PORTERS SKI AREA LIMITED

Erosion and Sediment Control Plan

Porters Ski Area, Porter Heights

July 2010

CPG New Zealand Ltd
A subsidiary of Downer EDI Limited

Erosion and Sediment Control Plan
Porters Ski Area Ltd

Porters Ski Area, Porters Height

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1.0 BACKGROUND AND PROJECT PROPOSAL

1.1 Background

This document is a broad-based erosion and sediment control plan (ESCP) that outlines the intentions and fundamental principles that will be followed in the planning and implementation of erosion and sediment control measures for construction activities associated with the proposed Porters Height Ski Field Expansion project. It aims to demonstrate to the consent authorities that appropriate measures can be implemented in accordance with relevant guidelines to ensure that the effect of any discharge to receiving waters during or after construction as a result of land disturbance can be avoided, remedied or mitigated to such an extent that the effects of the discharge on the receiving environment will be no more than minor.

It ensures that erosion and sediment transport are addressed early in the project development and therefore will make a difference to what happens on the ground.

This erosion and sediment control plan (ESCP) contains background information and fundamental advice relating to erosion and sediment control during the construction phase of the development.

It relates to site clearing and topsoil stockpiling, building construction, road construction, ski trails construction, drainage works, installation of services, reservoir construction and other associated construction activities. Water supply and wastewater pipelines will be covered in general only, as water supply pipeline installation within waterways and wastewater treatment and disposal facilities are dealt with separately in landuse consent applications for those activities. The ESCP presented here covers all construction activities and buildings works at various locations, that is, all activities associated with the construction of Porters Ski Area Expansion Project other than activities which were dealt with separately with their own application for consent. A copy of the concept Masterplan for the development is included in **Appendix A** of this report.

This plan is accompanied by a drawing or series of drawings showing the locations of various erosion and sediment control works during construction. However, this is subject to change since the project is only at master planning stage, and a comprehensive detailed design has not yet been undertaken. As such, the drawings attached aim to demonstrate that there are appropriate methods that can be installed to mitigate potential effects of stormwater discharge during construction.

The approach taken is to update this ESCP later during detailed design and when construction and earthworks contracts are let for the construction of various components of the proposed development. There is also a need to note that modification of this plan is required as the planning and detailed design and construction progresses and to allow the successful Contractor/s to adjust the ESCP as necessary but in consultation/approval of the consenting authorities. The ESCP at that later stage is termed a progressive ESCP.

This plan is to serve as a background document when the final construction-phase ESCPs are prepared. It examines various construction activities and makes recommendations for appropriate management. It has been prepared following guidelines contained in the *Erosion and Sediment Control Guideline (ESCG)* (ECan, 2007).

The proposed works are part of a ski field development located adjacent to Porter Stream, Crystal Stream and Porter River (see Site Plan). It sets out the control measures to be undertaken and maintained throughout the duration of construction activities and the related stormwater drainage works in order to minimise erosion and sediment discharge to water ways.

This generic plan will be supplemented by numerous progressive plans. For example, these progressive plans can be prepared that deal with the following activities:

- Specific ESC plan (e.g. for culvert installation);
- Specific ESC plan for installation of stormwater outfalls; and
- Others when detailed engineering design is completed.

This ESCP provides fundamental erosion and sediment control advice for this site. The proposed development can proceed without undue long term effects on the receiving waters both during and after the construction stages providing that:

(i) The management measures recommended for all earthworks here are implemented;
(ii) Works are appropriately staged to minimise the amount of land disturbance at any one time;
(iii) Erosion and sediment control works are appropriately sized and sited (e.g. sediment basins, diversion drains);
(iv) Any conditions of consent that might be placed on the development following approval are appropriately addressed and complied with.

This plan should be read with the following documents relating to this development:

(i) AEE for Stormwater Discharge Consent Application;
(ii) Assessment of Ecological Effects (Boffa, 2010);
(iii) Preliminary Engineering Report for Proposed Expansion of Porters Ski Area (Eliot Sinclair, 2010); and
(iv) Geotechnical Draft Summary Report (URS, 2010); and any other consultant reports relating to the proposal.

The ESCP will ensure works are performed in compliance with consents/permits (to be) issued by Environment Canterbury and Selwyn District Council.

1.2 Project Proposal

The Porters Ski Area development will involve the creation of a village base, expansion of the existing ski area from the Porter Heights Basin into the neighbouring Crystal Basin and the development of additional on-mountain facilities within an area of 708.2 ha (Certificate of title). The proposed development will enable Porters to offer activities and receive visitors throughout the year. It is expected that when fully developed, Porters will receive over 7,000 visitors per day at peak or just over 600,000 visitors per year.

The proposed village base will be located predominantly between the Porter and Crystal Streams on an elevated terrace above the Porter River. The main Village Core will comprise a mix of retail, skier services, amenities and accommodation and will have a combined building footprint of 3 hectares.

The remaining village precincts are illustrated in **Drawing No. 140A** and comprise the following:

- Hotel and visitor accommodation to the north of the village centre – approximately 9,000 m^2
- Crystal Chalets – private residences beyond the hotel and visitor accommodation to the north of the village centre – approximately 8.5 hectares;
- Slopeside visitor accommodation, spa and gym facilities to the south of the Porter Stream – - approximately 3.3 hectares; and

- Porters Chalets – private residences on top of the narrow spur to the south of Porter Stream – approximately 1.7 hectares.

A chairlift and gondola will extend from the village base to mid-mountain stations in the Porter Heights and Crystal Basins respectively. The Porter Heights mid-mountain station will comprise the existing café and facilities building, while the Crystal Basin mid-mountain station will comprise a new restaurant building (Day Lodge) with garage and workshop below.

In addition, a 90,000 m^3 snowmaking reservoir is proposed within the upper Crystal Basin along with a network of ski tracks and lifts to facilitate expansion of the existing ski area into the Crystal Basin. Ski trails proposed under the development totalled 8 km and 6 km of road is proposed to be formed (excluding the upgrading of part of existing access (off SH73) to Porters Ski Area).

1.3 Project Staging

The development proposed by Porters Ski Area Limited (Porters) involves the development of a 616 hectares into a world standard Ski Area destination with on-mountain accommodation. It will provide for a mix of visitors ranging from the Christchurch centred day use market to destination guests from the rest of New Zealand, Australia and elsewhere.

Construction activities for the proposed development primarily involve the construction of internal roading, trail smoothing earthworks, drainage facilities, stormwater management ponds, utilities installation and other necessary infrastructure required to support the on-mountain Village.

The proposed Plan Change for the expanded Ski Area provides for the construction of up to 50% of the Village concurrent with expansion into and development of the Ski Area in Crystal Basin. The Village can only then further develop once specified works in the Crystal Basin Ski Area are completed.

Development within the Village will be market-led and the final staging of works will be developed once the Plan Change is operative, final design work has been completed and an assessment has been made of market demands at that time. In order to inform and assist the development of the Erosion and Sediment Control Plan an indicative staging has been proposed. This is given in [Figure 6-1] (Boffa, 2010 Ecological Report) and assumes the following order:

Table 1.3: Project Staging

Stage	Components
1	Upgrading of existing access road to Porters Ski Area; Construction of new access to Porters Chalets; Construction of new access to Crystal Basin from Porters Basin (1.6km); Construction of snow making reservoir; Construction of new ski trails in Crystal Basin. Construction of new ski trails from Village to Porters Basin.
2	Construction of Western Village Centre
3	Construction of access road to Crystal Chalets; Slopeside apartments.
4	Crystal Chalets; Porters Chalets.
5	New Car Park; Construction of Eastern Village Centre; Slopeside apartments.
6	Hotel and visitor accommodations;

	Spa and hot pools.
7	Apartments, service suites.

The expected duration of project implementation for Porters Ski Area Expansion Project is expected to take up to 10 years.

1.4 Construction Management

Construction of the Porters Ski Area Expansion may take up to 10 years. This requires the establishment of a full time dedicated Construction Site Manager by the successful contractor for staging of construction activities, management of materials storage and handling, and environmental and project management.

The Site Manager must identify the potential environmental impacts relating to the set-up and management of the construction site and describe the measures that the Contractor will implement to mitigate the potential effects and to comply with consent conditions.

The Site Manager must address or provide procedures for the following items in a **Construction Management Plan** to be developed and submitted to ECan 20 working days prior to commencement of construction. The philosophy for this approach is that the Contractor Site Manager is entirely familiar with the operation, maintenance and management of all of the activities that have the potential to adversely impact on the environment. Furthermore, the Contractor has direct control over the plant, equipment, staff and resources employed on this project and is therefore best placed to plan, programme, implement and monitor mitigation practices. This plan will address as a minimum, the following matters:

i) Erosion and Sediment Control (Detailed Plans);
ii) Material management;
iii) Waste management;
iv) Emergency procedures; and
v) Monitoring and reporting, including the following:

- The establishment and operation of construction camps:
  - Water supply;
  - Sewage collection, storage and disposal; and
  - Domestic garbage collection, transportation and disposal;

- The Location, boundaries, areas, alignments and limits for:
  - Equipment maintenance and storage areas, including describing any containment measures that will be established (i.e. berms, liners, ponds);
  - Offices and facilities locations;
  - Staging and storage areas;
  - Temporary parking;
  - Access control, security and notices; and
  - Clearing, grubbing and disposal;

- Noise and nuisance control measures:
  - Hours of operation.

