# Appendix Fifteen

Assessment of Ecological Effects

Ecology Management Plan (SEMP 6)

**SUMNER ROAD RE-OPENING PROJECT**

**ASSESSMENT OF ENVIRONMENTAL EFFECTS: - ECOLOGY**

**Contents**


**1 Introduction** ..... 1

**2 Methods** ..... 1

**3 Ecological description** ..... 2

3.1 Ecological context ..... 2
3.2 Vegetation of the consent area ..... 3
3.3 Birds and lizards of the consent area ..... 7
3.4 Invertebrates of the consent area ..... 8
3.5 Ecological significance assessment ..... 12

**4 Statutory and non-statutory context** ..... 17

4.1 National Policy Statements ..... 17
4.2 Proposed NPS on indigenous biodiversity ..... 18
4.3 Canterbury Regional Policy Statement ..... 19

**5 Assessment of effects** ..... 20

5.1 Vegetation ..... 20
5.1.1 Construction effects ..... 20
5.1.2 Operational effects ..... 25
5.1.3 Summary of effects ..... 25
5.1.4 Mitigation ..... 26
5.2 Birds and lizards ..... 27
5.1.1 Construction effects ..... 27
5.1.2 Operational effects ..... 29
5.1.3 Summary of effects ..... 29
5.1.4 Mitigation ..... 30
5.3 Invertebrates ..... 30
5.1.1 Construction effects ..... 30
5.1.2 Operational effects ..... 31
5.1.3 Summary of effects ..... 31
5.1.4 Mitigation ..... 31
5.4 Overall significant adverse effects ..... 32
5.5 Residual adverse effects ..... 32

**6 Discussion** ..... 34

**7 Conclusions** ..... 35

**References**

**Attachments**: 1. Plant species in or near the consent area
2. Lizard photos and location map
3. Invertebrates in the consent area
4. Significance definition and criteria
5. Statutory and non-statutory policies



Mark Davis, Marieke Lettink, Brian Patrick


January 2014

# 1 Introduction

The Christchurch City Council is currently working on re-opening the 2.6 km section of Sumner Road between Evans Pass and Lyttelton, which is the main route between Lyttelton and Sumner. The area suffered significant rock fall damage during the February and June 2011 earthquakes, and has remained closed since the February 2011 earthquake.

Resource consents are needed to reconstruct and maintain the road, and for rock risk mitigation works above the road. The rock mitigation works are required to minimise risks to road users once the road is re-opened. This involves removing or securing loose rocks or bedrock (scaling), and benching the extensive line of cliffs. Subsequent maintenance work is expected to be minimal.

Most of the land in the Sumner Road re-opening project area (the consent area) is comprised of Buckley's Bay and Tauhinukorokio Scenic Reserves, which are administered by the Department of Conservation (DOC). A pine plantation/recreation reserve is administered by the Christchurch City Council, and a small area of land is owned by the Lyttelton Port Company (LPC).

Mark Davis (Vegetation/Ecologist), Marieke Lettink (Herpetologist/Ecologist, Fauna Finders) and Brian Patrick (Entomologist/Ecologist, Wildlands) have been engaged by Christchurch City Council to prepare this technical report. The purpose of the report is to assess the effects arising from the Sumner Road Reopening Project on the ecology of the area, with a secondary requirement to prepare an Ecological Management Plan to detail remediation and mitigation measures to be used in relation to site works.

This ecological report provides a description of the vegetation, birds, lizards and invertebrates occurring in the consent area, and an assessment of its significance. An assessment of environmental effects likely to be caused by consent activities is then provided, followed by recommended mitigation measures.

# 2 Methods

Background reading and research was undertaken prior to field work and this report being written. This included a review of the proposed consent activities, based on reports prepared by Aurecon and Resource Management Group (RMG). The DOC Herpetofauna Database was consulted but it did not contain any lizard records for the area. Other relevant literature was also reviewed including the Banks Ecological Region Protected Natural Areas Programme (PNAP) survey report (Wilson 1992), Plant life on Banks Peninsula (Wilson 2013), Whaka Raupo interim reserve management plan (Couch and Downey 2012), and statutory and non-statutory policy documents.

Field visits were undertaken on November 20, 21 and 29 2013 in variable weather conditions. Two of these days were not optimal for fauna surveys as it was too windy, cold or hot and many species are not active in these conditions. For invertebrates the late November timing is ideal for rock face moths and many of the grassland-shrubland insects, though it will not reveal the total invertebrate fauna. Approximately two thirds of the consent area could not be visited because of localised geotechnical hazards (CERA safety). This meant that the indigenous biodiversity of localities most likely to be affected by rock stabilisation measures could not be directly assessed, i.e. rock habitats and forest. Some of these areas were however, able to be viewed through binoculars or from Aurecon's detailed

photos. Assessments of forest margins were supplemented by information from previous reports by other ecologists, including one for Buckley's Bay Scenic Reserve (BBSR).

Because of these access restrictions, additional vegetation surveys were undertaken on adjoining bluff systems. The natural bluffs of Gollans Bay quarry (north-east of the consent area) and Mt Cavendish Scenic Reserve (north-west of the consent area) were surveyed on December 5 by Nick Head (DOC plant ecologist) and Mark Davis. Limited fauna observations from an adjacent catchment are also included as a proxy for habitats in the consent area that could not be surveyed.

Where the vegetation was surveyed, it was described in terms of species abundance i.e. A (abundant), C (common), O (occasional) and R (rare). The meaning of these terms is provided below though it should be noted that lichens, mosses and liverworts were recorded as broad groups only, not to species level.

A = plants that are very common and usually widespread
C = plants that are common, either locally or in lower numbers over a wider area.
O = plants which were seen irregularly, either locally or scattered over a wider area.
R = plants that were seen rarely, up to a few occasions.

All bird species seen and/or heard were recorded, using binoculars to aid identification where necessary. Visual and hand searching was used to locate active (basking and foraging) and inactive lizards within their retreat sites (e.g. in crevices and under rocks). In addition, detailed photographs of the dominant bluff system were examined to assess its likely value for lizards, particularly Canterbury gecko. This species is largely restricted to rocky habitats as they provide the greatest refuge from mammalian predators and opportunities for thermoregulation.

Bird and lizard species were categorized by their current (2012) conservation status, using Robertson et al. (2013) for birds and Hitchmough et al. (2013) for lizards. They are referred to by their common names, as used by these authors.

Invertebrates were searched for using a combination of hand searching, sweeping of vegetation and netting of flying insects, with an emphasis on rock face invertebrates. Observations were also made of the characteristic leaf damage to particular indigenous plants. On one warm and cloudy night, a light trap was used to trap nocturnal invertebrates in the consent area near Evans Pass, and spot lighting of the bluffs was undertaken near the light trap site. It is acknowledged that light trapping may attract flying nocturnal species from at least 500 metres away, and thus some of the invertebrates collected by this method could be from the main bluff system. Any invertebrates collected were curated and assessed for their significance, with voucher specimens being stored in Brian Patrick's private collection.

## 3 Ecological description

### 3.1 Ecological context

The consent area is entirely within the Port Hills Ecological District (ED) of Banks Ecological Region (ER) (Wilson 1992). Geologically the rocks of the ED are largely basalts and trachytes of the Lyttelton volcano. Originally the ED would have been almost entirely forested with podocarp/hardwood forest, but after Polynesian fires and European settlement, logging,

burning and farming, only tiny old growth forest remnants remain (Wilson 1992). The ED is now dominated by grasslands, although there are substantial areas of mixed hardwood forest and rock outcrops supporting plants adapted to open habitats as well as a scattering of other plants including trees and shrubs.

Roughly two thirds of the consent area north-east of LPC land (hazard zones 118 and 124) are comprised of Level 4 Land Environment F3.2a, while land to the south-west is Land Environment F3.1a (Koordinates.com 2013). Both land environments are similar, being comprised of eroded basalt remnants with steep slopes mantled by loess, but with some soil differences such as a higher annual water deficit for F3.1a (Leathwick et al. 2002). Neither land environment is threatened, both being classified as 'at risk' (20-30% indigenous cover remaining nationally). It is noted however, that further habitat loss in these land environments will exacerbate threats and decrease the security of indigenous biodiversity associated with these environments (Walker et al 2007).

The cliffs, bluffs and other rock habitats in the consent area are classified as a naturally rare ecosystem type (coastal cliffs on mafic rock) (MfE 2007). It is a national priority to protect such areas as identified by the New Zealand Coastal Policy Statement (NZCPS) and the Proposed National Policy Statement on Indigenous Biodiversity (Proposed NPS).

The ER contains a range of habitats for birds and lizards, including coastal areas, wetlands, dunelands, grasslands, shrublands, forests and rocklands. Habitat mosaics are common, e.g. shrubland-forest and grassland-rockland-shrubland. Vegetation of these habitats may be indigenous, exotic, or a mixture of both. Terrestrial habitats in the ER support at least 66 indigenous bird species (Lettink 2013) and five indigenous lizard species (Lettink & Whitaker 2004, Whitaker 2008, DOC Herpetofauna Database). Approximately 40 indigenous bird species are thought to breed in the ED (Wilson 2009). None of the bird and lizard species recorded in the ER are endemic, i.e. they are only found only there.

From an invertebrate perspective, the consent area contains a range of ecosystems typical of the ED. In terms of its topography and its mosaic of rock habitats, grasslands, shrublands and forest remnants, the consent area is part of a wider continuum on the Port Hills. The presence of volcanic rock outcrops has been a major reason for the retention of indigenous vegetation and invertebrates on Banks Peninsula as a whole and on the Port Hills in particular. The consent area epitomises this with impressive rock bluffs and extensive rock outcrops. These rock habitats support nationally important invertebrates as well as a wide range of other invertebrates that are confined to such habitats.

### 3.2 Vegetation of the consent area

The vegetation is described by four vegetation types that are based on the structural classes of Atkinson (1985). Plants known to be in the consent area, plus those in similar habitats adjacent are listed in Attachment 1. An asterix denotes that a plant is exotic, including indigenous plants outside their natural range e.g. *Coprosma repens**. Note 3 of Attachment 1 explains the reasons for altering some of the structural classes that have been used. Only the most prominent or troublesome exotic plants are included in the descriptions below.

#### 3.2.1 Grassland

The main grasslands visited were on the spur of the north-western side of the consent area (adjacent to hazard zone 201), and in hazard zone 118 on the east side of the 'Lyttelton

ridge'. Smaller areas of grassland were visited at the bottom of BBSR and in hazard zone 102 near Evans Pass.

Grasslands on sunny spurs and slopes support abundant exotic grasses such as such as ryegrass, cocksfoot, sweet vernal, ripgut brome, soft brome and barley grass. Plants occurring occasionally include silver tussock, scrub pohuehue, common broom, broom and thistles. Indigenous plants seen rarely include *Acaena novae-zelandiae*, matagouri, mikimiki, porcupine shrub, *Dichondra repens*, dwarf stonecrop and yellow oxalis. Low bedrock exposures within grasslands are dominated by abundant lichens and common mosses, sometimes with rare prostrate kowhai and *Convolvulus waitaha.* Between the fence and the Crater Rim cliffs, additional indigenous species include common yellow rock groundsel, occasional prickly shield fern and harakeke.

The grasslands of hazard zone 118 and BBSR are similar because of their shady aspect. They are dominated by tall and dense exotic grasses such as cocksfoot, ryegrass, Yorkshire fog and sweet vernal. In hazard zone 118 broom, gorse, mahoe, ngaio, elderberry, bracken and scrub pohuehue are common, while niniao, *Coprosma crassifolia, C. virescens,* poroporo, taupata, kaikomako, narrow-leaved lacebark, flowering currant and boneseed occur occasionally. *Hypolepis ambigua*, pohuehue and kowhai are rare.

Ephemeral streams were not found in BBSR, though access was restricted due to localised geotechnical hazards.

### 3.2.2 Shrubland and scrub

Only the margins of scrub/shrubland in BBSR were visited (due to geotechnical hazards), but additional information was obtained from references. Native bindweed is abundant in these margins, while common plants include mahoe, *Coprosma crassifolia*, mikimiki, ngaio, niniao, kawakawa and broom. Hard shield fern, ribbonwood, kowhai, yellow clematis, hybrid *Coprosma linariifolia* and elderberry occur occasionally. Plants seen rarely include five finger, red mapou, *Rubus cissoides*, poataniwha, and hybrid fuchsias.

The reserve was also accessed from 'Lyttelton ridge' via a bench in hazard zone 117. Common plants there include ongaonga, native bindweed, mahoe, niniao, climbing aniseed and *Rubus cissoides*. Occasionally present are broom, *Coprosma crassifolia, C. rotundifolia,* elderberry, fuchsia, *Parsonsia heterophylla, P. capsularis*, yellow clematis, hard shield fern, kowhai, red mapou, mikimiki, yellow rock groundsel and kaikomako. Rarely seen plants include prickly shield fern, fireweed and spindleberry.

### 3.2.3 Forest

The main forest species observed in BBSR were identified using binoculars from hazard zone 117. Kowhai is abundant, while mahoe, narrow-leaved lacebark, ngaio, elderberry and kohuhu are common. Kaikomako and fuchsia are seen occasionally and broadleaf is rare. Additional species recorded by Kelly (1972) include cabbage tree, putaputaweta, lemonwood, rohutu, weeping mapou and a single matai. Wilson (1992) recorded fragrant tree daisy in the reserve (field card 125).

The pine plantation above Windy Point supports quite a few indigenous and exotic plants among the pines. Abundant species are old man's beard and miner's lettuce, while common plants include flowering currant, hawthorn, velvety nightshade, cleavers, German ivy,

common polyplody, hard shield fern, necklace fern, mahoe, spur valerian, exotic grasses, scrub pohuehue and marguerite. Occasional plants are elderberry, *Coprosma rotundifolia, Dichondra repens*, sunflower and broom. Karo, kohuhu, boneseed, taupata, matagouri, ongaonga, shining spleenwort and hound's tongue fern are rare. Native spinach is locally common near the ridge and *Einadia allanii* occurs among scrub pohuehue.

### 3.2.4 Rock outcrops and bluffs

Most road cuttings from Evans Pass to Battery Point have a different ecological character to the natural cliffs of hazard zone 200 above. While we were unable to visit all road cuttings because of safety constraints, those that were seen were similar. The most obvious difference between the road cuttings and natural cliffs is their reduced cover of lichens and indigenous plants, and their greater weediness.

