mm)	Type
Upper (TR) south spring	95	2	Matting orange, some black, minor brown filamentous
Upper north (TL) spring	100	4	Matting orange, brown and green periphyton with minor filamentous brown.
Spring confluence	50	<0.5	Very thin brown film on more stable large pebbles, cobbles and boulders
Mid Crystal Stream	100	4	Matting orange & browns

Fish

Fish sampling locations are shown on Figure 4-1.

[23] Maxted J., Evans B., and C. Keenan 2002. *Quality control report for habitat data, summer 2002.* Auckland Regional Council unpublished technical report. 3rd September, 2002.

While the 2010 sampling effort in the upper Crystal Stream did not return any species, the earlier lower valley sampling returned two species: small brown trout, and alpine galaxiids (*G. paucispondylus*) (Photo 35). All 12 of the alpine galaxiids caught (ranging in size from 8-12cm with one adult form) were in one reach (one location). Crystal Stream is noted as being an important source of native fish within the Porter River system, notably for alpine galaxiids (McIntosh pers com). Given the small size of the stream and the fish's behavioural adaptations, the alpine galaxiid is thought to be able to co-habitat with trout in this stream, although this may only be a temporary situation. It may be that the trout are not able to grow large enough (<150mm) to become capable of predating on the larger alpine galaxiids. No other native fish are known from the stream (or the main stem of the Porter River as high in the catchment as here).

Of note was the complete absence of fish above the middle reach of Crystal Stream. Prior to sampling, this area was considered likely to be the upstream limit for trout due to the increasing difficulty of passing the boulder cascades; it was therefore thought likely to have more native fish. However, no fish were recorded above this point in 2010.

Macroinvertebrates

Macroinvertebrate sampling locations are shown in Figure 4-1 and the results are presented in Appendix 3.

In terms of the aquatic invertebrate fauna, all the upper Porter River tributaries, including the Crystal Valley, have excellent alpine, clean water communities. The mayflies *Nesameletus* and *Deleatidium* and the stonefly *Acroperla* are abundant and numerically dominant. In March 2007, typically four caddis, three stonefly, four mayfly and three dipteran taxa were recorded from each 0.25cm^2 sample. Table 5-10 summarises the statistics from invertebrate samples.

Table 5-10 : Summary of macroinvertebrates in Crystal Stream (March 2007)

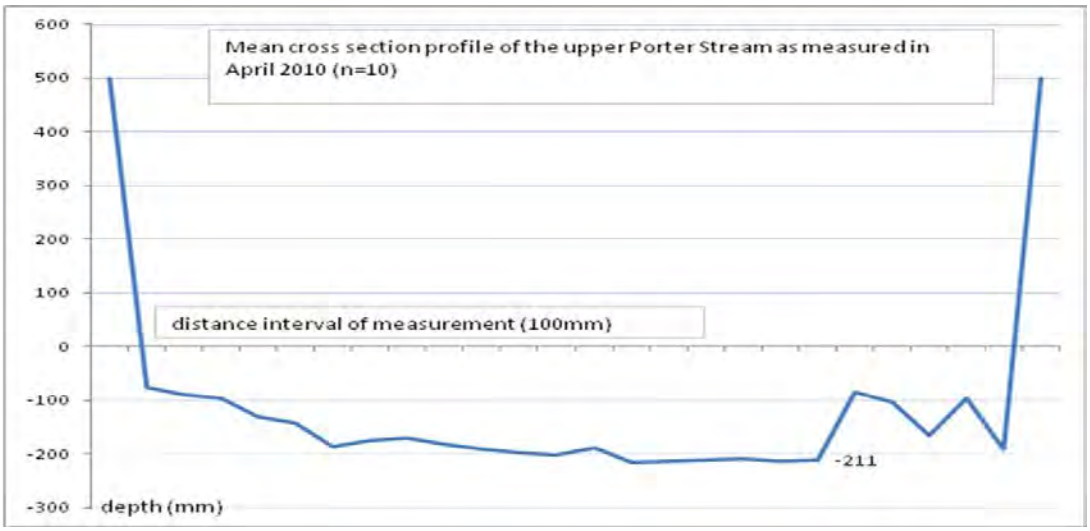
	Crystal Stream
Species richness	8
EPT taxa %	100%
MCI	157.5
QMCI	6.8
EPT% abundance	100%

While species richness was low, the macroinvertebrate community index is very high and the QMCI of moderate rank and reflects the numerical dominance of *Deleatidium*.

5.3.4 Porter Stream

This Stream runs from its spring-fed source just below the existing Ski Area ticket office area to join the Porter River just upstream of the Ski Area main Access Road crossing. Its flows are modified by existing takes for ski-field activities, and a dam/weir (related to local hydro-electricity production) restricts fish passage.

The stream falls steeply and comprises mostly riffles, cascades and small pools. (Photo 36)



Flow at cross section was measured at 208L/S (CPG May 2010)

Figure 5-8: Mean cross-section profile of Porter Stream, upper section (April 2010)

Water quality

No water quality readings were taken as part of the BML ecological investigations. General observations together with data from CPG (2010b[24]) suggest that water quality is very good. Porter Stream (like Porter River and Crystal Stream) exhibits many traits assigned to the upper mountain class of Meredith and Hayward (2002)[25] – low nutrient status, high clarity and low (undetectable) hydrocarbon levels. In the late summer, long green filamentous algae were prominent in the upper catchment and there was heavy matting of brown algae in the flush zones.

It is also of note, that no events of high sediment loading were captured by monitoring.

Riparian vegetation

The stream riparian vegetation is a variation on the *Dracophyllum* heath surrounding it but with taller specimens and frequent and large fern cover (*Polystichum vestitum*), tall red tussocks, taller *Dracophyllum* and *Aciphylla colensoi* var. *maxima* as well as occasional *Astelia nervosa*. Near its headwaters below the storage pond the riparian zone becomes short tussock grasslands and, as the bank gets lower, flush edge species can also be found. Near the existing Ski Area Access Road crossing and existing dam the edges have a notable exotic component of Lotus and cocksfoot, Yorkshire fog and buttercup. The riparian zones and 0.5m or more of free-board in the bank provides a substantial amount of shading cover, and this may be one reason why periphyton and algae levels were noticeably lower in Porter Stream than Crystal Stream.

Periphyton

Only a thin layer (2 mm) of brown periphyton (50%) was observed on stable boulders and cobbles amongst cascades and riffles. Much of the deeper run and pool reaches have sufficient shade that algae are restricted.

[24] CPG 2010b. *AEE accompanying resource consent applications to Environment Canterbury.* Prepared for Porters Ski Area Expansion project.
[25] AS Meredith & SA Hayward (2002): *An overview of the water quality of the rivers and streams of the Canterbury Region*. ECan Report no RO2/25

Fish
Fish sampling locations are shown on Figure4-1

Curiously no fish have ever been sampled from the Porter Stream. While it would appear that the lower steep section of the stream and the dam are likely to exclude trout, those obstructions would not keep out juvenile native fish which have the ability to climb.

5.4 Evaluation and significance of ecological features

5.4.1 Introduction

In this section the significance of ecological values described in previous sections are assessed and summarised. The assessments are based on criteria set out in a range of different systems. An overall conclusion on significance of parts of the core area is reached.

5.4.2 Selwyn District Plan

The Selwyn District Plan, under Appendix 12 Section E12.1, recognises seven criteria - 5 primary and 2 secondary ones for determining whether a site is a "significant area of indigenous vegetation or habitat of indigenous fauna" under Section 6(c) RMA. A site can be ranked low, medium or high for each criterion and its overall significance (and therefore consideration for protection) in terms of the Plan is determined according to how many of each rank it receives. The criteria are given in full in Appendix 5 to this report and summarised below:

Primary

- ***Representativeness*** – the degree to which current vegetation and fauna is representative of that which formerly occupied Selwyn District, measured in at the scale of ecological districts. The extent to which LENZ environments of the site are represented in protected natural areas should also be assessed. Through this criterion, SDC seeks to identify ecosystems that have suffered the greatest impact from human activities. As examples, the District Plan suggests that red tussock grasslands rate "high" while alpine snow tussock grasslands would rate "low".

  Note: The District Plan does not specify whether pre-European or pre-human condition should be taken as the baseline against which to measure former cover. In this Ecological District, large areas of beech forest cover were removed through human-induced fires and replaced by successional communities dominated by indigenous vegetation (e.g. Dracophyllum- tussock heathlands and grasslands.)

- ***Diversity and pattern*** – the level of diversity and or valuable natural ecological patterns. Through this, SDC wants to concentrate protection efforts on sites which offer the greatest potential to preserve ecological processes and interactions. As examples, the District Plan suggests that an intact gradient from wetland through shrubland forest would have a "high" ranking while a uniform patch of tussock grassland with exotic inter-tussock species would rank "low".

- ***Rarity/special features*** - supports any rare or threatened species; or the extent to which the site supports habitat and vegetation types or species that have been

reduced from their former extent (ie become rare); the extent of special and unusual ecological features is also a consideration. As examples, the District Plan suggests that sites containing species listed as "gradual decline" or higher would have "high" ranking; a site with no rare or threatened species and vegetation type common in the ED and elsewhere would rank "low".

- ***Naturalness*** – the extent to which the site has been modified directly or indirectly by human activities. As examples, the District Plan suggests that ungrazed alpine snow tussock grasslands with minor occurrence of exotic species would rank "high"; short tussocks in pasture on the foothills would rank "low".

- ***Ecological context*** – the degree to which an area of indigenous habitat or vegetation has links to other such areas, or contributes to the ecological significance of the immediate vicinity. This criterion takes into account the contribution of ecological functions of an area. As an example, the District plan suggests that wetlands with links to river systems would rank "high".

Secondary

- ***Size and shape*** – the degree to which size and shape contribute to the viability of the site. In general large, compact sites are more likely to be viable that small sites with irregular boundaries. As examples, the District Plan suggests that large areas of tussock grassland would rank "high"; scattered mountain beech in an area of pasture would rank "low".

- ***Fragility, threat and buffering*** – the degree to which a site is susceptible and resilient to specific threats and effects of threats. The degree to which it is buffered is also important. As examples, the District Plan suggests that tussock grassland with scattered wildling conifers would rank "medium"; ungrazed alpine snow tussock grasslands would rank "low" (that is, low level of threat and high level of resilience).

Table 5-11 summarises the assessment of each management unit against the criteria made for the purposes of this report. The assessments and the features considered in making the assessments are set out in Appendix 6 and outlined below:

A *Porter Basin – Not significant:*

- Presence of kea (which use a very wide area) = at risk species category /naturally uncommon
- Modification by Ski Area activities and structures, so former cover is not represented here
- Low species and community diversity

B, C *Porter Stream Valley including Porter Stream - Significant:*

- Good representative of successional vegetation following fire removal; vegetation types common in ED
- Good example of vegetation and habitat pattern in response to physical environmental gradients
- A high level of naturalness and quality of aquatic habitat in Porter Stream but no fish
- An excellent aquatic macroinvertebrate fauna developed in the apparent absence of predatory fish
- Well-developed riparian corridor different from the surrounding cover and linking Porter Basin with Porter River Valley

- Area modified by localised Ski Area activities and structures including dam/weir

D, E, F Lower Porter River Valley including Lower Porter River and Porter River hillslopes – Not significant:

- Matagouri/short tussockland with high weed component now in place of former cover
- Lower valley modified by former grazing, and Ski Area Access Road crossing and operation; trout but no native species in River
- Susceptible to weed invasion

G Southern terrace – Not significant:

- Representative of successional vegetation following fire removal; vegetation types common in ED
- High spp diversity, but low diversity communities
- Small amount of red tussock in gully one of few areas of red tussock in study area
- Vegetation has high proportion native species but weeds present
- Area locally modified by tracks and buildings associated with Ski Area; weeds, rubbish
- Significance difficult to assess due to being intact but secondary vegetation cover

H Crystal Basin- Significant

- Communities that are not unique to the Craigieburn Range, but Crystal Basin appears to be one of the largest. Helicopter flights with short landings have confirmed that there are at least 20 other similar basins along the range which contain similar features to those noted at Crystal Basin
- Unusually high spp and community diversity for an alpine area
- Naturally uncommon scree and rock outcrop plants providing a distinctive element of the flora
- *Schizeilema pallidum* is a threatened species in the 'naturally uncommon' category (de Lange, 2009) and was recorded on a damp shady bank above the alpine watercourse (True Right Branch Crystal Stream)
- Highly specialised plants occupying this habitat that are sparse and cryptic and therefore require very large areas to sustain populations
- Alpine watercourse flushes/seeps that only occur in some of the cirque basins along the Craigieburn Range (There are no alpine flushes in the Porters Ski Area basin or the small, unnamed basin to the south of the Ski Area). This association occupies the most fertile sites in the alpine zone
- Very high level of naturalness
- Presence of kea (which use a very wide area) = at risk species category /naturally uncommon
- Fragile plant communities due to high altitude and other environmental stressors

I, J Crystal Stream Valley and Crystal Stream - Significant

- Representative of likely former cover of stream /riparian at this altitude in ED; valley side representative of former cover

- High spp and community diversity reflecting gradients
- Presence of one of only two persistent native fish populations in the wider Porter River system
- A high level of naturalness with few introduced species in 50% (upper section); very few exotic plants in upper valley
- Emergent spring flushes with intact vegetation in specialist natives
- Unmodified waterway/riparian vegetation from alpine flushes at source to main stem Porter River
- Susceptible to weed dominance through natural flood disturbance and link into Porter River Valley

K Northern terrace – Not significant

- Representative of intact successional vegetation following fire removal; vegetation types common in ED
- High indigenous species diversity (richness); low community diversity due to simple physical environmental pattern
- An abundance of young kanuka and manuka which is unusual (for the current location)
- A high level of naturalness following burning, with few introduced species, although *Pinus contorta* is present and needs control
- Significance difficult to assess due to being intact but secondary vegetation cover

Table 5-11 summarises the assessment of these different criteria by terrestrial management unit.

Area	**Significance assessment**
A Porter Basin	Not significant
B Porter Stream Valley, C Porter Stream	Significant
D Lower Porter River, E Porter Porter River Valley, F Porter hillslopes	Not significant
G Southern Terrace	Not significant
H Crystal Basin	Significant
I Crystal Stream Valley, J Crystal Stream	Significant
K Northern Terrace	Not significant

Table 5-11: summary of site assessments against Selwyn District Plan criteria

5.4.3 LENZ analysis

A simple LENZ analysis has been carried out for this assessment to assess the broad patterns across the site in the context of Craigieburn Ecological District.

Figure 5-9 shows the distribution of LENZ level IV environments across the site and illustrates that most of the study area falls into Type P1.2d (Central Mountains)(Leathwick *et al, loc cit*). Environment P1 is very extensive throughout the South Island and is characterised by cold climate, very low to non-existent annual water deficits, well-drained/ low nutrient soils and steep terrain. Type P1.2d represents the mountains east of the Southern Alps with slightly warmer temperatures, and is well-represented in protected areas within the Ecological District.

The Northern and Southern Terraces fall into Type E1.4c (Central dry foothills). Environment E4 is also widespread across foothills in the east of both North and South Islands. Type E1.4c is characterised by cool climate, low annual water deficit, and well-drained soils of moderate fertility. While Type E1.4c is common in the ED (and widespread across adjoining EDs) it is only moderately well-represented in Korowai-Torlesse and Craigieburn Conservation Parks. At a broad level, Type E1 characteristically supports beech forest; however, the terraces within Porters are covered in secondary shrubland.

Figure 5-10 shows the that the LENZ level IV environments found across the Plan Change area are not considered "Threatened" – they are in fact characteristic of the eastern ranges of the Alps in this area.

"Representativeness" is viewed by ecologists in two primary ways – either to mean the extent of different vegetation types remaining relative to a historical extent, i.e. how well is a vegetation/community type still represented spatially in an ED (or other spatial scale) today compared to that predicted pre 1840. Alternatively, to mean the extent to which the condition and species composition of an area represents a naturally occurring historic type (i.e. the species and quality are as expected for a particular vegetation community type). Both elements are important in an analysis of "significance" which "representativeness" is a criterion.

To examine the current extent versus the historic a commonly employed tool is the combination of the LENZ data base with soils and Land Cover data base (LCDBII). Using GIS tools this allows a prediction of the historic extent or cover of a vegetation community and allows calculation of current and historic cover. The process requires reasonably in-depth field knowledge to support the estimate of current community extent as often the LCDB and other remote data is not accurate and a quality and composition check is required for a thorough assessment.

This more complex representativeness analysis has not been undertaken for the whole Plan Change area or the management units for two reasons. The first is that, from information in the PNA Report (Shanks *et al*) and knowledge of the DOC estate in the ED, it is apparent that vegetation and habitat types found in the Plan Change area are well represented in the ED and well protected. The second is that the Selwyn District Plan requires only consideration of the extent of different LENZ environments within protected areas.

Rarity of the Physical Environment and Vegetation in Crystal Basin at the National Scale

Williams, Wiser, Clarkson & Stanley (2007)[26] described New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. In this review of habitats in New Zealand, acidic rock screes are, at a national level, potentially rare (i.e. a naturally rare habitats). They report screes derived from acidic rocks raw/acidic rock/gravel/cobbles/talus/ in both inland and alpine situations on open land such as those at Porters Pass, Canterbury as an example of a naturally rare system.

The scree habitat type in Crystal Basin has been assessed in its local context in determining the "ecological value" of Crystal Basin. Figure 5-11 illustrates that there are at least 19 other basins along the Craigieburn Range with similar aspect and vegetation, starting with the Ryton Basin in the south through to the Mt Cheeseman South Basin. Photographic comparison (on Figure 5-11) shows that the Crystal Basin and the stream arising from it has

[26] Williams, Wiser, Clarkson & Stanley (2007): New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. NZ Journal of Ecology 2007 31(2), pgs 119-128.

a pattern of communities repeated along the Craigieburn Range, However, it appears that the Crystal Basin is the second largest example of this basin type between Porter River and Castle Hill.

5.4.4 Protected areas and Recommended Areas for Protection (RAPs)

The site was not surveyed in the 1990 PNA survey (Shanks *et al*).

Two areas, Ryton Basin to the immediate south (RAP 1), and Mt Cheeseman, (RAP 3) to the north were identified as RAPS. Ryton Basin holds physical, geological and floral patterns typical of upper basins, very similar to Crystal Basin and also unmodified. Mt Cheeseman is similar and also has broad leaf shrub and beech forest communities. These two RAPs total 3380 ha in area. In total, 15,010 ha of alpine-sub alpine communities were identified in the PNA as worthy of protection (i.e. within an RAP), implying a substantial quantity of the same habitats as found in the study area are recognised and valued. All of the areas recognised were representative, had high diversities, high naturalness and many had specific fauna of conservation value but low threat status.

5.4.5 Aquatic Value Assessment

There are no formalised criteria or systems for assessing the significance of a waterway, other than to note that they are/or are not in a "natural state" as per the Waimakariri River Regional Plan and Natural Resources Regional Plan. In making assessments of "significance" under SDC criteria for this proposal, the waterways have been considered as part of their surrounding landforms and hence management units.

The Crystal Valley Stream, Porter Valley Stream and the Upper Porter River systems are largely without land use contamination, have good to excellent aquatic benthic fauna, are in relatively natural condition, and contain some native fish. Trout on the other hand are pervasive in the Porter River and diminish the potential values and indigenous biodiversity of the waterways.

An overview of aerial photographs and limited helicopter fly-overs of the area suggest that there are few sub-alpine headwater valleys of similar nature in tussock-heathlands of similar size in the Torlesse or Craigieburn Ecological Districts. However, there are many other alpine streams and rivers with sub-alpine headwaters in native catchments (largely in beech forest)

By running an analysis on river type using the River Environment Classification (NIWA 2004[27]) it has been possible to compare all river types in the Torlesse Ecological District. This analysis shows that the Upper Porter River is one of six similar types in the ED (Figure 5-12). It is one of six that share climate, source of flow, parent geology, land-cover, network position and valley landform; and is of an equivalent length to the other five.