2.0 SITE CHARACTERISATION

2.1 Overall Site

Porters Ski Area is located over the southern end of Craigieburn Range, approximately 90 Km west of Christchurch.

The Craigieburn Range trends approximately northeast-southwest and forms the eastern margin of the Central Southern Alps. It comprises steep slopes (typically 30 to 45 degrees) which rise approximately 1000 m above the Castle Hill Basin to the east and the Harper River valley to the west.

Upper slope areas (above approximately 1300 metres above mean sea level (m amsl)) are typically devoid of vegetation and covered with scree, while lower slopes are vegetated by tussock and scrub.

Currently, Porters Ski Area comprises approximately 206 skiable hectares of the Porters Basin. The ski area operates 5 ski lifts, comprising 3 T-bars, 1 Platter Lift and 1 Carpet Lift. These extend from the mid-mountain base, at an elevation of 1,300 m amsl, to the top of the mountain at 1,900 m amsl. Existing facilities at the mid-mountain base include a day lodge café, public toilets, ticket outlet and ski hire. There are two parking areas, as well as staff day quarters and a maintenance building.

Both the Porters Ski Club Lodge, which provides limited accommodation (42 beds), and the staff housing lodge (16 beds) are located at the bottom of the mountain at an elevation of 960 m amsl. These facilities are immediately adjacent to the mountain access road and sit on a terrace above the Porter River.

Porters Ski Area operates throughout the ski season, which typically runs for around 90 to 100 days from the end of June through to early October.

2.2 Site Cover and Site Soils

Vegetation cover in the Porters and Crystal Basins generally varies according to altitude. Vegetation types were characterised by Boffa Miskell as part of detailed ecological site surveys undertaken in 2007 and 2010 (see Figures 5-1 to 5-4 of Boffa Miskell Ecological Report). Some of the main points are summarised below.

Crystal Basin (Management Unit H)

The upper slopes of the Porters and Crystal Basins comprise loose scree and occasional prominent rock outcrops with little vegetation. Below this area, slopes are more stable and are characterised by a zone of snow totara-tussock grasslands.

Photo 1: Crystal Valley

At around 1,250 m to 1,300 m amsl, there is a distinct transition from snow totara-tussock to a *Dracophyllum* heath, which is an abundant vegetation type and covers the lower slopes, terraces and some of the Porter River Valley floor as well as the location of the proposed Village Base development.

The Crystal Basin skifield area valley walls consist primarily of active scree slopes that have been formed by the ongoing deposition of material that has fallen from the exposed fractured and dilated greywacke above. In this area, the process of erosion is particularly well developed, so that scree has covered almost the entire slope, leaving only the occasional outcrop of insitu rock in the upper valley area. The scree consists of greywacke rock clasts that are up to 200 mm in length and are angular and fresh or slightly weathered. The scree slopes form at their natural angle of repose, which is approximately 37 degrees for coarse scree. Degradation of the scree will occur due to the action of water and freeze/thaw processes, and as material rolls/slides/bounces downslope. In some cases, small debris flows occur down the scree slopes, especially during heavy rain. Localised size grading of scree may occur during this process, and in some instances zones of fine material (sand and silt) may develop, especially at the lower part of the slope as a result of runoff erosion of fine material.

The absence of vegetation (see Photos 1 and 2) and the poorly developed nature of lichen indicate the dynamic nature of these slopes. While large scale mass movement of material is unlikely, the rolling/sliding and localised movement of individual rocks is a continual process. In winter, the cover of snow acts as a stabilising blanket to scree slopes, with localised instability occurring during the spring thaw or large rainstorms.

Photo 2: Crystal Valley - One View Showing the Nature of Soil

Photo 3: Crystal Valley - View from Lower Elevation

During major seismic events, movement of substantial volumes of scree from the valley sides is likely, possibly leading to 'lobes' of rock debris encroaching onto the valley floor. At this stage, infrastructure located on scree slopes consists of chairlift pylons.

Much of the Crystal Basin valley floor comprises an unusual geomorphic landform type composed of material similar to the scree slopes. URS has recently investigated the origin and nature of this feature, determining that it likely comprises a depositional landform related to the 'rock glacier' group of landforms. This landform is judged to be no longer active, and it is anticipated that significant movement or settlement is therefore unlikely.

Crystal Basin to the north east of the present Porters Ski Field will be opened in this expansion project by the construction of trails and installation of lifts and a Day Lodge.

Access to the Crystal Basin for skiers will be exclusively by a gondola direct from the village to the Day Lodge at 1,550 m amsl. Eventually access to the existing Porters Basin will be provided by a chair lift direct from the village by which time public vehicle access to Porters Basin will be discontinued.

A ski out trail from Crystal Basin will also serve as summer maintenance access. A steeper ski out trail will also run from Porters Basin to the Village centre with a branch trail to the Crystal Chalets.

Village Centre

The proposed Village Centre is to be located on elevated river terraces adjacent to the north bank of Porters River between the Porter Stream and Crystal Stream. Chalets and visitor accommodations are proposed on both sides of the Village Centre. To the west of Porter Stream, part of the proposed village is sited on a moraine ridge that was formed by glacial processes (URS (2010) - see Drawing C002 of URS report). It is likely to comprise similar materials to that found within the fluvio-glacial surface. Overlying this is an approximately 0.5 m thick layer of distinctive yellow loess silt, which is an air-borne post glacial deposit.

Two loess samples from the Porters Ski Area were collected for Dispersion Test Analysis (**Appendix C**). The soil samples showed no signs of dispersion during any of the trials. It is therefore concluded that the loess soils around the Village Area are not dispersive in nature and therefore treatable using standard ESCP measures.

2.3 Climate and Hydrology

The site has a montane-alpine climate (cool and wet), with rainfall across the Craigieburn Ecological District being 1,500 - 2,400 mm per year. The predominant winds are north-westerlies but cold fronts can bring snow at any time of the year.

Snow packs typically develop in late May to early June and thaw between September and mid-January. Frost can occur all year round and frost heave is a feature of the soils.

Meteorological data is recorded at two elevations at the Porters Ski Area. The lower elevation site is located just above the base area at 1,323 m amsl (2399859.50E, 5769430.99N NZMG) on a flat man-made terrace at the base of a large northeast face and includes a snow study plot and an automatic weather station (AWS). A wind fence around the snow study plot minimises the influence of the wind and provides more accurate snow measurements. The high elevation meteorological site is located on an exposed ridgeline at 1,937 m amsl (2398298.49E, 5769768.65N NZMG) and consists of a high elevation AWS that was installed in 1996.

The low elevation meteorological site records of rainfall, air temperature, wind and RH data consist of a few winter months for 2005; all winters between 2006 and 2009; and most summer data from 2007/2008. The upper elevation meteorological site data record comprises snow pack temperatures, rainfall normals/intensity, RH data and temperature normals from all winters since 1997 and most summers since 2005/2006.

Unfortunately, the recorded rainfall intensity is too short for statistical analysis, so runoff assessments employ interpolations of nearby data, as adopted by Selwyn District Council for infrastructure design purposes (Opus 2009). In Table 2.4 below the rainfall record for the neighbouring Mt Cheeseman is summarised.

Table 2.4: Mt Cheeseman Design Rainfall Table for Various Durations (1990-2009) – mm/hr

Average Return Interval (years)	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	25	21	19	14	11	7.3	5.2	3.3
5	33	27	24	17	13	8.6	6.3	4.0
10	41	33	28	19	14	9.7	7.1	4.5
20	51	40	34	21	16	11	7.8	5.0
50	67	50	41	24	18	12	8.8	5.6

Source: Table 6.4 (Opus, 2009)

The bulk of incident rainfall soaks into the ground on this site except where human activities have compacted the land surface in the establishment of roading and the buildings.

Stormwater drainage within the site discharges to the Porter Stream and Crystal Stream which then discharges to Porters River.

2.4 Key Assumptions and Design Standards

All ESCP measures specified will be installed in accordance with ECan Erosion and Sediment Control Guideline (ESCG) (ECan, 2007). Flow and volume based devices are sized according to the following criteria:

- Flow based Devices Design Storm: 10 minute, 5% AEP rainfall event (51 mm/hr);
- Volume based Devices Design storm: 10 hour, 20% AEP rainfall (7 mm/hr) and runoff coefficient reflecting different soil types and slopes, Table A3 (ECan, 2007). For pond sizing in areas other than Christchurch, site specific rainfall depth can be used to extrapolate a value. Based on this criterion, and assuming the village construction site is of steep silt loam (Table A2 ESCG), sediment ponds should be sized based on 350 m^3/ha of disturbed land.

2.5 Existing and Future Drainage Patterns

Refer to CPG AEE for Discharge of Stormwater.

2.6 Nature and Staging of Construction Activities

The nature of the construction activities for this project involves land disturbance or earthworks with potential to discharge sediment-laden stormwater runoff to the receiving environment if robust ESC measures are not implemented and maintained in accordance with the approved ESCP.