On road cuttings lichen cover is variable, reflecting the retention of some original surfaces. In general lichen abundance is common, though locally they are rare or abundant while mosses are occasional. Exotic grasses and dwarf stonecrop are sometimes common, but usually occasional. Other plants seen occasionally include 'at risk' Banks Peninsula blue tussock, silver tussock, spur valerian, mosses, broom, white stonecrop, scrub pohuehue and wallflower. Rarely seen plants are hard shield fern, *Haloragis erecta*, *Linum monogynum*, boneseed, common polyplody, bracken, *Rytidosperma* sp*., Hebe speciosa* x *H. strictissima*?, and *Wahlenbergia gracilis*.

The small roadside bluff in hazard zone 101 by Evans Pass appears to have retained some of its natural surfaces and supports additional species. Lichens, mosses, broom and spur valerian are common, while yellow rock daisy occurs occasionally. Other plants seen rarely include onion leaved orchid, silver tussock, Banks Peninsula blue tussock, native iris, red woodrush, *Luzula banksiana* var*. orina*, ground spleenwort, hard shield fern, necklace fern and the uncommon *Asplenium trichomanes*.

Steep soil slopes between the road cuttings and the cliffs above are dominated by abundant exotic grasses and spur valerian. Common plants include harakeke, mahoe, mikimiki, common broom, prickly shield fern, bracken and broom. Occasional plants include scrub pohuehue, silver tussock, Banks Peninsula blue tussock and karamu, with *Hebe speciosa* x Hebe *strictissima*?, and niniao being rare.

On the margins of hazard zone 107 (a natural bluff), lichens and broom are abundant and common plants include scrub pohuehue, dwarf stonecrop, prostrate kowhai and gorse. Occasional plants include yellow oxalis, *Dichondra repens*, 'at risk' yellow rock groundsel, bristle tussock, harakeke, mountain flax, native bindweed, native jasmine, yellow rock daisy, akiraho, *Luzula banksiana* var. *orina*, Banks Peninsula blue tussock, silver tussock, porcupine shrub, *Rytidosperma* sp., niniao, ongaonga, *Coprosma crassifolia*, native iris, necklace fern and ground spleenwort. Rare plants are Banks Peninsula button daisy, sun orchid, *Celmisia gracilenta*, blue tussock, native chickweed, green mistletoe (parasitic on mikimiki), 'at risk' *Aciphylla subflabellata* and *Einadia allanii*.

The sunny rock platform at the top of hazard zone 208 is typical of other similar rock spurs where thin patches of soil occur in a mosaic with exposed bedrock. Species noted include abundant lichens, common matagouri, broom, bristle tussock, silvery hair grass, white fuzzweed, yellow rock groundsel and mosses. Native cranesbill, 'at risk' *Raoulia monroi, Luzula banksiana* var. *orina*, porcupine shrub, onion leaved orchid, dwarf stonecrop, Banks Peninsula button daisy, scrub pohuehue, spur valerian, *Rytidosperma* sp., and *Coprosma crassifolia* are seen occasionally. 'At risk' Banks Peninsula sun hebe, stonecrop, mikimiki, white sun orchid, native iris and Banks Peninsula blue tussock are rare.

Natural rock bluffs were visited near the consent area that supported additional species. *Rytidosperma racemosum*? and *Galium propinquum* are common, while *Brachyscome*

*radicata, Euchiton traversii* and mingimingi are occasional. Plants seen rarely are the threatened annual fern, hen & chicken fern, shore spleenwort, rock fern, yellow wood, *Coprosma rhamnoides, C. lucida, C. wallii*, Easter orchid, *Euchiton* sp. *Epilobium* sp., holy grass, *Hydrocotyle microphylla*, wind grass, prickly mingimingi, 'at risk' Banks Peninsula hebe, mountain akeake, woolly cudweed, *Senecio minimus*?, dwarf button daisy and the critically threatened Banks Peninsula forget-me-not (two plants).

### 3.2.5 Flora of the consent area

Table 1 lists the threatened, at risk and uncommon indigenous plants that are found in the consent area, or may occur there because they are found in similar habitats adjacent. Attachment 1 lists all the species found in or adjacent to the consent area.

**Table 1: Threatened, at risk and uncommon indigenous plants (after de Lange et al. 2013)**

| Species | Status | In consent area |
|---|---|---|
| *Leptinella nana* | Nationally critical | Maybe (occurs nearby) |
| *Myosotis lytteltonensis* | Nationally critical | ✓ |
| *Anogramma leptophylla* | Nationally vulnerable | Maybe (occurs nearby) |
| *Aciphylla subflabellata* | At risk (declining) | ✓ |
| *Coprosma wallii* | At risk (declining) | Maybe (occurs nearby) |
| *Coprosma virescens* | At risk (declining) | ✓ |
| *Heliohebe lavaudiana* | At risk (declining) | ✓ |
| *Olearia fragrantissima* | At risk (declining) | ✓ |
| *Raoulia monroi* | At risk (declining) | ✓ |
| *Einadia allanii* | At risk (naturally uncommon) | ✓ |
| *Festuca actae* | At risk (naturally uncommon) | ✓ |
| *Hebe strictissima* | At risk (naturally uncommon) | ✓ |
| *Leptinella minor* | At risk (naturally uncommon) | ✓ |
| *Senecio glaucophyllus* subsp. *basinudus* | At risk (naturally uncommon) | ✓ |
| *Asplenium trichomanes* | Locally uncommon[1] | ✓ |
| *Leptecophylla juniperina* | Locally uncommon[2] | Maybe (occurs nearby) |
| *Leucopogon fasciculatus* | Locally uncommon[3] | Maybe (occurs nearby) |

[1] This fern is uncommon in the ER but was not recorded in the Port Hills ED by Wilson (1992).
[2] This shrub is uncommon at scattered localities in the ER (Wilson 2013).
[3] This shrub is only known from a few localities in the ED (Wilson 2013).

**Regionally endemic taxa**

Eight endemic taxa are known from Banks ER (Wilson 1992). Of these, the following five have been recorded in the consent area.

*Festuca actae*
*Heliohebe lavaudiana*
*Hebe strictissima*
*Leptinella minor*
*Myosotis lytteltonensis*

**Table 2: Type localities of indigenous plants in Banks ER** (after Wilson 1992)

| Species | Collector | Year |
|---|---|---|
| *Brachyglottis lagopus* | Raoul | 1840 |
| *Clematis foetida* | Raoul | 1840 |
| *Convolvulus waitaha* | Melville, Godley & Mason | 1961 |
| *Coprosma robusta* | Raoul | 1840 |
| *Corokia cotoneaster* | Raoul | 1840 |
| *Discaria toumatou* | Raoul | 1840 |
| *Griselinia littoralis* | Raoul | 1840 |
| *Heliohebe lavaudiana* | Raoul | 1840 |
| *Hebe strictissima* | Kirk | 1876 |
| *Hoheria angustifolia* | Raoul | 1840 |
| *Leptinella minor* | Lyall | ? |
| *Lophomyrtus obcordata* | Raoul | 1840 |
| *Luzula banksiana* var. *orina* | Edgar | 1964 |
| *Myosotis lytteltonensis* | Laing | 1917 |
| *Olearia avicenniifolia* | Raoul | 1840 |
| *Senecio glaucophyllus* subsp. *Basinudus* | Dawson | 1954 |
| *Uncinia leptostachya* | Raoul | 1840 |

Note: The type locality is the place where the type specimen of a particular taxon was collected. The type specimen is the single herbarium specimen on which the scientific name of a particular taxon is based.

**Table 3: Indigenous plant species distribution limits in Banks ER** (after Wilson 1992)

| Species | Southern limit | Northern limit |
|---|---|---|
| *Asplenium oblongifolium* | ✓ | |
| *Leucopogon fasciculatus* | ✓ | |
| *Olearia fragrantissima* | | ✓ |
| *Passiflora tetrandra* | ✓ | |
| *Piper excelsum* | ✓ | |
| *Rytidosperma corinum* | | ✓ |

Wilson notes that *Rytidosperma corinum* may extend a little more northward in the west.

### 3.3 Birds and lizards of the consent area

Twenty-two bird species (10 indigenous and 12 introduced taxa; Table 4) and four lizard species (Table 5) were recorded in or near (≤ 0.2 km) the consent area. A total of 65 individual lizards were found, consisting of 60 Canterbury geckos, one jewelled gecko, one common skink, one McCann's skink and two unidentified skinks (glimpsed too briefly to permit identification, they would have been common or McCann's skinks). Photos of these lizard species and a map showing the locations of all sites where lizards were found are provided in Attachment 2.

**Table 4: Bird species recorded in the consent area and their conservation status**

| Common name | Scientific name | Conservation status |
|---|---|---|
| **Indigenous and endemic species** | | |
| New Zealand pipit | *Anthus n. novaeseelandiae* | Declining |
| Bellbird | *Anthornis m. melanura* | Not threatened |
| Grey warbler | *Gerygone igata* | Not threatened |
| New Zealand kingfisher | *Todiramphus sanctus vagans* | Not threatened |
| Shining cuckoo | *Chrysococcyx l. lucidus* | Not threatened |
| Silvereye | *Zosterops l. lateralis* | Not threatened |
| South Island fantail | *Rhipidura f. fuliginosa* | Not threatened |
| Southern black-backed gull | *Larus d. dominicanus* | Not threatened |
| Swamp harrier | *Circus approximans* | Not threatened |
| Welcome swallow | *Hirundo n. neoxena* | Not threatened |
| **Introduced and naturalised species** | | |
| Australian magpie | *Gymnorhina tibicen* | Introduced & naturalised |
| Blackbird | *Turdus merula* | Introduced & naturalised |
| California quail | *Callipepla californica* | Introduced & naturalised |
| Chaffinch | *Fringilla coelebs* | Introduced & naturalised |
| Dunnock | *Prunella modularis* | Introduced & naturalised |
| Goldfinch | *Carduelis carduelis* | Introduced & naturalised |
| Greenfinch | *Carduelis chloris* | Introduced & naturalised |
| Redpoll | *Carduelis flammea* | Introduced & naturalised |
| Skylark | *Alauda arvensis* | Introduced & naturalised |
| Song thrush | *Turdus philomelos* | Introduced & naturalised |
| Starling | *Sturnus vulgaris* | Introduced & naturalised |
| Yellowhammer | *Emberiza citronella* | Introduced & naturalised |

**Table 5: Lizard species found in the consent area and their conservation status**

| Common name | Scientific name | Conservation status |
|---|---|---|
| Common skink clade 5 | *Oligosoma* aff. *polychroma* Clade 5 | Declining |
| Canterbury gecko | *Woodworthia* cf. *brunnea* | Declining |
| Jewelled gecko[1] | *Naultinus gemmeus* | Declining |
| McCann's skink | *Oligosoma maccanni* | Not Threatened |

[1] This species was recorded in an adjacent catchment about two hundred metres from the consent area. It is likely to occur in indigenous shrubland and forest habitats of BBSR, which was not surveyed due to access restrictions.

### 3.4 Invertebrates of the consent area

Indigenous invertebrates, particularly insects are a conspicuous and important component of all terrestrial ecosystems. In terms of the specialist relationships they have with the flora and other fauna, the ecological services they provide such as pollination, parasitism and nutrient recycling, their high species richness and often large population numbers, they a major drivers of ecological systems. In this way they provide an informative layer for biodiversity studies and management based on the ecological roles they play.

### 3.4.1 Rock bluffs

Despite limited access to the consent area, examination of the rock bluffs on the edge of the consent area revealed all the known specialist rock bluff moths of Banks Peninsula (see Table 6). One of these, the day-flying geometrid *Dichromodes cynica* is endemic to Banks Peninsula, and is abundant on sunny days between late September and November. It's extremely cryptic larvae feed on lichens growing on dry sunny rock faces. For the moths *Dichromodes cynica, Kiwaia brontophora* and *Gadira petraula* the Port Hills are an especially important location as this is where they were first discovered and described from, making this the Type Locality for each species. All three were formally described by Christchurch school teacher Edward Meyrick in the early 1880s.

**Table 6: Specialist rock face moths in the consent area with conservation status, distribution and host details**

| Species | Host | Distribution | Conservation status |
|---|---|---|---|
| *Kiwaia brontophora* | moss | Widespread but local | Not threatened |
| *Dichromodes cynica* | lichen | Endemic to Banks Peninsula | Not threatened |
| *Helastia cinerearia* | moss | Widespread | Not threatened |
| *Helastia corcularia* | moss | Widespread | Not threatened |
| *Helastia mutabilis* | moss | Widespread but very local | Uncommon and local |
| *Eudonia manganeutis* | moss | Widespread | Not threatened |
| *Eudonia steropaea* | moss | Widespread | Not threatened |
| *Gadira acerella* | moss | Widespread | Not threatened |
| *Gadira petraula* | lichen | Stephens Is, Kaikoura area & Banks Peninsula | At risk (naturally uncommon) |
| *Glaucocharis elaina* | moss | Widespread but local | Not threatened |
| *Scoparia aspidota* | moss | Widespread but local | Not threatened |
| *Scoriodyta sereina* | algae | Kaikoura to Canterbury coast | Uncommon and local |

Of the twelve specialist rock face moths found in the consent area three are significant in terms of rarity, threat status and restricted distribution. Another two species have their type localities on the Port Hills and one of them is endemic to Banks Peninsula. Additional information about these five species is provided below.

*Gadira petraula* (Crambidae)

This highly cryptic species is of particular interest as it is only found in three discrete areas nationally; Stephens Island in Cook Strait, the Kaikoura area from sea level to above treeline, and several places on Banks Peninsula. This restricted distribution is partly explained by the species having a short winged and flightless female, making the species relatively immobile. This must slow the colonisation although the species has managed to colonise the rock road cutting of the Sumner Road in the consent area within the last 130 years. It's larvae feed on lichens growing on dry rock faces. Adults emerge from September to November and there is just one generation per year.

Based on its narrow range, the vulnerability of its specialised habitat and the female being flightless, DOC has classified it as 'at risk, naturally uncommon' (Stringer *et al.,* 2012).

*Helastia mutabilis* (Geometridae)

This species is another highly cryptic moth that in both its adult and larval life stages is found on the rock faces. Its larvae feed on mosses in damper parts of the rock face and are extremely well camouflaged in these situations. The species has a patchy distribution from the centre of the North Island to Otago. On Banks Peninsula it is rare with very few records. One adult was found on rock bluffs in the consent area, but its abundance and host moss is unknown.

*Scoriodyta sereinae* (Psychidae)

The tiny and fragile adult males of this species fly on calm mornings in the early spring seeking out a wingless female that is clinging to the end of her larval case, from which she has just emerged. Following mating the female lays her eggs back into the case from which the tiny larvae emerge long after she has died. The young larvae construct a small case for shelter and protection and begin feeding on algae on the rock face. This species is found in a few coastal rocky places from the Kaikoura area south to Banks Peninsula. Only a few populations of this relatively immobile species are known. The species prefers dry rock faces where its larval cases are often seen in crevices or beneath overhangs.