Those closest are the upper headwaters of the Kowai River (above SH 73) and the upper reaches of Stair Case Gully. While not unique the Upper Porter River is one of only a few rivers in the ED which remain in comparatively natural condition (making no biotic comparisons).

[27] T Snelder, B Biggs, M Weatherhead (2004): *New Zealand River Environment Classification User Guide.* Ministry for the Environment, Wellington.

Thus the Porter River environment is not common in the ED. The current aquatic habitat condition in the upper river is good; trout however, are common and adverse to the native fishery. The native fishery is almost non-existent while the invertebrate diversity is good and representative of the sub-alpine type. The riparian condition however, below the Ski Area Access Road is poor and degrading through dominance of exotic plants. While the river in terms of the water quality and benthic invertebrate fauna is "natural state" and representative, it is not a significant waterway for native fish other than for its potential and as a corridor. The section of river adjacent to the site is not likely to be a significant trout spawning area or young fish habitat. It is concluded that the aquatic system including the riparian area is not a significant faunal habitat.

The Crystal Valley Stream, on the other hand, has high quality water, natural physical habitat, representative benthic fauna, some trout but also one of the few stable populations of alpine galaxiid in the catchment. It is also a "natural state" waterway and it is concluded that this river is considered to be a significant aquatic faunal habitat (largely because of the alpine galaxiid) with significant representative habitat.

The Porter Stream is also a "natural state" waterway and also has high physical habitat quality and high benthic representative values. There is a total absence of fish in this waterway and that has allowed the development of an invertebrate fauna in the absence of typical fish predation. For the scientific value associated with the absence of fish, and its representative value (benthos and riparian) and supported by its habitat quality, this tributary is also considered to be ecologically significant for the purpose of this assessment.

5.4.6 Conclusion

Through application of the Selwyn District Plan criteria, the management units of Crystal Basin/ Valley and the Porter Stream /Valley are considered areas of significant indigenous vegetation and habitat for indigenous fauna. Within those management units there are areas of higher and lower ecological value.

Crystal Stream is a significant waterway in terms of its naturalness and fauna although there is weed incursion into the lower valley. Porter Stream is also significant in terms of its unusual habitat, community and quality of condition although it is dammed and parts of the valley are affected by Ski Area activities.

The Southern and Northern terraces are not considered significant. While in reasonable condition and partially representative of the heathland/shrubland successional stage following burning of beech forest, they do not offer to the same degree the biological diversity values of the wider area.

The Lower Porter River Valley is not considered significant due to weed dominance while the Porter River mainstem alone is not, due to trout dominance, considered to be a habitat of significance for indigenous fish.

6.0 Assessment of Effects on habitats, species and ecosystems

6.1 Introduction

In this Section, the potential and actual effects of activities anticipated through the Plan Change on ecological features and values, and the proposed mitigation of adverse effects, are described. Effects at design, construction and operation stages are covered.

As part of the development of the proposals put forward as part of this Plan Change application, adverse effects have been minimised and positive outcomes maximised by integrating ecological values into the master planning and subsequent decision-making. Where significant effects have been avoided through design modifications, these are noted since they provide an indication of the way in which this project has been designed within its ecological framework and the capacity of its surroundings.

Residual adverse design effects and further potential effects at construction and operation stages are discussed here, and avoidance, remedy or mitigation proposed. At the detailed design stage, effects on specific places, habitats and areas of vegetation will be clarified, and site-specific mitigation developed as part of earthworks and other consenting processes. In this report, the generic effects and mitigation opportunities are discussed. Site specifics are discussed where these are known.

In one location (Crystal Basin) the residual adverse effects of the proposed development on ecological values cannot be immediately avoided, remedied or mitigated, and further work is being undertaken to address this. Although the amount of land-shaping and tracking has been reduced through the design development phases, there will still be loss of significant vegetation and habitats within Crystal Basin.

In considering effects on ecological values, the RMA terms have been interpreted as having the following meaning:

Avoid – an activity or feature of the proposal is taken out of the project to avoid adverse effects on areas, habitats or species of high ecological value

Remedy – the adverse effects of an activity or feature of the proposal are redressed or remedied by actions or methods directed at reducing the impact of the activity. Remedy is usually carried out at the site of the activity or its direct effect.

Mitigate – the adverse effects of an activity or feature of the proposal are lessened or mitigated by actions or methods carried out to counter the adverse effects. Mitigation may be carried out at the site of the activity or elsewhere.

Where effects are unable to be completely avoided, remedied or mitigated, it may be appropriate to consider environmental compensation. The Plan Change provides for this.

The activities and their potential adverse effects occur in various locations across the site (as provided for in the Plan Change). In this Section of the report, the following broad groupings are used.

Four broad activity areas, based on the similarity of the effects on ecological values of these activities have been identified for descriptive purposes:

- Earthworks/soil disturbance;
- Water takes/ discharges;
- Snow management; and
- Business, residential and recreation activities.

These are discussed in general terms for the Plan Change area in Section 6.2.

The potential effects that these activities may have can also be grouped for a generic description in Section 6.3:

- Effects on soil structure, cover and pattern
- Effects on indigenous species or populations at specific locations
- Effects on the quality/ condition of habitat or vegetation; and/ or
- Effects on the quantity/area of habitat or vegetation

Avoidance, remedy and mitigation opportunities are discussed in Section 6.4:

- Management Plans
- Master plan, route or site design refinement
- Controls, management or protection during the construction stage
- Long-term operational control, management or protection.

In Section 6.5, the effects of specific activities in specific places (and proposed mitigation) are described, based on the areas and ecological features described in Section 5.

6.2 Activities

6.2.1 Earthworks/ soil disturbance

The developments proposed through the Outline Development Plan will require large earthworks and areas of soil disturbance over the development period, as well as some ongoing soil disturbance as part of day to day operations. Consequently the activities will not occur simultaneously – the anticipated staging is shown in Figure 6-1. The activities that may have effects on the ecological values of the area are considered to be:

- Cut and fill
- Tracks, trails and road construction or upgrades, with deposition and/or storage of spoil
- Village construction including residential and commercial buildings, lift /ski facilities, car parks, and associated infrastructure
- Services and structures/utilities outside the Village – shelter/emergency huts, pump sheds, toilets, underground cabling or pipe-laying, water-take structures; waste-water disposal structures, water storage structures;
- Towers/pylons for gondola, chair lifts, power, tele-communications
- Bridges and culverts for vehicles and skiers; including temporary construction structures
- Snow area shaping and contouring – particularly in the proposed new Ski Area

- Grooming on thin snow – particularly in proposed new Ski Area

6.2.2 Water takes/diversions/discharges

Water takes and discharges would be subject to resource consents and are described in detail in CPG 2010. The effects of these activities are operational. The effects associated with building the take structures, piping and delivery are considered as construction earthworks' effects.

It will be necessary to take more water from permanent or ephemeral watercourses than is currently taken for Porters Ski Area activities. In selecting the location(s) and quantities of takes aquatic ecological values have been considered, so that adverse effects have been minimised. There will be no takes from the Porter River or Crystal Stream.

Water will be discharged only to land and this is made possible by the porous nature of the soils and gravels on the site (CPG 2010). Stormwater from the proposed Village will (under normal conditions) be discharged to land around individual properties and in major events directed to a secondary flowpath through an existing red tussock gully. Stormwater from impervious areas outside the Village (e.g. Porters Basin café) will be discharged to ground after treatment.

Waste water will be treated through a combination of primary at-source effluent treatment and community secondary treatment producing high quality effluent for discharge to land through an irrigated area on the Northern terraces. This area will be planted in *Dracophyllum* and kanuka shrubland with some mountain beech, red tussock and other native species appropriate to the location and micro-sites. Waste water from all parts of the Ski Area will be piped into this system.

In locations where filling of ephemeral watercourses is proposed, it may be necessary to pipe flows. The ecological values of ephemeral waterways must be considered when doing this.

6.2.3 Snow and ice management

Snow management activities currently occur in Porters Ski Area. These will be extended as the proposed developments take place. For purposes of this discussion, snow management is an operational effect and includes:

- Snowmaking, using snow guns, stored water and nucleating agent(s) – this activity is currently consented and occurs in Porters Basin .
- Snow grooming – regular use of groomers to compact and flatten the snow surface
- De-icing – on occasions de-icing chemicals may be used on the skifield and by residents
- Avalanche control activities by use of hand-thrown explosives (either on foot or from helicopter and/or from fixed avalanche control devices)
- Snow clearing from the Village Base Area and road

6.2.4 Business, residential and recreation activities.

Activities in this category are essentially those related to the presence of large numbers of people in an area which currently experiences only occasionally large numbers.

Included in this category are:

- Skiing/snowboarding
- Hiking/walking/tramping
- Mountain biking
- Other future potential recreation activities on the site (e.g. paragliding)
- Vehicle use for access to Village
- Vehicle use for Ski Area management
- Solid waste management
- Creation of residential and commercial area

6.3 Effects

6.3.1 Effects on soil structure, cover and pattern

The soils on the site are described in CPG (2010). They are fragile and porous, susceptible to erosion by wind and water.

The indigenous vegetation and habitats found on the site reflect these underlying soil characteristics and patterns. Any changes to soils will affect invertebrates within the soils as well as vegetation and habitats. In particular activities which result in:

- Increased instability
- Reduced soil cover/soil loss
- Breakdown of structure and/or
- Compaction

could have an adverse effect on vegetation, habitats and the species using them.

Table 6-1 identifies the activities which could have effects on soil characteristics.

Table 6-1: Generic Activities and potential effects on soils.

Activity	Effect
Cut and fill	Soil loss, breakdown structure
Tracks, trails and road construction or upgrades, with deposition and/or storage of spoil	Increased instability Reduced soil cover/soil loss Breakdown of structure and/or Compaction
Village construction including residential and commercial buildings, lift /ski facilities, car parks, and associated infrastructure	Reduced soil cover/soil loss Breakdown of structure and/or Compaction
Services and structures/utilities outside the Village – shelter/emergency huts, pump sheds, toilets, underground cabling or pipe-laying, water-take structures; waste-water disposal structures, water storage structures;	Reduced soil cover/soil loss Breakdown of structure and/or Compaction
Towers/pylons for gondola, chair lifts, power, tele-communications	Reduced soil cover/soil loss Breakdown of structure and/or Compaction
Bridges and culverts for vehicles and skiers; including temporary construction structures	Reduced soil cover/soil loss
Snow area shaping and contouring – particularly in proposed Crystal Basin Ski Area	Increased instability Reduced soil cover/soil loss Breakdown of structure and/or Compaction
Grooming on thin snow – particularly in proposed Crystal Basin Ski Area	Increased instability Reduced soil cover/soil loss Breakdown of structure and/or compaction of soils.

6.3.1 Effects on indigenous species or populations at specific locations

While much of the development and construction of the proposed expansion will affect ecological values at the landscape, habitat or vegetation cover scale, some activities will have effects on specific species of plant or animal. These may be as a result of the nature of the activity, its location or the sensitivity of the species. For example, some plants are found only in very localised habitats such as rocky outcrops. E.g. *Schizeilema pallidum.*

Kea are known to be affected by human use of their habitat- they are attracted to general rubbish, food waste, vehicles and general activity (including construction sites). This can lead to them becoming accustomed to being fed or finding unsuitable food. There is recent evidence of lead poisoning in kea as a result of eating lead flashing on old hut roofs or lead shot used for predators (which kea then eat). Kea will also eat material from uncontrolled construction waste areas (e.g. plastics). They can also become a nuisance around habitation or recreation areas, leading to demands for their removal. There is considerable information about risks to keas and options to minimise risks in alpine recreation areas as well as ongoing research into their distribution.

The native alpine galaxias (*Galaxias paucispondylus*), found in Crystal Stream is one of only two populations of native fish known in the Upper Porter River system. Other waterways either have no fish or only trout, even though their habitat quality is good. This suggests that native fish populations are not at full potential in the area.

In particular activities which result in:

- Indigenous species loss or reduction in local population size
- Threat to health of individuals or populations of indigenous species and/or
- Weed or predator competition

could have an adverse effect on species/populations. Conversely activities which increase indigenous species numbers/populations, improve their health or reduce weed competition have beneficial effects.

Table 6-2 identifies the activities which could have effects on indigenous species..

Table 6-2: Generic Activities and potential effects on indigenous species.

Activity	Effect
Cut and fill	Indigenous species loss or reduction in local population size Weed competition
Tracks, trails and road construction or upgrades, with deposition and/or storage of spoil	Indigenous species loss or reduction in local population size Weed competition
Village construction including residential and commercial buildings, lift /ski facilities, car parks, and associated infrastructure	Indigenous species loss or reduction in local population size Weed competition Poisoning of kea
Services and structures/utilities outside the Village – shelter/emergency huts, pump sheds, toilets, underground cabling or pipe-laying, water-take structures; waste-water disposal structures, water storage structures;	Indigenous species loss or reduction in local population size Weed competition Poisoning of kea
Towers/pylons for gondola, chair lifts, power, tele-communications	Indigenous species loss or reduction in local population size Weed competition
Bridges and culverts for vehicles and skiers; including temporary construction structures	Indigenous species loss or reduction in local population size Weed competition
Snow area shaping and contouring – particularly in proposed new Ski Areas	Indigenous species loss or reduction in local population size Threat to health of individuals or populations of indigenous species and/or Weed competition
Grooming on thin snow – particularly in proposed new Ski Areas	Indigenous species loss or reduction in local population size Threat to health of individuals or populations of indigenous species and/or Weed competition
Water takes	Threat to health of individuals or populations of indigenous species Threat to kea (drowning in storage tanks)
Water discharges (wastewater and stormwater)	Threat to health of individuals or populations of indigenous species
De-icing – on occasions de-icing chemicals may be used on the skifield and by residents	Threat to health of individuals or populations of indigenous species
Hiking/walking/tramping	Threat to health of individuals or populations of indigenous species
Mountain biking	Threat to health of individuals or populations of indigenous species
Other potential recreation activities on the site (e.g. paragliding)	Threat to health of individuals or populations of indigenous species

	Increased awareness of indigenous biodiversity values on Ski Area and wider area
Solid waste management	Threat to health of individuals or populations of indigenous species Threat to kea
Creation of residential and commercial area	Threat to health of individuals or populations of indigenous species - lighting
Habitat enhancement programme	Improve available habitat and health of target populations
Weed and pest control	Improve health of indigenous species; reduce risks to indigenous species (plants, kea, lizards)
Monitoring programme	Improve available habitat and health of target populations

6.3.2 Effects on the quality/ condition of habitat or vegetation

The quality of vegetation cover or habitat is related to there being a high level of naturalness. This is indicated by factors such as low level of introduced plants or animals, unmodified processes (e.g. flow regime) and an intact area that is large enough to support healthy populations of the plants and animals that naturally occur there. It is not practical to measure “habitat quality” empirically, but it can be assessed during site surveys.

Quality of habitat or vegetation cover could be adversely affected by a range of construction and operational activities. However, positive effects on quality can be obtained through restoration, enhancement and revegetation programmes, pest management and cessation of activities that have an adverse effect.

Table 6-3 identifies the activities which could have effects on habitat or vegetation quality.

Table 6-3: Generic Activities and potential effects on habitat or vegetation quality.

Activity	Effect
Cut and fill	Fragmentation Introduce weeds Sediment run-off Contaminant run-off
Tracks, trails and road construction or upgrades, with deposition and/or storage of spoil	Fragmentation Introduce weeds Sediment run-off Contaminant run-off
Village construction including residential and commercial buildings, lift /ski facilities, car parks, and associated infrastructure	Fragmentation Introduce weeds Sediment run-off Contaminant run-off Introduction pest animals
Services and structures/utilities outside the Village – shelter/emergency huts, pump sheds, toilets, underground cabling or pipe-laying, water-take structures; waste-water disposal structures, water storage structures;	Fragmentation Introduce weeds Sediment run-off Contaminant run-off
Towers/pylons for gondola, chair lifts, power, tele-communications	Fragmentation Introduce weeds
Bridges and culverts for vehicles and skiers; including temporary construction structures	Fragmentation Introduce weeds Sediment run-off Contaminant run-off
Snow area shaping and contouring – particularly in proposed new Ski Area	Fragmentation Introduce weeds Sediment run-off Contaminant run-off
Grooming on thin snow – particularly in proposed new Ski Area	Introduce weeds Compaction and freezing under groomed snow.
Water takes	Modify flow regimes Change physical habitat
Water discharges (wastewater and stormwater)	Introduce weeds

	Sediment run-off Contaminant run-off Change nutrient status soil/water
De-icing – on occasions de-icing chemicals may be used on the skifield and by residents	Contaminant run-off
Snow making	Contaminant run-off
Hiking/walking/tramping	Trampling, compaction Introduce weeds Introduce pests
Mountain biking	Trampling, compaction Introduce weeds Introduce pests
Other potential recreation activities on the site (e.g. paragliding)	**?** Trampling, compaction Introduce weeds Introduce pests Increased awareness of indigenous biodiversity values on Ski Area and wider area
Vehicle use for access to Village	Introduce weeds
Vehicle use for Ski Area management	Introduce weeds
Solid waste management	Introduce weeds Introduce pests
Creation of residential and commercial area	Introduce weeds Introduce pests
Habitat enhancement programme	Improve available habitat and health of target populations
Weed and pest control	Improve health of habitats/vegetation
Monitoring programme	Improve available habitat and health of target populations

6.3.3 Effects on the quantity/area of habitat or vegetation

The quantity or area of habitat or vegetation cover can be measured. Aerial photography and surveys can be used to map terrestrial areas while the physical characteristics of waterways can be assessed to determine the habitat types within any system.

Given the state of New Zealand's Biodiversity (DOC/ MfE 2000 *loc cit)* any loss of quantity of good quality indigenous vegetation or habitat for indigenous fauna is to be avoided. Activities that could reduce quantity of terrestrial areas as a result of the development provided for in this Plan Change are the earthworks and associated cut/fill works and deposition of spoil. A small area of ephemeral aquatic habitat may be lost through infilling or piping.

Table 6-4 identifies the activities which could have effects on habitat or vegetation quantity or area.

Table 6-4: Generic Activities and potential effects on habitat or vegetation quantity or area.

Activity	Effect
Cut and fill	Removal or burial
Tracks, trails and road construction or upgrades, including bridges, with deposition and/or storage of spoil	Removal or burial
Village construction including residential and commercial buildings, lift /ski facilities, car parks, and associated infrastructure	Removal or burial
Services and structures/utilities outside the Village – shelter/emergency huts, pump sheds, toilets, underground cabling or pipe-laying, water-take structures; waste-water disposal structures, water storage structures;	Removal or burial
Towers/pylons for gondola, chair lifts, power, tele-communications	Removal or burial
Bridges and culverts for vehicles and skiers; including temporary construction structures	Removal
Snow area shaping and contouring – particularly in proposed new Ski Area	Removal or burial
Grooming on thin snow – particularly in proposed new Ski Area	Removal or burial
Water takes	Change in habitat type through removal of water
Monitoring programme	Improve available habitat and health of target populations
Cessation selected water takes	Creation of aquatic habitat

6.4 Avoidance, remedy and mitigation

6.4.1 Avoidance and mitigation through design

The development is in the early stages of detailed design, appropriate to meet the requirements for the Plan Change and resource consent applications at this stage. As part of this early design, the findings and recommendations of the Interim Ecological Report were taken into consideration, and an ecologist was part of the project team.