Construction staging and scheduling has been cited as one of the most cost effective erosion and sediment control measures.

The sequence or staging of construction at Porter Ski Area will generally follow that given in Section 1.3 of this ESCP. This is to ensure only the required disturbance is allowed to occur and to achieve minimum area of disturbance at any one time.

2.7 Construction Site Characteristics

The proposed development can be characterised by clusters or management units where construction activities will happen. At the Village Base Area (Lower Mountain next to Porters River), construction areas can be identified for the Village Centre, Hotel and Visitor Accommodation, Crystal Chalets, Slopeside Visitor Accommodation and Porters Chalets.

Typically construction activities for the proposed development primarily will involve the construction of internal roading, drainage facilities, stormwater management ponds, utilities installation and other necessary infrastructure required to support the mountain resort development. The areas of land disturbance are clustered around:

- Village centre;
- Hotel and visitor accommodation;
- Crystal Chalets;
- Slopeside visitor accommodation;
- Porters Chalets;
- Ski fields upgrade; as well as
- The required roading and services infrastructure.

On the mountain, approximately 1.9 km of access track is planned between Porters Basin and Crystal Basin. Within the Porters and Crystal Basins, approximately 6 km of ski trails are proposed. Another ski trail, 1.4 km long joins the Village Base Area and Porters Basin.

A water reservoir for snow making is also planned at 1,740 m amsl.

The indicative stages of implementation are described in Section 1.3 and illustrated in Figure 6-1 (Boffa Miskell Ecological Report). The overall extent of earthworks for the proposed Porters Ski Area project is given in **Drawing No. 147A**.

2.8 Potential Source of Pollutants

Potential sources of sediment to stormwater runoff are:

- Land disturbance activities such as: bulk earthworks for ski trails and roads construction, and reservoir construction; excavation for building foundation and/or building platform; excavation for lift terminal foundation and/or lift tower; and excavation for utilities installation.

Potential pollutants and sources, other than sediment, to stormwater runoff are:

- Potential spill of fuel from construction equipment due to accidents.

All ESC measures, both structural and non-structural, specified to be implemented on site are meant to reduce the risk of pollution from erosion identified above to an acceptable level.

2.9 Receiving Environment

The receiving environment for stormwater discharges both during construction and long term service is **Porters River**, described below (Photo 4). Within the development site, it is fed by runoff from Porters Stream and Crystal Stream. The Porter River drains the southern part of the Craigieburn Range and the northwestern side of the chain of mountains which extend from Cloudy Hill to Red Hill, including the Coleridge Pass Area. At its widest point, the modern river valley is approximately 200 m wide and incised to depths of approximately 50 m (see Figure 2-2 of URS Geological Report). The modern river channel is approximately 5 m wide. The river valley is in filled by a combination of alluvial and glacial/fluvioglacial deposits, with rare fan deposits (URS, 2009).

Photo 4: Porters River

Construction activities during implementation of the development are happening in the upper catchment of the Porter River, which flows from Coleridge saddle, to the south of the ski field, into Broken River, approximately 6 km downstream of the site, and on to the Waimakariri River.

Numerous tributaries drain into the Porter River with the Porter Stream and Crystal Stream being the largest waterways within the boundaries of the ski area. The catchment details of Porter Stream and Crystal Stream are given in **Drawing No. 190A**.

The Porter Stream has two branches, the true left branch being ephemeral and arising in the gully below the snow grooming garage. The true right (and main branch) flows below the ski field water reservoir and car park areas adjacent to the ski road for some 1.5 km down to the Porter River.

The Crystal Stream originates in Crystal Basin (Photo 5), immediately to the north of the existing ski field and flows through a steep gully before levelling and splitting into multiple branches to enter the Porter River.

Water quality in Crystal Stream has been described as very good with excellent water clarity, no evidence of sediment deposit among the gravel lays in pools and quiet backwaters. It can be described as a moderately stable system with very low nutrient based clear and clean water with little embeddedness.

Photo 5: Upper Reaches of Crystal Stream

Vegetation cover is limited above approximately 1,500 m. Several groundwater springs are present at around 1,500 m elevation, feeding Crystal Stream. Only seasonal ephemeral surface flows are present above these springs. No infrastructure or access roads are present in the Crystal Basin.

Hydrological modelling has been carried out by URS as part of their flood hazard assessment. The contributing catchment upstream of the point of interest is assessed to be 15.26 $km^{2,}$ based on the Porter Catchment of 11.74 km^2 and the Crystal Stream Catchment of 3.52 km^2.

There are two springs within the proposed Village site. The first feeding an ephemeral waterway which runs between the road and the Porter Stream and down to the Porter River below the staff lodge. The second spring discharges to a channel that runs down the centre of the main spur to the top of the terrace scarp before dropping steeply to the Porter River. The road to the Porter Ski Club lodge cuts across this channel at the base of the spur.

3.0 KEY EROSION AND SEDIMENT CONTROL STRATEGIES

3.1 Key Strategies

As the site is located within a relatively pristine alpine environment, care will need to be taken during the construction phase to minimise the area susceptible to erosion. The stormwater erosion and sediment control plan (ESCP) for the site contained in this document has been prepared according to the following key principles of Environment Canterbury Erosion and Sediment Control Guidelines (2007):

- Control run-on water;
- Separate 'clean' water from 'dirty' water;
- Protect the land surface from erosion; and
- Prevent sediment from leaving the site.

The ESCP also covers best management practice measures, such as construction scheduling and revegetating (where appropriate) or covering areas that will be exposed for extended durations, and the use of sediment traps and/or ponds around the perimeter of work areas to aid in preventing any sediment loaded runoff from exiting the site.

When preparing this ESCP Plan, CPG has determined that the best practice relevant to the control of construction stage stormwater discharge is to prepare a **Construction Management Plan** which details respective construction activities and sets out protocols and ESC measures (as discussed in the following sub-headings) to protect active construction sites and to implement the four strategies identified above.

In doing so, most erosion problems can be avoided or minimised and sediment containment issues can be addressed prior to construction disturbances.

The sections that follow, detail the main control and practices that will be implemented, maintained and upgraded if necessary during the construction phase of the development project.

3.2 ESC Measures

3.2.1 Construction Sequencing and Staging

Good erosion and sediment control requires construction sequencing – this is outlined below:

Sequences of Major Activities

1. Preconstruction site inspection by relevant parties. Briefing of site staff on the existence of an approved ESCP and the importance of implementation, monitoring and maintenance of erosion and sediment control prior to commencement;

2. Identify and peg/mark protection areas (e.g. buffer zones, trees and native vegetation that are to be preserved) and/or clearing zone for access roads and ponds;

3. Construction access - there is one construction access to the site and this has a cattle stop on it. It is not expected that there will be a lot of exiting construction vehicles as earthworks are being contained on-site. The need for a stabilised construction entrance/exit, in addition to the existing cattle stop is unlikely. However, this will be monitored and the cleaning of tracked dirt onto the public road undertaken if necessary;

4. Install ESC measures and perimeter controls e.g. earth diversion bunds/channels upstream and sediment fences and other measures downstream;

5. Clearing and grubbing for stormwater detention ponds, and decanting earth bunds (DEB). Construct stormwater ponds and DEBs complete with all diversions to the ponds for sediment control. Ponds should be fully equipped with inlet, outlet and decant systems;

6. Bulk earthworks (cut and fill operation, stockpiling) for road construction/building platform formation;

7. Retaining Wall construction, where required;

8. Road grading/compaction

9. Utilities installation;

10. Stabilise cleared areas (permanent seeding or a combination of other surface stabilised measures) in a timely manner and continue to install diversion channels as required;

11. Apply sub-base to road;

12. Final surfacing / or paving of road as per detailed design;

13. Remove accumulated sediment from basins, sediment fences and replace bales/fences as and when required;

14. When all construction activity is completed and the site is stabilised, remove earth channels and reseed any areas disturbed by their removal; and

15. Maintenance - inspect and maintain (repair) ESC measures to ensure compliance with resource consent conditions, take appropriate action where ESC shows signs of ineffectiveness, update ESC plan and maintain records of inspection and construction activities. Frequency: weekly or immediately after periods of rainfall maintenance inspection and repairs.

The following points should be considered when considering ways to minimise disturbed areas:

- Carefully schedule and phase construction. Avoid starting during wet months. Use temporary cover measures (polyethylene sheet, mulch or gravel) whenever construction is halted for an extended period; and

- Delay removing vegetation where necessary and maintain existing vegetation for areas not required to be cleared for construction or commencing earthworks until just before building starts.

Avoid delays and work expeditiously on any part of the site. Install landscaping fixtures upon the completion of any sequence and prior to moving on to the next activity.

3.2.2 Divert “Clean” Water Away from Work Area

Avoid contamination of stormwater with sediment by using diversion devices (e.g. cut-off drains) to reduce the volume of runoff reaching disturbed areas. For example, within this particular development, there is a ‘clean’ water diversion drain proposed upstream of the village base construction which is intended to intercept up-gradient runoff and hence reducing the volume of “dirty” water to be treated before draining to Red Tussock Gulley.