*Dichromodes cynica* (Geometridae)

With its grey coloration the fast-flying geometrid *Dichromodes cynica* is a feature of sun-drenched rock faces on Banks Peninsula, including the Port Hills, from the tops down to sea-level. Adults fly by day between late September and November. Described by Edward Meyrick from the Port Hills it is endemic to Banks Peninsula and remains common wherever rock faces are common and of high naturalness. The well camouflaged larvae feed on various lichens on the rock faces.

*Kiwaia brontophora* (Gelechiidae)

Tiny, fast-moving and intricately marked, the gelechiid moth *Kiwaia brontophora* is a rock face specialist. Adults can easily be disturbed by day but the species is generally active by night. During this survey its larval host was discovered for the first time. A sample of the moss *Grimmia pulvinata* was collected off damp rock faces and soon afterwards this species emerged from it, confirming it to be its host plant. The Port Hills is the type locality for this species and its ecology and host plant have now been clarified too. *K. brontophora* is widespread in New Zealand at low altitude and locally abundant where rock bluffs occur.

Other invertebrate fauna associated with the bluffs include the large clapping rock cicada *Amphipsalta strepitans* which is common above the Sumner Road. Its favoured habitat is a mosaic of sunny rock bluffs and shrubland. Its nymphs are thought to feed underground on the roots of various shrubs where they spend many years developing into an adult. This species has a patchy distribution across New Zealand, and it appears to be restricted to the western half of Banks Peninsula where only a few populations are known (Johns, 1986). The night survey revealed a small shiny byrrhid beetle and a medium-sized native slug, the latter being common in several places along the bluffs. Both groups are poorly known taxonomically so little can be said with about the importance of these records.

### 3.4.2 Forest habitat

Indigenous forest in BBSR occupies steep slopes among many rock bluffs. This provides ideal habitat for a range of indigenous invertebrates associated with trees, lianes and ferns, as there are many edges and micro-habitats to maximise invertebrate diversity. The dynamism of the system of unstable rock bluffs promotes diversity in vegetation structure and therefore invertebrate species richness.

Only the lower forest edge was sampled and thus the wider diversity of invertebrates is unknown, though light trapping did confirm the presence of a few specialist moths. The following indigenous forest plants are known to be important hosts for a suite of specialist invertebrates on the Port Hills, mainly moths:

- Mahoe supports two noctuid moths and a seed-feeding tortricid moth.
- Narrow-leaf lacebark supports two noctuids, a geometrid and a gelechiid moth.
- Ongaonga supports the red admiral butterfly, two geometrid, two noctuid and one crambid moth.
- *Coprosma* species support two noctuid, four geometrid, one gelechiid and one tortricid moth, and two mired bugs.
- Pohuehue and scrub pohuehue support two copper butterflies, four noctuids, three geometrids, one thyridid, one carposinid, one tortricid moth and a myriad stick insects, bugs and beetles.
- Bush lawyer supports one noctuid and one geometrid species of moth.
- Kowhai supports a noctuid, geometrid, stathmopodine and a crambid moth.
- Five finger supports leaf mining gracilariids and the stunning South Island zebra moth.

The exotic pine plantation contains a scattering of indigenous plants, and while some support indigenous invertebrates their populations are very small and will be transitory as the pine forest matures.

### 3.4.3 Grasslands

Indigenous plants are often a relatively minor component of the grasslands in open areas, but indigenous grasses are more prominent around rocky habitats where they occur with other indigenous shrubs and herbs, extending onto steep upper slopes. The invertebrate fauna of these mixed semi-natural grassland / shrubland mosaics is described below.

Mixed grasslands of *Poa, Festuca* and exotic grasses support many indigenous insects including the grassland katydid, cricket and two stem-boring moths *Glyphipterix achlyoessa* and *G. oxymachaera*. These are widespread and typical indigenous species of this habitat. The infamous and cosmopolitan locust (*Locusta migratoria*) is found on sunny slopes on the western parts of Banks Peninsula, and it is common on the grassy ridge above Evans Pass. Its Port Hills population is the southern-most known in Australasia (Johns, 1986).

Patches of common broom support a range of indigenous insects including a seed-feeding weevil, a mired bug and a suite of specialist moths. Five moth species were found as larvae, and two of them have their type localities in the area. While one is explicitly stated as the Port Hills, the Christchurch one may actually be the Port Hills too. The species are *Pseudocoremia melinata* (Geometridae), *Pasiphila* new species (Geometridae), *Orthenches chlorocoma* (Plutellidae) (type locality Christchurch), *Athrips zophochalca* (Gelechiidae) and *Scythris epistrota* (Scythrididae) (type locality Port Hills). This combination of insect species

and type populations is important and underscores the scientific and conservation value of these scattered shrubs. All five of these moth species are uncommon, matching the national demise of some native brooms.

Other indigenous shrubs that support specialist insects include niniao with two moths, korokio with two moths, porcupine shrub with two moths, matagouri with one fine grey noctuid and prostrate kowhai with four moths. Prostrate kowhai was also found to be a favoured food for the short-horned grasshopper *Sigaus campestris*. This grasshopper has a patchy distribution on the Port Hills and elsewhere close to Christchurch. Patches of the small shrub *Haloragis erecta* support a brentid weevil (*Rhadinosomus acuminatus*) the moth *Epicyme rubropunctaria*, both of which have a widespread distribution.

While only one plant of *Aciphylla subflabellata* was seen, other plants are likely to be present. This species is known to support the specialist day-flying geometrid moth *Dasyuris partheniata* on the Port Hills, which is listed as being at risk (Stringer et al., 2012). The large, metallic black spider-hunting wasp *Priocnemis monachus* was locally common in grassland / shrubland of the ridge above Evans Pass, where adults were observed searching for spiders. This species is "rather uncommon in the Christchurch area" (Johns, 1986).

The tiny moth *Bedellia psamminella* was first described from the Port Hills in the 1880s. It is still common and conspicuous, as its larvae feed openly on the foliage of abundant indigenous bindweeds scrambling through forest edges and open grasslands. This moth species is especially common in the consent area among disturbed open habitats.

## 3.5 Ecological significance assessment

### 3.5.1 Significance definition and significance criteria

Until a set of significant natural areas are identified within the BPDP using the DP significance criteria, the DP provides definitions of significant indigenous vegetation to be used as an interim measure. The definitions are based on a combination of different community or vegetation types, and sometimes area or height thresholds. These definitions are applied in Table 7 below to determine if areas supporting indigenous vegetation in the consent area are considered to be significant. The full definitions, including species composition are provided in Attachment 4.

**Table 7: BPDP significant indigenous vegetation types**

| Vegetation type | Present | Comments |
|---|---|---|
| Old growth podocarp/hardwood forest | | • None present |
| 0.5ha or more of mixed hardwood forest | ✓ | • All of the species mentioned in the definition are present and the area threshold is exceeded in BBSR. |
| 0.25ha or more of mature & regenerating kanuka | | • Kanuka is rarely seen |
| 0.5ha or more of lower altitude mixed scrub | ✓ | • All but one of the species mentioned in the definition are present, and the area threshold is likely to be easily exceeded in BBSR. |
| Subalpine mixed scrub | | • None present as too low an altitude. |
| 0.1ha or more of low altitude small-leaved shrubland | ✓ | • All the species mentioned in the definition are present and the threshold |

| | | |
|---|---|---|
| | | is exceeded, especially in BBSR. |
| Rock communities with 30% or more of indigenous vegetation cover. | ✓ | • There are a large number of bluff communities throughout the consent area which have at least 30% indigenous vegetation cover. Nearly all the species mentioned are present, plus extensive lichens and mosses. |
| 0.5ha or more mixture of the above vegetation types. | ✓ | • The consent area is a mosaic of these vegetation types and this threshold would be easily met in many localities. |
| Indigenous tussock grassland | | • None present that reach the thresholds set for the three types that are defined. |
| Indigenous coastal vegetation | | • While coastally-influenced vegetation occurs in the area, specific coastal types close to the sea are not present. |
| Indigenous wetland vegetation | | • None present. |
| Threatened indigenous species | ✓ | • 1 threatened and 10 at risk species are present, and a further 2 threatened and 1 at risk species may be present. |

Of these definitions of significant indigenous vegetation, six are present within the consent area. They are essentially the bluffs and other rock outcrops; the forest, scrub and shrubland of BBSR and smaller areas of scattered scrub / shrubland associated with rocky habitats elsewhere; and the habitats of threatened and at risk plants scattered throughout the consent area. The main areas that do not meet the definitions are the pine plantation (even though the 'at risk' *Einadia allanii* and *Festuca actae* occur there), the adjacent LPC land to the east and perhaps the grassland ridge above Evans Pass ('at risk' *Aciphylla subflabellata* was seen nearby).

Table 8 contains significance assessments for the consent area using the BPDP and RPS significance criteria, with specific assessments for indigenous vegetation, birds, lizards and invertebrates. The BPDP criteria are broad in nature and do not have particular thresholds attached to them. The Canterbury RPS criteria are more comprehensive and have a set of guidelines to assist with their application. The guidelines encourage the use of ratings and thresholds for most of the RPS criteria and these have been used for the assessments. 'Not applicable' in the BPDP column indicates that there is no equivalent criterion to a particular criterion of the RPS. Both sets of criteria are provided in full in Attachment 4.

**Table 8: Ecological significance assessment**

| Criterion[1] | BPDP[2] | RPS | Justification |
|---|---|---|---|
| Representativeness 1 | ✓ | ✓ H | • The bluffs, cliffs, and their associated grasslands, shrublands, scrub, forest and ecological processes are typical of the ED (*BPDP rating*).<br>• There are many good quality examples of rock bluffs and cliffs, and smaller rock features characteristic of the ED. Associated with these are grasslands, shrublands and scattered trees. Exotic plants are prominent, but a characteristic indigenous flora is present (*RPS 1 rating = high*).<br>• The secondary forest, scrub and shrubland of BBSR is modified with open patches and has a suite of weeds, but it is characterised by functional ecological processes, e.g. pollination, regeneration and dispersal (*RPS rating = moderate*).<br>• The site contains faunal habitats that are representative of the ED, including rock outcrops, bluffs, grasslands, shrublands and forest. Bird and lizard assemblages are close to the expected composition and structure.<br>• The native bird fauna is represented by multiple feeding guilds (e.g. insect, nectar and carrion feeders). Some species found in similar habitats elsewhere in the ER were not recorded, reflecting local extinction (e.g. brown creeper no longer occurs in the Port Hills), extreme rarity (e.g. tui) or presumed presence that could not be confirmed due to access restrictions (e.g. kereru).<br>• Four out of five lizard species that occur in the ER were recorded: the only species not seen (Central Canterbury spotted skink) has not been recorded in the Port Hills for 60 plus years and is extremely rare in the ER.<br>• Good quality examples of rock faces and outcrops are present, and are of high representative value. Shrubland or treeland with indigenous birds and lizards also meets the threshold despite being modified.<br>• The rock bluffs, forest and grassland/shrublands are typical of the ED, providing habitat for common and uncommon indigenous invertebrates living in or on them, and depending on their various plant species for food and cover. |
| Representativeness 2 | NA | ✓ H | • The bluff system and other rock outcrops are extensive, extending west of the Crater Rim cliffs to include those within BBSR (*RPS rating = high*).<br>• The rock outcrops and bluffs are a relatively large example of their type and provide an extensive area of faunal habitat.<br>• Other habitats present (grassland, shrubland and forest) are of reasonable size but are not large.<br>• The bluff system is a relatively large example of important invertebrate habitat in the ED. |
| Rarity/Distinctiveness 3 | NA | ✓ | • Indigenous vegetation types or habitats of indigenous fauna that are reduced to less than 20% of their original extent applies to indigenous forest (Wilson 2009). This reduction is likely to have reduced |

| | | | |
|---|---|---|---|
| | | | forest habitat for invertebrates and jewelled gecko by a similar extent (*RPS rating = met*).<br>• Land environments are at risk (20-30% indigenous cover), except for the acutely threatened land environment underlying the pine plantation which is ecologically compromised (*RPS rating = not met*). |
| Rarity/Distinctiveness 4 | ✓ | ✓ H | • As shown in Table 1, there are 1 threatened and 10 at risk plant species present, plus a further 2 threatened and 1 at risk species likely to be present; 1 locally uncommon species is present (*BPDP*).<br>• The information applies to the RPS criterion also. Vegetation types that support these species include bluffs, low bedrock outcrops, associated grassland, shrubland, scrub and forest (*RPS rating = high*).<br>• The area supports one bird and three lizard species that are at risk: New Zealand pipit (found in grassland and rocky areas), Canterbury gecko (rocky areas), jewelled gecko (indigenous shrubland and forest) and common skink clade 5 (grassland and rocky areas).<br>• The guidelines consider rock outcrops providing habitat for Canterbury gecko and forest remnants providing habitat for jewelled gecko to have high rarity value.<br>• The rock bluffs support 3 uncommon or locally rare moth species, including *Gadira petraula* which is at risk. The rock cicada *Amphipsalta strepitans* has one of its few ER populations here.<br>• Common broom supports five uncommon moth species, and it is highly likely that the Spaniard supports the at risk geometrid moth *Dasyuris partheniata*. Two of them have their type locality here. |
| Rarity/Distinctiveness 5 | ✓ | ✓ | • At the ER scale there are 5 endemic plant species, 17 type localities and 5 plant species have their distribution limits here. (*BPDP, and RPS rating = threshold met*).<br>• Canterbury and jewelled geckos reach their respective southern and northern distribution limits in Canterbury.<br>• None of the ten indigenous bird species found have distribution limits in Canterbury.<br>• The rock bluffs support the moth *Dichromodes cynica* which is endemic to Banks Peninsula and reaches its western distribution limit in the ED. 3 moth species have their type localities in the ED.<br>• Two of the moth species found on common broom have their type locality in the ED, and locusts in the ED represent the southern distribution limit for Australasia. |
| Rarity/Distinctiveness 6 | NA | ✓ H | • The bluffs and cliffs are a naturally rare ecosystem type of coastal cliffs on acidic rocks, as they occur within the coastal environment. Plants characteristic of coastal conditions confirm this e.g. shore spleenwort, *Einadia triandra* and native spinach. (*RPS rating = high*)<br>• The lizard assemblage is distinctive in terms of its species association. Only one other site on Banks Peninsula and in Canterbury has this particular association of species (Lettink 2012; DOC Herpetofauna Database), though this is partly a reflection of the large size of the consent area and lack of survey coverage for much of the ER.<br>• The indigenous bird fauna is not considered distinctive in terms of its species' make-up. |
| Diversity and Pattern 7 | NA | ✓ H | • The area contains 5 vegetation types and a variety of slope and bluff aspects, though north-facing slopes or bluffs are limited. Plant diversity is fairly high. There is an incomplete altitudinal sequence |