Through inputs and integration to date the following steps have been undertaken:

- Ryton Basin was excluded from the development area proposed initially for ecological and land management reasons. Ryton Basin has high ecological values, because it contains unusual plant communities and has no introduced plants.

- The Village layout and stormwater treatment system recognises the value of "red tussock gully" in the proposed Village area, and the opportunity to enhance vegetation cover it while creating a secondary flow path for stormwater.

- Buildings/structures in the village will be set back from waterways by between 5 and 10m. On flat land, 5m will be adequate, but on steeper land the setback should be 10m.

- No water takes are proposed from the Porter River. This recognises its importance as a system supporting native fish in the presence of trout – it is likely that if the amount of water in the River were reduced, native fish would not survive.

- No water will be taken from Crystal Stream recognising its importance as a source for native fish in the Porter River system; the existing take will be removed once an alternative source is established

- The hydro-electric system will be removed from Porter Stream

- A *Dracophyllum*-kanuka revegetation area has been identified on the northern terraces. This will reflect the former natural cover of this area, while assisting in nutrient uptake from waste water.

- The access track and ski trail into/out of Crystal Basin have been aligned to avoid alpine spring flush area

- There will be no private gardens or obvious marking of property boundaries in the village, so that the integrity of vegetation cover remains.

Further mitigation of effects of earthworks and structures can be achieved through refinement of routes and locations during the detailed design stages.

6.4.2 Mitigation during construction

Construction of the structures provided for in this Plan Change is likely to take place over an extended period. However, the construction stage is one where the greatest potential

adverse effect on indigenous habitats, vegetation cover and species could occur. Mitigation of effects can be through application of standard /best practice procedures as well as site-specific practices which will address the issues of this location and environment.

Protection and controls at the construction stage should include:

- Carrying out pre-construction surveys of lizards and invertebrates at specific sites to determine their vulnerability; following up with trap and transfer as appropriate. These groups of animals are difficult to quantify and/or identify so that it is more practical to focus investigations on areas which are most likely to be affected by proposals.

- Use of existing tracks by vehicles during construction; use of helicopters where possible to access locations not on tracks

- Ensuring bridge and culvert design provides for indigenous fish and invertebrate passage

- Fencing off 5-10m riparian buffers and any substantial areas of indigenous vegetation which are to remain undisturbed by works (with vehicle-proof-fencing)

- Minimising the removal of indigenous vegetation at any stage and throughout the site.

- As soon as planting conditions are suitable, carrying out revegetation with native species in “red tussock gully”, northern terraces, snow play area, adjacent to all buildings and on any sites that are to remain undeveloped for more than 3 months.

- Carrying out aquatic habitat enhancement in Porter Stream and Crystal Stream as soon as conditions are suitable.

- Implementing/following Management Plans as set out in section 6.4.4

It should be noted that at the altitude of the proposals, plants are generally slow-growing and environmental conditions are difficult. Consequently, all revegetation will be relatively slow and relatively high plant losses may be anticipated.

6.4.3 Mitigation during operation

The operation of the Village and Ski Area facilities, and associated recreation activities have potential effects on ecological values. Many of these can be managed to avoid or minimise adverse effects. In the long term, benefits from revegetation, enhancement and sustainable management of the land will accrue.

Mitigation activities during operation include:

- Convenants on high value ecological areas, with associated ecological management to protect them from further development disturbance.

- Adoption of best practice snowmaking and snow grooming techniques

- Undertaking a monitoring programme for ecological factors and incorporating social and wider environmental monitoring. The monitoring programme will include

management response and review components. Monitoring is addressed in Section 9 of this report.

- Adoption of residual flows and flow regime in waterways which is based on ecological requirements.
- Adoption of best practice treatment for all discharges
- Adopting controls on lighting with low level and low intensity lights
- Maintaining the riparian buffer in healthy, vegetated state and maintaining all indigenous vegetation cover across the site.
- Prohibiting pets or introduced animals on the site, except for working dogs (e.g. seeing eye dogs, avalanche rescue dogs).
- Placing covenants on private property titles addressing environmental matters such as introduced plants, pets.
- Carrying out or enabling research activities related to effects of recreation and residential development on alpine ecosystems.
- Addressing residual adverse effects

6.4.4 Management Plans

It will be difficult to integrate all environmental aspects of site design, staged construction and operation without clear documentation. Many recognised standard documents exist which can be applied to the area (with some modification to suit local conditions), for example Environment Canterbury's Erosion Control and Sediment Management Guidelines, ARC TP 21 stormwater guidelines.

However, documents specific to this site and development will be needed to set out the management required for the protection and enhancement of ecological values over the lifetime of the Ski Area. The following is a list of suggested topics that could be addressed through "Management Plans" or similar documents. Some will be required by law (e.g. Hazardous Substances legislation); others will be needed to manage effects of activities (e.g. kea management). The topics could be combined reduce the number of documents needed and achieve better integration. A "Porters Ski Area Environmental Management Plan" (PSEMP) may be an appropriate "umbrella" plan.

- Porters Ski Area Environmental Management Plan (EMP)

Management topics:

- Weed and pest management
- Recreation management
- Erosion control and sediment management
- Stormwater management
- Kea management
- Crystal Basin habitats management
- Waste water management
- Land and habitats management
- Hazardous substances management

6.5 Site-specific effects and mitigation of adverse effects on ecological values

In this Section the effects of specific activities in specific places and proposed mitigation of adverse effects are described, based on the areas and ecological features described in Section 5. The effects and mitigation were described in general terms in the previous sections, and here they are outlined at the site level to the extent appropriate for the Plan Change.

It is assumed that all works in the proposed development will be subject to an Erosion and Sediment Control Plan; and that storage and use of fuels and other potentially hazardous substances will be subject to Hazardous Substances Management Plans and legislation as appropriate. Similarly all earthworks and movement of vehicles between Porters and other sites will create opportunity for weed invasion here, especially at the lower altitudes. A Weed Management Plan should be drawn up to identify ways of avoiding weed spread into the site (for example by having vehicle washing facilities on the access road) and for monitoring and actively managing problem weeds within the developed area. It may be appropriate to combine this with documentation for Pest Management.

6.5.1 A Porters Basin and H Crystal Basin

In this section the types of **activities** which are proposed to take place in the Porters and Crystal Basins are discussed together with their potential **effects**, and the **mitigation** proposed to address adverse effects.

Earthworks/ soil disturbance

Within the Basins, the Plan Change provides for works associated with preparation and operation of a Ski Area.

The Ski Area in Porters Basin will be reshaped and new access tracks/ski trails will be built. There will also be upgrading of existing tracks. This will involve cut and fill on scree slopes and removal and deposition of scree/spoil material within the Basin. There is very little vegetation cover in Porters Basin, due to its lack of suitable substrate and no significant habitats. However, damage to the valuable small amounts of existing vegetation should be avoided, by refining track/trail selection to avoid any substantial areas of plant cover. Material from cut/fill along tracks should be deposited on bare scree, and in small amounts in different places to retain the existing scree slopes and form as far as possible. Existing tracks should be upgraded rather than new ones formed; and existing tracks should be used for access rather than forming new access tracks. Track work should be done working along

newly formed tacks, with material that has to be taken out being taken back along the formed route.

There will be upgrading of ski lifts which will involve tower placements and potentially buildings over time. Preference should be given to using existing towers/pylons bases where this is possible and safe. Access to new locations should be along existing tracks or by helicopter where practicable to avoid unnecessary disturbance of scree slopes. A separate telecoms tower may be constructed.

Kea are commonly seen in Porters Basin, and a high-level café with humans and food /food waste would be an attractive feature for these birds. This is currently the case at Porters. Waste disposal is strictly controlled and customers are required not to feed kea. With any expansion of facilities, there should be ecological input to design and operation of the café to continue the minimal any impact on kea, through management of the building process and operation to avoid adverse interactions between visitors and keas.

Keas are naturally herbivores, but are often omnivorous. Experience at skifields shows that they quickly find and become accustomed to human food sources and other waste material. To minimise this, Porters propose:

- Notices to discourage kea-feeding (especially chocolate)
- No use of lead products on the site (especially lead shot)
- Strict control on storage of construction materials and waste materials) with a particular focus on plastics and fibre glass batts)
- No uncovered water tanks

Kea Management should be part of a broader Environmental Management Plan for the Ski Area and Weed/pest Management should recognise the threat to young kea posed by possum and mustelids. Porters is a member of the NZ Kea Conservation Trust and monitors the Ski Area population.

Pipes for potable water, snow making water, and wastewater and cables for electricity and telecomms will be placed underground. Where possible these should be along track or trail lines to minimise earthworks/disturbance. A Weed Management Plan should address minimisation of weed spread onto/along all disturbed ground.

Contouring and grooming in Porters Basin are undertaken under the current Ski Area lease– under the proposed development Porters consider that an area approximately20%-30% greater than at present will be contoured.

The types of activities provided for by the Plan Change in the Crystal Basin are:

Earthworks

- Water storage reservoir for snowmaking purposes
- Land contouring for Ski Area
- Towers/poles for Crystal Gondola
- Top Station building for Crystal Gondola (including day lodge facilities)
- Towers/poles/ base and top station buildings for smaller lift
- Access road /ski return trail
- Stream crossings
- Underground infrastructure (pipes for potable and waster water, cables)

Snow management

- Snow making

- Snow grooming

People (business and recreational activities)

- Skiing and other recreational activities

Any change to these activities would require a resource consent from SDC. The Plan Change enables appropriate conditions to be imposed at that time.

The area to be affected by earthworks in Crystal Basin has been minimised through the design development stages. As a result of this, a small area of Crystal Basin will be set aside from any ski development and protected through a long term covenant on the title, prohibiting activities which would damage ecological values.

Some vegetation and habitat loss in Crystal Basin cannot be avoided, remedied or mitigated. Mitigation is not possible since the effect is one of loss of landform and physical environment which form the substrate for plants and animals.

Detailed surveys for lizards and invertebrates have not been carried out in Crystal Basin although the potentially good habitat there has been recognised. Rather it is proposed that pre-construction surveys should be carried out on selected routes and at selected locations. Trap and transfer programmes could then be carried out as appropriate. Alternative mitigation for damage or loss of animal habitat will then be built into construction or operations.

Revegetation of earthworked areas will be undertaken using a limited range of appropriate alpine plants. However, revegetation at this altitude will be difficult – climatic and soil conditions for establishment of plants are not good and the species used will have to be selected for their ecological appropriateness, tolerance of winter compaction under snow grooming, and their value in re-establishing cover. It is proposed to use *Chionochloa macra* and *Poa colensoi* as the main species for revegetation in the Basin.

Crystal Basin is almost totally free of introduced plants and during construction and earthworking, weed monitoring and control will be necessary to ensure that weeds do not become established. While the high altitude will act as a barrier to some species, common pasture grasses (e.g. *Agrostis capillaris*) will be able to survive.

Snow and ice management

Snowmaking, using snow guns, stored water and nucleating agent(s) will be carried out in Porters and Crystal Basins – this is an ongoing activity in Porters Basin under the existing Ski Area lease arrangements.

Similarly, snow grooming occurs on slopes to compact and flatten the snow surface and will be provided for in both Ski Areas under the Plan Change.

Snow grooming compacts the snow and is likely to compact vegetation and possibly soils beneath[28]. In natural conditions, snow provides an insulating layer in which plants can survive freezing surface temperatures – grooming means that the snow takes longer to melt, so growing seasons can be affected. While there is considerable research literature addressing the issue around the world, there seems to be variation in results and effects depending on species, altitude, slope and operational factors which make it difficult to predict potential effects in Crystal Basin.

[28] K Wardle & B Fahey (1999): *Environmental effects associated with snow grooming and skiing at Treble Cone skifield. Part 1 Vegetation and soil disturbance.* Science for Conservation 120A: 1-48.

It appears likely then, that vegetation species and patterns will change under snow grooming. However, given that the vegetation affected in Crystal Basin will have been modified by contouring and earthworks, the relative effect of grooming is likely to be minor.

Snow-making nucleation compounds are natural proteins (bacteria) and there is no evidence of adverse effects of their use to date. Research overseas into the effects of discharge of snow making nucleating agents indicates that the agents do not harm human health. However evidence on effects on aquatic ecosystems is inconclusive. Snowmax ® is used at Porters. The makers report no documented reports of adverse environmental effects[29]. However, given that research is based on overseas habitats and ecosystems, it is recommended that water quality and ecological monitoring be used to detect any potential adverse effects at Porters.

Business, residential and recreation activities.
Two scenarios are considered: in a conservative scenario, the demand assessment estimates annual winter visitation of 116,000 skier-days30 after one year of full operation, which would grow to 130,100 skier days after ten years. This compares with 35,000 currently. A more optimistic scenario begins with 121,900 in year one, with total demand growing to 167,200 skier days in year ten.

Summer visitors are expected to average around 950 per day. Currently both Basins have low levels of summer use. Summer visitors to any high-level café are likely to be free to access trails around it.

Unlike Porters Basin, Crystal Basin has no commercial skiing use and probably almost no summer recreation use at present so the Village development will introduce people in winter into a previously undisturbed area. While skiing, these people will generally have no adverse effects on the ecological values in the area. However, at the seasonal margins, if snow conditions are poor and snow cover is thin, skiers may damage vegetation. Marking is proposed for the high value spring flush vegetation (bollards/ropes)

Hazardous substances (e.g. vehicle fuels) should be stored at least 20m from the spring/headwaters of Porter and Crystal Streams to avoid accidental contamination.

6.5.2 B Porter Stream Valley

In this section the range of **activities** which are proposed to take place in the Porter Stream Valley are discussed together with their potential **effects**, and the **mitigation** proposed to address adverse effects. It is acknowledged that the Plan Change will require specific resource consents for these activities, and that are still subject to detailed design. This section therefore describes the activities only and indicates the types of mitigation that would be appropriate. Parts of the Village development extend up into the Porter Stream Valley management unit but these are assessed in Section 6.5.7 G Southern Terrace.

[29] http://www.johnsoncontrols.com/publish/etc/medialib/jci/be/commercial/products/snowmaking/snomax.Par.42580.File.dat/Snomax%20FAQ.pdf

[30] The terms “skier-days” and any reference to “skiers” includes snowboarders unless specified otherwise.

Earthworks/ soil disturbance
Outside the Village developments in the valley (see 6.5.7) the works proposed here involve provision for the location of new lift towers, contouring/construction of two new ski trails including a proposed "Snow Play" area, underground laying of pipes to carry potable water to, and waste water from, Crystal Basin, underground cabling for electricity and telecommunications, and the installation of a new fire water-storage tank.

One of the new trails will involve contouring work down the valley of the northern Porter Stream through an area of predominantly *Dracophyllum*/snow tussock. The bed/riparian area of the ephemeral northern Porter Stream and the wetland area between it and Porter Stream will be filled for the formation of the trail and the proposed "Snow Play Area". This northern tributary does not appear to have a surface flow (no flowpath has been observed on site*)* so the contouring will have no effect on aquatic habitat. The trail construction will cause the loss of existing *Dracophyllum*/snow tussock shrubland. This is the most common vegetation type at this altitude on the site. It is recommended that the contouring work should be over the minimum area necessary. Wherever possible the utilities pipe will be laid as part of the earthworks for tracks and trails to minimise ground and vegetation disturbance.

The wetland is 1.2 ha in area, and most of this will be filled or recontoured in preparing the Snow Play area.

Mitigation of this loss should be through revegetation of the disturbed area with *Dracophyllum acerosum* and *Chionochloa flavescens* in a pattern that replicates the existing cover while enabling skiing, together with restoration planting in the red-tussock wetland gully within the Village (approximately 0.2 ha). Plant growth across this site will be slow, so that it is recommended that this revegetation work be carried out as soon as possible in the development process to allow recovery and stabilisation prior to skiing activity.

The second trail – to the Crystal Chalets - crosses another area of *Dracophyllum*/snow tussock with some bare ground. It is recommended that this too be of minimum width.

The water storage structure for fire protection should be of the minimum size needed for protection purposes to avoid disturbance to vegetation. Its construction should be done without forming a new access track –the new ski trail should be used as far as possible. This should also be used for pipes to deliver water to storage.

Preference should be given to using existing sites of towers/pylons where this is possible, safe and practicable. Access to new locations should be along existing tracks or by helicopter where practicable to avoid unnecessary disturbance of scree slopes.

Bridges and/or culverts over Porter Stream will be built for skiers returning to the Village Base Area along the newly constructed trail and Snow Play area. These must be built in a way that does not modify the flow of Porter Stream and minimises the disturbance of vegetation along the banks. Revegetation with appropriate plants (including riparian species) should be undertaken.

Water takes/diversions/discharges
Water takes and discharges in relation to Porter Stream and associated earthworks are assessed in the following section (6.5.3) and in appropriate resource consent applications.

The proposed Snow Play area will involve filling the ephemeral Northern Porter Stream. The ecological values of ephemeral waterways must be considered when doing this. The new surface should be planted with appropriate native species, noted earlier.

Snow and ice management

Snow management activities currently occur in Porters Ski Area, and the Porter Stream Valley is affected by operations needed to clear the road and facilities area to safe standards. However, these operations will be extended as the proposed developments take place to manage snow on new trails. Snow piles compact the soils and vegetation beneath them, and melt more slowly than general snow cover. To minimise adverse effects on vegetation and soils cover, snow cleared from access roads or areas accessing new pedestrian bridges should be cleared to nearest point on the roadside where it can be disposed of into rock chutes. Rock gabions will be placed at the bases of these chutes to prevent construction/road maintenance material from going straight into Porter Stream. These gabions will prevent large accumulations of snow in the watercourse.

Business, residential and recreation activities.

It is anticipated that the expansion of the Ski Area and construction of the Village Base Area nearby will bring more people into the Porter Stream Valley during both winter and summer than current activities. This brings potential trampling, winter compaction, and off-road habitat damage, all of which can lead to increased weed invasion and spread. There is also a potential for more littering – litter can be harmful to inquisitive kea as well as potentially contaminate waterways. This is an area that is already influenced by low level disturbance, and the roadside in particular has a number of weeds.

The effects of litter and weed spread can be managed through regular monitoring and control actions.

6.5.3 C Porter Stream

Activities proposed that have potential effects on Porter Stream are:

- Water take of between 50 and 70 l/sec varying according to season (see CPG 2010 for details)
- Upgraded structures for take water from Stream and delivery to Village and snowmaking storage areas
- Bridge/culvert crossings for vehicles on the Ski Area Access Road and skiers/pedestrians
- Crossing by pipe carrying waste water (using road crossing)

Earthworks/ soil disturbance

Earthworks for buildings adjacent to the stream; stormwater runoff from impermeable surfaces take place within the Village Base Area and are discussed in Section 6.5.7 below.

Upgraded structures to enable water takes at the same place of:

- Up to 40 L/sec for snowmaking purposes (see CPG 2010);
- Up to 30 L/sec for potable supplies.

The structures themselves will be galleries in gravels, and provided that their construction is in line with current best practice for works in or adjacent to waterways and revegetation is carried out where needed, any adverse effects can be mitigated.

The existing structures associated with the hydro scheme will be removed and but the existing dam/weir at the Ski Area Access Road crossing will remain (to prevent trout moving into the upper reaches of the Stream.)

As noted above, bridges and/or culverts over Porter Stream will be built for skiers returning to the Village Base Area along the newly constructed trail and Snow Play area. These must be built in a way that does not modify the flow of Porter Stream and minimises the disturbance of vegetation along the banks. Revegetation with appropriate plants (including riparian species) should be undertaken.

Crossing by the waste water pipe is addressed in CPG 2010. The likely crossing will be the road crossing with best practice operations to protect the waterway itself – this should have minimal effect on the aquatic habitats in the Stream.