3.2.3 Minimise the Potential for Erosion

Minimise Areas of Disturbances

Protection of surfaces from erosion is best achieved by **not** clearing land unnecessarily or by programming land clearing to coincide with construction activities, which are similar to the approach advocated in Section 3.2.1 (construction staging and sequencing) above. The following points should be considered to minimise disturbed areas:

a. Do not disturb areas of the construction site that are not scheduled for improvements and keep existing vegetation, even if it is scheduled to be removed, for as long as possible;

b. Carefully schedule and phase construction. Avoid earthworks during wet months. Use temporary cover measures (gravel, mulch or other manufactured coverings) whenever construction is halted for an extended period;

c. Phase site earthworks to limit the area and duration of an area's exposure. Exposed areas should be stabilised immediately following the completion of earthworks;

d. Plan and implement permanent structures throughout the earlier phases of the project; and

e. Avoid delays and work expeditiously on any part of the site. Install landscaping upon the completion of any sequence and prior to moving on to the next phase.

If the subject land is well vegetated and if areas of disturbance are minimised and only limited to the footprint of the excavation plus an allowance, then the risk of any sediment discharge is greatly reduced.

Stabilised Disturbed Areas

Bare surfaces created by the removal of the cover and located in an area where there are no control measures immediately downstream of the disturbed area will be immediately stabilised with mulch material or other appropriate temporary measures if the expected exposure to weather is likely to be more than 48 hours (e.g. the batter above the stormwater outfall and the restoration of the service trench). Completed batters will be topsoiled and covered with approved erosion control coverings, as appropriate, at the completion of the works.

3.2.4 Prevent Sediment from Leaving the Site

Good house keeping is the least expensive method to reduce and control erosion and sediment run-off. The following house keeping tips are to be considered to minimise disturbed areas and/or reduce erosion and control sediment movement:

a. Minimise disturbance;
b. Practice good material storage, delivery and use;
c. Spill prevention and control;
d. Practice good solid, concrete and hazard waste management;
e. Secure stockpiles;
f. Install sediment trapping systems;
g. Early stormwater connection (to control roof runoff);
h. Dust control and tracking; and
i. New stormwater pipes are to be capped at all times (until ready for connection).

3.2.5 Inspection and Maintenance

Inspection and maintenance of the selected practices are critical towards the success of preventing erosion and sediment transport. Maintaining a daily or weekly checklist of practices to inspect for deficiencies of those practices is critical to the success of preventing erosion and sediment displacement.

A sound inspection and maintenance strategy should include the following:

1. Daily - verify that sediment-laden stormwater is directed to temporary sediment fences/bunds or other sediment barriers. Verify that sediment fences and traps are at low points below disturbed areas;

2. All measures will be inspected immediately following rainfall events that generate runoff, with any required maintenance undertaken immediately, or additional methods implemented to ensure ESC is maintained on the site during the rainfall event. A record of inspection and maintenance shall be kept in a site diary, and made available upon request to council monitoring staff;

3. Attached **Drawing No. 136B** shows details of various erosion and sediment control measures applicable for various construction sites/clusters. All measures specified on approved drawings will be constructed and maintained in accordance with the Environment Canterbury Erosion and Sediment Control Guidelines 2007. (See also Section 5 for further details).

4.0 PROPOSED WORKS AND MORE SPECIFIC ESC METHODOLOGIES

4.1 Scope of Works and Main ESC Method

This ESCP covers activities related to:

- Soil stripping and stockpiling;
- Road construction;
- Building platform formation;
- Construction of stormwater diversions;
- ESC for the construction of snow making reservoir;
- Decommissioning of existing reservoir;
- Construction and expansion of existing and new access roads;
- Construction of new ski trails;
- Construction of stormwater outfall to streams;
- Utilities (water supply and wastewater treatment plant) installation; and
- Decommissioning of erosion and sediment control measures.

Main ESC Measure

This site is very different to other hill areas being developed in Canterbury, for the following reasons:

- The surficial soils are not dispersive – they stay as peds when saturated and settle quickly;
- The soils are only in isolated areas where tussock and other flora exist;
- The soils are generally shallow, particularly on the upper mountain;
- Much of the upper mountain has mobile scree, meaning standard silt fences would be toppled over;
- Slopes on the upper mountain are very steep;
- Runoff does not appear to occur in the upper mountain where the scree absorbs rainfall. It exits as springflow further down the valley. This may not be the case in extreme events; and
- The scree appears very effective as a filter.

What can be gathered from the above is that standard ESC measures may not be effective on the upper mountain due to the mobile scree, the steepness of the slope and the inability to create ponds. However, it is very apparent that the scree works very well in filtering sediment from runoff (good quality water is to be used for water supply, taken from a groundwater flow under the scree). In addition, the loess and colluvium will settle well in standard ponds that could be used around the village area.

Therefore, the main ESC measure for the upper mountain area and areas on the lower mountain where ponds cannot be built will be to build up large filter bunds of scree material between active working areas and the surface water to be protected. Ponds will be used where possible around the village.

4.2 Methodology for Soil Stripping and Stockpiling

Soil stripping is only allowed in areas that are scheduled for clearing in accordance with an approved work programme in order to limit the total exposed area at any one time.

Due to the nature of the construction activities, some stockpiling is also often necessary. There are possible locations for temporary stockpiling of soils and these are identified in Drawing No.136A.

The ESC methodologies for soil stripping and stockpiling are (See Figures 2 and 3):

- Protect materials that may erode, particularly soil stockpiles, with erosion proof coverings;
- Contain waste in covered bins or traps made from geotextile fabric;
- Locate stockpiles of building materials away from drainage paths and uphill of sediment barriers;
- Provide a filter bund downgradient of the stockpile;
- Divert runoff around stockpiles unavoidably located in drainage paths using a perimeter bank uphill; and
- Use biodegradable erosion control mats to protect exposed earth.

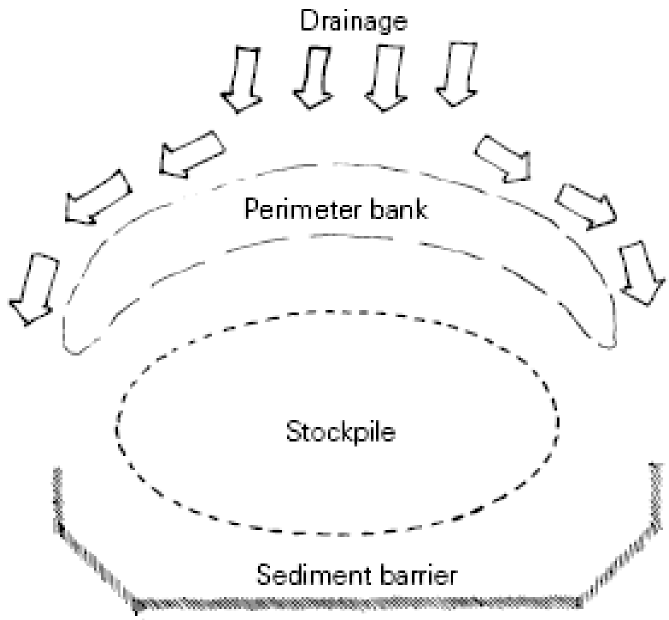

Figure 2: ESC for Stockpile Plan

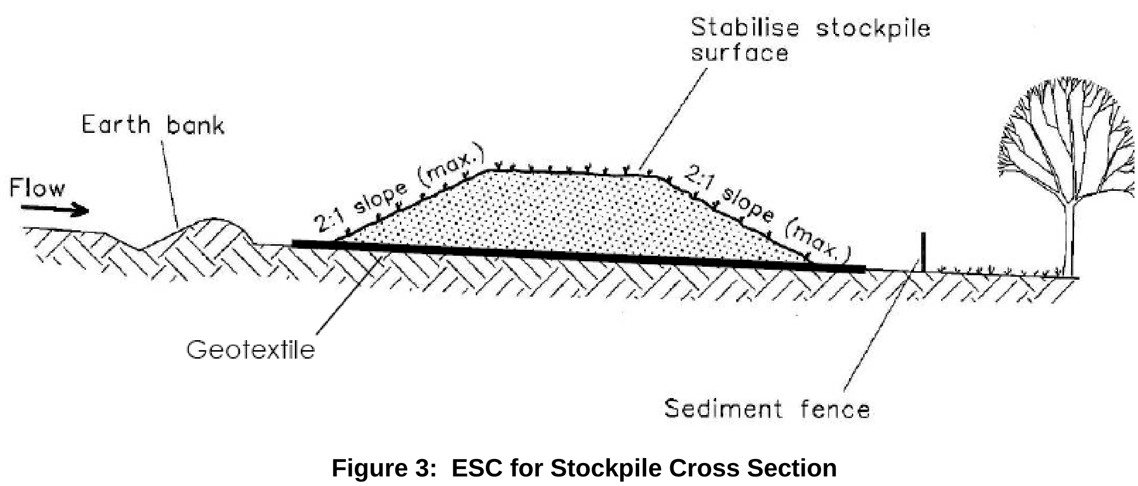

Figure 3: ESC for Stockpile Cross Section

4.3 Methodology for Road Construction

Scope of Proposed Roading Infrastructure

The Porters development will continue to be accessed from the current entrance to Porters Ski Area on State Highway 73. The road will follow the existing ski area access road alignment.