| | | | |
|---|---|---|---|
| | | | down to the Sumner Road (*RPS rating = high*).<br>• Species-rich for lizards (has four out of five possible species; sites supporting all five species are not known to occur in the ER).<br>• Species richness for indigenous birds is considered moderate.<br>• The rock bluffs support a relatively high number (12) of specialist moths reflecting the high number of micro-habitats available. Species such as *Dichromodes cynica* and *Gadira petraula* require sunny faces while others like *Kiwaia brontophora* and *Helastia mutabilis* prefer shady, damp faces. |
| Ecological context 8 | ✓ | ✓ H | • The Crater Rim cliffs, other bluffs and their associated communities are a central part of a series of south-facing bluffs on the Lyttelton side of the harbour. Vegetation within the consent area contributes to a range of ecological process including pollination and dispersal. The cliffs provide natural buffering, but weed spread from the west in particular is apparent. (*BPDP met and RPS rating = high*).<br>• Adjoins Tauhinukorokio Scenic Reserve, a large Public Conservation Area adjacent to Lyttleton Scenic Reserve on its western flank. Much of this area is covered with indigenous vegetation that provides continuous habitats for birds and lizards.<br>• Indigenous invertebrates move between rock bluff habitats, despite barriers to dispersal such as flightless females. This is shown by colonisation of the Sumner Road cuttings (130 years old) by all 12 specialist moths, several beetles and a native slug. The rock bluffs of the ED thus are ecologically connected and provide a corridor for dispersal over time. Forest patches also provide important ecological linkages to adjacent forests in scenic reserves for a suite of indigenous invertebrates. Grasslands / shrublands provide similar linkages and are especially important for indigenous invertebrates with limited mobility.<br>• The scattered areas of grassland /shrubland contribute to the continuity of this habitat type in the ED, having survived because of their remoteness and the protection provided by steep shady slopes and abundant rocky habitats. They are buffered to some extent by the steep rock bluffs, the pine plantation and presence of scenic reserves nearby. |
| Ecological context 9 | NA | NA | • No known wetlands present. |
| Ecological context 10 | NA | ✓ H | • Provides feeding and breeding habitat for at least nine indigenous bird species (all those listed in Table 1 except Southern black-backed gull) and four lizard species.<br>• Creviced rock outcrops and bluffs provide vital refugia from predation for Canterbury gecko.<br>• The rock bluffs are an important permanent habitat for indigenous invertebrate fauna. |

[1] The numbers in this column correspond to numbered criteria and sub-criteria definitions in the RPS.
[2] The BPDP criteria are simpler and less numerous, and they do not always correspond to the RPS criteria.

### 3.5.2 Overall significance assessment

The overall assessment of ecological significance for the consent area is established by integrating the information in Tables 7 and 8 with national policy requirements. From this it is clear that most of the consent area is significant, the only exception being the pine plantation. Theoretically, the pine plantation is significant because it occurs on an acutely threatened land environment (nationally important, NZCPS); at risk *Einadia allanii*, *Festuca actae* and Canterbury gecko are present near the ridge or on more open rock habitat (nationally important, NZCPS); and *Asplenium oblongifolium* reaches its distribution limit in the ER (nationally important, NZCPS). From a practical perspective, its ecological values have been compromised by soil disturbance during planting, and as the trees age they are likely to be removed. Additionally the species referred to are not restricted to the plantation and occur elsewhere in the consent area. On this basis it was decided not to rate the pine plantation as significant.

The Crater Rim cliffs and other bluffs are particularly significant for being a naturally rare ecosystem, and for their diversity of common and rare indigenous flora and fauna. The forest, scrub-shrublands and grasslands also support a range of common and rare indigenous flora and fauna and have important ecological interrelationship with each other and with rocky habitats. The LPC land between the pine plantation and BBSR is significant; primarily because of the valuable role it plays in helping to buffer the indigenous biodiversity of BBSR. The overall significance assessment is summarised in Table 9 below.

**Table 9: Summary of overall significance assessment**

| Habitat type | Abundance | Region / District[1] | National[2] | Overall[3] |
|---|---|---|---|---|
| Rock | Abundant | ✓ | ✓ | ✓ |
| Forest | Common | ✓ | ✓ | ✓ |
| Scrub-shrubland | Common | ✓ | ✓ | ✓ |
| Grassland | Common | ✓ | ✓ | ✓ |
| Freshwater | None | Na | Na | na |
| Exotic forest | Abundant | ✓ | ✓ | × |

[1] A tick means the habitat type is significant based on the RPS and BPDP significance criteria.
[2] A tick means the habitat type is nationally important because of national policies, e.g. NZCPS.
[3] A tick means the habitat type is significant based on the integration of all information.

## 4 Statutory and non-statutory context

### 4.1 National Policy Statements

National Policy Statements (NPS) are prepared in accordance with the RMA. The New Zealand Coastal Policy Statement (NZCPS) applies to the coastal environment, which includes terrestrial land adjacent to the coast. The coastal environment is not defined by specific limits as its width varies at different localities, but it includes land influenced by coastal processes such as the movement of sediment, wind and water. It contains specific provisions about indigenous biodiversity which apply to the consent area. These are Objective 1 and Policy 11, which are provided in full in Attachment 5.

Objective 1 aims to maintain natural ecological processes and to protect significant natural ecosystems in the coastal environment.

Policy 11 provides the policy context for managing adverse effects on indigenous biodiversity within the coastal environment. This policy sets a relatively high threshold that activities that have an adverse effect on significant values are avoided. It does not provide for adverse effects on indigenous biodiversity values that are recognised through 11(a) to be remedied or mitigated. The significant values where adverse effects are to be avoided include:

- Threatened or at risk species.
- Naturally rare ecosystems.
- Habitats where species are at their natural distribution limits.
- Areas set aside for protection of indigenous biodiversity under other legislation e.g. Buckley's Bay and Tauhinukorokio Scenic Reserves.

On the basis of Policy 11(a) all of the consent area is significant except for the pine plantation (as was explained earlier). The provisions of Policy 11(a) are thus sending a strong signal to consent authorities about the importance of the consent area, irrespective of other relevant considerations, e.g. Section 5 RMA.

Policy 11(b) recognises and provides for the maintenance of indigenous biodiversity values generally, though they are not applied here as the relevant provisions (i.e. (i) and (vi)) have already been applied through the RPS and BPDP significance criteria.

### 4.2 Proposed NPS on indigenous biodiversity

Work has been undertaken on a NPS addressing indigenous biodiversity. While the Proposed NPS does not carry the same weight as an operative NPS, when considering an application for a resource consent the consent authority is to have regard to any 'other matter' they consider is relevant and reasonably necessary to determine the application.

The Proposed NPS is intended to provide a clearer direction to local authorities about their responsibilities for managing indigenous biodiversity under the RMA. It outlines policies and decision-making frameworks for the identification and management of indigenous biodiversity found outside the public conservation estate. Local authorities are required to manage the effects of activities through district and regional plans and resource consent decisions, (or be satisfied that effects are managed by other methods) to ensure there is no net loss of significant indigenous biodiversity. The relevant provisions of the Proposed NPS are provided in full in Attachment 5.

The proposed NPS seeks to promote the maintenance of indigenous biodiversity while recognising the rights and responsibilities of landowners and the interests of Maori.
Policy 1 states:

> *For the purpose of this national policy statement, an area of significant indigenous vegetation or a significant habitat of indigenous fauna is an* area *or habitat whose protection is important for the maintenance of indigenous biological diversity.*

Policy 2 addresses the main components of uncommon and threatened indigenous biodiversity and provides list of criteria for identifying areas of indigenous vegetation and habitats of indigenous fauna that are nationally uncommon or threatened. These criteria are based on the Government's Statement of National Priorities for Protecting Rare and Threatened Native Biodiversity on Private Land (i.e. MfE 2007).

Policy 5 states that local authorities must manage the effects of activities to ensure there is "no net loss" of significant indigenous vegetation and significant habitats of indigenous fauna. Where adverse effects cannot be adequately mitigated, residual adverse effects are to be offset according to the principles in Schedule 2. The policy recognises that offsets will not be possible where ecosystems are irreplaceable. When the Schedule 2 principles are applied to the adverse effects of this proposal, they cannot be offset because the naturally rare cliff ecosystems are irreplaceable. Additionally, a comprehensive assessment has not been undertaken because much of the area could not be visited due to localised geotechnical hazards, and therefore the presence of highly vulnerable and irreplaceable biodiversity cannot be confirmed. The quantity and quality of the indigenous biodiversity has not been measured either, and the Crater Rim cliffs and other bluffs in the consent area represent a non-negligible portion of what remains of south facing bluffs in the ED. For these reasons, residual adverse effects on indigenous biodiversity are not capable of being offset.

Policy 6 promotes the maintenance of indigenous biodiversity generally, in addition to areas of significant indigenous vegetation and significant habitats of indigenous fauna. Many of the issues that it raises are implicitly recognised by the BPDP and RPS significance criteria, and will be specifically addressed under the assessment of environmental effects.

### 4.3 Canterbury Regional Policy Statement

Operative Regional Policy Statements (RPS) are the over-arching documents which other regional plans cannot to be inconsistent with, and district plans cannot be inconsistent with regional plans. Chapter 9 of the operative Canterbury RPS addresses ecosystems and indigenous biodiversity, with two objectives and three policies being particularly relevant to the consent application. These policies are summarised as follows:

- **9.3.1** Focuses on the protection of significant natural areas, and provides criteria to be used for significance assessments. These are detailed in Appendix 3 of the RPS with areas being considered significant if one of the 10 criteria is met. There are also guidelines to assist in applying the significance criteria (Wildland Consultants 2013).
- **9.3.2** Identifies the national priorities for protection, which are based on rarity considerations. They are effectively addressed through the RPS significance criteria guidelines.
- **9.3.6** Limitations on the use of biodiversity offsets. The following criteria will apply to the use of biodiversity off sets:
  - (1) the offset will only compensate for residual adverse effects that cannot otherwise be avoided, remedied or mitigated;
  - (2) the residual adverse effects on biodiversity are capable of being offset and will be fully compensated by the offset to ensure no net loss of biodiversity;
  - (3) where the area to be offset is identified as a national priority for protection under Policy 9.3.2, the offset must deliver a net gain for biodiversity;
  - (4) there is a strong likelihood that the offsets will be achieved in perpetuity; and
  - (5) where the offset involves the ongoing protection of a separate site, it will deliver no net loss, and preferably a net gain for indigenous biodiversity conservation.

Offsets should re-establish or protect the same type of ecosystem or habitat that is adversely affected, unless an alternative ecosystem or habitat will provide a net gain for indigenous biodiversity. There will be cases where the indigenous biodiversity at risk is so significant that it should not be significantly modified or destroyed under any circumstances (other than when necessary for avoiding risks to human health and safety). This safety issue

is directly relevant to the reopening of the Sumner Road. The explanation notes there are also situations where residual effects cannot be fully compensated because the biodiversity is highly vulnerable or irreplaceable, and there are few or no opportunities to deliver an offset. In such cases off-setting cannot be considered as a means of environmental compensation for adverse effects.

Under the methods, the key consideration in consent applications is the significance criteria and the related (non-statutory) guidelines for determining ecological significance. These criteria have been applied in Table 8 above to determine if any vegetation within the consent area is significant.

## 5 Assessment of effects

At the time of field work the nature of some proposed construction activities and their location were not fully defined, which means that some areas were not visited. Consequently there may be insufficient biodiversity information about some areas which makes assessing effects more difficult. This uncertainty is compounded by limited knowledge about the distribution and numbers of vulnerable species within the consent area generally, as approximately two thirds of the area could not be visited because of safe site access constraints (localised geotechnical hazards).

Despite these limitations, reasonable assessments can still be made about the magnitude and nature of adverse effects, and these are provided for the main activities and locations that will be affected. Adverse effects are categorised as minor, moderate, major or severe, with the last three being significant. A summary of all effects is provided in Table 10.

### 5.1 Vegetation

#### 5.1.1 Construction effects

**Benching**

The proposal to excavate and bench the Crater Rim cliffs for a width of approximately 500m (location plan, Aurecon Stage 3 Report) and a height of 100m will have severe effects. It will remove the largest section of natural cliffs within the consent area and effectively destroy any associated indigenous vegetation. These effects are also long term in nature.

The cliffs provide habitat for a wide range of indigenous plants from widespread and common species to nationally threatened or at risk species. Attachment 1 lists the plant species present or likely to be in the consent area, and what their main habitats are. Of this list approximately 116 indigenous species are associated with bluffs and other rock habitats, and 88 of these are present in the consent area. For threatened, at risk and uncommon plants, 14 of the 17 species in Table 1 are associated with rock habitats and 10 of these occur in the consent area. It is also likely that further threatened species will occur on the cliffs, given that they occur elsewhere in the consent area or on adjacent bluffs. By way of example, the critically threatened Lyttelton forget-me-not has been recorded from BBSR and Gollans Bay quarry, while the critically threatened dwarf button daisy occurs in Mt Cavendish Scenic Reserve further to the north-west.

The benching will also bisect the cliffs and bluffs within the consent area, largely separating the north-eastern and western bluffs from each other. This will increase the isolation of

some plant populations as they will have little opportunity to recolonise the benched area due to a lack of suitable habitat. The benched area is likely to remain bare of many indigenous species for a long time, as the new surfaces will lack the microhabitats that characterise the natural cliffs. Eventually microhabitats will begin to develop as lichens, mosses and liverworts colonise the bare rock and soil slowly develops on ledges and in cracks. Apart from cryptograms (e.g. lichens, mosses, liverworts and algae), colonisation is likely to be dominated by exotic grasses as has happened at Gollans Bay quarry and this will further limit colonisation by indigenous species.

The ecotone[1] between the north-western grassland and the cliffs will also be destroyed as the cliffs are cut back, further depleting the diversity of indigenous plants associated with them and the adjacent grassland.

**Haul roads A and B**

The haul roads will cause further losses of indigenous vegetation by cutting across steep slopes from the Sumner Road to the benching area (Road B), and by following the ridge above the Crater Rim cliffs (Road A). It also likely that finger roads will be needed from the haul roads to provide vehicle access to the benches. These finger roads will extend for something like 100 metres (Luci Swatton, pers.comm.) This will cause additional habitat loss and destruction of indigenous vegetation. While Road B is shorter, it is likely to have a similar effect to Road A because the cliffs and associated habitats support a greater range of indigenous plant species than the grasslands traversed by Road A.