Water takes/diversions/discharges

Porter Stream does not have any fish, due to structures obstructing fish passage – however, it has a healthy periphyton and macroinvertebrate community and these contribute to the health of the wider Porter River system and give Porter Stream value. CPG 2010 sets out the existing takes from the Stream. There are currently takes for domestic, snowmaking and generation of electricity of a total of 21 L/sec. Removal of more water than this will affect the existing community and possibly the Porter River aquatic habitat. However the amount to be taken has been determined through consideration of ecological values as well as Ski Area needs. Table 6- 5 shows the residual flows required to maintain ecological values in Porter Stream, calculated on the flow information from CPG, and the bed profile shown in Figure 5-8 and data in Appendix 3.

Table 6-5: Residual flows for ecological values in Porter Stream.

Month	l/sec (from CPG)	Residual* required
Jan	220	100
Feb	220	100
Mar	220	100
Apr	220	100
May	600	60
Jun	240	30
Jul	120	30
Aug	400	30
Sep	220	60
Oct	240	100
Nov	250	100
Dec	220	100

*The residual flow is that required at a position above the current mid-system take (E1490693, N5207565), and should not diminish downstream of that point.

The proposed take from the Stream has been set at a level which ensures that a residual flow will remain in the Stream throughout the year sufficient to ensure that useable habitat remains. This will be sufficient to ensure that the periphyton and macroinvertebrate communities are maintained.

The take of water will not be constant throughout the year (CPG 2010). It is anticipated that peak takes will be in later summer/winter (for snowmaking and visitor/residential supply) which means that the stream will have higher flows in spring/early summer – these will provide "freshes" from which macroinvertebrates and periphyton will benefit.

Porter Stream and its riparian vegetation is an important part of the Porter River system. The Stream contributes to the flow of the Porter River. To protect it from accidental damage during construction a fenced setback of 5-10m will be constructed with a similar 5m zone around building sites in the Village. In the longer term, a setback or buffer zone of up to 20m should be marked by low key markers, to indicate the ecological values of the waterway to visitors and staff.

Water will discharge into the Porter Stream only during higher rainfall events after treatment in the constructed stormwater treatment pond (CPG 2010). Monitoring in Porter Stream will be carried out to detect any adverse effects of this discharge on the aquatic biota.

Snow and ice management

While meltwater from snow made artificially is very likely to find its way into Porter Stream, Porters currently has a discharge consent for this. No adverse effects have been noted to date. The invertebrate community in Porter Stream is healthy and diverse; the reasons for the absence of fish are not known.

Research overseas into the effects of discharge of snow making nucleating agents indicates that the agents do not harm human health. However evidence on effects on aquatic ecosystems is inconclusive. Snowmax ® is used at Porters. The makers report no documented reports of adverse environmental effects[31]. However, given that research is based on overseas habitats and ecosystems, it is recommended that water quality and ecological monitoring be used to detect any potential adverse effects at Porters.

Business, residential and recreation activities.

It is not likely that increased recreational activity will affect Porter Stream outside the Village area other than through the ways described above.

6.5.4 D Porter River Mainstem

Earthworks/ soil disturbance

Only one activity has potential direct effects on the Porter River; that is, upgrading the crossing point of the Ski Area/Village access road. Upgrading is anticipated to involve constructing a large single culvert, and raising the height of the road approaches to improve road gradients. Lifting the road will require widening of supporting batter slopes.

Currently the road crossing comprises three culverts. As part of any road and crossing upgrade sediment discharge will occur, and this could adversely affect the aquatic habitat. There is intact riparian vegetation around the current crossing. Works on the approaches should minimise vegetation loss while accepted best practice methods for construction of new bridges /culverts should be followed to minimise sediment discharges.

31

http://www.johnsoncontrols.com/publish/etc/medialib/jci/be/commercial/products/snowmaking/snomax.Par.42580.File.dat/Snomax%20FAQ.pdf

Approach works should be confined to as small an area as possible. A pre-construction inspection by an ecologist should be carried out to identify and mark any higher value areas (such as mature native shrubs). A 5m buffer should be marked and fenced where practical to minimise damage during road upgrade works.

Earthworks near to waterways can be an entry point for weeds to a river system because vehicles or materials can carry seeds onto newly disturbed areas. The proposed Weed Management Plan and ESCPs should address this.

The proposed new section of road below Long Spur is discussed in Section 6.5.5.

Water takes/diversions/discharges

Water will discharge into the Porter River only during higher rainfall events after passing through the enhanced red tussock gully wetland (CPG 2010) and will be subject to a resource consent application. Monitoring in Porter River will be carried out to detect any adverse effects of this discharge on the aquatic biota.

6.5.5 E Porter River Valley

The existing access road will be upgraded within this area for access to the Village for visitors and residents, while a new maintenance access road will be built on the south facing slopes (behind Long Spur) to avoid the Ski Areas. The earthworks involved in these two activities have potential adverse effects on the soil cover/structure and on the quantity and quality of vegetation cover and riparian (and aquatic) habitat.

The road margin vegetation currently has a high proportion of introduced plants and is regularly disturbed by road grading and snow clearance activities. The Porter River is close to the road edge in places. An upgrade should be carried out in a way that follows the existing road line. During construction, the adjacent native vegetation and river habitats should be protected through use of fencing and sediment / run-off control structures to mark a narrow working area and prevent vehicles leaving the road/driving over adjacent vegetation.

The new road line will remove *Dracophyllum*/snow tussock vegetation. The exact area is dependent on final route/road width. This is a common vegetation type on this landform in the area and ED – however the loss of this area should be mitigated through planting as part of the overall revegetation/ habitat restoration package for the site. All construction work and vehicle access should be contained within a fenced area along the road line. The Erosion and Sediment Control and Weed Management Plans should address this activity.

6.5.6 F Porter Hill Slopes

These south-west facing slopes below Porter Basin will be outside the patrolled Ski Area. No development is proposed in this area. They are largely unvegetated, except for “fingers” of *Dracophyllum*-snow totara below the ridge and scattered scree plants.

It is expected that there will be no direct effects of activities provided for through the proposed Plan Change on the ecological values there.

6.5.7 G Southern terrace – Village Base Area

In this area the most intensive development activity will take place (see Figure 1-2 Master Plan). The activities that have potential effects on ecological features and values are:

- Buildings – footprints, construction and operation
- Roads and trails – routes, construction, operation
- Impermeable surfaces – stormwater run-off
- Infrastructure - waste water and stormwater treatment systems – construction and operation
- Rubbish disposal/littering – construction and operation
- Human disturbance (noise, lighting) – construction, operation

Earthworks/soil disturbance

The Master Plan (Figure 1-2) shows that approximately 10 ha of land will be covered by buildings, roads or other structures in the central "Village Base Area" and the wider "Village". In addition, there will be earthworks associated with their construction, as well as piping and underground infrastructure. For the purposes of this assessment therefore, an area of 15 ha ground disturbance has been estimated. This is approximately 70% of the area of the Village area sub-zone (21.21ha). The dominant vegetation type across this site is *Dracophyllum*-snow tussock. This occupies 134ha (23% total) across the whole Ski Area and is one of the most widespread vegetation types in the Ecological District (ED). Although this is a common vegetation type on this landform in the area and ED the loss of this area should be mitigated through planting as part of the overall revegetation/ habitat restoration package for the site. Disturbance or vegetation clearance should be minimised throughout the Village construction and all disturbed ground within the Village should be revegetated. Unbuilt development sites should be revegetated if development is not planned to happen within 3 months of ground preparation to prevent weed spread. The proposed Plan Change includes assessment matters for resource consent applications in relation to development of the Village Base Area.

The disturbance will cause removal/loss of the terrestrial vegetation or habitat across the Village area. This should be minimised by fencing off 5 - 10m riparian set backs from Porter Stream, Crystal Stream and Porter River. The fencing should be sturdy enough to be vehicle-proof as well as delineating no-go areas. The "red-tussock gully wetland" should also be fenced together with a buffer of approximately 5metres, to prevent unintentional damage there – together further planting of native species and weed control will mitigate the loss of wetland in Porter Stream Valley. Prior to construction starting, it should be possible to identify other "no-go" areas across the Village Area – in particular on slopes around the Porters and Slopeside buildings, and around the Crystal Chalets and Hotel. Leaving these undisturbed during construction will provide a framework of native vegetation cover which will assist in weed management and facilitate revegetation.

Weed invasion is likely to occur into such a large area of earthworks. Many of the species will be annuals, which will not re-grow once the land is re-covered. However others will be perennials including species already present nearby and species brought in as seeds on vehicles or materials brought into the site. Weed monitoring and control will need to be carried out throughout the lifetime of the earthworks/construction of the Village area. Control should involve spraying, use of weed mat, washing vehicles and minimising the amount of materials brought onto the site. Gravels in particular should be sourced as close to the site as possible.

During construction, the area of bare soil could cause sediment or construction contaminants (e.g. vehicle fuels, construction materials) to be carried in stormwater to one of the adjoining waterways. The ESCP should identify methods to prevent contamination of waterways – these waterways are of high ecological value and must be protected throughout the development and operation.

Use of fuels and other hazardous substances will be controlled under the HSNO legislation. On this site, vehicles, fuels and hazardous substances should be stored at least 20m away from watercourses – there should be no refuelling within 20m of a watercourse.

Water diversions/discharges

Porter Stream and red tussock gully (an ephemeral waterway/wetland) pass through the Southern terraces/Village area while Porter River and Crystal Stream lie adjacent.

The activities in relation to water that may have effects on these waterways (that are not addressed elsewhere) are:

- Discharge of stormwater from impervious surfaces to treatment

The treatment of stormwater is described in CPG 2010 and discharge will be subject to a resource consent application. It is proposed that stormwater from the Village that does not percolate to ground will be treated prior to discharge to ground. Under higher rainfall events, stormwater from the Village Base Area will travel to a stormwater treatment pond located between the car park and Porter Stream, while stormwater form the more extensive parts of the Village development will be directed into the red tussock gully wetland prior to discharge to the Porter River.

Snow and ice management

Snow management activities in the Southern terrace/Village area will include:

- Snow clearance around facilities and accommodation buildings – this will be confined to areas already modified through Village construction; deposition of snow will be taken into account in detailed design
- De-icing – on occasions de-icing chemicals may be used by operators and residents. These will be limited to the Village Base area, and effects of run-off will be confined within the treatment systems for general Village stormwater run off.

Business, residential and recreation activities.

The Village area will be the area in which most activities in this category will occur. The potential effects of large numbers of people and their vehicles will occur during the operational phase of the development. People-activities will be concentrated in the Village Base Area commercial and Ski Area access points; however people will use buildings throughout the sub-zone.

Animals brought to the site by workers, visitors or residents could injure or kill native animals. Keas are probably the native animals most susceptible to this, since they are inquisitive and are likely to be attracted to the village area. The Ski Area expansion is unlikely to provide new or additional habitat for the pest animals common in the area, with the exception of mice and rats. Cafes, hotel and residential buildings will provide sources of food for rodents. While rodents could prey on native invertebrates and lizards, efficient rodent control in the Village Base Area will be required to keep this under control.

Keas are naturally herbivores, but are often omnivorous. Experience at other skifields shows that they quickly find and become accustomed to human food sources. To minimise this, kea-feeding should be discouraged, and rubbish/waste management must take these birds into consideration. Kea Management should be part of a broader Environmental Management Plan for the Ski Area. Porters is a member of the NZ Kea Conservation Trust and monitors the Ski Area population.

Pets can injure or kill native animals – invertebrates and lizards are probably the most susceptible in the Porters Ski Area. A ban on all introduced animals except working dogs in the Ski Area is a clear option for managing potential adverse effects of pets.

Plant pests/weeds could spread from the Village. The spread of wilding pines into the Castle Hill/ Craigieburn Basin area from Craigieburn Forest to the north illustrates the potential. Scattered pines are already in the study area. Some introduced plants (e.g. *Hieracium* spp) can smother or out-compete and replace native plants in this environment, although others (e.g. vipers bugloss) remain confined to disturbed sites such as road sides. Many of these will arrive naturally (through wind or bird spread of seed) and can be controlled through identification of serious problem species, monitoring and on-going management. However, pest plants could be brought into the Ski Area deliberately for landscape work or gardens.

Private gardens are not provided for in the Master Plan and the Plan Change requires all planted to be of locally sourced indigenous species. This should avoid the introduction of potentially pest plants.

The proposed ban on private gardens, introduced plants and introduced animals could be part of any covenants on property titles linked to environmental protection. In addition, the Plan Change includes standards for acceptable planting.

The Village will introduce lighting into an area that currently has little or no lighting. Street, house and vehicle lights will attract flying insects – this could have an adverse effect on emergent aquatic insects (such as mayflies). These insects have only a short terrestrial life span, during which time they must mate and lay eggs near water. If they are attracted away from water in large numbers, there could be an adverse effect on local aquatic invertebrate populations. This in turn could have an adverse effect on fish which feed on their larvae.

It would be impossible to determine the effect of lighting on aquatic insects empirically so a precautionary approach is recommended. Low intensity and low level lighting should be used for streets and public places. The southern terrace and ridges probably form natural barriers to light reaching Porter River and Crystal Stream; planting can be used to increase the barrier effect and will be the main mitigation possible for the Porter Steam which passes through the Village.

Overall, the confined and relatively small area to be lit and the small lengths of watercourse close to the Village suggest that the effects of lighting on insect populations will not be significant. Monitoring of stream health will pick up any significant changes in macroinvertebrate populations.

The Village expansion will also introduce noise into an otherwise quiet area. No animals that would be adversely affected by noise have been identified in the area.

6.5.8 I Crystal Stream Valley

Crystal Stream Valley lies on the north-eastern boundary of the Southern terraces/Village Base area and Porter Valley Stream. The types of activities that could occur in this area are:

Earthworks

- Construction of access road/return ski trail between Porter Stream Valley and Crystal Basin
- Towers for Crystal Gondola
- Approaches for waster water pipe crossing Crystal Stream

Earthworks/soil disturbance

Erosion control and sediment management are particularly important in this area because of the amount of ground that is bare or open in its existing state.

Construction in this area will result in removal of some *Dracophyllum*-snow tussock vegetation along the road route, although most of it is on bare scree or around rock outcrops. Pre-construction lizard/invertebrates surveys will be carried out to determine the need for a trap and transfer programme or alternative mitigation for loss of habitat. Further mitigation will be possible by ensuring that construction work takes place along the road as it is built and that spoil/scree material is deposited onto existing scree slopes.

The pipe carrying waste water from all parts of the Ski Area to the irrigation area on the Northern Terrace will traverse the Valley. It will follow the trails and tracks as far as possible – where this is not possible, land disturbance should be minimised and subject to Weed Management.

A Crystal Stream habitat enhancement programme is proposed (see next section) and this should take into consideration the activities in the Valley.

6.5.9 J Crystal Stream

There will be no water takes from Crystal Stream. The small existing take/structure will no longer be needed, so will be removed once the infrastructure development proceeds into the Crystal Chalets zone.

Wastewater irrigation will take place on land on the terrace above Crystal Stream. There is a potential adverse effect if excess nutrients or contaminants from this reach Crystal Stream if the system does not function as anticipated. Monitoring in the Stream downstream of the proposed irrigation area (sampling both water quality and biological health) should be carried out to identify any adverse effect from the waste water treatment. This is to be recommended as a condition of the Regional Council consent.

The pipe carrying waste water from all parts of the Ski Area will cross Crystal Stream at the weir which is proposed as part of the Stream enhancement package as part of the overall mitigation package proposed by Porters. In Crystal Stream the package will include:

- Construction of a trout barrier in the form of an appropriately designed structure;
- Removal of all trout upstream of the barrier
- Introduction of alpine galaxias upstream of the barrier

6.5.10 K Northern Terrace

The northern terrace will be specifically used for disposal by irrigation of treated waste water from the Village and facilities on the Ski Areas and for revegetation with *Dracophyllum acerosum*- kanuka shrubland with mountain beech, red tussock and associated species in places where the conditions are appropriate. The minimum vegetation disturbance is recommended. However, since installation of the irrigation pipes may involve ground disturbance, an intensive revegetation programme is recommended. The revegetation will restore something of the original vegetation cover of this area, at the same time as assisting with nutrient uptake and waste water disposal.

The irrigation of wastewater onto the ground is likely to raise the nutrient levels of soils on the terrace (CPG 2010). This in turn will affect the plants living there, since they are species adapted to low nutrient montane environments.

However, Porters propose to restore some of the secondary shrubland and mountain beech forest cover in this area, by planting the northern terrace with species drawn from the list in Table 6-6. While mountain beech forest would have been widespread in the Craigieburns prior to the arrival of humans, *Dracophyllum acerosum* is now dominant over the terrace, and provides an intact native cover. It is proposed that a mix of *Dracophyllum* and kanuka be used to restore vegetation cover to disturbed soils, while red tussock and broadleaved snow tussock be planted in depressions or naturally open areas. Mountain beech should be added in clumps, copses or as ribbons alongside natural gullies to provide core areas from which further regeneration can occur in the longer term. Beech will also add to the ability of the area to absorb excess nutrients and irrigated treated waste water.

This area will be a possible site for weed invasion during any earthworks associated with placing the sub-surface irrigation system, and will need to be covered by the Weed Management Plan for the site.

Monitoring soils status in the disposal area, and aquatic habitat and water quality in the Crystal Stream and Porter River will be necessary to ensure that nutrient uptake is occurring as proposed and that excess is not travelling into waterways.

Table 6-6: Species for restoration of Northern Terrace

Latin name	Common name
Dracophyllum acerosum	
Chionochloa flavescens	Broad-leaved snow tussock
Chionochloa rubra	Red tussock
Nothofagus solandri var cliffortioides	Mountain beech
Kunzea ericoides	Kanuka

6.6 Cumulative effects

It is anticipated that construction of the proposed expansion will be staged, so that construction effects are unlikely to occur across the whole ODP area simultaneously. However, the Plan Change does provide for a wide range of activities, and once they have been carried out the cumulative effects of all the activities described above would result in:

- loss of lower part of unmodified alpine Basin (Crystal Basin)
- loss of area of approximately 15 ha *Dracophyllum*-tussock in construction of the Village
- gain of a lesser area of *Dracophyllum*- kanuka-tussock vegetation on the Northern Terrace
- gain of habitat for galaxias in Crystal Stream and reduction trout access to higher catchment
- covenanting/enhancement red tussock gully wetland through proposed Village
- loss of wetland in creation of Snow Play area
- loss of vegetation and habitats under upgraded tracks and trails
- revegetation/enhancement/ natural recovery of disturbed land with locally sourced shrubs, grasses and herbs
- introduction of more people into alpine environment during summer and winter
- weed and pest control
- additional kea management opportunities

Revegetation and pest/weed management effort will have to occur on all disturbed ground to prevent soil loss and weed incursion/spread. At higher altitudes few native species will be suitable for revegetation and the emphasis will have to be on weed control. At lower altitudes, intact cover should be retained wherever possible. Where ground has to be disturbed a programme of planting, mulching and pest/weed control should be used. A list of plants which are found on or close to the site and which are suited to propagation and use for revegetation on this site is given in Table 6-7 below. Plants should be selected from this list for particular parts of the site and uses in consultation with an ecologist and plant nursery staff.