The access road to the site is 4.9 km. There is a proposal to upgrade **part** of this stretch of access road and preliminary engineering plans are being prepared by Elliot Sinclair & Partners Limited. The proposed sealed carriageway is 7.5 m wide. The road is currently unsealed from State Highway 73 and it is proposed to be chip sealed for the proposed development.

Internal roading within the Village Base Area is approximately 4 km in total length serving the Porters Chalets, Slopeside Visitor Accommodation, Crystal Chalets and hotel and visitor accommodation. The volume of excavated material resulting from the formation of the Crystal Chalet's roading is approximately 9,000 m^3 (Section 6.3 Eliot Sinclair Report).

With the Ski Field Access Road (Village to Porters Basin), a slight surplus of material after cutting and filling to form the ski field access road will be used to fill the main access road in the vicinity of the Porter River crossing. The volume to be excavated will be approximately 24,000 m^3 (Section 6.4 Eliot Sinclair Report).

For the Crystal Basin Access Road, which measures 1.9 km, it is proposed to provide access to Crystal Basin from Porters Basin. The volume of excavated material required to form the access will be approximately 24,000 m^3 (see Section 6.5.1 Eliot Sinclair report).

Methodology for Road Construction – General

In general, mitigation measures or methodologies for road construction have been proposed to reduce the predicted adverse effects of the project to a level of insignificance. These measures include but are not limited to:

- Minimising the geographic extent of the project by adopting best construction methodologies (e.g. avoid or minimise side casting);
- Incorporating the recommended design criteria and construction practices for culvert installations;
- Applying best management practices for controlling soil erosion during and after construction;
- Planning culvert design and placement to minimise habitat disturbance;
- Incorporating the appropriate safety protocols and procedures during construction; and
- Undertaking extensive environmental monitoring and maintenance programs to verify that the measures adopted are effective.

The proposed methodology for erosion and sediment control for the proposed construction activities at Porter Ski Field will concentrate on the strategies discussed in the following sections and depicted in Figure 4 below.

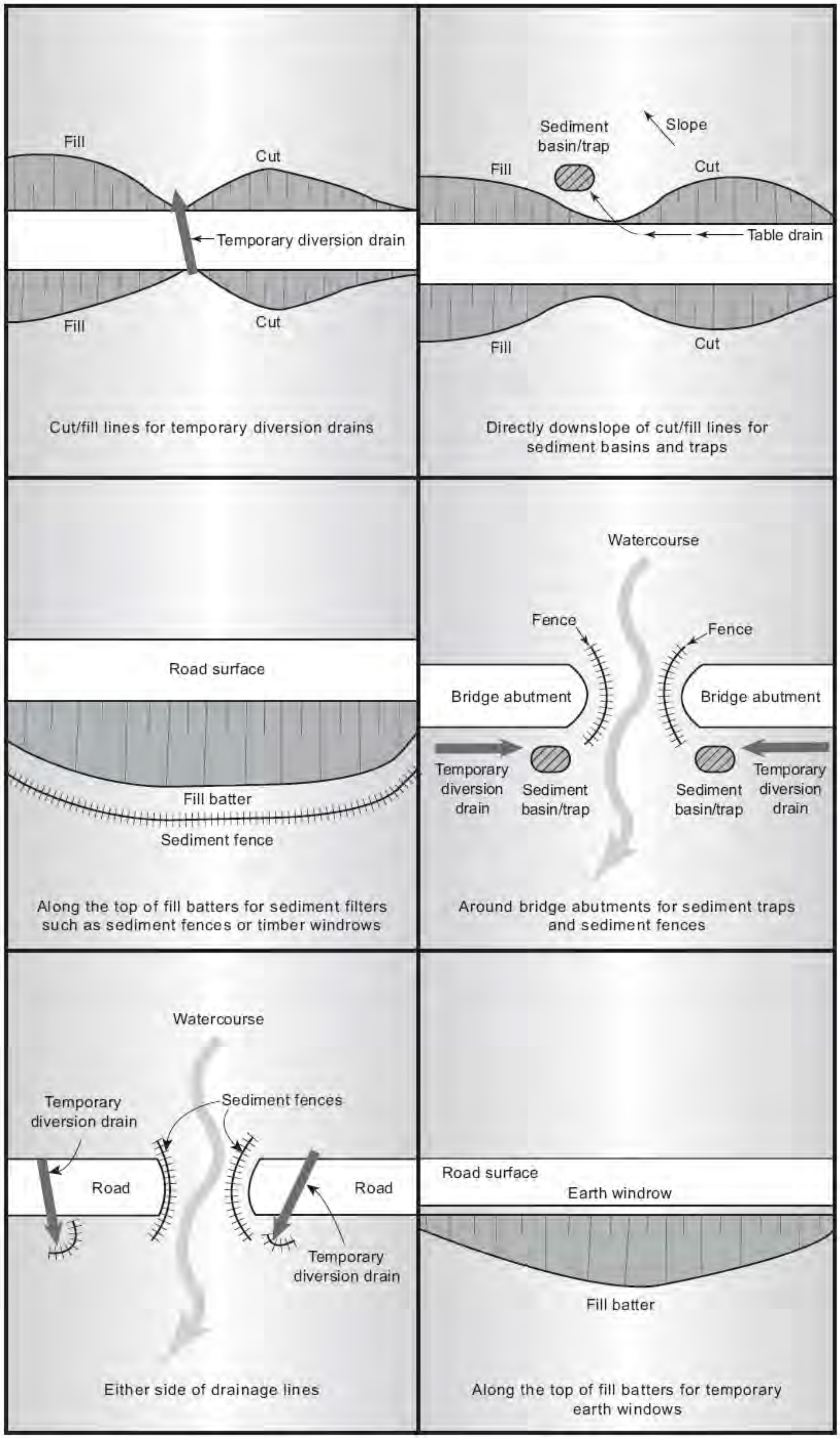

Figure 4: Key Locations for Temporary ESC Measures for Road Construction

a. Culverts

To accommodate the natural drainage of the project area, a number of culverts and ditches will be designed by Elliot Sinclair & Partners to **not** impede the natural flow of water. Culverts of sufficient size and/or numbers will be installed across the ski area access road to ensure that a 1:100 year flood can be managed.

Photo 6: Culvert Across Existing Access Road

Other potential locations where culvert crossing may be required are given in Drawing No. 136B and Elliot Sinclair's Preliminary Engineering Plans. Rip-rap and energy dissipation structures will be installed where required, and Porters Ski Area Limited will provide stream crossing designs to appropriate standard ensuring that the designs are adequate to avoid drainage problems.

Effects of culvert installation depend on a number of factors, for example, size and type of culvert and whether the installation is on or off-line.

At this stage of the project, detailed design of the culvert installation has not been prepared. Subject to detailed design, only generic ESC measures can be proposed for this ESCP. Photo 7 below shows a typical culvert installation.

Photo 7: Typical Culvert Installation

b. Stream Diversion, Working in-stream or in the vicinity of Stream

Road construction within Porters Ski Area will include activities that may impact on the ecological values of existing watercourses. These are identified as culvert installation described above. It is possible that there may be a requirement for temporary stream diversion for which a detailed Progressive ESCP specific to this activity is required. Information to be provided will include but will not be limited to:

- Consent conditions - Describe the integration of consent conditions into the Contractor's construction and rehabilitation activity schedule relating to:
  - Sequence of in-stream activities;
  - Timing windows:
    - Start date
    - End date
  - Channel restriction;
  - Timing restrictions (fisheries and wildlife);
  - Berm material quality and type.

- Describe procedures for in-stream sediment control such as:
  - Cofferdams, berms and silt ponds;
  - In-stream silt barriers;
  - Sensitive area isolation; or
  - Sediment collection and water release.

- Describe procedures for bank erosion control such as:
  - Riprap armouring;
  - Gabions;
  - Bank protection; or
  - Bio-engineering.

Describe procedures related to waterway realignment for diverting flow to the new channel, including but not limited to:

- Bank protection;
- Timing;
- Water flow, depth and velocity;
- Pumping activities if any; and
- Inland filtering.

Describe procedures for reclaiming the existing waterway with respect to the following:

- Grading;
- Soil replacement;
- Revegetation; and
- Erosion control.

4.3.1 Specific ESC Measures

a. Village Access Road (Part of Access to Porters Ski Area from SH 73)

The existing access to Porters Ski Area is going to be widened and re-graded (see Elliot Sinclair Village Roading Layout). ESC measures to be implemented include:

- Prepare and submit method statement (including timing and sequence of construction);
- Maintaining a vegetative buffer where appropriate;
- Constructed a compacted earth bund, where appropriate;
- Construct a permeable gravel filter bund, where appropriate;
- Install sediment fences (where appropriate); and
- Revegetating batter slopes and other disturbed areas immediately where appropriate following completion of each section of roading.