The roads will also cause further losses and fragmentation of cliff and other rock habitats, including the upper margin of the cliffs and north-eastern bluffs which Road A traverses. Road A will thus exacerbate the loss of the ecotone between the grassland and the cliffs, and limit the natural development of another ecotone by facilitating the spread of weeds, which in turn will impede recolonisation by indigenous species.

Overall the effects caused by Haul Roads A and B (and their finger roads) are assessed as at least moderate.

**Removal of rock from other bluffs**

While most of the bluffs where scaling will occur are in the BBSR, there are other bluffs and rock outcrops north-east of the benches which will also be subject to scaling. Apart from the removal of rocks and the plants associated with those rocks, the scaling will reduce the extent of microhabitats and reduce the opportunity for future plant recolonisation. The extent of scaling and its downslope impact is expected to be greatest in BBSR, partly because the valleys below the bluffs support a substantial area of indigenous shrubland, scrub and forest. At least some of the falling rocks will hit indigenous plants, with damage being greatest from larger rocks or where rocks are channelled by gullies or chutes. This will destroy some plants and damage others, which could include threatened or at risk plants.
At least 10 of the threatened and at risk plants listed in Table 1 are known to occur in BBSR. The most vulnerable of these is the Lyttelton forget-me-not, which was recorded on the

[1] Ecotones are particularly important zones for species and community diversity, being transitions between adjacent ecological patterns or communities. They tend to be very productive, supporting a high species diversity and providing important habitats for species from adjacent communities. In comparison to their adjacent communities, they have a greater importance for a range of biota than their size suggests.

upper bluffs in 1999 by Pender, but has not been re-located since. Nine individuals were found at the time and this represents approximately 25% of the known wild population of the species (Nick Head, pers.comm.). The loss of this sub-population would be a serious threat to the viability of this species given the extremely small total population. It also appears that there may be no more than a few plants of fragrant tree daisy (at risk, declining) in the reserve, and the loss of any plants would be significant locally.

The Stage 3 Aurecon Report indicates that up to 82% of the total consent area may be subject to scaling at either end of the area (broadly east and west), but it is unclear what the magnitude of the effects will be. This is because the likely type of scaling is identified for each hazard zone, but the volume of rock that will be removed is unknown. It is anticipated that given a substantial number of hazard zone bluffs will be subject to heavy scaling and "possibly light blasting", that a significant volume of rock will be removed.

An indirect effect of this disturbance is likely to be an increased level of weed invasion from a suite of weeds that occur in the affected areas or nearby. In the medium term at least, this will increase the need for weed control in the reserve and in other DOC administered land within the consent area, e.g. boneseed, spindleberry, gorse and broom.

Overall, the effects of scaling are likely to be at least moderate and could be major depending on the extent of rock removal and what indigenous species are removed or killed. If the *Myosotis* is present and any plants are killed, the effects would be severe.

**Soil stockpiling area**

This area was not specifically assessed as its location and areal extent was not defined before field work was done. On the basis of plants seen in similar habitats, indigenous plants that may be present include lichens, mosses, silver tussock, *Rytiosperma* spp., scrub pohuehue, common broom, matagouri, porcupine shrub, mikimiki, dwarf stonecrop, yellow oxalis, *Convolvulus waitaha, Acaena novae-zelandiae*, cotton fireweed and at risk *Aciphylla subflabellata*. Because the area is gently north-facing and has some low bedrock outcrops, it may support additional plants such as at risk *Raoulia monroi*, rock fern and at risk Banks Peninsula button daisy. Whatever plants are present, they are likely to be destroyed.

This will also cause some fragmentation, which is likely to affect rock habitats more than grassland which is much more extensive in this vicinity. Effects are unlikely to be permanent, providing any exposed rock is re-exposed when the stockpile is removed. If rare or uncommon species are not present, the effects are likely to be minor because exotic grasses are dominant in similar grasslands and there are substantial areas of similar habitat in the wider area. If rare or uncommon species are present, then the effects are likely to be moderate (depending on the species and their numbers).

**Site offices A and B**

Site office A is located immediately north-east of the quarry at Windy Point. The area was already modified by the operation of the quarry, and further earthworks have been undertaken to stabilise the point after the earthquakes. As a result, the great majority of vegetation in the locality is likely to be exotic grasses and herbs, with woody weeds and few indigenous plants. The construction of Site office A is therefore likely to have minor effects.

Site office B is located at the base of the spur immediately above Evans Pass. The vegetation in the area is grassland that is dominated by exotic grasses, and from satellite imagery there do not appear to be any rock outcrops present. Some of the indigenous plants referred to for the soil stockpiling area above are likely to be scattered through the area. On this basis, the effects are likely to be minor.

**Magazines A and B, and their access tracks**

Magazine A would be located in grassland on a north-west facing slope below 'Lyttelton Ridge'. Grasslands west of the ridge were not inspected, but they are likely to be dominated by exotic grasses and other herbs. Few if any rocks appear to be present. The access track follows a 4WD track from Lyttelton to near a patch of secondary forest, before heading north-east to the ridge. The formed track does not extend to the ridge, so the upper section will be a new vehicle track. This upper section also cuts across the corner of an open shrubland, whose composition is unknown. It will likely cross a few small areas of exposed bedrock whose vegetation is also unknown. The track will probably be metalled, and this is likely to facilitate the spread of weeds in the area. The upgraded track will cause some increase in fragmentation within the grassland, and perhaps between adjoining shrublands, though this effect is likely to reduce over time if the track reverts to a vegetated 4WD track.

Overall the effects are likely to be minor unless uncommon or rare plants are present, e.g. *Aciphylla subflabellata,* and depending what their numbers are. In that situation the adverse effects could increase to moderate.

Magazine B and its access track would be located on a north facing slope below Haul Road A. This area has not been specifically assessed as the magazine and track were not identified prior to field work. The area's vegetation is likely to be dominated by exotic grasses, but because of its sunny aspect and the presence of bedrock exposures there are likely to be additional indigenous plants present. These could include lichens, mosses, silver tussock, scrub pohuehue, common broom, *Acaena novae-zelandiae*, matagouri, mikimiki, porcupine shrub, *Dichondra repens,* dwarf stonecrop, yellow oxalis, prostrate kowhai, *Rytidosperma* spp., at risk *Aciphylla subflabellata* and *Convolvulus waitaha*. Further species adapted to dry rocky conditions may be present, e.g.at risk *Raoulia monroi*, rock fern, at risk Banks Peninsula button daisy and possibly the threatened annual fern.

Overall the effects are likely to be moderate, depending on what species are present and what their numbers are.

**Bund A and B**

The area in which Bund A will be located is grassland, and while the site of Bund B was not visited its grassland is likely to be of similar character. Very few indigenous plants occurr in the Bund A grassland as it is strongly dominated by dense and tall exotic grasses. There was virtually no evidence of an ephemeral stream here and overall effects are likely to be minor. The identity of the few scattered shrubs that occur in the vicinity of Bund B is unknown, but the effects of constructing the bund are likely to be minor unless threatened or uncommon species are present. It is not known how far disturbance beyond the bund may extend, but if it was substantial, it could potentially affect more indigenous vegetation.

**Activities beyond the construction areas**

During construction there is likely to be a requirement for vehicle turning and parking, plus storage of materials and equipment beyond the obvious footprint of roads and buildings. Depending on the extent, frequency and time duration, this may expand construction effects more widely though they are likely to be minor. If there is additional indigenous woody vegetation or bedrock outcrops affected, it is possible that moderate effects could occur (depending on what species are present and what their numbers are).

**Use of road metal**

The Haul Roads will be metalled, and it appears likely that the access tracks will be too. It is unclear if the road metal will be produced from local rock, or obtained off-site. On-site rock has the potential to spread weeds that are already present in the consent area, while off-site gravel could potentially introduce additional weeds. The use of road metal and the associated disturbance is very likely to increase weed spread around the roads and tracks. These effects are likely to be at least moderate, because of the competitiveness of weeds and the possibility that they could displace some indigenous plants, including uncommon ones. The roads and tracks could also act as a source of weeds that could potentially invade higher value habitats nearby, e.g. low bedrock outcrops.

**Dust**

Dust is likely to be generated from construction, including from scaling, blasting, excavation and the use of roads and tracks. It is considered to be a temporary effect as the dust should be washed off vegetation by rainfall events over time. It is therefore not expected to inhibit plant growth and its effects are considered to be minor.

**Fire risk**

There is a possibility that fire could inadvertently be caused by construction activity, e.g. hot vehicle exhausts, sparks from equipment or wiring, or from workers smoking on site. If a fire were to occur its effects could range from minor to potentially major, depending on its extent, its duration and the values of the vegetation affected.

**Weed spread**

All disturbed areas will tend to be colonised by weeds and exotic plants generally. The greater the disturbance the greater will be the likely spread, providing there are weed sources nearby. Weeds may also be introduced by road metal and by vehicles and equipment. Not only will disturbed areas be colonised by weeds (initially grasses and other herbs, then woody weeds), but they will also provide the nucleus for further weed spread into areas of indigenous vegetation and habitat generally that are not directly disturbed by construction activities. Because there are many weeds present in the consent area, the expectation is that weed invasion will have at least moderate effects and perhaps major effects locally if rare or uncommon species are affected.

**Pine plantation tree felling**

It is likely that some pine trees may be felled to facilitate the removal or securing of rocks resting against the trees, or to enable the scaling of bluffs within the plantation. While

indigenous plants occur within the plantation, they are relatively sparsely distributed and the effect is therefore likely to be minor.

### 5.1. 2 Operational effects

**Vehicle use**

Some vehicle use will be associated with maintenance of the benches, and Haul Road B and its finger roads. Activity should be restricted to the roads and while dust may be generated, its effects are considered to be minor.

**Further removal of rocks**

Further removal of rocks and other material may be required from time to time as weathering (and possibly further earthquakes) dislodges rocks and they fall onto roads, benches or bunds. Unless there are major rock fall events, the removal of rock and sediment is likely to have relatively minor effects. Depending on the extent and frequency of this activity it may disrupt natural succession over time, though the main concern is weed invasion. If further scaling is required, the effects may be moderate or even greater if rare or uncommon plants are destroyed.

**Fire risk**

There is likely to be some fire risk from the use of vehicles and machinery that may be needed to remove or dislodge rock material. The potential for accidental fire to occur through operational activities is likely to be less compared to construction activities, because of their reduced scale and frequency, and presumably, less use of machinery. It is nonetheless a risk and its effects could still be moderate or major.

### 5.1.3 Summary of effects

- Benching of the Crater Rim cliffs will destroy existing indigenous vegetation, reduce the availability of habitats for future colonisation, increase fragmentation, destroy ecotones and facilitate weed spread (severe effects).
- Scaling and blasting of other bluffs will destroy or damage some indigenous vegetation, reduce the availability of habitats for future colonisation and facilitate the spread of weeds (moderate to major effects; severe if the Banks Peninsula forget-me-not is killed).
- Construction of Haul Roads will destroy some indigenous vegetation, remove an ecotone, increase fragmentation and facilitate weed spread (at least moderate effects).
- Soil stockpiling will cover and destroy whatever indigenous vegetation is present, mostly grassland but also some low bedrock exposures (minor to moderate effects).
- Site offices A & B are in grassland and limited indigenous species are likely to be present (minor effects).
- Magazines A & B and their access tracks were not visited, and while they are located in grasslands some rock habitats may be affected (minor to moderate effects).
- Bunds A & B are located in grasslands with a low indigenous component (minor effects).
- Construction activities beyond the margins of roads and buildings (minor effects).
- Use of road metal will increase weed spread and this may displace some indigenous plants (moderate effects).
- Dust is likely to be produced, but will be washed off vegetation by rain (minor effects).

- Fire risk is associated with the use of vehicles and mechanical equipment, and the increased presence of people and activities (minor to major effects).
- Weed spread resulting from all activities and disturbances (moderate to major effects).
- Operational use of vehicles (minor effects).
- Operational removal of rocks (minor to moderate effects, possibly major).
- Operational fire risk (minor to major effects).
- Overall, the cumulative effects of the proposal will be severe. This is because of the extensive removal of rock habitat, damage to a naturally rare ecosystem, destruction of indigenous vegetation (including species whose protection is nationally important), and the spread of weeds.

### 5.l.4 Mitigation

- The most effective way to minimise the loss of indigenous vegetation and a reduction in ecological functioning is to minimise the level of disturbance and habitat loss, i.e. avoidance. This means recognising the high indigenous biodiversity values associated with rock habitats and BBSR, by re-evaluating the rock risk remediation options in more detail to take account of ecological considerations.
- The avoidance approach should also be applied to the benches, to avoid complete modification of the Crater Rim cliffs. Aurecon has identified this possibility whereby the top 4 or 5 benches could be excavated, allowing easier access to the bottom half of the cliffs and thus a closer evaluation of possible scaling options there. The possibility of not constructing full length benches should be discussed.
- It is important to identify the most stable bluffs and to apply the least damaging remediation methods to those bluffs. If it is unlikely that rocks from particular outcrops would reach the Sumner Road, then those outcrops should be left alone as this would help to retain the natural character of at least some rock habitats.
- Where there are particularly vulnerable high values, strenuous efforts should be made to avoid damaging them. The most critical example is the small population of the Banks Peninsula forget-me-not which was recorded in BBSR in 1999. This locality must be surveyed prior to any remediation activities being undertaken, to try and clarify if the population is surviving. If it is, scaling activities should not damage or disturb its habitat because its known population numbers are so low. The loss of any individuals will increase its vulnerability and push the species closer to extinction. Disturbance which could encourage weed invasion of its habitat should also be avoided.
- Irrespective of whether the forget-me-not is found, seed should be collected so it can be on-grown and strategically replanted in the consent area once it has been decommissioned. This is very much a secondary option as maintaining the habitat of naturally occurring plants is by far the most effective method of protection.
- Another example of this approach is to undertake minimal scaling in hazard zones 101 and 102, and to avoid damaging the habitat of *Asplenium trichomanes*, as these sites appear to be the only records of the species in the ED.
- During the construction and operational stages of the project, all machinery and vehicles should be thoroughly cleaned before entering the consent area to minimise the ingress of additional weeds, e.g. steam cleaning and visual checks.
- Vehicle spark arresters should be fitted to all vehicles operating in or immediately adjacent to the consent area to minimise the fire risk. A fire management plan should be produced which includes methods to minimise the fire risk, and to address contingency plans should a fire break out within or adjacent to the consent area.
- Weed monitoring and control should be undertaken around the margins of construction sites, including haul roads, access tracks, building sites and the soil stock-piling area. The

main weeds to target are gorse, broom, hawthorn, barberry, spindleberry and boneseed. Additional species to control are spur valerian, common polyplody, male fern and stonecrop. Monitoring colonisation of disturbed areas is needed to confirm which of these weeds are establishing and therefore need controlling. Monitoring may also reveal other weeds establishing in these areas which require control.