Table 6-7: Revegetation- recommended species list

	Botanical name	Comments
	Tussocks suitable for planting amongst shrubs	
G	*Chionochloa flavescens*	
G	*Chionochloa macra*	Use in Basins
G	*Chionochloa rubra*	red tussock, damper areas
G	*Festuca novae-zelandiae*	
G	*Poa colensoi*	blue tussock; use widely for cover
	Low ground covers for bare ground or stony areas. Also intertussock species.	
H	*Acaena spp*	Bidibid; use widely for cover
H	*Anaphalioides bellidioides*	
H	*Astelia nervosa*	
H	*Blechnum penna marina*	
H	*Brachyglottis bellidiodes*	
H	*Carmichaelia monroi*	
H	*Celmisia angustifolia*	
H	*Celmisia gracilenta*	
H	*Celmisia lyallii*	
H	*Celmisia spectabilis*	
H	*Muehlenbeckia axillaris*	
H	*Parahebe odora*	
H	*Pimelea oreophila*	
H	*Polystichum richardii*	
H	*Raoulia subsericea*	
H	*Scleranthus uniflorus*	
	Shrubs and trees suitable for planting in clusters	
S	*Carmichaelia australis*	native broom
S	*Coprosma cheesemanii*	
S	*Discaria toumatou*	
S	*Dracophyllum acerosum*	Use widely for cover
S	*Dracophyllum uniflora*	
S	*Dracophyllum pronum*	
S	*Gaultheria crassa*	
S	*Gaultheria depressa var. novae-zelandiae*	
S	*Hebe odora*	
S	*Hebe pinguifolia*	

S	*Kunzea ericoides*	Use widely for cover
S	*Acrothamnus colensoi (prev.Leucopogon colensoi)*	
S	*Leptosperma scoparium*	manuka
S	*Melicytus alpinus*	
S	*Ozothamnus leptophyllus*	
S	*Pimelia traversii*	
S	*Podocarpus nivalis*	Use at higher altitudes
S	*Notofagus solandri var cliffortioides*	mountain beech
S	*Olearia avicenniifolia*	
	KEY	
H	Low ground covers for bare ground or stony areas. Also intertussock species.	
G	Tussocks suitable for planting amongst shrubs	
S	Shrubs and trees suitable for planting in clusters	
	Primary species for use across site- select according to site conditions	
	NOTES	
	Other species to use for amenity as well as infill	
	Plant same associations as currently present ie. Dracophyllum / snow tussock	
	Cause as little disturbance as possible - bare areas are prone to frost heave so are very difficult to revegetate	
	Mulch with stones or gravel to reduce frost heave	
	Plants should be locally sourced	

7.0 Mitigation summary

7.1 Introduction

This section sets out the approach Porters has taken to avoid, remedy, and mitigate the potential adverse effects discussed in Section 6 (Figure 7-1), concluding with a summary of all actions taken or proposed (Table 7-1).

The proposed Ski Area expansion has been in development by Porters since 2006, and ecological inputs made since 2007. This has been an iterative process. Initial ecological investigations, including desktop and brief field surveys in early 2007 enabled ecologists to advise on the likely areas of high ecological value and potential effects of activities proposed at that time.

Over the following two years, Porters developed a concept proposal incorporating this information. In 2009 Porters commenced negotiations in relation to land status with the Department of Conservation, using the initial information. Further ecological investigations took place in 2009 and early 2010 encompassing the amended proposed Ski Area expansion.

Figure 7-1 outlines the ecological inputs to decisions. As noted earlier, in this report the RMA terms have the following meaning:

Avoid – an activity or feature of the proposal is taken out of the project to avoid adverse effects on areas, habitats or species of high ecological value

Remedy – the adverse effects of an activity or feature of the proposal are redressed or remedied by actions or methods directed at reducing the impact of the activity. Remedy is usually carried out at the site of the activity or its direct effect.

Mitigate – the adverse effects of an activity or feature of the proposal are lessened or mitigated by actions or methods carried out to counter the adverse effects. Mitigation may be carried out at the site of the activity or elsewhere.

Where effects are unable to be completely avoided, remedied or mitigated, it may be appropriate to consider environmental compensation. The Plan Change provides for this.

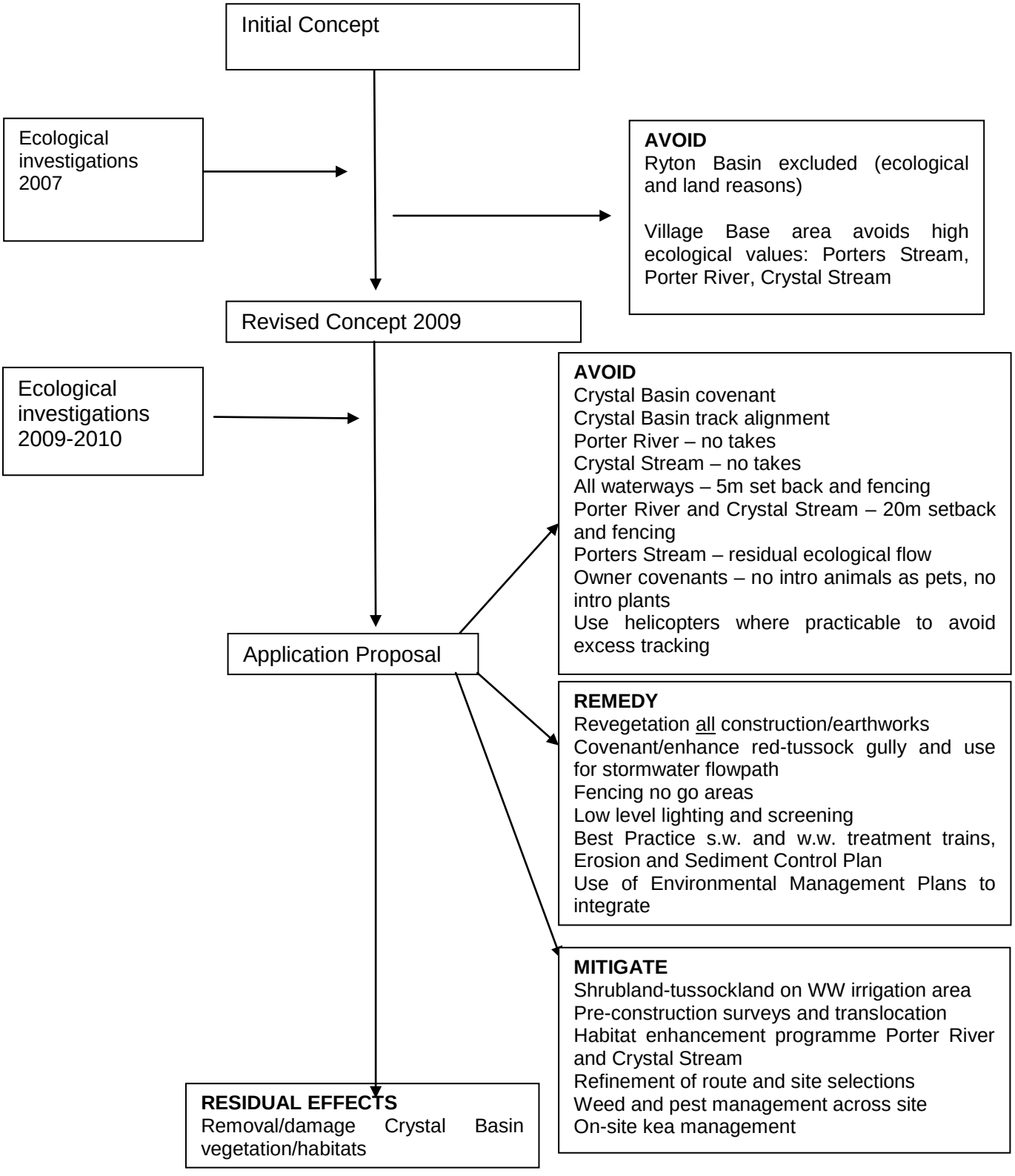


Figure 7-1 : Summary of process to address adverse effects

Table 7-1: Summary of avoidance, remedy and mitigation proposals

Location	Activities	Potential Effects	Proposed Actions
A Porter Basin	Re-contouring, earthworks, spoil and soil disturbance, new trails, cell site/telecomms tower Changes to existing water storage New buildings	Loss of vegetation and habitat fragments Weed invasion Spoil covering habitat Kea disturbance/ interactions Soil compaction	Refine route and site selection Use existing tracks for construction access Best Practice earthworks and stormwater operation - Erosion sediment control plan (ESCP) Weed management (inc Plan) Kea management plan, including choice of construction materials Land/habitats management plan (weeds and other general issues) Hazardous substances management plan
B Porters Stream Valley	Lift towers (spoil and soil disturbance) New ski return trails New fire water storage tank installation	Vegetation clearance Soil disturbance Weed invasion Reduction in wider habitat integrity/intactness	Refinement route and fire tank site selection Weed management (inc Plan Land /habitats management plan Best Practice earthworks and stormwater operation - Erosion and sediment control plan (ESCP)

Location	Activities	Potential Effects	Proposed Actions
C Porters Stream - perennial	Increased water take New structures for take and delivery Bridge/culvert crossings Earthworks for dwellings adjacent to stream, Stormwater runoff from impermeable surfaces Waste water pipe under road bridge	Reduced aquatic habitat Increased aquatic ecosystem stress due to low flow Contamination from earthworks and stormwater Riparian habitat disturbance	Ecologically designed residual flow regime Best Practice earthworks and stormwater operation - Erosion and sediment control plan (ESCP) Ecologically appropriate crossings 5m riparian buffer – fenced during construction Fencing no-go areas around habitation Long-term demarcation of sensitive areas Leave open through Village
C North Porters - ephemeral	Re-contoured, filled and piped partially	Loss of vegetation / habitat Weed invasion	Minimise infill and piping Revegetate edges Retain and enhance Village red tussock gully as mitigation
C Porter wetland (Propose Snow Play area)	Re-contoured, filled and removed	Complete loss of moderate value wetland habitat and vegetation	Enhance village red-tussock gully and expand to form new wetland in proposed stormwater "pond"
D Porter River Mainstem	Access road crossing Indirect discharge stormwater, sediments, treated waste water	Modified aquatic and riparian habitat Reduced water quality	Best Practice waste water, earthworks and stormwater operation - Erosion and sediment control plan (ESCP) Weed management (inc Plan) Ecologically appropriate crossings 5m riparian buffer – fenced during construction

Location	Activities	Potential Effects	Proposed Actions
E Porter River Valley	Upgrade Ski Area Access Road including river crossing	Loss of vegetation Weed invasion Sediment discharge to Porter River	Erosion and sediment control plan (ESCP) Weed management (inc Plan) Revegetation programme
F Porter Hill slopes	New road around main valley side slope	Loss of vegetation Weed invasion Sediment discharge to Porter River	Erosion and sediment control plan (ESCP) Weed management (inc Plan) Revegetation programme
G Southern Terrace (Village Area)	Building footprints Roading Stormwater runoff from impermeable surfaces Underground and surface infrastructure (stormwater treatment, wastewater treatment) Rubbish People disturbance (lighting, noise)	Vegetation clearance Habitat disturbance Contamination from stormwater run off (urban, metals, PAH etc) Kea disturbance/ interactions Trampling and recreational damage especially in summer Weed invasion including garden plants Pet and pest (predator) introductions Aquatic habitat stress due to warm water Light disturbance (especially of flighted mating invertebrates) Noise disturbance (birds)	Minimise vegetation clearance Revegetation of all sites not immediately built Weed management (inc Plan) Covenant red tussock gully and buffer it Prohibit introduced animals except working dogs Prohibit gardens and limit curtilage Lighting controls (low level, low intensity, screened), B.P. treatment train for stormwater, including cooling process for hot pools Kea management plan, , including choice of construction materials Recreational management plan Property covenants

Location	Activities	Potential Effects	Proposed Actions
H Crystal Basin	Construction of water reservoir Recontouring earthworks Gondola and lift towers Buildings (day lodge) Stream crossing Snow making Snow grooming (compaction), People disturbance	Vegetation loss and damage Habitat damage fragmentation and interruption of sequence Soil disturbance and compaction Weed invasion Rubbish Kea disturbance/ interactions Vegetation change through compaction (change in freeze refugia) Trampling and recreational damage to vegetation Stream contamination (see J below)	Avoidance of key areas (as per plan) Covenants over avoided area Retain sequence and minimise effects through route and site refinement ESCP specific to the basin Crystal Basin Habitat management plan (to integrate kea, weeds, recreation , snow making and grooming etc issues) Water quality monitoring (biological and chemical) Wastewater Management Plan Pre-construction lizard and invertebrate surveys to finalise mitigation (trap and transfer programme if needed) Kea management Plan , including choice of construction materials
I Crystal Valley	Road construction Trail construction Lift tower installation Wastewater crossing Pipe laying for wastewater transfer from Crystal Basin facilities	Vegetation loss Habitat disturbance and fragmentation Discharge of sediment to Crystal Stream (see J below)	Refinement route and tower site selection Weed management (inc Plan) Best Practice earthworks and stormwater operation - Erosion and sediment control plan (ESCP) Enhancement programme Crystal Stream

Location	Activities	Potential Effects	Proposed Actions
J Crystal Stream	Possible wastewater pump installation Wastewater pipe crossing Installation of trout barrier/weir	Sediment discharge from earthworks Soil disturbance Weed invasion Removal of trout from upper reaches	Crystal Valley Stream Enhancement Programme, including native fish return into trout free reaches Best Practice earthworks operation - Erosion and sediment control plan (ESCP)
K Northern Terrace	Wastewater irrigation Infrastructure for release of treated waste water	Changes to soil nutrient status Soil disturbance Weed invasion	Plant through with *Dracophyllum,* kanuka and appropriate species Wastewater management plan Weed management (inc Plan) Removal pines

7.2 Residual adverse effects

Based on Table 7-1 the potential adverse effects fall into three broad areas and can be summarised as follows.

1 Most effects are addressed through proposed mitigation actions. However there are some residual adverse effects on ecological values and these are partially or not addressed by actions proposed at present.

2 Effects that are only partially addressed are:

- Small scale removal and damage of common *Dracophyllum*/tussock vegetation and habitats by tracking, roading, towers etc in Southern Terrace (Village), Porter Basin, Crystal Valley, Northern Terrace.

- Large scale removal of common *Dracophyllum*/tussock vegetation and habitats in Southern Terrace Village Core area.

- Removal/damage to small wetland in Snow Play area

These are addressed in part by:

- Ecological input into final design/route selection
- Revegetation programme across Village
- Revegetation programme for all disturbed ground
- Pest and weed management across site
- Covenanting and enhancement planting red tussock gully
- Garden and animal controls in Village
- Best practice construction and earthworks management
- On site kea management

Additional options to completely address effects include:

- Weed control and revegetation in Porter River valley floor
- Weed control and revegetation associated with total length access road (to SH)
- Off-site kea, weed and pest management
- Additional small scale revegetation/wetland enhancement within ED

3 Effects that are not addressed are:

- Large scale removal /damage to Crystal Basin vegetation and habitats by contouring outside area set aside for covenanting – loss of intactness, naturalness, sequences in alpine basin. This is a significant adverse effect on ecological values.

***Options to address these residual effects – environmental compensation*.**
"Like-for-like" protection/enhancement is unlikely to be possible (due to the lack of a large alpine basin in need of protection/enhancement outside existing protected areas in the ED). Following international principles for addressing effects, the next option is *protection and /or enhancement of an area of threatened vegetation/habitat.* This should be located as close as possible to the site, but proximity may be less important if an area of high level of threat is used.

The process for calculating size, location, type of such an area should be developed prior to resource consent applications.

In summary, then, the array of spatially small and varied adverse effects can largely be remedied and mitigated (where they cannot be avoided) by actions proposed, the majority of which are on-site. Often specific management actions will address specific effects.

The large-scale disturbance of Crystal Basin is a significant adverse effect.

8.0 Monitoring

8.1 Monitoring programme

A monitoring programme is proposed to set a baseline, assess changes to the environment and review construction or operation in response to any adverse changes resulting from the development. The details of the long-term monitoring programme will be developed through the management plan and consents preparation. Monitoring will be needed for a number of aspects of the proposal (e.g. water quality) and there will be overlap between requirements which will require integrated management of monitoring over the whole site.

Monitoring during earthworks will be addressed through earthworks consents.

For ecological aspects it is proposed that the long-term monitoring programme should include:

- Vegetation – changes to vegetation at selected points on the site, to assess effects of snow management, success of the revegetation programme, success of weed management.
- Weeds – success of removal of pines etc; spread of new species
- Soil nutrient levels in wastewater irrigation field
- Aquatic habitat - changes to water quality, periphyton, macroinvertebrate and fish populations in Porters Stream, Porter River and Crystal Stream as well as residual flows.
- Stream enhancement programme success – in Crystal Stream, Porter River
- Invertebrates – terrestrial invertebrates at selected sites to assess long-tem changes resulting from introduction of lighting to the area.
- Lizards - population estimates at selected places to assess changes resulting from snow management, pest controls and recreational use.
- Kea – effects of additional visitors

A key feature of any monitoring programme is a system to review data and information from data, and feed that back into management. The system can be developed during preparation of Environmental Management Plan for the Ski Area.

APPENDIX 1: Plant species recorded during investigations

Species	Common name	Exotic*
Acaena caesiiglauca	bidibid	
Acaena fissistipula		
Acaena inermis		
Aciphylla aurea		
Aciphylla colensoi var. maxima		
Aciphylla monroi		
Agrostis capillaris	browntop	*
Agrostis muelleriana		
Agrostis petriei		
Aira caryophyllea		
Anaphalioides bellidioides		
Anisotome aromatica		
Anisotome filifolia		
Anisotome flexuosa		
Anthoxanthum odoratum	sweet vernal	*
Astelia nervosa		
Betula pendula	silver birch	*
Blechnum penna marina		
Brachyglottis bellidiodes		
Brachyglottis cassinioides		
Brachyscome radicata		
Bromus diandrus		
Bulbinella angustifolia		
Carex coriacea		
Carex wakatipu		
Carmichaelia australis	native broom	
Carmichaelia monroi		
Celmisia angustifolia		
Celmisia gracilenta		
Celmisia laricifolia		
Celmisia lyallii		
Celmisia spectabilis		
Celmisia viscosa		
Chionochloa flavescens	broad-leaved snow tussock	
Chionochloa macra	slim snow tussock	
Chionochloa rubra	red tussock	
Chionohebe pulvinaris		
Chrysanthemum leucanthemum	ox eye daisy	*
Colobanthus acicularis		
Colobanthus strictus		
Cirsium arvense	Californian thistle	*
Cirsium vulgare	Scotch thistle	
Coprosma cheesemanii		
Coprosma petriei		

Species	Common name	Exotic*
Coprosma propinqua		
Coriaria plumosa		
Coriaria sarmentosa	tutu	
Craspedia sp		
Cystopteris tasmanica		
Cytisus scoparius	broom	*
Dactylis glomerata	cCocksfoot	
Deyeuxia avenoides		
Discaria toumatou	matagouri	
Dolichoglottis lyallii		
Dracophyllum acerosum	inaka	
Dracophyllum pronum		
Dracophyllum uniflorum		
Drosera arcturi	sundew	
Echium vulgare	vipers bugloss	*
Elymus rectisetus		*
Elymus solandri		
Epilobium alsinoides		
Epilobium macropus		
Epilobium pyncnostachyum		
Epilobium sp		
Exocarpus bidwillii		
Festuca rubra	chewings fescue	*
Festuca novae-zelandiae	hard tussock	
Forstera tenella		
Gaultheria crassa		
Gaultheria depressa var. novae-zelandaie		
Gentianella bellidifolia		
Gentianella corymbifera subsp. corymbifera		
Gentianella sp		
Geranium brevicaule		
Geranium sessiflorum		
Geum leiospermum		
Gnaphalium laterale		
Gonocarpus micranthus		
Haastia recurva		
Hebe epacridea		
Hebe odora		
Hebe pinguifolia		
Helichrysum intermedium		
Hieracium aurantiacum		*
Hieracium lepidulum		*
Hieracium pilosella		*
Hieracium praealtum		*
Hierochloe recurvata		
Holcus lanatus	Yorkshire fog	*
Hydrocotyle novae-zelandiae		
Hypochoeris radicata	catsear	*