A detailed ESCP with level of information as outlined above for works adjacent to or within waterways (culvert installation) will be prepared by a competent person during detailed design and appropriate certification will be required for such plan for submission to ECan prior to commencement of culvert installation/stream diversion and upgrading.

b. Crystal Basin Access Road (to New Ski Area at Crystal Basin from Porters Basin)

The access road is approximately 1.9 km and will be formed just about solely in cut. Material removed will be hauled to mid-mountain and placed as fill material in the existing Porters main car park area. Excess material could further be pushed over the edge into the second car park which is no longer required (see Photo 8 below). Bunding and/or diversion drains around the fill site will be built from compacted gravel to act as filter for any stormwater runoff preventing any uncontrolled sediment discharge to Porter Stream.

Photo 8: Mid Mountain Car Park

Where the road alignment crosses deeply incised scree chutes, rock filled gabion will be installed as a pervious structure for the passage of water and scree.

No tussock or vegetated areas will be covered with excess material as far as practicable. ESC measures to be implemented will follow what were outlined in Section 4.3.1 above. The principal ESC measure is a compacted gravel bund to act as a filter downstream of the road/ski trail construction (upstream of receiving waterway – Crystal Stream).

4.4 Methodology for Building Platforms

The proposed Porters Ski Area Expansion Project features an all season alpine resort containing a wide range of visitor accommodation together with shops, restaurants, visitor services, hot pools and car parking. To accommodate the building of these facilities, building platforms are required at various locations around the resort.

The total material expected to be removed due to the excavation for building is 133,000 m^3. The total disturbed area is 21 ha out of the 708 ha total ski lease area.

ESC measures to be implemented include:

4.4.1 Prepare and submit a method statement (including timing and sequence of construction);
4.4.2 Maintaining a vegetative buffer where appropriate:
4.4.3 Construct a upstream clean water diversion;
4.4.4 Provide sediment retention pond;
4.4.5 Constructed a compacted gravel filter bund (upstream of receiving waterway);
4.4.6 Practice good housekeeping;
4.4.7 Install sediment fences; and
4.4.8 Revegetating batter slopes and other disturbed areas immediately where appropriate following completion of each building platform.

A detailed ESCP with level of information as outlined in Section 4.3 above for works adjacent to or within waterways will be prepared by a competent person during detailed design and appropriate certification will be required for such plan for submission to ECan prior to commencement of construction. The distribution of various building is given in Drawing No. 140A.

Table 4.4: ESC Measures for Building Platform

Building Cluster	4.4.1	4.4.2	4.4.3	4.4.4	4.4.5	4.4.6	4.4.7	4.4.8
Village Centre	√	√	√	√	√	√	√	√
Hotel and Visitor Accommodation	√	√	√	-	√	√	√	√
Slopeside Visitor Accommodation	√	√	√	-	√	√	√	√
Crystal Chalets	√	√	√	-	√	√	√	√
Porters Chalets	√	√	√	-	√	√	√	√

√ = Required

Notes on various building clusters:

Village Centre

Centrally located at the base of the mountain, this is a 2.5 hectares area which includes 15 buildings located above an underground car park. The roof of this car park forms the 'ground' for the village centre. The main feature of this centre is its multi-storey underground car park with buildings of various heights (from 2 to 6 storeys) on top. Approximately 133,000 m^3 of excavation is required to form the underground carpark (Section 6.2 Eliot Sinclair Report). It is proposed to use this excess material for forming or re-grading the existing access road to the Village.

The main ESC measure includes the use of a proposed pond for sediment retention during excavation of the basement (car park) and the rehabilitation of the same pond for permanent service in accordance with approved procedures. Other key measures include a clean water diversion upstream of the construction area and maintaining a vegetative buffer between earthworks and existing water bodies.

There are a few buildings within the Village Centre that are located next to Porter Stream (Buildings 1 and 12) and existing ephemeral gully (Building 11). Exact locations of these buildings will be established during detailed design and will meet the minimum offset requirement. It is prudent to limit excavation in this cluster for Buildings 1, 11 and 12 to only during the drier months.

Hotel and Visitor Accommodation

The close proximity to Crystal Stream requires careful planning in the development of this building cluster. It is prudent to limit excavation in this cluster to only during the drier months.

Slopeside Visitor Accommodation

The close proximity to Porters Stream requires careful planning in the development of this building cluster. Development of individual buildings requires specific ESC measures for individual buildings in order to protect the receiving waterway from sediment. It is prudent to limit excavation in this cluster to only during the drier months.

Crystal Chalets

The close proximity to Crystal Stream requires careful planning in the development of this building cluster. It is prudent to limit excavation in this cluster to only during the drier months.

Porters Chalets

The close proximity to Porters Stream requires careful planning in the development of this building cluster. It is prudent to limit excavation in this cluster to only during the drier months and to limit the total exposed area at any one time to a manageable level.

4.5 Methodology for the Construction of New Ski Trails

A 6 to 12 metre wide trail is to be constructed from Porters Basin to the Village down the northeastern gully. The route is approximately 1.4 km long. The excavated material, based on the methodology provided, is estimated to be approximately 28,000 m^3 (Section 6.5.2 Eliot Sinclair Report).

Ski trails are also proposed within Crystal Basin. The volume calculation performed by Eliot Sinclair indicates that there is reasonable balance of cut to fill in this area. The volume to be cut and placed in the upper half of the Basin is approximately 300,000 m^3 and in the lower half of the Basin is 400,000 m^3 (Section 6.5.2 Eliot Sinclair Report).

ESC measures to be implemented for ski trails are similar to that of a road construction and in principle, follow what were outlined above (Section 4.3.1), with the main ECS being the gravel filtering bund.

The key mitigating factors are the nature of the soil and lack of vegetation within the Crystal Basin area, and the distance from the majority of the trail earthworks to where flowing water in Crystal stream starts.

4.6 Methodology for Utilities Installation

4.6.1 Pipelines

Utilities, such as potable water pipes, sewer and stormwater drains are required to serve the resort. There are about 6 km of pipelines to be installed to serve the proposed mountain resort. These are normally carried out when the proposed roads are formed.

When excavating trenches for utilities and other facilities, the contractor is to place excavated soil upslope and clear of the trench. The contractor will ensure trench widths and depths are the minimum necessary. The contractor will organise installation to enable progressive backfilling. After backfilling, the contractor is to remove excess or unsuitable spoil from the site. The contractor will finish the works to their final form as soon as practically possible, e.g. replace topsoil and vegetate to match surrounding ground levels and vegetation species as soon as possible.

Typical ESC measures for utilities installation are given in Figure 5 below.

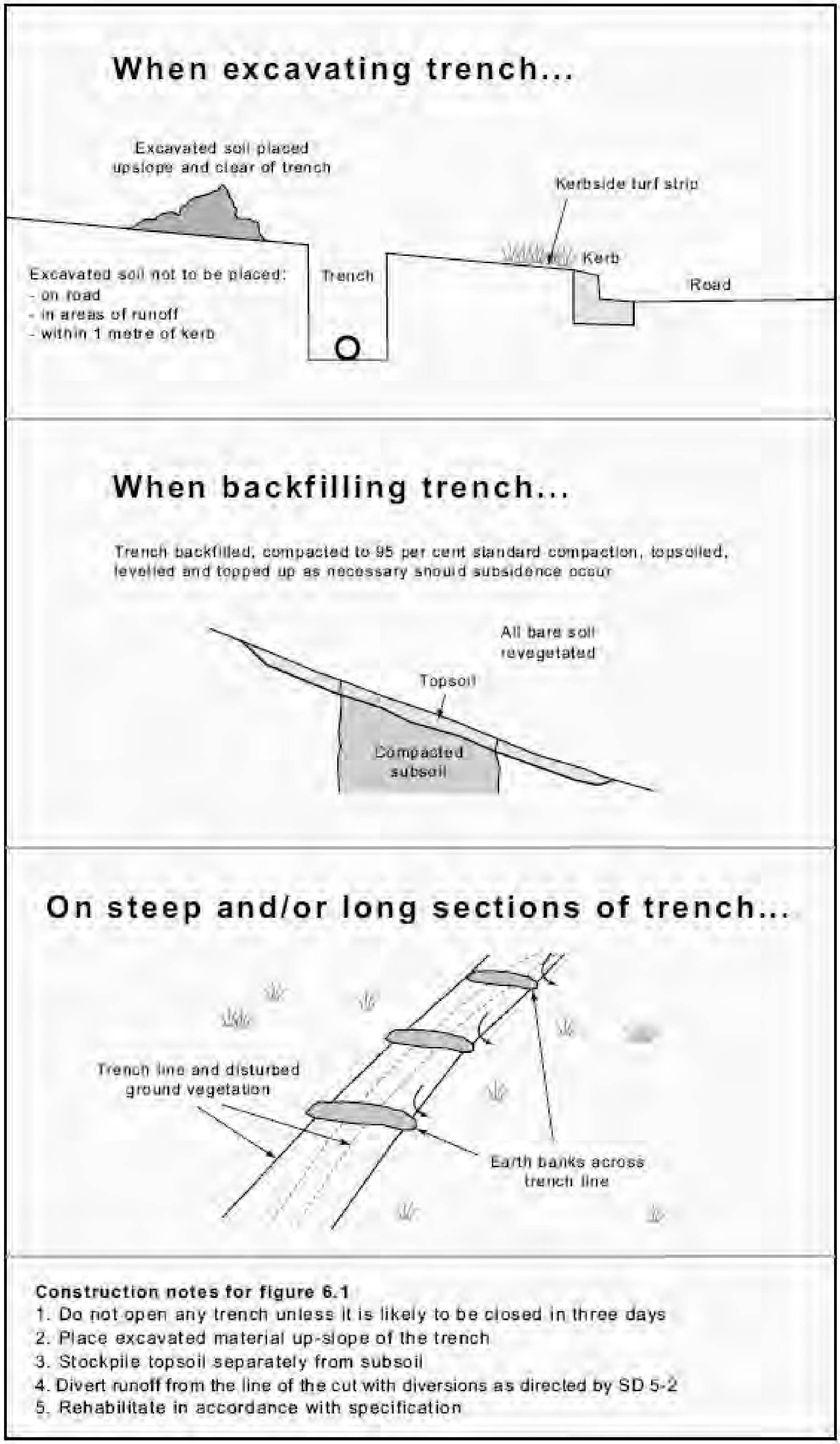

Figure 5: ESC for Utilities Installation

4.6.2 Outfall to Porters/Crystal Stream

The design of the stormwater pipe termination at Porters Stream can take several forms.