- Undertake general weed control within the consent area, targeting the weeds mentioned in the previous bullet point. Additional weeds to control in shrubland, scrub or forest are old man's beard, any pines, any ivy's, elderberry, karo, tree lupin, taupata and flowering currant. The main locations to target are BBSR, the 'Lyttelton ridge' and the LPC land west of BBSR to improve the buffering of BBSR. This includes the removal of existing mature pines, gum trees or macrocarpa on the LPC land.
- Restoration planting of indigenous woody species should also be undertaken on the LPC land to improve its value as a buffer area between BBSR and the pine plantation. This would also provide long term benefits through an increase in indigenous vegetation.
- Any security fencing within or around the consent area should be erected by hand, not using a dozed or cleared vegetation line. This will minimise disturbance to existing indigenous vegetation or habitats, and help to limit the spread of weeds. A suitably qualified ecologist or ecologists should be on hand to evaluate the proposed location of any fences that are to be erected.
- When decommissioned, any revegetation of the haul roads, 4WD tracks, building sites and the soil stockpile area should use sparse planting of indigenous species already in the consent area, e.g. silver tussock, matagouri, common broom, scrub pohuehue and porcupine shrub. The possibility of using direct seeding of key indigenous species could also be investigated e.g. *Rytidosperma* grasses. The disturbed sites should not be seeded with exotic grasses or clovers.
- It is recommended that the remaining natural bluffs in the adjacent Gollans Bay Quarry be formally protected, and the key weeds be controlled, e.g. spur valerian, broom and gorse. This is a compensation measure for the loss and modification of extensive rock habitats in the consent area which cannot be mitigated. It is not a biodiversity offset.

## 5.2 Lizards and birds

### 5.2.1 Construction effects

Indigenous bird and lizard species of national conservation concern recorded in or near the consent area are New Zealand pipit, Canterbury gecko, common skink clade 5 and jewelled gecko. The actual and potential adverse effects of construction activities on these species are described as follows:

**Haul Road A**

There will be direct habitat loss and potential loss of nests for New Zealand pipit, particularly during the construction of Haul Road A. This species was seen in small numbers (four individuals) on the ridge in the eastern third of the site. These effects are considered minor because the species is not abundant and only a small portion of its habitat (rough pasture and tussock grassland) is affected.

**Benching and scaling**

Rock remediation works will cause permanent habitat loss and significant mortality for Canterbury gecko. The Crater Rim cliffs of Hazard Zone 200 alone (18% of the total site, half

of which will be affected; figures from Aurecon Stage 3 report) are likely to support several hundred to several thousand individuals. These animals will not survive elimination of their habitat by blasting and excavation. Scaling elsewhere will also have significant adverse effects on this species because the area nominated for scaling is large and scaling corresponds precisely to the type of crevices occupied by geckos. Geckos have communal retreat sites and can form large aggregates in creviced rock, particularly where fissures are deep and narrow (<2 cm wide). It is impossible to quantify the number of individuals that will be affected because the area could not be surveyed and the amount of scaling is unknown. However, based on the number of animals (60) found during the survey, the large size of the affected area, an in-depth knowledge of the species' ecology, and an examination of detailed photographs and video footage of the bluffs, it is highly likely that thousands of individuals will perish as a direct result of rock remediation works. This loss of habitat is permanent as the bare rock faces left behind will be of little value to Canterbury geckos because the crevices on which they depend for refuge from predation and protection against the elements will be gone, as will the plants that provide geckos with shelter and food (invertebrate prey and fruit). These effects are considered severe.

The scaling of bluffs above BBSR will cause habitat degradation, potential injury and mortality to jewelled gecko from rock fall and this is the only potentially suitable habitat of shrubland and forest in the consent area. Interestingly, the jewelled gecko found near the consent area had a severe spinal deformity that may have been caused by rock fall. Evidence for this was the presence of earthquake-dislodged boulders piled up against the base of native shrubs in which this gecko was found. Such a deformity has not been seen previously in more than 700 wild individuals, suggesting it is not a natural abnormality (such as a birth defect). The effect on jewelled gecko habitat (damage and destruction of shrubs and trees by falling rocks) is likely to be moderate though it depends on the amount of rock removed and their trajectory. Potential injury and mortality from rock fall is considered to be a minor effect because of the likely low density of this species and the small chance of a direct hit.

For forest birds there will be some habitat degradation, potential nest loss, injury and mortality from rock fall associated with scaling in or above BBSR. While some mortality seems inevitable, these effects are considered minor because the species concerned are well-represented and/or abundant within their respective ranges.

**Haul Road B**

This road and its finger roads connecting with the benches will cause permanent habitat loss and significant mortality for Canterbury gecko, where the road traverses rock habitats and requires blasting or excavation. The reasons for this assessment are essentially the same as those described under benching and scaling.

There will be habitat loss and likely mortality for McCann's and/or common skink clade 5 during any construction activity undertaken in rocky areas and grassland (particularly in open, dry rocky sites with some vegetation cover). These effects are considered minor for McCann's skink because the species is well-represented and/or abundant within its range, and moderate for common skink clade 5 because of its at risk( declining) conservation status

**Haul Road A, magazines, access tracks and soil stock-piling area**

Construction activities undertaken in rocky areas, undeveloped grassland and grassland-shrubland mosaics will cause habitat loss and likely mortality for common skink clade 5.

Although few skinks were found (the species identity of only one individual was confirmed), the effects on this species are considered moderate because the numbers present will be much higher than observed; potential habitat for this species is abundant; and there is a high risk of mortality during earthworks, particularly if undertaken in cool conditions (when cold-blooded lizards are inactive and unable to respond to habitat disturbance).

There will be habitat loss and likely mortality for McCann's skink during any construction activity undertaken in rocky areas and grassland (particularly in open, dry rocky sites with some vegetation cover). These effects are considered minor because the species is well-represented and/or abundant within its range.

**Habitat fragmentation**

Habitat fragmentation will occur in any areas where construction bisects the habitats of species with limited mobility (i.e. all lizard species present, but not mobile birds). This effect varies from minor for skink habitat bisected by haul roads, to major for Canterbury gecko habitat disrupted by the removal of an entire bluff system.

**Tree felling in the pine plantation**

If tree felling is undertaken in the pine plantation as part of rock scaling activities, habitat loss, potential nest loss, injury and mortality to forest birds may occur. These effects are considered minor because the species concerned are well-represented and/or abundant within their respective ranges.

### 5.2.2 Operational effects

Actual and potential adverse effects of operational activities on indigenous bird and lizard species in the consent area include on-going disturbance from dust, noise and vehicle traffic. These effects are considered minor because of pre-existing noise pollution in areas directly above Lyttelton Port, predicted low traffic volumes and intended management plans which should minimise these effects.

### 5.2.3 Summary of effects

Predicted effects of construction and operational activities on indigenous bird and lizard species are summarised below:

- Haul Road A will cause some habitat loss and potential nest loss for New Zealand pipit (minor effect), plus habitat loss and likely mortality for McCann's and/or common skink clade 5 (minor and moderate effects, respectively).
- Benching and scaling will cause habitat loss and mortality for Canterbury gecko (severe effect).
- Benching and scaling will cause habitat degradation, potential injury and mortality to jewelled gecko (moderate and minor effects respectively), and habitat degradation, potential nest loss, injury and mortality to forest birds (minor effect).
- Haul Road B will cause habitat loss and mortality for Canterbury gecko (major effect), as well as habitat loss and likely mortality for McCann's and/or common skink clade 5 (minor and moderate effects, respectively).
- Construction of Haul Road A, the magazines, access tracks and the soil stockpile will cause habitat loss and likely mortality for McCann's and/or common skink clade 5 (minor and moderate effects, respectively).

- Habitat fragmentation where excavation or vegetation clearance bisects the habitats of species with limited mobility (all lizards) is assessed as having minor to major effects, depending on the species.
- Operational effects will consist of on-going disturbance from dust, noise and vehicle traffic (minor effects).

### 5.2.4 Mitigation

- Measures that may minimise the effects of development on indigenous birds and lizards include reducing the amount of habitat that is removed, staged construction (e.g. altering timing to avoid the breeding season of threatened birds), translocation (capturing live animals in the development footprint and moving them to alternative, secure habitats) and habitat restoration.
- Of these, minimising habitat loss is the most effective measure, especially for the habitat and species that will be most affected (Canterbury geckos living in the Crater Rim cliffs).
- Translocation of lizard species of conservation concern could be attempted in accessible parts of the site (which excludes most of the Crater Rim cliffs because of the steep, unstable terrain). This would be an extremely difficult undertaking that would at best recover only a small portion (most likely <5%) of the affected populations. It would also be an expensive operation, requiring abseil access by suitably-qualified herpetologists and/or rope technicians trained in lizard capture methods.
- Habitat restoration is not considered a viable mitigation option because it will not be possible to restore the Crater Rim cliffs to their former state or anything resembling it.
- If less-damaging rock remediation options are not selected, it is recommended that compensation should be provided. This should be designed to benefit the species and habitats that are most affected by the project.

## 5.3 Invertebrates

### 5.3.1 Construction effects

The construction effects of the proposal on significant indigenous terrestrial invertebrate fauna are severe. The total destruction of the 600m wide, 100m high cliffs at the core of the consent area means the total loss of indigenous invertebrates living there and their natural habitats. While colonisation of the resulting raw rock faces by indigenous invertebrates should occur over time, this will largely depend on maintaining sources of indigenous invertebrates as close as possible to the new rock faces. Scaling and other remediation work on other rock outcrops in the vicinity will destroy more invertebrates and their habitats, and this will ultimately slow the recovery of invertebrate populations in the benched area.

Haul Roads A & B will have an adverse effect on invertebrates and their habitats in the consent area. Where Haul Road B departs from the Sumner Road it will destroy an existing road cutting and then traverse the slopes above the road to near the bottom of the benches. Finger roads will be required to link the benches with Haul Road B, though they are not shown on the Aurecon plan. On these steep slopes the haul road and its finger roads will destroy natural rock bluffs and other rock habitats. This destruction significantly increases the loss of rock habitat and will further impede re-colonisation of the artificial rock faces of the benches. These are major effects which are long-term in nature.

Haul Road A traverses a ridge of mainly dry exotic grassland with some rock outcrops, rock platforms and scattered indigenous shrubs. It will be connected to the benches below by

several finger roads. From satellite imagery it is apparent that significant natural rock habitats will be destroyed by Haul Road A and its finger roads. These effects are considered to be moderate, reflecting the exotic nature of these grasslands in comparison to the slopes below which have a greater indigenous component and more indigenous shrubs.

Construction of Bunds A & B will not affect effect indigenous invertebrates or their habitats as they occur in areas of rank exotic grass. No evidence of streams was found here so the bunds do not truncate any freshwater systems, or affect any indigenous freshwater invertebrates. Their construction effects are therefore minor.

### 5.3.2 Operational effects

Operational effects on indigenous invertebrates and their habitats will be confined to vehicle use of the benches, Haul Road B and its finger roads, and the removal of any loose rocks.

### 5.3.3 Summary of effects

- The destruction of the Crater Rim cliffs will have severe effects on indigenous invertebrates and their habitats. Twelve specialist moths, a host of spiders, some beetles and a native slug occur here. Among the moths, one is 'at risk', one is endemic and three have restricted distributions. The effects are also likely to be of long term nature.
- The effects on forest and grassland/ shrubland habitats appear to be much less, providing minimal scaling is undertaken.

### 5.3.4 Mitigation

- From an ecological perspective, retaining some natural rock surfaces within or on the edges of the Crater Rim cliffs would be beneficial. This is unlikely at the eastern end because of access roads, but it may be possible within the benched area and at the western end. The images generated by the Landscape Architects support this possibility.
- Efforts should be made to minimise overall disturbance and damage to rock habitats such as bluffs, faces, platforms and outcrops. This is important as it will help to retain as many natural surfaces as possible, with their attendant cover of lichens and mosses.
- Care is needed with all preparatory and construction activity to confine effects to the actual construction footprint. It is important to avoid spill-over onto adjacent areas as this could increase the extent of adverse effects.
- Ecologists should be involved with monitoring or inspections at strategic times to discuss options prior the various construction phases. The purpose of this is to minimise adverse effects and to retain as much natural invertebrate habitat as possible.
- An effort should be made to retain the Sumner road footprint, and to avoid modifying the existing road cuttings as they provide valuable habitat for invertebrates.
- Exotic weeds that establish on the benches should be removed, as they reduce the potential development of invertebrate habitat on the lower sections of rock faces. On older rock faces these sections support a disproportionate amount of specialist rock face insects, due to the shelter they provide from wind, rain and temperature extremes. If woody weeds and herbs are allowed to establish on the benches they could create a 'hedging effect' effect, shading the lower faces and reducing colonisation by lichens, algae and mosses (as was seen on the Sumner Road cuttings). They would also provide a source for weed colonisation of the wider rock faces.
- Control of woody weeds in disturbed areas (tracks, roads, storage sites, benches) after construction is required, to prevent them spreading into adjoining invertebrate habitats.

- Ecologists should conduct long-term monitoring of the consent area to quantify the recovery of key natural communities and assess the opportunities for re-introducing indigenous fauna (and flora) lost through construction activities.

## 5.4 Overall significant adverse effects

The cumulative effects of the project as currently proposed are considered to be severe. The proposed benching of the Crater Rim cliffs will undoubtedly cause severe adverse effects, essentially destroying its indigenous biodiversity. These will be long term effects because of fragmentation, and because the new rock surfaces will lack indigenous vegetation and the microhabitats of natural cliffs. The scaling of other bluffs is likely to have similar effects to the benching, though not at the same scale and with less fragmentation. The combination of roads, tracks, buildings and soil stock-piling will result in death or injury to lizards, invertebrates and indigenous plants, plus further fragmentation which constitute a major adverse effect, particularly for some lizard species. Weed spread will impact on indigenous vegetation in particular, its magnitude depending on the suite of weed species and their localities. Weed spread into high value habitats not directly affected by construction activities is a central concern because it could have a major impact on rare or vulnerable species. While there may be a low probability of an accidental fire occurring, the fire risk does have the potential to have major effects, particularly in summer.

The main actual and potential effects of the project are summarised in Table 10 below.

## 5.5 Residual adverse effects

Proposed mitigation will primarily be addressed through management plans and consent conditions. The mitigation proposed in this report will be developed further through a management plan and should partly mitigate some of the adverse effects. In particular it should reduce the risk of weed spread and the extent over which it occurs. Similarly it should reduce the fire risk and ensure that any fire can be quickly controlled. If restoration planting and weed control is carried out on the LPC land, it should reduce weed spread into BBSR from the west, as well as improving habitat values over time.