Species	Common name	Exotic*
Hypolepis ambigua		
Hypsela rivalis		
Juncus edgariae		
Juncus effusus	soft rush	*
Kelleria dieffenbachii		
Koeleria cheesemanii		
Kunzea ericoides	kanuka	
Lachnagrostis filiformis		
Lachnagrostis lyalli		
Lagenifera cuneata		
Leonohebe tetrasticha		
Leptinella atrata		
Leptinella pyrethrifolia		
Leptospermum scoparium	manuka	
Leucogenes grandiceps	South Island edelweiss	
Acrothamnus colensoi (prev Leucopogon colensoi)		
Leucopogon fraseri		
Lignocarpa carnulosa		
Linum catharticum	flax	*
Lobelia roughii		
Lotus pedunculatus	lotus	*
Luzula pumila		
Luzula rufa		
Lycopodium australianum		
Lycopodium fastigiatum		
Melicytus alpinus	porcupine shrub	
Mentha cunninghamii		
Microseris scapigera		
Microtis unifolia		
Mimulus moschatus		
Muehlenbeckia axillaris		
Myosotis australis		
Myosotis traversii		
Myrsine nummularia		
Neopaxia australasica		
Nothofagus solandri var. cliffortioides	mountain beech	
Notothlaspi rosulatum	penwiper plant	
Olearia avicenniifolia x		
Olearia cymbifolia		
Oreobolus pectinatus		
Ourisia caespitosa		
Ozothamnus fulvida		
Ozothamnus leptophyllus		
Parahebe lyallii		
Parahebe odora		
Pentachondra pumila		

Species	Common name	Exotic*
Phyllachne colensoi		
Pimelea oreophila		
Pimelia traversii		
Pinus contorta		*
Poa buchananii		
Poa cita		
Poa colensoi	blue tussock	
Poa dipsacea		
Poa novae-zelandiae		
Poa pratense		*
Podocarpus nivalis	snow totara	
Polystichum richardii		
Polystichum vestitum		
Prasophyllum colensoi		
Pratia angulata		
Pratia macrodon		
Pseudognaphalium luteoalbum		
Pseudotsuga menziesii	Douglas fir	*
Racomitrium pruinosum		
Ranunculus enysii		
Ranunculus foliosus		
Ranunculus glabrifolius		
Ranunculus haastii		
Raoulia australis	scabweed	
Raoulia grandiflora		
Raoulia mammilaris		
Raoulia subsericea		
Rosa rubiginosa	sweet brier	*
Rumex acetosella	sheeps sorrel	*
Rytidosperma setifolia	bristle tussock	
Rytidospermum pumila		
Salix cinerea	Grey willow	*
Schizeilema hydrocotyloides		
Schizeilema pallidum		
Schoenus pauciflorus		
Scleranthus uniflorus		
Senecio glaucophyllus ssp. discoideus		
Sphagnum sp		
Stellaria gracilenta		
Stellaria roughii		
Thelymitra longifolia		
Trifolium pratense	red clover	*
Trifolium arvense		*
Trifolium repens	white clover	*
Uncinia fuscovaginata		
Viola cunninghamii		
Vittadinia australis		
Wahlenbergia albomarginata	NZ harebell	

APPENDIX 2: MCI/QMCI discussion

MCI/QMCI have been derived from the USEPA Rapid Bioassessment Protocols for use in streams and rivers (Plafkin *et al*. 1989[1]) and from the Stream and Benthic Ecology Group of the University of Lund (Sweden) Riparian, Channel and Environment (RCE) Inventory for small streams in agricultural landscapes (Petersen, 1992[2]).

MCIs work by using certain macroinvertebrates as indicator species, linking their presence / absence with low / high levels of organic loading. The indicator species themselves are weighted according to their particular sensitivity to organic pollution (i.e. the more sensitive the species then the higher the MCI score that has been allocated to it).

The MCI scores allocated to these indicator species range from 1 - 10. Species with an allocated score of 6 - 10 are associated with low levels of organic pollution, while those with a score of 1 - 5 are associated with higher levels of such pollution. When all indicator species have been scored according to their MCI allocation the following equation is applied to derive an overall MCI for the particular site in question:

$$MCI = \frac{\text{Site Score}}{\text{\# of Scoring Taxa}} \times 20$$

This gives an MCI minimum-possible value of 0 (where no scoring taxa are present) and a maximum-possible value of 200 (where all scoring taxa are 10). MCI values greater than 100 are taken as indicating low levels of organic pollution. Those lower than 100 are associated with increasingly higher levels of such pollution.

The QMCI is also used to reflect the abundance weighting that the different quality-sensitive indicator taxa have on the MCI, and better reflects the make up of communities. The QMCI utilises abundance data to illustrate the proportional abundance of the different indicator taxa caught. This can produce a result that is not in line with that produced by the MCI index. This happens when there is a large abundance of one taxon and, in the MCI index, this abundance (and so ecological importance) is not reflected in the index score. For example, if a sample returned 200 worms and 1 stonefly the MCI index does not suggest to the reviewer that the high scoring taxon (ie the stonefly) may be only there by chance, whereas the QMCI weights the index in favour of the abundant species. This reflects a truer comparison between waterways.

$$QMCI = \sum \frac{\text{Site Score}}{\text{Total abundance}} \times \text{abundance}$$

An EPT dominance ratio (with taxa or abundance data) is presented which shows the level to which the faunal assemblage is dominated by EPT taxa, (that is, taxa which are generally considered to represent a natural condition) and taxa which are generally more sensitive to contamination and general modifications. EPT typically have the higher MCI values.

[1] Plafkin, J et al. (1989) : "Rapid Bioassessment Protocols for use in Streams and Rivers : Benthic Macroinvertebrates and Fish." USEPA Report EPA/444/4-89-001.
[2] Peterson, R (1992) : "The RCE : A Riparian, Channel and Environment Inventory for Small Streams in the Agricultural Landscape."

APPENDIX 3: Aquatic Survey results (from March 2007 and May 2010)

A3-1 Physical Habitat Assessment for Porter River system

	Main Stem Porter River		**Porters Stream**	**Crystal Stream**	
	Lower	mid	tributary	terrace	cascade
Aquatic habitat abundance	18	19	20	15	10
Aquatic habitat diversity	16	18	19	15	8
Hydrologic heterogeneity	14	15	18	12	8
Channel alteration	19	20	19	20	20
Bank stability	9 9	10 10	10 10	10 10	10 10
Riparian vegetation	7 7	10 10	7 9	7 7	9 9
Total	**99**	**112**	**112**	**96**	**84**
Total possible	**120**				
%	**82**	**93**	**93**	**80**	**70**

A3-2 Aquatic Macroinvertebrates Data

One Kick net Sample each stream, May 2007

Taxa	Main Stem Porter River	Western tributary porter River	Porters Stream	Crystal Stream (lower)
Acroperla	72	49	31	58
Spaniocercoides		5		
Austroperla	2		17	1
Hydrobiosis	5	7	11	8
Costachorema	1	3	6	2
Zelolessica				5
Polyplectropus	3	1	5	
Pycnocentria	2			
Deleatidium	135	47	73	80
Colobruscus	7	3	2	1
Nesameletus	57	32	61	31
Zephlebia	3		7	1
Elmidae			17	
Nothohoraia	1		2	1
Tanypodinae	17		21	3
Austrosimutium	2		1	1
Hexatominae			3	
Paralimnopnila	5		1	
Zelanditopula	2			
Archichauliodes	3			

A 3-3 Porter River samples (May 2010)

TAXON	MCI score	Porter River 1	2	3	4	5
COLEOPTERA						
Elmidae	6	R	R	C	R	C
Scirtidae	8			C	R	R
DIPTERA						
Austrosimulium species	3		R	R	C	R
Empididae	3		R	R	R	R
Eriopterini	9			C		R
Hexatomini	5				R	
Limonia species	6		C	C	R	R
Maoridiamesa species	3		C	R	C	R
Muscidae	3	C	C	C	C	R
Neocurupira species	7				R	
Orthocladiinae	2	A	A	A	VA	VA
Tanytarsini	3	A				
EPHEMEROPTERA						
Coloburiscus humeralis	9		A	C	R	
Deleatidium species	8	VA	VA	VA	A	A
MEGALOPTERA						
Archichauliodes diversus	7	R		R	R	
MOLLUSCA						
Potamopyrgus antipodarum	4	R			R	
OLIGOCHAETA	1		R	C	R	R
PLATYHELMINTHES	3				R	
PLECOPTERA						
Stenoperla species	10	R		R		
Zelandobius species	5	A	C	A	A	C
Zelandoperla species	10		C	R	R	R
TRICHOPTERA						
Aoteapsyche species	4		A	A	R	C
Beraeoptera roria	8	A	A	A	VA	VA
Costachorema xanthopterum	7	R	C	C		
Hydrobiosidae early instar	5		C	R		C
Hydrobiosis umbripennis group	5			R	R	
Olinga species	9	A	C	C	C	R
Oxyethira albiceps	2	R				
Psilochorema species	8	C	C	C	C	C
Pycnocentria species	7				R	R
Zelolessica species	10	A				
Number of taxa		15	18	23	24	19
EPT taxa		9	10	12	10	9
MCI score		123	111	121	112	114
SQMCI score		6.9	6.8	6.5	5.3	5.3

A3-4 Upper Crystal Valley samples May 2010

TAXON	MCI score	Crystal Upper TL Stream			Crystal Upper TR Stream			Porters below waterfall Crystal Valley			Small stream on TL of Porters (above ridge)
		1	2	3	1	2	3	1	2	3	
COLEOPTERA											
Elmidae	6				A	A	A	VA	VA	VA	
Hydraenidae	8										A
Hydrophilidae	5							R			
Scirtidae	8	R			A	A	C	R		R	C
DIPTERA											
Austrosimulium species	3	A	A	VA	A	VA	VA	A	A	VA	R
Empididae	3	R			C						
Eriopterini	9							R	R	R	
Maoridiamesa species	3	VA	VA	VA	VA	A	VA	A	C	A	C
Muscidae	3	A	A	A	C	C	C	C	R	R	
Neocurupira species	7	R	R				C	C	C		
Nothodixa species	4								R	R	
Orthocladiinae	2	VA	VA	VA	VA	VA	A	C	C	C	A
Tanypodinae	5									R	R
EPHEMEROPTERA											
Deleatidium species	8	VA	A	A	VA	VVA	VVA	VVA	VA	VVA	R
Nesameletus species	9	R	R	C			R	C	C	R	C
HEMIPTERA											
Sigara species	5				R						
MECOPTERA											
Nannochorista philpotti	7										R
OLIGOCHAETA	1	C	C		C	C	R		R	R	C
PLATYHELMINTHES	3	R						R	R	R	
PLECOPTERA											

Stenoperla species	10		C		A	VA	A	A	C	A	C
Zelandobius species	5	A	VA	A	A	VA	A	A	C	C	C
Zelandoperla species	10					A	A		C		
TRICHOPTERA											
Costachorema xanthopterum	7	A	C	R	A	A	A	A	A	A	
Hydrobiosidae early instar	5		C	R	A	A	A	C	C	R	
Hydrobiosis clavigera group	5									R	
Olinga species	9							C	C	C	
Psilochorema species	8			R				R	R	R	
Zelolessica species	10	R							R	R	C
Number of taxa		14	12	10	14	13	15	18	20	21	13
EPT taxa		5	6	6	5	6	7	8	10	10	5
MCI score		103	105	106	99	109	116	122	122	117	122
SQMCI score		4.4	3.7	3.2	4.9	6.6	6.5	7.3	6.6	6.9	5.7

A3-5 Upper Crystal Valley Stream May 2010 Periphyton observations

Upper TR Stream (above waterfall)

Coverage 95%

Avg. 2 mm thick (range 1 - 5 mm)

Mat orange and black periphyton with minor filamentous brown.

Photos 4 & 5

Upper TL Stream (above waterfall)

Coverage 100%

Avg. 4 mm thick

Mat orange, brown and green periphyton with minor filamentous brown.

Photo 8

Crystal Stream (below confluence) GPS 003

Coverage 50%

<0.5 mm thick

Very thin brown film on more stable large pebbles, cobbles and boulders none on smaller pebbles or gravels.

Photos 28 & 30

Crystal Stream (lower - near water tank)

Coverage 100%

Avg. 4 mm thick

Mat orange, brown

Photos 21 & 22

A 3-6 Cross sectional information measured and used to establish wetted habitat in Porters Stream.

Date 22/04/2010 Porters Stream
Start GPS 033, worked downstream, finish GPS 037
Measurements at 100 mm intervals starting on TL, depth in mm.
See below for cross-section specific notes

Number of cross sections

↓Interval	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0
10	190	190	90	40	40	25	0	110	25	80
20	220	180	130	50	45	0	55	155	55	110
30	260	190	180	90	75	35	0	130	90	110
40	280	115	160	75	120	5	0	165	95	130
50	280	205	155	195	150	70	200	170	140	145
60	278	225	160	185	215	110	230	150	170	200
70	300	115	170	5	180	115	295	155	25	275
80	280	220	180	0	300	95	310	85	65	230
90	280	130	205	0	340	95	280	130	250	215
100	280	45	215	0	355	130	235	155	260	210
110	200	0	210	155	370	115	205	180	195	270
120	280	0	225	75	390	180	220	215	205	235
130	255	0	235	65	400	210	310	215	230	240
140	260	250	245	80	395	190	320	215	365	260
150	275	220	275	95	400	155	310	230	390	275
160	275	250	290	280	380	175	380	190	385	295
170	290	230	310	245	375	240	410	200	350	275
180	280	285	305	270	350	205	280	175	350	280
190	265	300	200	280	335	150	150	15	290	325
200	250	240	200	355	310	120	50	15	260	340
210	235	280	210	145	325	35	0	110	230	330
220	230	290	210	130	310	25		145	185	310
230	225	295	215	215	285	0		110	150	130
240	215	190	240	0	255	0		25	0	120
250	210	260	230	40	265	0		0		115
260	220	230	210	0	235	20				195
270	25	200	215		270	50				190
280	210	0	225		185	50				60
290	0		230		125	100				90
300			25		60	75				70
310			180		90	100				35

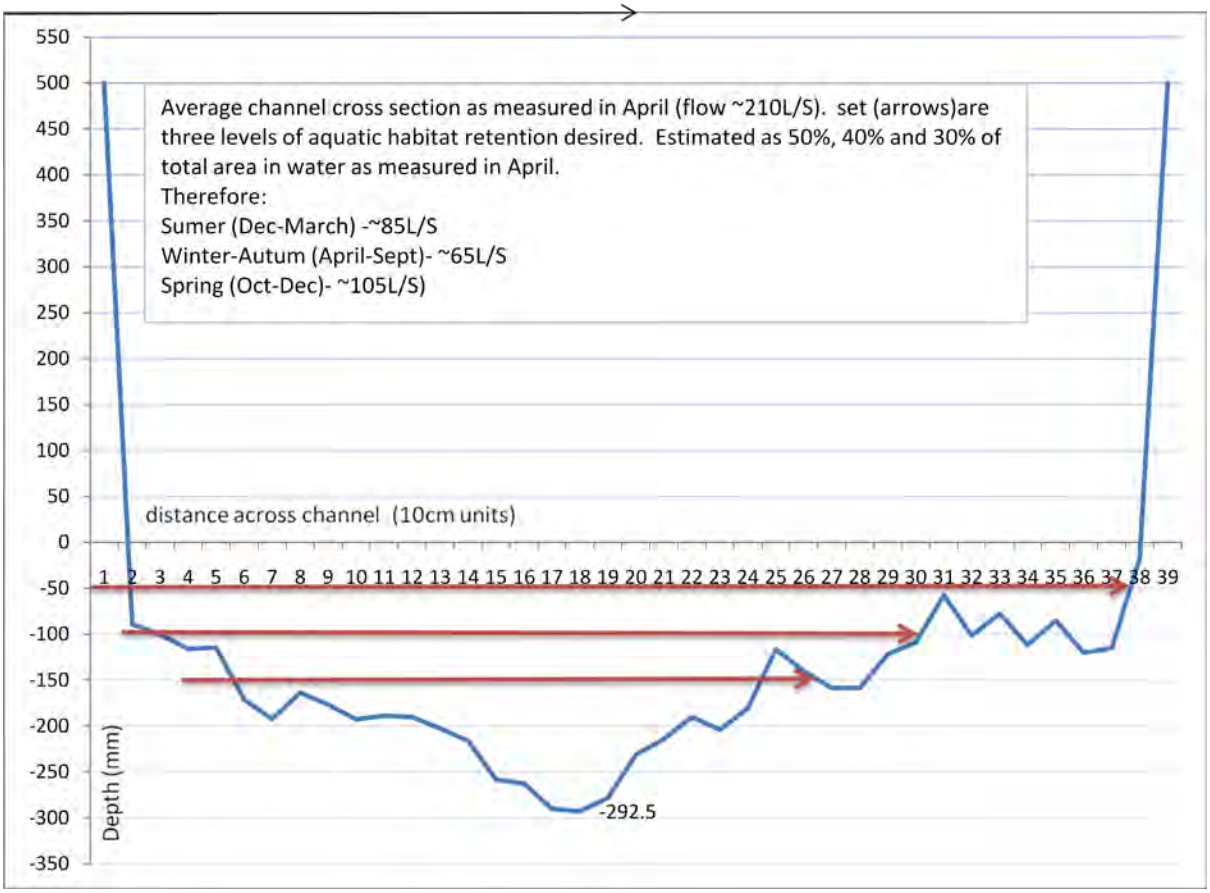
↓Interval	1	2	3	4	5	6	7	8	9	10
320			185		85	40				0
330			170		65	100				
340			155		0	100				
350			115			125				
360			105			125				
370			35			0				
380			0							
390										
400										

A 3-7 Gauging Porters Stream
24/04/2010

Site 025 Porters Stream

	Chainage	Depth	Average velocity	Q m^3/sec
	0	0.24	0.1	0.024
	0.5	0.3	0.3	0.09
	1	0.28	0.1	0.028
	1.2	0.22	0.3	0.066
				0.208
Site 038 Porter River				
	Chainage	Depth	Average velocity	Q m^3/sec
	0	0.12	0.1	0.012
	0.5	0.14	0.3	0.042
	1	0.31	0.3	0.093
	1.2	0.23	0.4	0.092
				0.239

A3-8 Profile used to estimate habitat retention values Porters Stream .