One of the options is to approach the stream at an elevated level and cascade the flow down to the receiving water level via a rock filled gabion mattress. This approach is purposely selected to discharge above the high water mark to minimise works within the bed of the stream. Minimising the area and duration of disturbance are of particular relevance to the installation of the stormwater outfall. Any potential for scouring due to the discharge is avoided by specifying a stone filled gabion mattress.

During installation, all necessary material required will be ready on site. The contractor will first mark out the footprint of the mattress outside of the waterway and excavate the minimum required to receive the mattress including allowance for 50 mm thick AP20 as bedding material. As soon as the mattress is in place, the contractor will restore any disturbed areas to match the existing levels and revegetate where required.

The duration of the actual installation of scour protection for one outfall should be completed in one day (based on the requirement to have all necessary material required available on site).

4.7 Methodology for Construction of Snow Making Reservoir

A 90,000 m^3 water reservoir is proposed at elevation 1,750 m amsl to store water for snow making. The developed conceptual design (undertaken by URS – see URS Revised Crystal Valley Snowmaking Reservoir Conceptual Design Report (2010) for the proposed snowmaking reservoir is shown on the attached URS Drawings 42170087-C028 to C029. The reservoir has been sited over gently sloping terrain within the upper basin to minimise earthworks. Foundation conditions within the reservoir footprint are expected to comprise unconsolidated glacial and scree deposits. These materials typically comprise sub-angular to subrounded gravels, cobbles and boulders with minor sand and silt. Excavated materials are judged suitable for use within a homogeneous embankment (with compaction). Some foundation preparation work and grading of materials is anticipated for construction materials.

The proposed location of the reservoir is shown on Figure 6, below.

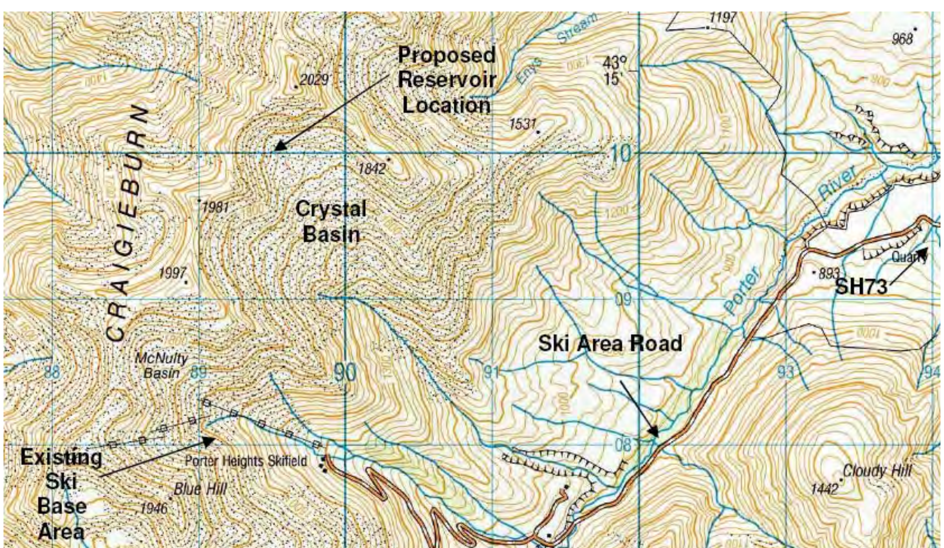

Figure 6: Proposed Location of Snow Making Reservoir

Development of a bunded reservoir with volume of approximately 90,000 m^3 would require approximately 24,500 m^3 cut to fill and 29,500 m^3 cut to waste. A maximum filled embankment height of approximately 9 m would be required (maximum dam height above foundations). A nominal 1 m freeboard, 5 m crest width and 1.5 H : 1 V batter slopes have been used for development of the conceptual design. An approximately 1.5 mm thick HDPE Liner will be required, with a nominal 0.5 m thick bedding layer. The reservoir would be pump-filled with water from the existing source in the Porters Basin that is currently being used for snowmaking. An emergency overflow will be required, the size of which will be determined by the rate the reservoir can be pump filled only (i.e. there is no requirement to design for flood flows as the storage will be constructed as a bunded reservoir out of the stream) with upgradient cutoff bunds/drains. The elevated location of the proposed reservoir would allow gravity feed of the snowmaking system.

The footprint of the proposed reservoir is given in URS Drawing No.42170087–C028 covering an estimated 8,400 m^2. The soil at this location is similar to that of Crystal Valley Access Road i.e. mainly scree slopes made up of fractured and dilated greywacke and the receiving environment of any stormwater discharge is Crystal Stream. The shortest distance from the reservoir construction site to Crystal Stream is 800 m.

The duration of construction for this snow making reservoir should not last longer than one season.

To control stormwater discharge, the following ESC measures are to be undertaken:

4.7.1 Prepare and submit method statement (including timing and sequence of construction);
4.7.2 Maintaining a vegetative buffer where appropriate:
4.7.3 Construct upgradient clean water diversions around the constructions site;
4.7.4 Construct a compacted gravel filter bund (upstream of receiving waterway);
4.7.5 Practice good housekeeping;
4.7.6 Install sediment fences if appropriate; and
4.7.7 Revegetating batter slopes and other disturbed areas immediately **where appropriate** following completion of each batter/slope faces.

4.8 Methodology for Decommissioning Existing Reservoir

An existing snow making reservoir at elevation 1,300 m amsl is to be replaced by the new 90,000 m^3 reservoir. The methodology to decommission this existing reservoir is to remove the impervious liner and backfill the reservoir with excess cut material from road/ski trail construction.

4.9 Spill Prevention and Response Plan

No hazardous wastes the likes of pesticides, paints, cleaners, fertilisers, and solvents will be stored on site for the duration of the construction. Due to the size and duration of the project, a limited amount of fuel may be stored on site. This will be managed in accordance with industry best practices in avoiding possible spill and contamination. However, in the event of an accident, the applicant shall clean up and report the spill to the relevant authority as soon as possible.

5.0 INSPECTIONS AND REPORTING

The Consultant will in association with the Contractor's Site Manager(s) develop an inspection and reporting procedure in accordance with the requirements of the discharge consent conditions. The appropriate monitoring and reporting program to be developed will be consistent with the contract terms and conditions, site characteristics, work activities and potential environmental risks associated with the work to be performed.

Monitoring and maintenance of the selected ESC measures or BMPs are critical towards the success of preventing erosion and sediment transport. Maintaining a daily or weekly checklist of practices to inspect for deficiencies of those practices are critical to the success of preventing erosion and sediment migration.

A sound inspection and maintenance strategy will include the following:

1. Verify that sediment-laden stormwater is directed to temporary sediment traps, filters or basins. Verify that sediment basins, filters and traps are at low points below disturbed areas.

2. Protect all existing or newly installed storm drainage structures from sediment clogging by providing inlet protection for area drains and inlets. Stormwater inlet protection can utilise sand bags, sediment traps, or other similar devices.

3. Permanent stormwater detention ponds will be excavated early in the project, and used as sedimentation ponds during construction. Removal of accumulated sediment during this period is required when sediment accumulated takes up 20% of the storage. The ponds will be landscaped when the upstream drainage area is stabilised.

4. Inspect temporary sediment barriers such as sediment fences, rock filters, and continuous berms after every rainfall. These barriers should only be used in areas where sheet flow runoff occurs. They are ineffective if the runoff is concentrated into rill or gully flow.

5. Internal outfalls will also be stabilised to reduce scour from high velocity flows leaving pipes or other drainage facilities.

6. The contractor will inspect all erosion and sediment control devices at least once a week and at least once a day during rainfall events. The contractor will perform any repairs or maintenance immediately in order to ensure effective erosion and sediment control.

7. The contractor will maintain a record of all inspections and maintenance activities at the project site. This record will be made available to the Environment Canterbury upon request.

The Contractor's Site Manager will be responsible for the implementation, regular inspection and maintenance (repair, cleaning and modification) of the ESC system during the construction period. ESC as-built information (such as pond volumes, contributing catchment of pond, etc) is to be completed and forwarded to ECan within a month of construction.