If cliff benching and scaling is reduced it will lessen the magnitude of adverse effects on indigenous biodiversity, but the effects are likely to remain severe unless the chosen options are much less destructive than those currently recommended.

**Table 10: Summary of actual and potential adverse effects**

| Effects | Vegetation | Lizards | Birds | Invertebrates |
|---|---|---|---|---|
| **Construction effects** | | | | |
| Cliff benching | Severe | Severe | | Severe |
| Bluff scaling | Moderate to major | Severe; minor-moderate[1] | Minor | Moderate to major |
| Haul Road A | Moderate (at least) | Moderate | Minor | Moderate |
| Haul Road B | Moderate (at least) | Major and minor[2] | | Major |
| Soil stockpile | Minor to moderate | Moderate | | Minor |
| Site offices A & B | Minor | Minor | | Minor |
| Magazine A & track | Minor to moderate | Minor and moderate[3] | | Minor |
| Magazine B & track | Minor to moderate | Minor and moderate[3] | | Minor |
| Bund A & B | Minor | Minor | | Minor |
| Activities adjacent to construction areas | Minor | | | Minor |
| Use of road metal | Moderate | | | Minor |
| Noise | | Minor | Minor | Minor |
| Dust | Minor | Minor | Minor | Minor to moderate |
| Fire risk | Minor to major | | | Moderate to major |
| Weed spread | Moderate to major | | | Moderate |
| Habitat fragmentation | Minor to major | Minor to major | | Moderate to major |
| Plantation tree felling | Minor | Minor | Minor | Minor |
| **Operational effects** | | | | |
| Vehicle use | Minor | Minor | Minor | Minor |
| Dust | Minor | Minor | Minor | Minor to moderate |
| Noise | | Minor | Minor | Minor |
| Rock and sediment removal | Minor to moderate | | | Minor |
| Fire risk | Minor to major | | | Moderate to major |
| **Cumulative effects** | Severe | Severe | Minor | Severe |

[1] Severe effects are for Canterbury gecko, and minor to moderate effects are for jewelled gecko. There will also be minor effects for forest birds in BBSR.
[2] Major effects are for Canterbury gecko, and minor effects are for McCann's skink.
[3] Moderate effects are for common skink clade 5, and minor effects are for McCann's skink.

# 6 Discussion

A significant limitation for this AEE is that access restrictions, due to localised geotechnical hazards, means that a thorough field assessment of ecological values could not be undertaken. Approximately two thirds of the consent area was not visited, and this means that detailed information about the presence and distribution of plants and animals on the bluffs and in the forest cannot be clarified. Because of this it was necessary to gather additional information about the vegetation and some fauna adjacent to the consent area. This enabled a sound description to be provided for the vegetation, lizards, birds and insects likely to occur in the consent area, but limitations remain about the locations of many threatened, at risk and uncommon plants and animals. This is best illustrated by the Banks Peninsula forget-me-not, as it is has a very restricted distribution and an extremely small population.

Irrespective of these concerns, it is clear that much of the consent area is of very high value for its indigenous biodiversity. The Crater Rim cliffs and other bluffs are identified as a nationally rare ecosystem type, and the core of the area is comprised of two scenic reserves which were set aside to protect their natural features and indigenous flora and fauna. At least three threatened and fifteen at risk plant and animal species are known to occur in the area or nearby. The NZCPS identifies several nationally important matters, which include four types of values which are all found in the consent area. This means that much of the consent area is nationally important for its indigenous biodiversity.

It is also clear that what is proposed to enable the re-opening of the Sumner Road will have severe effects on the indigenous biodiversity of the consent area, with benching of the Crater Rim cliffs being particularly destructive. Effects on other bluffs in the consent area are more difficult to assess, as detailed information about the amount of rock to be removed is unknown. Irrespective of this, it is likely that the effects on at least some of them and their associated indigenous biodiversity are likely to be severe.

In terms of the avoiding, remedying and mitigating hierarchy, none of the potentially significant effects on indigenous biodiversity are avoided as the methods proposed are focussed on road safety. While this is understandable to a degree, it is essential that a full range of other remediation options be scrutinised in detail to minimise damage to this nationally important area. Some adverse effects can be mitigated by ensuring particular actions are taken, e.g. hand erection of security fences, and cleaning vehicles and equipment to reduce weed risks, but this will not reduce the severity of the main effects i.e. benching and scaling.

In terms of indigenous biodiversity, there are only limited opportunities to remedy the effects of what is currently proposed. After decommissioning Haul Road A & the construction site will be rehabilitated, though it is unclear if this applies to Site Office B, the access track to Magazine B and the soil stockpiling area. For the cliffs, bluffs and their associated indigenous biodiversity, the losses and the damage that they will suffer cannot be remedied. That leaves mitigation for which there is only a limited range of options, e.g. surveying and monitoring key threatened species, weed control within the consent area, limited restoration planting west of BBSR, and perhaps replanting threatened plant species.

While it has not been explicitly suggested, the option of using a biodiversity offset to address residual adverse effects on indigenous biodiversity is inappropriate and cannot be considered. This is because the indigenous biodiversity affected is highly vulnerable or

irreplaceable and is not capable of being offset. For this reason, compensation is proposed to address residual adverse effects. This compensation should focus on protecting areas that would benefit the species and habitats most affected by residual adverse effects, e.g. through a Trust to achieve these ends.

## 7 Conclusions

- Much of the consent area is assessed as being nationally important for its indigenous biodiversity values.
- As it currently stands, the proposal to re-open the Sumner Road will have severe adverse effects on these values, primarily because of the destruction of the Crater Rim cliffs.
- Severe damage to other bluffs is also likely because of rock scaling.
- Some adverse effects will be long term or permanent e.g. the loss of habitats for geckos, specialised moths and plants.
- The scale of adverse effects will be greater than predicted if critically threatened plants occur in the consent area, which they may well do.
- Avoiding or reducing habitat damage is the most effective means of minimising indigenous biodiversity losses, and to this end other remediation options should be considered.
- Residual adverse effects should be compensated for by protecting (in other areas) the most affected species and habitats. This could be achieved by the formation of a Trust.

**References and bibliography**


Atkinson IAE 1985. Derivation of vegetation mapping units for an ecological survey of Tongariro National Park, North Island, New Zealand. *New Zealand Journal of Botany* 23: 361-378.

Aurecon New Zealand Ltd 2013. Sumner Road reopening project – methodology report. Aurecon New Zealand Ltd, Christchurch.

Aurecon New Zealand Ltd 2013. Sumner Road Stage 3 A & B concept design report. Aurecon New Zealand Ltd, Christchurch.

Couch R and Downey B 2012. Whaka Raupo reserve interim management plan review. Report prepared for Lyttelton Reserves Management Committee, January 2012, Lyttelton.

de Lange PJ, Rolfe JR, Champion PD, Courtney SP, Heenan PB, Barkla JW, Cameron EK, Norton DA and Hitchmough RA 2013. Conservation status of New Zealand indigenous vascular plants 2012. *New Zealand threat classification series 3.* Department of Conservation, Wellington.

Department of Conservation 2010. New Zealand National Coastal Policy Statement. Department of Conservation, Wellington.

Department of Conservation Herpetofauna Database (www.doc.govt.nz/nzherpatlas).

Environment Canterbury 2013. Canterbury Regional Policy Statement 2013. Environment Canterbury, Christchurch.

Hitchmough R, Anderson P, Barr B, Monks J, Lettink M, Reardon J, Tocher M and Whitaker T 2013. Conservation status of New Zealand reptiles, 2012. *New Zealand threat classification system series 2.* Department of Conservation, Wellington. 16 pp.

Johns PM 1986: Arthropods of Banks Peninsula Reserves. Report to Commissioner of Crown Lands, Christchurch. 114 pp.

Kelly GC 1972. Scenic Reserves of Canterbury: biological survey of reserves, report 2. Botany Division, Department of Scientific and Industrial Research. New Zealand.

Leathwick J, Morgan F, Wilson G, Rutledge D, McLeod M and Johnston K 2002. Land environments of New Zealand: a technical guide. Ministry for the Environment, Wellington.

Lettink M 2012. Lizard survey of Misty Peaks and Te Oka Regional Parks, Canterbury. Unpublished report produced for Christchurch City Council, Christchurch. 17 pp.

Lettink M 2013. Flora and fauna habitats on Banks Peninsula, Canterbury. Unpublished Report, Canterbury Regional Council, Christchurch. 40 pp.

Lettink M & Whitaker T 2004. Lizards of Banks Peninsula. Department of Conservation, Christchurch.

Ministry for the Environment 2007. Protecting our places. Information about the statement of national priorities for protecting rare and threatened native biodiversity on private land. Ministry for the Environment, Wellington.

Ministry for the Environment 2011. Proposed National Policy Statement on Indigenous Biodiversity. Ministry for the Environment, Wellington, New Zealand.

Pender R 1999. Three locally threatened plants. Unpublished report for Peter Skellerup Plant Conservation Scholarship.

Robertson HA, Dowding JE, Elliott GP, Hitchmough RA, Miskelly CM, O'Donnell CFJ, Powlesland RG, Sagar PM, Scofield RP & Taylor GA 2013. Conservation status of New Zealand birds, 2012. *New Zealand Threat Classification Series 4.* Department of Conservation, Wellington.

Stringer IA, Hitchmough RA, Dugdale JS, Hoare RJ and Patrick BH 2012. The conservation status of New Zealand Lepidoptera. *New Zealand Entomologist* 35(2): 120-127.

Walker S, Cieraad E, Grove P, Lloyd k, Myers S, Park T and Porteous T 2007. Guide for Users of the Threatened Environment Classification. (Version 1.1, August 2007). Landcare Research Limited.

Whitaker AH 2008. Conservation of lizards in Canterbury Conservancy. Department of Conservation, Canterbury Conservancy. Canterbury Series 0308.

Wildland Consultants 2013. Guidelines for the application of ecological significance criteria for indigenous vegetation and habitats of indigenous fauna in Canterbury. *Contract report no. 2289i*, for Environment Canterbury.

Wilson HD 1992. Banks ecological Region: Port Hills, Herbert and Akaroa Ecological Districts. *Protected Natural Areas Programme survey report No 21*. Department of Conservation, Christchurch.

Wilson HD 2009. Natural history of Banks Peninsula. Canterbury University Press, Christchurch.

Wilson HD 2013. Plant life on Banks Peninsula. Hugh Wilson, Hinewai Reserve, New Zealand. Manuka Press, Cromwell / The Caxton Press, Christchurch.

**Attachment 1. Plant species found in or near the consent area.**

| Common name | Plant species[1] | In consent area[2] | Main vegetation types[3] | Survey source[4] |
|---|---|---|---|---|
| Akiraho | *Olearia paniculata* | ✓ | R, S | MD |
| Annual fern | *Anogramma leptophylla* | | R | NH-MD |
| Banks Peninsula blue tussock | *Festuca actae* | ✓ | R, G | MD |
| Banks Peninsula button daisy | *Leptinella minor* | ✓ | R | MD |
| Banks Peninsula forget-me-not | *Myosotis lytteltonensis* | ✓ | R | PENDER |
| Banks Peninsula hebe | *Hebe strictissima* | ✓ | R | MD |
| Banks Peninsula sun hebe | *Heliohebe lavaudiana* | ✓ | R | MD |
| Barley grass | *Hordeum murinum** | ✓ | G | MD |
| Beaked parsley | *Anthriscus caucalis** | ✓ | G, R | MD |
| Biddibid | *Acaena anserinifolia* | ✓ | G | MD |
| Biddibid | *Acaena novae-zelandiae* | ✓ | G | MD |
| Bittercress | *Cardamine* aff. *debilis* | ✓ | R | MD |
| Blue tussock | *Poa colensoi* | ✓ | R, G | MD |
| Boneseed | *Chrysanthemoides monilifera** | ✓ | G, R, S | MD |
| Bracken | *Pteridium esculentum* | ✓ | G, R, S | MD |
| Bristle tussock | *Rytidosperma corinum* | ✓ | R, G | MD |
| Broadleaf | *Griselinia littoralis* | ✓ | S, F, R | MD |
| Broom | *Cytisus scoparius** | ✓ | G, R, S | MD |
| Bush flax | *Astelia fragrans* | | F, S | NH-MD |
| Bush lawyer | *Rubus cissoides* | ✓ | R, S, F | MD |
| Bush lawyer | *Rubus schmidelioides* | ✓ | R, S | MD |
| Cabbage tree | *Cordyline australis* | ✓ | S, F, G | KELLY |
| Californian thistle | *Cirsium arvense** | ✓ | G, R | MD |
| Catchfly | *Silene gallica** | ✓ | G, R | MD |
| Catsear | *Hypochoeris radicata** | ✓ | G, R | MD |
| Chewing's fescue | *Festuca rubra** | ✓ | G | MD |
| Cleavers | *Galium aparine** | ✓ | G, S, F | MD |
| Climbing aniseed | *Scandia geniculata* | ✓ | G, S | MD |

| | | | | |
|---|---|---|---|---|
| Climbing fuchsia | *Fuchsia perscandens* | ✓ | G, S, R | MD |
| Cocksfoot | *Dactylis glomerata** | ✓ | G, R | MD |
| Comb fern | *Notogrammitis heterophylla* | ✓ | R, S, F | MD |
| Common broom | *Carmichaelia australis* | ✓ | G, R, S | MD |
| Common polyplody | *Polypodium vulgare** | ✓ | R, S, F, G | MD |
| Cotton fireweed | *Senecio quadridentatus* | ✓ | G, R | MD |
| Creeping willowherb | *Epilobium nummulariifolium* | ✓ | R | MD |
| Cudweed | *Euchiton traversii* | | G, R | NH-MD |
| Dwarf button daisy | *Leptinella nana* | | R | NH-MD |
| Dwarf stonecrop | *Crassula sieberiana* | ✓ | R, G | MD |
| Easter orchid | *Earina autumnalis* | | R | NH-MD |
| Elderberry | *Sambucus nigra** | ✓ | G, S, F | MD |
| Elfin bindweed | *Convolvulus waitaha* | ✓ | G, R | MD |
| Fennel | *Foeniculum vulgare** | ✓ | R, G | MD |
| Fireweed | *Senecio glomeratus* | ✓ | G, R | MD |
| Fireweed | *Senecio minimus?* | | G, R | NH-MD |
| Five finger | *Pseudopanax arboreus* | ✓ | F, S, R | MD |
| Flowering currant | *Ribes sanguineum** | ✓ | G, S, F | MD |
| Foxglove | *Digitalis purpurea** | ✓ | G, R | MD |
| Fragrant tree daisy | *Olearia fragrantissima* | ✓ | S, F | HW |
| Fuchsia | *Fuchsia excorticata* | ✓ | S, F | MD |
| German ivy | *Senecio mikanioides** | ✓ | F | MD |
| Gorse | *Ulex europaeus** | ✓ | G, R, S | MD |
| Green mistletoe | *Ileostylus micranthus* | ✓ | S | MD |
| Ground spleenwort | *Asplenium appendiculatum* | ✓ | R, S, F | MD |
| Hairy buttercup | *Ranunculus reflexus* | | F, S | NH-MD |
| Hairy vetch | *Vicia hirsuta** | ✓ | G, R | MD |
| Hanging spleenwort | *Asplenium flaccidum* | ✓ | F | KELLY |
| Harakeke | *Phormium tenax* | ✓ | R, G, S | MD |
| Hard shield fern | *Polystichum oculatum* | ✓ | R, S, F | MD |
| Harebell | *Wahlenbergia gracilis* | ✓ | R, G | MD |
| Hawksbeard | *Crepis capillaris** | ✓ | G, R | MD |