APPENDIX 4: Areas of vegetation and habitat types

Table A4-1: A - Porter Basin

	Vegetation type	Area (ha)	Percentage of
1	Scree	141	88
3	Rock outcrop	0.21	0
4	Boulder Field/fellfield/rock glacier	12	7
6	*Celmisia* Herb Field	2	1
7	Tall Tussock - Snow Totara	3.5	2
10	Slim Snow Tussock	2	1
	Total	160.7	

Table A4-2: B - Porter Stream Valley

	Vegetation type	Area	Percentage of
1	Scree	26.47	27
4	Boulder Field/fellfield/rock glacier	4.70	5
5	Spring Flush	1.61	2
7	Tall tussock - Snow Totara	12.27	12
8a	*Dracophyllum* – Tall tussock	25.15	25
8b	Tall tussock *Dracophyllum*	13.07	13
9	Wetland	1.34	1
10	Slim snow Tussock	13.23	6
11	Riparian Vegetation	1.70	2
	Total	99.5	

Table A4-3: F –Porter River Valley hillslope

	Vegetation type	Area	Percentage of
1	Scree	0.02	0
8a	*Dracophyllum* - Tall Tussock	6.39	82
8b	Tall tussock - *Dracophyllum*	0.02	0
10	Slim snow Tussock	1.31	17
13	Short Tussock	0.06	1
15	**Total**	7.8	

Table 4-4: G Southern Terrace

	Vegetation type	Area	Percentage of
1	Scree	0.28	1
8a	*Dracophyllum* - Tall Tussock	17.32	82
8b	Tall tussock - *Dracophyllum*	2.40	11
9	Wetland	0.29	1
11	Riparian Vegetation	0.92	4
	Total	21.21	

Table A4-5: H Crystal Basin

	Vegetation type	Area (ha)	Percentage of
1	Scree	153.61	85
2	Scree Chute / Loose Rock	2.14	1
3	Rock Outcrop	1.24	1
4	Boulder Field/fellfield/rock glacier	8.31	5
5	Spring Flush	0.54	0
6	*Celmisia* Herb Field	2.32	1
10	Slim snow tussock	12.37	7
	Total	180.53	

Table A4-6: I Crystal Stream Valley

	Vegetation type	Area (ha)	Percentage of
1	Scree	29.45	40
2	Scree Chute / Loose rock	5.95	9
3	Rocky Outcrop	0.82	1
4	Boulder Field/fellfield/rock glacier	0.07	0
7	Tall Tussock - Snow Totara	0.49	1
8a	*Dracophyllum* - Tall Tussock	21.00	29
8b	Tall tussock - *Dracophyllum*	8.31	11
10	Slim snow tussock	4.20	6
11	Riparian Vegetation	1.62	2
13	Short Tussock	1.27	2
	Total	73	

Table A4-7: K Northern Terrace

	Vegetation type	Area (ha)	Percentage of
1	Scree	1.20	3
5	Spring Flush	0.31	1
8a	*Dracophyllum* - Tall tussock	38.06	91
8b	Tall tussock - *Dracophyllum*	2.38	6
11	Riparian Vegetation	0.50	1
	Total	42	

APPENDIX 5: Selwyn DC Appendix 12 Criteria

APPENDIX 12

PROCESS AND CRITERIA FOR IDENTIFYING SIGNIFICANT SITES

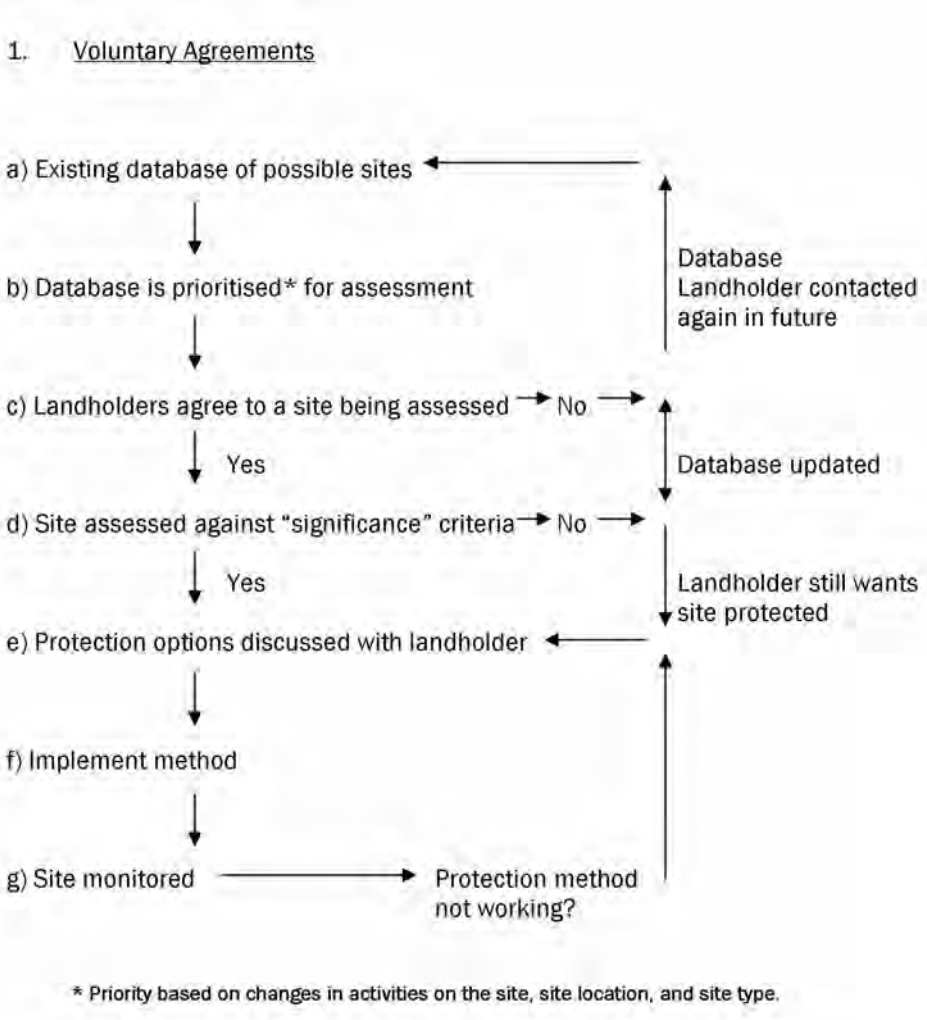
Introduction

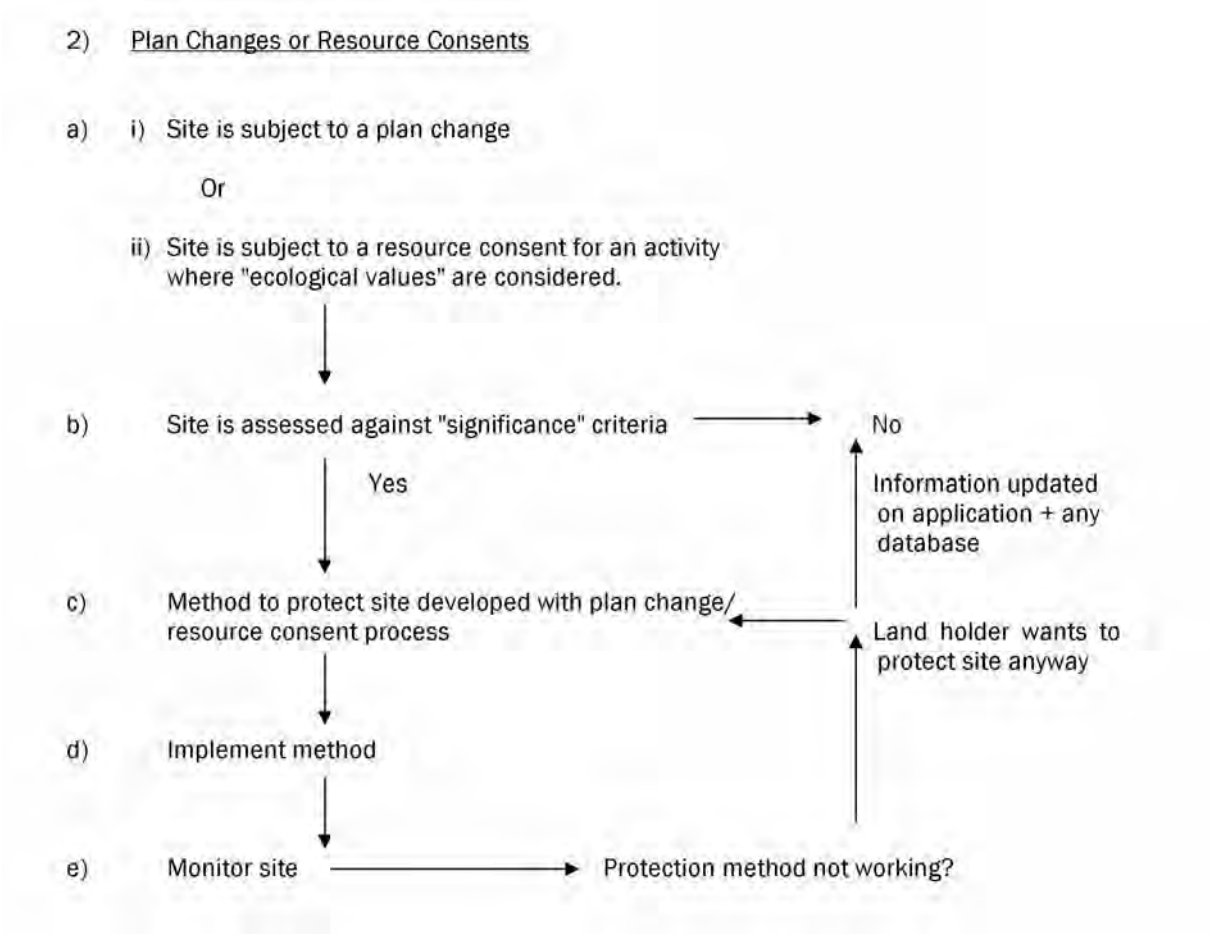
Appendix 12 outlines the process the Council will use to identify whether a site is a "significant area of indigenous vegetation or habitat of indigenous fauna", under section 6 (c) of the Act.

The appendix describes:

- the processes used to identify possible sites;
- the criteria used to assess if these sites are "significant"; and
- the process for protecting "significant" sites.

Identifying Sites





Significant Criteria

- A site is assessed to see if it is "significant" under section 6(c) of the Act, using the seven criteria listed in Table E12.1.
- Each site is ranked "high", "medium", or "low" on each criterion.
- As a guide a site that has one or more "high" rankings, or five or more "medium rankings among the primary criteria will be considered for protection. A site that has four "medium" rankings among the primary criteria will be considered for protection if it ranks highly for the secondary criteria.

For example, a site that has one "high" ranking and six "lows" may be "significant" if the "high" ranking is for "rarity or special features". It may be less "significant" if the "high" ranking is for "surrounding land uses and conditions."

A site with four "mediums", three "lows" and a willing landholder may be protected before a similar site with five "mediums", two "lows" and an unwilling landholder.

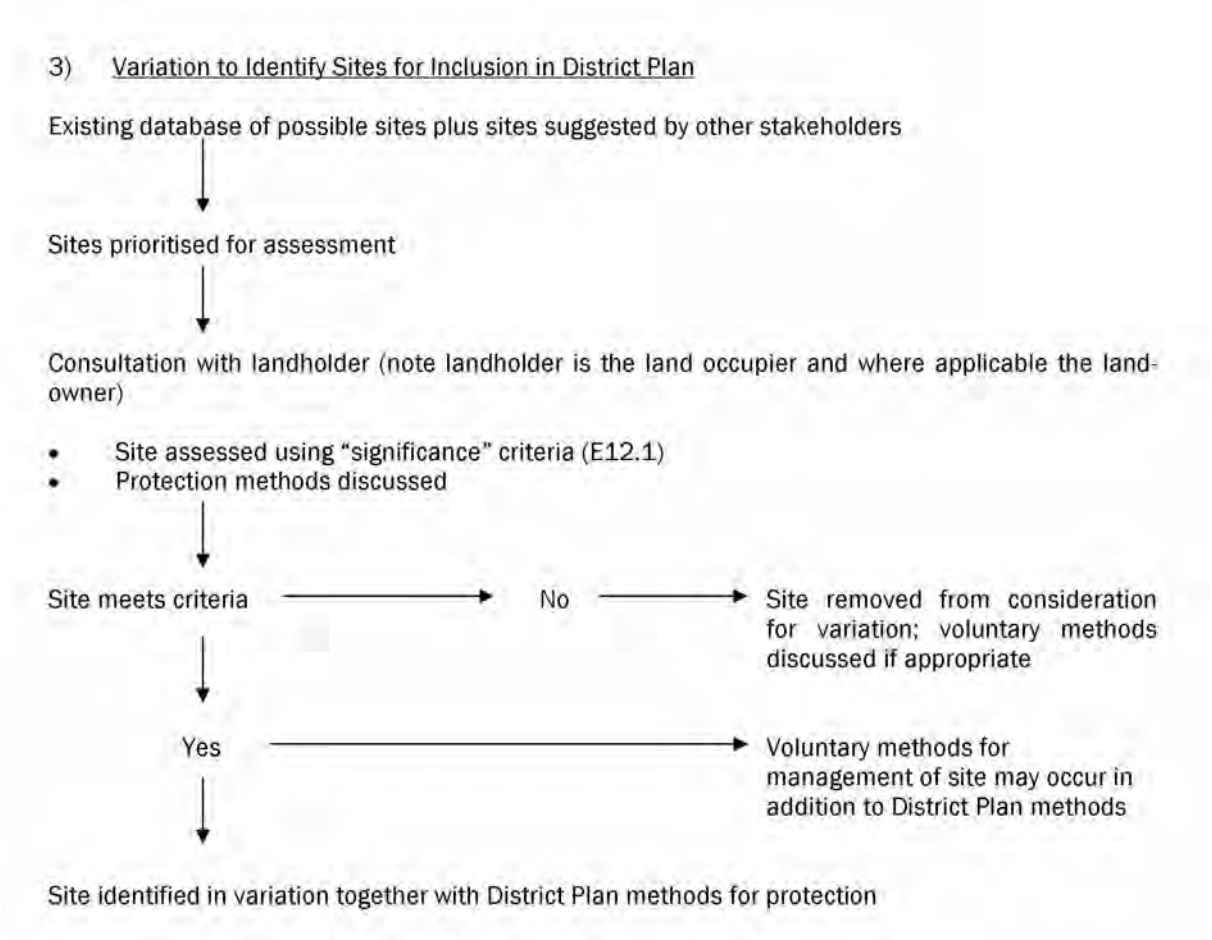


Table E12.1 — Criteria for Assessment of Areas of Significant Indigenous Vegetation

Primary Criteria	Description
Representativeness	The degree to which current vegetation and fauna is representative of that which formerly occupied Selwyn District, measured at the scale of ecological districts. This identifies the ecosystems that have suffered the greatest impact from human activities. It can be assessed at two baseline levels, (1) at the time of European settlement or (2) prior to human arrival. The extent to which the LENZ environment(s) of the site are represented within the protected natural area should also be assessed. This criterion places a site which is poorly represented within an ecological district at a higher ranking than a site which is represented in proportion to its original extent. This is because Selwyn District Council wants to concentrate their initial efforts on vegetation types that have suffered the greatest impact from human activities
Examples	
High	Podocarp forest or dry kanuka woodland on the Canterbury Plains. Bog pine/mountain toa-toa woodland of intermontane basins. Red tussock grasslands. Sand dunes dominated by indigenous species.
Medium	High country mountain beech forest.
Low	Alpine snow tussock grasslands.

Primary Criteria	Description
Diversity and Pattern	Diversity is the number of indigenous habitats and species contained in an area. Like habitats must be compared with like because diversity differs markedly between different habitats. Pattern refers to changes in the distribution and abundance of species/habitats across the site, and is driven by underlying variation in the environment, e.g. aspect differences, natural disturbance, altitudinal change, soil characteristics. It can be represented by successional sequences and ecological gradients. High species diversity provides for greater interaction between species while habitat diversity allows ecological processes (e.g. dispersal, nutrient transfer) to operate across different ecosystems. Containing diverse habitats and strong ecological variation at a higher ranking than similar sites that are less diverse and contain only one habitat. This is because Selwyn District Council wants to concentrate their initial efforts on sites which have the greatest potential to preserve ecological processes and interactions.
Examples	
High	Sand dunes with many indigenous species. An intact gradient from wetland through shrubland forest.
Medium	Grazed shrublands with several shrub species present.
Low	A uniform patch of tussock grassland with exotic intertussock vegetation. Low-stature matagouri in rough pasture.

Primary Criteria	Description
Rarity and Special Features	Rarity refers to the presence of threatened or naturally rare indigenous species, and the degree to which types of habitat or ecosystem have been reduced from their former extent. It should be assessed on both a national scale and on the scale of ecological districts. Special features refers to any unusual natural biotic or abiotic characteristic of the site which contributes to its value, for example distinctive landforms such as limestone outcrops or caves; the presence of unusual associations of species; species at their distribution limits. This criterion places sites which contain rare species or special features at a higher priority than sites where these features are not known to occur. This is because Selwyn District Council wants to concentrate their initial efforts on sites which are of greatest importance for conserving indigenous biodiversity.
Examples	
High	Site contains a species listed as 'gradual decline' or higher under the New Zealand Threat Classification System (Hitchmough 2002). Wetlands or sand dunes dominated by indigenous species. Rare plants growing on a limestone outcrop. A site containing species at their distribution limits.
Medium	Site contains a species listed as 'sparse', 'range restricted', or 'data deficient' under the New Zealand Threat Classification System (Hitchmough 2002). Vegetation is very common within the district but uncommon elsewhere.
Low	Site contains no rare or threatened species and the vegetation type is very common within the district and elsewhere.

Primary Criteria	Description
Naturalness	The extent to which the site has been modified directly or indirectly by human activities. For most sites in Selwyn District the extent of modification by fire, habitat destruction, logging, or pest impacts will be quite evident. For some larger or less accessible sites, the indigenous character may be relatively intact compared to smaller and less isolated sites. This criterion places sites showing evidence of disturbance at a lower ranking than sites which are apparently undisturbed and predominantly indigenous in character. This is because Selwyn District Council wants to concentrate their initial efforts on the most intact sites.
Examples	
High	Ungrazed alpine snow tussock grasslands with minor occurrences of exotic species. Forest on the Port Hills with emergent podocarps and few exotic understorey species
Medium	Secondary forest without podocarps. Montane tussock grasslands where indigenous woody plants are scarce
Low	Scattered indigenous shrubs and trees in stands of gorse or broom. Dunes dominated by marram grass and other exotic species. Short tussocks in pasture on foothills.

Primary Criteria	Description
Ecological Context	The degree to which an area of indigenous habitat or vegetation has links to other such areas or contributes to the ecological significance of the immediate vicinity. Such areas have a significant ecological function if they are within the flying distance for the majority of native birds or if they increase habitat suitability for terrestrial and aquatic fauna by providing cover, shelter, food or nesting sites, or provide a buffer from adverse impacts. The intention of this criterion is to ensure that the ecological functions of areas of indigenous vegetation are taken into consideration. The criterion places sites that are well-buffered and help to maintain ecological processes in the surrounding environment at a higher priority than sites which are poorly buffered and do not contribute to the functioning of neighbouring ecosystems. This is because Selwyn District Council wants to concentrate their initial efforts on sites that are the most important for maintenance of ecological function and linkages.
Examples	
High	Continuous riparian forest Wetlands with links to river systems. Coastal shrublands providing nesting habitat for seabirds. Whole catchments covered by indigenous vegetation.
Medium	Stands of flax or kowhai in rough pasture that provide a seasonal food source for tui and bellbird.
Low	Kanuka woodland surrounded by pasture and crops and distant from other areas of indigenous forest.

Secondary Criteria	Description
Size and Shape	This criterion refers to the size of an area of vegetation or habitat and the degree to which its shape influences the viability of the site. Large sites are likely to meet the habitat requirements of a greater range of species because they contain more resources (e.g. nesting habitat; flowers and fruit) than small sites. Shape determines the ratio of 'core' to 'edge' habitat within a patch of vegetation. For a fixed patch size, a compact shape will contain more 'core' habitat than a linear patch, or a patch with irregular boundaries. Adverse effects such as exposure to wind, stock browse, and weed invasion are more important at the edges of a patch. For a given vegetation type, large, compact sites will be accorded higher priority than small sites with irregular boundaries. This is because Selwyn District Council wants to concentrate their initial efforts on sites that have the greatest chance of remaining viable.
Examples	
High	Compact areas of forest >9 ha. Large areas of alpine tussock grassland.
Medium	Linear remnants of riparian forest or shrubland.
Low	Scattered mountain beech trees in an area of pasture.