Performance inspection and maintenance for each measure will be carried out in accordance with Environment Canterbury's Erosion and Sediment Control Guidelines. An overview of the programme is given below.

Where maintenance of ESC measures is required, priority will be given to this work before other works continue on the site.

5.1 Daily Maintenance

After completion of work onsite each day, the site supervisor shall inspect:

- The cut-off drains specified and installed. Any drains or outfalls that have become filled or damaged will need to be reinstated as necessary.

5.2 Weekly Inspection of Control Measures

All measures will be inspected at least weekly.

- All measures will be maintained in good working order; if repair is necessary, it will be initiated within 24 hours of inspection.
- The diversion systems shall be inspected for erosion or sediment scour along the bund and repaired or protected immediately damage has occurred.
- The decanting earth bund will be inspected for depth of sediment, and built up sediment will be removed when 20% full of sediment.
- Sediment fences shall be inspected for tears, fabric clogging, to see if fabric is securely attached to the posts, lose wires or supports, leaking joints, overtopping, outflanking, and/or undercutting. Sediment will be removed when the depth exceeds 30% the height of the fence.

Temporary and permanent seeding and planting will be inspected for bare spots, washout, and unhealthy growth.

5.3 Inspection Before and Immediately Following Rainfall

All measures will be inspected immediately following rainfall events that generate runoff, with any required maintenance undertaken immediately, or additional methods implemented to ensure ESC is maintained on the site during the rainfall event.

5.4 Maintenance During Large Storm Events

Site monitoring shall be undertaken during heavy rainfall events. The person undertaking this monitoring shall be able to inspect and repair/replace any control measures that are not working effectively.

The responsible person will need to implement additional control measures in the event of system overload to ensure that effects of overland flows of stormwater are effectively mitigated.

5.5 Record of Maintenance

A record of inspection and maintenance shall be kept, as appended, and made available upon request to council monitoring staff. A sample Inspection Log is shown below.

Stormwater BMP Inspection and Maintenance Log (sample)

Project name: Inspected by: Time & Date: Weather at time of visit: Inspector Signature: Last Inspected on: Weather Forecast: Copies to ☐ Developer/Owner ☐ Designer
Location:

BMP ID #	BMP Description	Cause for Inspection	Exception noted	Comments

Instructions:

BMP ID# - use the same ID as in the ESC plan.
Record all inspections and maintenance for all treatment BMPs on this form.
Cause for inspection – note if the inspection is routine, pre-rainy season, post storm, or in response to a complaint or problem.
Exceptions noted – note any condition that requires corrective action or a need for maintenance or comment on compliance status.
Comments – describe any maintenance done and need for follow-up.

5.6 Record of Changes to Approved ESCP

Create a log here, or as an attachment, of changes and updates to the ESCP. Include additions of new BMPs, replacement of failed BMPs, significant changes in the activities or their timing on the project, changes in personnel, changes in inspection and maintenance procedures, updates to site maps, and so on.

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

6.0 DECOMMISSIONING AND REHABILITATION

ESC measures will be decommissioned only after all areas above the installed ESC measures have been stabilised or when construction activities have ceased. Each measure will be decommissioned in accordance with the procedures given in the ESC Guidelines for Canterbury.

Ski trails creation and infrastructure constructions are major developments in this Porters Ski Area Expansion Project requiring the disturbance of existing slopes with impacts on natural drainage systems, topography and at some location removal of native vegetation and micro-habitats.

Any areas disturbed by the decommissioning of ESC measures will be rehabilitated or stabilised using rehabilitation techniques that are consistent with rehabilitation practices for alpine and subalpine terrain. All rehabilitation programmes should be developed in association with an ecologist/landscape architect. For sites that will be slow to recover or prone to heavy use, the laying of indigenous grass is recommended. Indigenous species are generally very hardy and resistant to the impacts of slope grooming and snow accumulation. They produce a long lasting, resilient and self-sustaining ground cover. Furthermore, the air layer created between snow and the shrub canopy helps to prolong snow cover by allowing water to flows beneath the snow. A site specific rehabilitation program will be developed in association with Landscape Architect and Ecologist.

7.0 CONCLUSIONS

Construction activities for the Porters Ski Area Expansion Project will disturb the terrain along the route of the proposed road and the existing access road including the Village Area, trails and other ancillary areas associated with the proposed expansion.

Potential effects are expected to occur along the road itself, as well as at various building sites, temporary work camps, stream crossings and along the new ski trails.

The areas where road and stream crossing construction and earthworks occur, or where temporary work camps and staging areas are established, will be physically disturbed. The extent of disturbance will be a function of the road design and construction methods and will be related to type of surface material, terrain type, presence of vegetation, proximity of waterways, and drainage regimes.

The potential issues and concerns, which will require careful planning and management, include slumping and erosion of soil, and potential discharge of sediment to Porters Stream, Crystal Stream and Porters River.

Adverse effects to the receiving environment from project related activities could potentially occur as a result of erosion due to land disturbance and discharge of stormwater runoff laden with sediments **IF** proper construction techniques and/or appropriate mitigation measures are **not** employed.

Mitigation

CPG has developed a baseline ESCP to be adopted alongside a **Construction Management Plan** for effective erosion and sediment control to mitigate the potential effects of sediment discharge. Typical ESC measures include but are not limited to: use of erosion control blankets and/or mats to protect disturbed soils or slopes, re-vegetation techniques, and hydromulching where applicable. The construction of gravel filter bunds upstream of waterways will provide the bulk of protection – this method is similar to the filtering of the scree slopes and is therefore known to work in this topography and environment.

In addition to the ESC measures, the applicant has committed to minimise the extent and potential for sediment discharge from the disturbed area, avoid excavation during winter where possible, use cross-ditching and terracing where practical, and limiting disturbed and un-stabilised areas at any one time during construction to reduce the potential for soil erosion.

Erodable soils will be stabilised as soon as practical by seeding, spreading of mulch, or installing erosion control mats. Re-vegetation techniques will be utilised using self-sustaining plant communities to reduce soil erosion during the construction and operational phases of the ski area. The use of native plant species is preferable. A follow-up monitoring and maintenance program will evaluate the success of ESC measures undertaken and recommend further actions where required.

Construction equipment will be confined to the road right-of-way and the ancillary development areas. Vegetation clearing will be confined to the road right-of-way and the ancillary development areas and restricted to hand methods adjacent to watercourses, in areas of sensitive terrain, and in terrain too rugged to permit the use of mechanical clearing.

Significance

With proper design and construction practices and proper site management control instituted early in the project, in conjunction with adopting the best management practices such as avoiding excavation or land disturbance during winter, using best management practices in ESC and their associated monitoring and maintenance regime, and the use of seeding, mulching and erosion control mats, soils within the construction area will experience a negligible increase in erosion.

If erosion to soils does occur, the extent of the sediment control such as sediment fences, diversion bunds, sediment retention ponds and the gravel filter bunds to be incorporated during construction, will minimise the effect of sediment discharge.

With the robust ESCP measures outlined above in conjunction with a comprehensive monitoring and maintenance regime in place, the effects of earthworks and other land disturbance activities within Porter Ski Area can be avoided, mitigated and minimised.

REFERENCES

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4. Eliot Sinclair & Partners Ltd, 2010. *Preliminary Engineering Report for Proposed Expansion of Porters Ski Area.*

5. Environment Canterbury, 2007. *Erosion and Sediment Control Guidelines for the Canterbury Region. Report No. R06/23*, Canterbury Regional Council, Christchurch New Zealand.

6. Opus International Consultant Ltd, 2009. *Development of Design Rainfall for Selwyn District Council*.

7. URS, 2010. *Geotechnical Draft Summary Report*.

8. URS, 2010. *Revised Crystal Valley Snowmaking Reservoir Conceptual Design*.

APPENDIX A

Summer & Winter Masterplan Plans (Boffa Miskell)
Erosion and Sediment Control Plan – Conceptual Design (CPG)
Erosion and Sediment Control -TypicalDetails (CPG)
Stormwater Catchments Details (CPG)
Stormwater Conceptual Plan (CPG)
Extent of Earthworks (CPG)
Staging of Works (Boffa Miskell)
Study Areas and Management Units (Boffa Miskell)
Vegetation Types (Boffa Miskell)
Crystal Area Snowmaking Reservoir- Plan (URS)
Crystal Area Snowmaking Reservoir – Cross Sections (URS)
Village Roading Layout(Eliot Sinclair)

Boffa Miskell
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N

0 150m
1:2,500 @ A1
1:5,000 @ A3

Data Sources:
Aerial photo supplied by NZ Aerial Mapping.

Legend
- Proposed Buildings
- Existing buildings
- Hot Pools
- Waterways
- Plaza Space
- Bridge
- Ski Area Short Tussock and Acaena Species Mix
- Roads/Carparking
- Existing Species Mix
- Kanuka and Mountain Beech Mix
- Chinochloa flavescens and Dracophyllum Mix
- Mountain Beech and Tussock Mix

PROPOSED PORTERS SKI AREA EXPANSION

Landscape Masterplan - Summer

Date: 12 July 2010

Plan prepared for Porters Ski Area Limited by Boffa Miskell Limited

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