Secondary Criteria	Description
Fragility, Threat and Buffering	Refers to any specific threats to the site and its overall susceptibility and resilience to the effects of such threats. The degree to which the site is buffered (i.e. protected from threats) is important. This is related to surrounding vegetation and landuse and the degree of topographic protection. Threats include factors such as fire and invasion of pest plants and animals. Different vegetation types might be equally at risk but differ markedly in resilience – for example adjacent hill country forest remnants and montane tussock grasslands might be equally exposed to fire but the tussock grassland would be much more likely to recover from its effects. The nature of the threat must also be assessed, i.e. whether the risk can be easily reduced by a small management change or whether it is not easily mitigated. Areas of well-buffered or resilient vegetation with few or easily-mitigated threats will be accorded higher priority than highly susceptible sites exposed to chronic threats that are not easily mitigated. This is because Selwyn District Council wants to concentrate their initial efforts on sites that have the greatest chance of remaining viable.
Examples	
High	(High = more threatened , fragile) Mountain toatoa and bog pine stands in tussock grasslands under pastoral management. Sand dune communities not yet invaded by marram grass.
Medium	Unfenced forest remnants surrounded by pasture. Tussock grassland with scattered wilding conifers
Low	Ungrazed alpine snow tussock grasslands. Extensive high country mountain beech forests.

Protection Options

- Protection of "significant sites" is in partnership with landholders and other stakeholders, through either:
  - Voluntary (process 1);
  - Plan changes and resource consents (process 2); or
  - District Plan identification and rules (process 3).
- The method(s) used to protect a site is/are specific to each site, taking into account the factors listed in Table E12.2, and any other relevant matters including objectives, policies or rules in this Plan.

Table E12.2 — Factors to Consider in Protecting Significant Sites

Factor	Explanation
Landholder	Views on protecting the site. Activities they want to undertake on and around the site. Preferred options. Willing to be involved in managing or enhancing the site. Willing to have other groups involved.
Site Characteristics	What work is needed to maintain or protect the site? What is the cost and feasibility of that work? How much "effort" is needed relative to its ecological "significance?" Are there other similar sites that are easier to maintain?
Options available	What "protection" options are available for that site? Is the land regulated by other statutes; e.g., Crown Pastoral Land Act 1998? Is there high demand for re-zoning and subdivision, e.g., Port Hills and around Christchurch?
Cost of various options	Relative costs of "protection" options compared with the protection levels they give. Costs of protection options compared with the "significance" of the site.
Interested parties	Are there other interested parties willing to help fund the protection of a site? Does the landholder want other parties involved? **NOTE:** The involvement of other parties does not confer any rights of access or ownership to these parties
Other values	Does the site have other values as well as being ecologically significant? For example is it an outstanding natural feature or part of an outstanding landscape; or is it a heritage site, waahi tapu site, or site of mahinga kai? Do these other values make some protection methods for the site more cost-effective?

Protection Methods

Table E12.3 provides examples of some of the options that may be used to protect sites. The list is not exhaustive. Options should be tailored to meet the specific needs of each site.

Table E12.3 — Examples of Protection Options

Option	Comments
Do nothing	The site is not under any threats from existing or proposed land uses. Other "protection" mechanisms already apply to the land. The land holder is already contemplating protection through another process; e.g., tenure review. The general (interim) rules for indigenous vegetation will apply through the District Plan in any case.
Tenure review	If a landholder is contemplating tenure review, assessing the "significance" of sites may assist in establishing their value to be "traded".
Covenants	Legal protection of the site. Landholder retains ownership and may be able to negotiate some "use" rights or conditions. Good for small sites; or sites scattered amongst a large property; or where land owner is reluctant to have a site change ownership.
Management plans	Can be voluntary or incorporated into District Plan (legally enforceable). Good where owner wants to continue some use of the site or may want to undertake an activity in the future which may not be allowed if he/she allows the site to be protected or enhanced now.
Purchase	Council may consider purchasing a very special site. Other private organisations may purchase sites. Need to be large enough to be self-sustaining, have access for maintenance. Council may not purchase sites unless there are recreational benefits for ratepayers.

APPENDIX 6: Significance assessment (SDC criteria)

Summary of considerations in assessing significance of each management unit or group of units

A Porter Basin

Criterion	Features	LMH/significant/not
Primary		
Representativeness (LENZ)	Modification by ski area activities and structures so former cover not representative	L
Diversity/ Pattern	Low	L
Rarity/special features	Presence of kea (which use a very wide area) = at risk species category /naturally uncommon.	M
Naturalness	Modification by ski area activities and structures	L
Ecological context	No special role	L
Secondary		
Size/shape	Vegetation/habitats fragmented, small	L
Fragility, resilience, buffering	Damaged, threatened, no buffering, not resilient	L
	Overall assessment	Not significant

B Porters Stream Valley and C Porters Stream

Criterion	Features	LMH/significant/not
Primary		
Representativeness (LENZ)	Not beech forest (former cover) but good successional stage and representative heathland (not widespread former cover but would have been around naturally). More extensive now because of fires.	L
Diversity/ Pattern	High diversity spp, but not communities/types; good pattern appropriate to physical environment; stream and wetland	H
Rarity/special features	Special feature – fish free stream with good quality habitat conditions; inverts reflect no fish and good habitat – this is special feature	M
Naturalness	Modified by ski activity; road, weeds, dams/weir – localised	M
Ecological	Good wetlands, stream, riparian – stream/Porter River link; basin/valley links; functional; groundwater; dam or	M

context	two blocking passage	
Secondary		
Size/shape	Reasonably wide corridor; intact	H
Fragility, resilience, buffering	Mod fragility due to altitude but also altitude keeps weeds down; dense vegetation and some grazing keep weeds out	L
	Overall assessment	Significant

D Lower Porter River and E lower Porter River Valley and F Porter Hillslopes

Criterion	**Features**	**LMH/significant/not**
Primary		
Representativeness (LENZ)	Not representative of former cover; now weedy; forest/shrubs to edge formerly, now matagouri/short tussock mix.	L
Diversity/ Pattern	Community pattern/div is “natural” reflects hydro/geology but composition within comms is poor and dom by weeds	L
Rarity/special features	None.	L
Naturalness	Weedy; no native fish (only trout!)	L
Ecological context	River corridor; good water quality; no blocking features on river; part of Waimakariri R catchment	M
Secondary		
Size/shape	Long and narrow – weeds and disturbance	L
Fragility, resilience, buffering	Fragile; threatened (trout and weeds);	H
	Overall assessment	Not Significant

G Southern Terrace

Criterion	Features	LMH/significant/not
Primary		
Representativeness (LENZ)	Not beech forest (former cover) but good successional stage and representative heathland/shrubland; (not widespread former cover but would have occurred in places naturally). More extensive now because of fires.	L
Diversity/ Pattern	High diversity spp, but not of communities/types; good pattern appropriate to physical but this not diverse; environment; small wetland in red tussock gully	M
Rarity/special features	None	L
Naturalness	Localised buildings, tracks, rubbish/dump ; weeds, pines;	M
Ecological context	No specific role	L
Secondary		
Size/shape	Adequate	M
Fragility, resilience, buffering	Moderate fragility due to altitude but also altitude keeps weeds down; except pine = problem /threat	L
	Overall assessment	Not Significant

H Crystal Basin

Criterion	Features	LMH/significant/not
Primary		
Representativeness (LENZ)	All spp, communities represent diverse alpine communities; plus the likely fauna	H
Diversity/ Pattern	Lots diversity for an alpine Basin – spp and communities; responds to environmental gradients	H
Rarity/special features	*Schizeilema pallidum (*Threatened/naturally uncommon) – only one small location in flush ; kea (at risk/naturally uncommon)	M
Naturalness	Unmodified; few ungulates; very few exotic plants in very small flush location	H
Ecological context	Top of Crystal Stream valley; flush/spring source for tributary of Porter River	M
Secondary		
Size/shape	Vegetated areas of good size and shape/reflect environmental gradients; Basin is good size and shape	H
Fragility, resilience, buffering	Fragile; low threat; DOC land around buffers	H
	Overall assessment	Significant

I Crystal Stream Valley and J Crystal Stream

Criterion	Features	LMH/significant/not
Primary		
Representativeness (LENZ)	Valley sides represent screes etc of former cover; water and edges would have formerly been open based on flood pattern evidence	M
Diversity/ Pattern	Spp and community diversity high; alt gradient	H
Rarity/special features	Alpine galaxid community special features of upper P River (one of only two known native fish pops in UPR);	M
Naturalness	Relatively high except weeds into lower stream from Porter Valley due flood disturbance; small water take	L
Ecological context	River corridor; good water quality; no blocking features on stream; part of Waimakariri catchment; Basin/Valley link	M
Secondary		
Size/shape	Reasonably wide corridor	M
Fragility, resilience, buffering	Susceptible to weed dominance; fragile; not resilient	H
	Overall assessment	Significant

K Northern Terrace

Criterion	Features	LMH/significant/not
Primary		
Representativeness (LENZ)	Not beech forest (former cover) but good successional stage and representative heathland/shrubland (not widespread former cover but would have occurred in places naturally). More extensive now because of fires.	L
Diversity/ Pattern	High diversity spp, but not communities/types; good but simple pattern appropriate to physical environment but this not diverse;	L
Rarity/special features	None	L
Naturalness	Natural except pre-European burning; some weeds, pines;	H
Ecological context	No specific role	L
Secondary		
Size/shape	Adequate	M
Fragility, resilience, buffering	Moderate fragility due to altitude but also altitude keeps weeds down; except pine problem/ threat	L
	Overall assessment	Not Significant

APPENDIX 7: Photographs

Photographs of site and ecological features referred to in text.

1 Screes, Porters Basin

2 Scree plants

3 Scree chutes

4 Rock outcrops

5 Fellfield, Crystal Basin

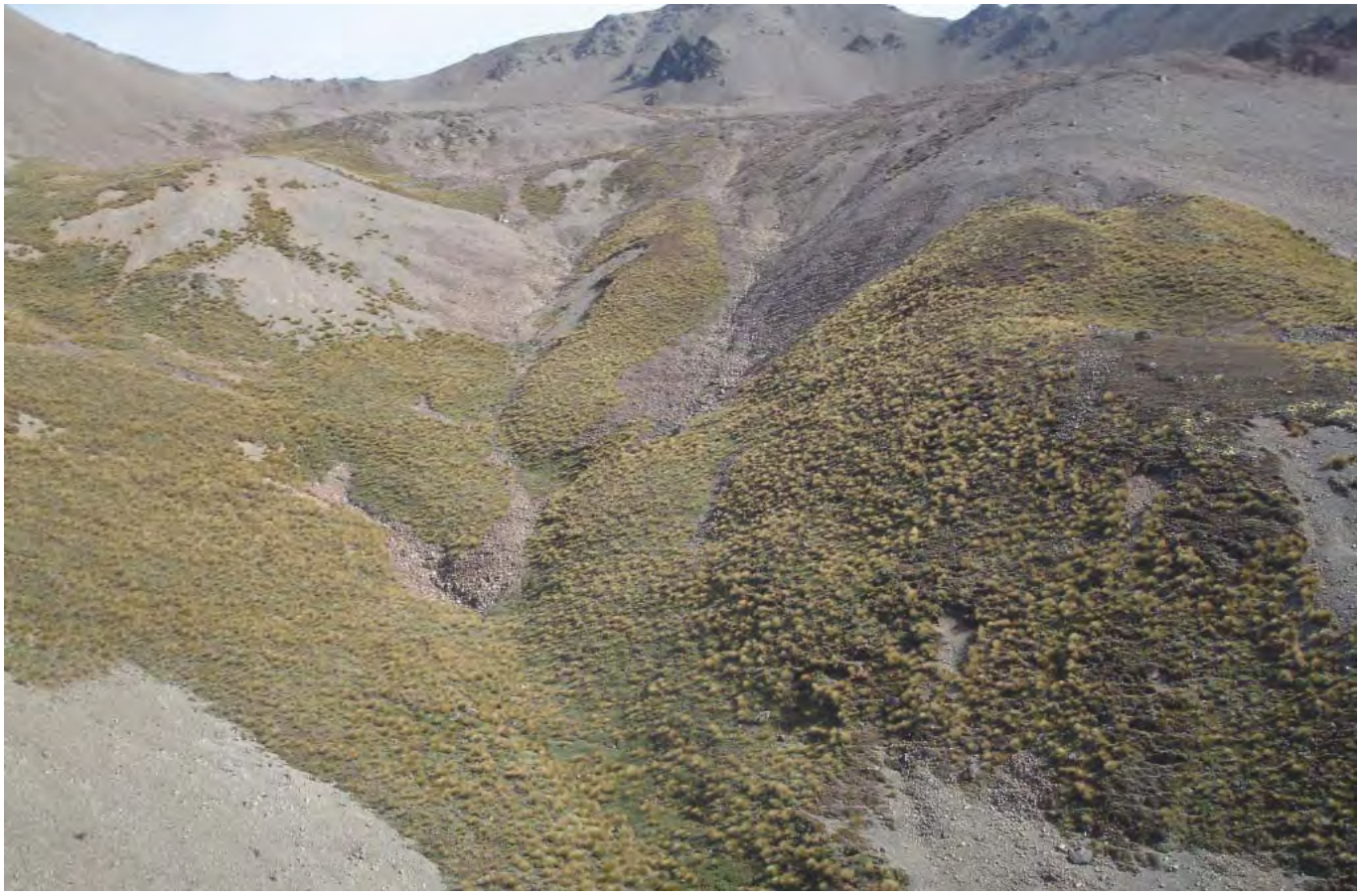
6 Spring flush, Crystal Basin

7 Celmisia herbfield

8 Tall tussock snow totara vegetation

9 Tall tussock-Dracophyllum vegetation

10 Red tussock wetland



11 Slim tussock grassland

12 Riparian vegetation

13 Valley floor vegetation

14 Porters Basin scree vegetation

15 Ryton Basin

16 Vegetation at edge of Big Mama

17 Upper Porter Stream Valley

18 Lower Porter Stream Valley

19 Porter stream wetland

20 Upper Porter River valley

21 Lower Porter River valley

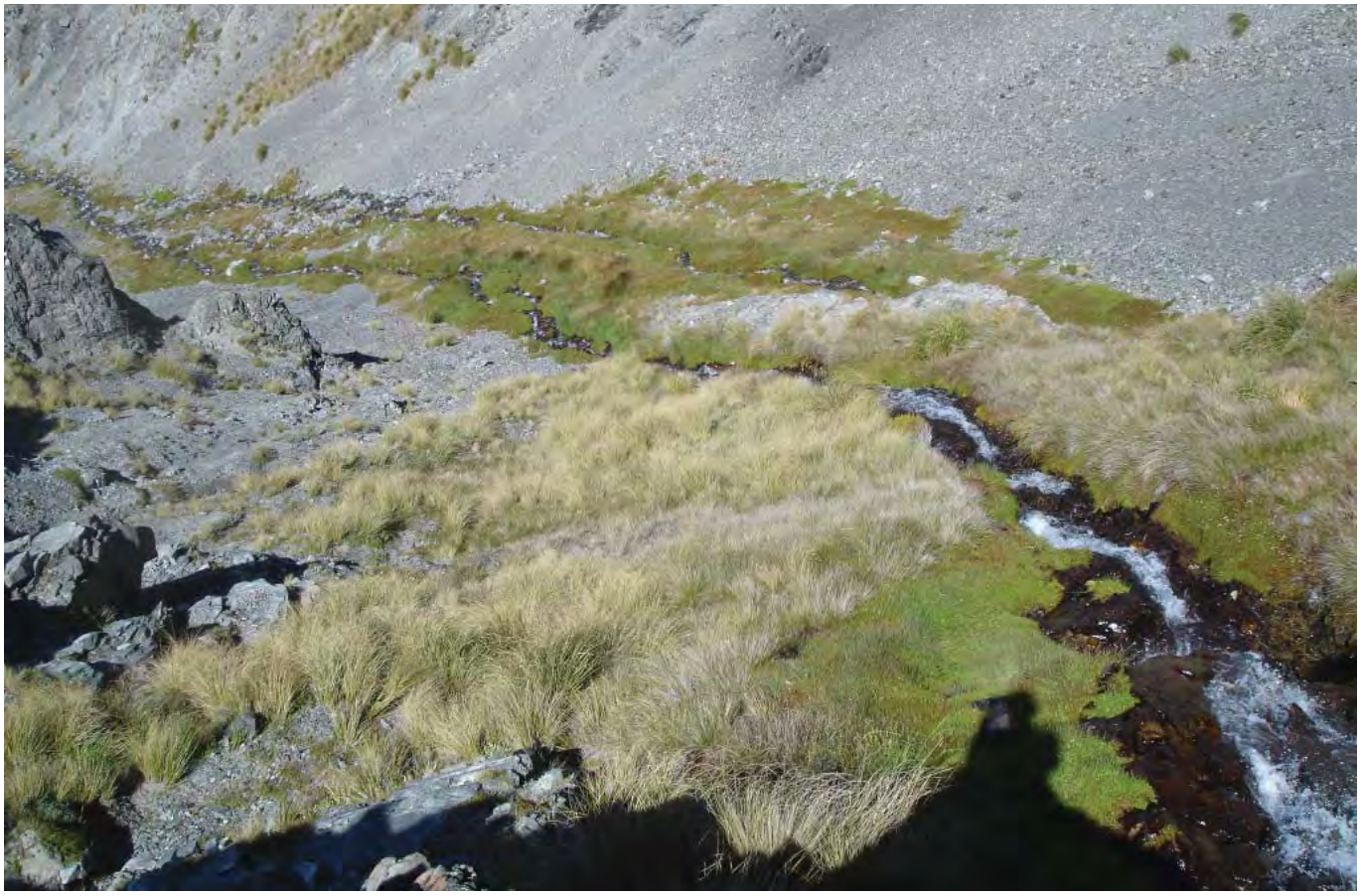
22 Lower Porter River Valley

23 Porter hillslope

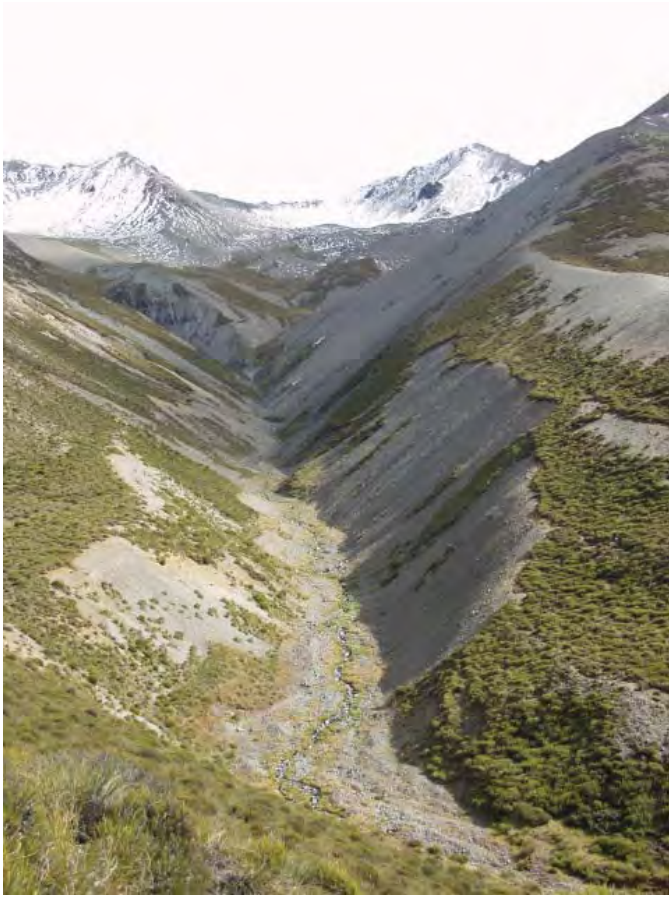
24 Southern terrace

25 Crystal Basin from south

26 Crystal Basin



27 Spring flush Crystal Stream



28 Crystal Stream Valley

29 Northern terrace (looking across Crystal Stream)

30 Kea

31 Grasshopper

32 Weta

33 Porter River

34 Crystal Stream

35 Alpine galaxias, trout

36 Porter Stream