| | | | | |
|---|---|---|---|---|
| Hedge mustard | *Sisymbrium officinale** | ✓ | G, S | MD |
| Hen and chicken fern | *Asplenium gracillimum* | | R, S, F | NH-MD |
| Holy grass | *Hierochloe redolens* | | G, R | NH-MD |
| Hooked sedge | *Uncinia leptostachya* | ✓ | R, S, F | MD |
| Hooked sedge | *Uncinia uncinata*? | | R, S, F | NH-MD |
| Hounds tongue fern | *Microsorum pustulatum* | ✓ | R, S, F | MD |
| Kaikomako | *Pennantia corymbosa* | ✓ | S, F | MD |
| Kanuka | *Kunzea ericoides* | ✓ | S, F | MD |
| Karamu | *Coprosma lucida* | | S, R, F | NH-MD |
| Karamu | *Coprosma robusta* | ✓ | S, R, F | MD |
| Karo | *Pittosporum crassifolium** | ✓ | G, S | MD |
| Kawakawa | *Piper excelsum* | ✓ | S, R | MD |
| Kiokio | *Blechnum novae-zelandiae* | ✓ | R | MD |
| Kohuhu | *Pittosporum tenuifolium* | ✓ | S, F | MD |
| Korokio | *Corokia cotoneaster* | ✓ | G, S, R | HW |
| Kowhai | *Sophora microphylla* | ✓ | F, S | MD |
| Lance fern | *Blechnum chambersii* | | F, S | NH-MD |
| Leafless clematis | *Clematis afoliata* | | R, S | KELLY |
| Leafless lawyer | *Rubus squarrosus* | ✓ | R, G, S | MD |
| Leather leaf fern | *Pyrrosia eleagnifolia* | ✓ | R, S, F | MD |
| Lemonwood | *Pittosporum eugenioides* | ✓ | F | KELLY |
| Little hard fern | *Blechnum penna-marina* | ✓ | G, R, S, F | MD |
| Mahoe | *Melicytus ramiflorus* | ✓ | R, S, F, G | MD |
| Maidenhair fern | *Adiantum cunninghamii* | | F, R | NH-MD |
| Maidenhair spleenwort | *Asplenium hookerianum* | | F, S, R | NH-MD |
| Male fern | *Dryopteris filix-mas** | ✓ | G, S, F | MD |
| Marguerite | *Argyranthemum frutescens** | ✓ | | MD |
| Mat daisy | *Raoulia glabra* | | G, S, R | NH-MD |
| Matagouri | *Discaria toumatou* | ✓ | G, R, S | MD |
| Mikimiki | *Coprosma propinqua* | ✓ | S, G, R | MD |
| Miner's lettuce | *Claytonia perfoliata** | ✓ | S, F | MD |
| Mingimingi | *Leucopogon fasciculatus* | | R | NH-MD |

| | | | | |
|---|---|---|---|---|
| Mountain akeake | *Olearia avicenniifolia* | | R, S | NH-MD |
| Mountain flax | *Phormium cookianum* | ✓ | R, G | MD |
| Mouse-ear chickweed | *Cerastium fontanum** | ✓ | G, R, S | MD |
| Narrow leaved plantain | *Plantago lanceolata** | ✓ | G, R | MD |
| Narrow-leaved lacebark | *Hoheria angustifolia* | ✓ | S, F | MD |
| Native bindweed | *Calystegia tuguriorum* | ✓ | G, S, R | MD |
| Native chickweed | *Stellaria decipiens* | ✓ | S, F, R | KELLY |
| Native cranesbill | *Geranium brevicaule* | ✓ | R, G | MD |
| Native iris | *Libertia ixioides* | ✓ | R, S | MD |
| Native jasmine | *Parsonsia capsularis* | ✓ | S, F | KELLY |
| Native jasmine | *Parsonsia heterophylla* | ✓ | S, F | MD |
| Native passion vine | *Passiflora tetrandra* | ✓ | S, F | HW |
| Native spinach | *Tetragonia implexicoma* | ✓ | G, S, R | MD |
| Necklace fern | *Asplenium flabellifolium* | ✓ | R, S, F | MD |
| Needle grass | *Austrostipa nodosa** | ✓ | G, R | MD |
| Ngaio | *Myoporum laetum* | ✓ | G, S, F | MD |
| Niniao | *Helichrysum lanceolatum* | ✓ | G, S, R | MD |
| Ongaonga | *Urtica ferox* | ✓ | G, R, S, F | MD |
| Onion orchid | *Microtis uniflora* | ✓ | G, R | MD |
| Patotara | *Leucopogon fraseri* | ✓ | G, R | MD |
| Pig's ear | *Cotyledon orbiculata** | ✓ | R, G | MD |
| Pigeon wood | *Hedycarya arborea* | ✓ | S, F | MD |
| Plume grass | *Dichelachne crinita* | ✓ | R | MD |
| Poataniwha | *Melicope simplex* | ✓ | S, F | MD |
| Pohuehue | *Muehlenbeckia australis* | ✓ | S, F | MD |
| Porcupine shrub | *Melicytus alpinus* | ✓ | R, G, S | MD |
| Poroporo | *Solanum laciniatum* | ✓ | G, S | MD |
| Prairie grass | *Bromus willdendowii** | ✓ | G | MD |
| Prickly mingimingi | *Leptecophylla juniperina* | | R | NH-MD |
| Prickly shield fern | *Polystichum vestitum* | ✓ | R, S, F | MD |
| Pride of Madeira | *Echium candicans** | ✓ | G, R | MD |
| Prostrate kowhai | *Sophora prostrata* | ✓ | R, G | MD |

| | | | | |
|---|---|---|---|---|
| Puha | *Sonchus oleraceus** | ✓ | G, R | MD |
| Purple fuzzweed | *Vittadinia gracilis** | ✓ | R, G | MD |
| Rangiora | *Brachyglottis repanda** | ✓ | G, S | MD |
| Rauhuia | *Linum monogynum* | ✓ | R | MD |
| Red mapou | *Myrsine australis* | ✓ | S, F, R | MD |
| Red wood rush | *Luzula rufa* | ✓ | R, G | MD |
| Ribbonwood | *Plagianthus regius* | ✓ | S, F | MD |
| Ripgut brome | *Bromus diandrus** | ✓ | G | MD |
| Rock fern | *Cheilanthes sieberi* | ✓ | R | MD |
| Rohutu | *Lophomyrtus obcordata* | ✓ | S, F | KELLY |
| Ryegrass | *Lolium perenne** | ✓ | G, R | MD |
| Scrambling fumitory | *Fumaria muralis** | ✓ | G, R | MD |
| Scrub pohuehue | *Muehlenbeckia complexa* | ✓ | G, F, S | MD |
| Sheep's sorrel | *Rumex acetosella** | ✓ | G, R | MD |
| Shining spleenwort | *Asplenium oblongifolium* | ✓ | R, S, F | MD |
| Shore spleenwort | *Asplenium obtusatum* | ✓ | R | MD |
| Silver tussock | *Poa cita* | ✓ | G, R | MD |
| Silvery hair grass | *Aira caryophyllea** | ✓ | G, R | MD |
| Slender everlasting daisy | *Helichrysum filicaule* | ✓ | R, G | MD |
| Small kiokio | *Blechnum procerum* | ✓ | S, F | MD |
| Small-leaved cranesbill | *Geranium microphyllum* | ✓ | G, S, F, R | KELLY |
| Small-leaved milk tree | *Streblus heterophyllus* | | S, F | HW |
| Soft brome | *Bromus hordeaceus** | ✓ | G, R | MD |
| South American barberry | *Berberis darwinii** | | S, F | NH-MD |
| Spaniard | *Aciphylla subflabellata* | ✓ | G | MD |
| Spindleberry | *Euonymus europaeus** | ✓ | G, S, R | MD |
| Spur valerian | *Centranthus ruber** | ✓ | G, R | MD |
| Squirrel-tail fescue | *Vulpia bromoides** | ✓ | G, R | MD |
| Stonecrop | *Sedum acre** | ✓ | R | MD |
| Suckling clover | *Trifolium dubium** | ✓ | G, R | MD |
| Sweet brier | *Rosa rubiginosa** | ✓ | G | MD |
| Sweet vernal | *Anthoxanthum odoratum** | ✓ | G, R, S | MD |

| | | | | |
|---|---|---|---|---|
| Taupata | *Coprosma repens** | ✓ | G, S | MD |
| Toatoa | *Haloragis erecta* | ✓ | R, S | MD |
| Toetoe | *Austroderia richardii* | ✓ | G | MD |
| Tree lupin | *Lupinus arboreus** | ✓ | G, S | MD |
| Tree tutu | *Coriaria arborea* | ✓ | F | KELLY |
| Variegated thistle | *Silybum marianum** | ✓ | G | MD |
| Velvety nightshade | *Solanum chenopodioides** | ✓ | G, R, S | MD |
| Vetch | *Vicia sativa** | ✓ | G, R | MD |
| Wall flower | *Erysimum cheiri** | ✓ | G, R | MD |
| Weak poa | *Poa imbecilla* | | F, S | NH-MD |
| Weeping mapou | *Myrsine divaricata* | ✓ | S, F | KELLY |
| White clover | *Trifolium repens** | ✓ | G, R | MD |
| White flowering rata | *Metrosideros diffusa* | ✓ | R | MD |
| White fuzzweed | *Vittadinia australis* | ✓ | R, G | MD |
| White stonecrop | *Sedum album** | ✓ | R | MD |
| White sun orchid | *Thelymitra longifolia* | ✓ | G, R | MD |
| Wind grass | *Lachnagrostis pilosa* | | R | NH-MD |
| Wire moss | *Polytrichum juniperinum* | ✓ | G, R | MD |
| Woolly cudweed | *Pseudognaphalium luteoalbum* | | R | NH-MD |
| Yarrow | *Achillea millefolium** | ✓ | G | MD |
| Yellow clematis | *Clematis foetida* | ✓ | S, F | MD |
| Yellow oxalis | *Oxalis exilis* | ✓ | G, R | MD |
| Yellow rock daisy | *Brachyglottis lagopus* | ✓ | R, G | MD |
| Yellow rock groundsel | *Senecio glaucophyllus* subsp. *basinudus* | ✓ | R | MD |
| Yellow wood | *Coprosma linariifolia* | | S, R | NH-MD |
| Yorkshire fog | *Holcus lanatus** | ✓ | G, S | MD |
| | *Asplenium appendiculatum* x *A. flaccidum* | | R | NH-MD |
| | *Asplenium trichomanes* | ✓ | R | MD |
| | *Australina pusilla* | | F, S | NH-MD |
| | *Blechnum fluviatile* | | F, S | NH-MD |
| | *Brachyscome radicata* | | G, R | NH-MD |
| | *Celmisia gracilenta* | ✓ | G, R | MD |

| | | | | |
|---|---|---|---|---|
| | *Coprosma crassifolia* | ✓ | S, R | MD |
| | *Coprosma dumosa* | ✓ | S, R | MD |
| | *Coprosma rhamnoides* | | S, R | NH-MD |
| | *Coprosma rigida* | ✓ | S, F | KELLY |
| | *Coprosma robusta* x *C. propinqua* | ✓ | S, R | HW |
| | *Coprosma rotundifolia* | ✓ | S, F | MD |
| | *Coprosma rubra* | ✓ | S, F | KELLY |
| | *Coprosma virescens* | ✓ | G, S, R | MD |
| | *Coprosma wallii* | | S | NH-MD |
| | *Dichondra repens* | ✓ | G, R | MD |
| | *Einadia allanii* | ✓ | G, S, R | MD |
| | *Einadia triandra* | ✓ | S, R | MD |
| | *Epilobium* sp. | | R | NH-MD |
| | *Euchiton* sp.small | | R | NH-MD |
| | *Fuchsia excorticata* x *F. perscandens* | ✓ | G, S, F | MD |
| | *Galium propinquum* | | G, R | NH-MD |
| | *Hebe speciosa** x *H. strictissima* ? | ✓ | R, G | MD |
| | *Hydrocotyle microphylla* | | G, R | NH-MD |
| | *Hydrocotyle moschata* | ✓ | G, R | MD |
| | *Hypolepis ambigua* | ✓ | G, S | MD |
| | *Lagenifera pumila* | ✓ | S, G | KELLY |
| | Lichens | ✓ | R | MD |
| | Liverworts | ✓ | R | MD |
| | *Luzula banksiana* var. *orina* | ✓ | R, G | MD |
| | Mosses | ✓ | G, R, S, F | MD |
| | *Prumnopitys taxifolia* | ✓ | F | KELLY |
| | *Raoulia monroi* | ✓ | R, G | MD |
| | *Rytidosperma caespitosum*?* | ✓ | G, R | HW |
| | *Rytidosperma clavatum* | ✓ | G, R | HW |
| | *Rytidosperma racemosum*?* | | G, R | NH-MD |
| | *Rytidosperma* sp. | | R | NH-MD |
| | *Rytidosperma unarede* | ✓ | G, R | HW |

**Explanatory notes:**

[1] Lichens, mosses and liverworts are not identified to species level, but included in plant species column as three separate groups.

[2] A tick denotes the species is known to be in the consent area as a result of this survey or records from a previous field survey, e.g. Hugh Wilson's field cards. Where a tick is absent, it indicates that species is present in adjoining similar habitats and may therefore occur in the consent area, e.g. Hugh Wilson's field cards, a survey of Gollans Bay quarry and Mt Cavendish Scenic Reserve by Nick Head and Mark Davis. Only those species not recorded in the consent area have been included in this manner.

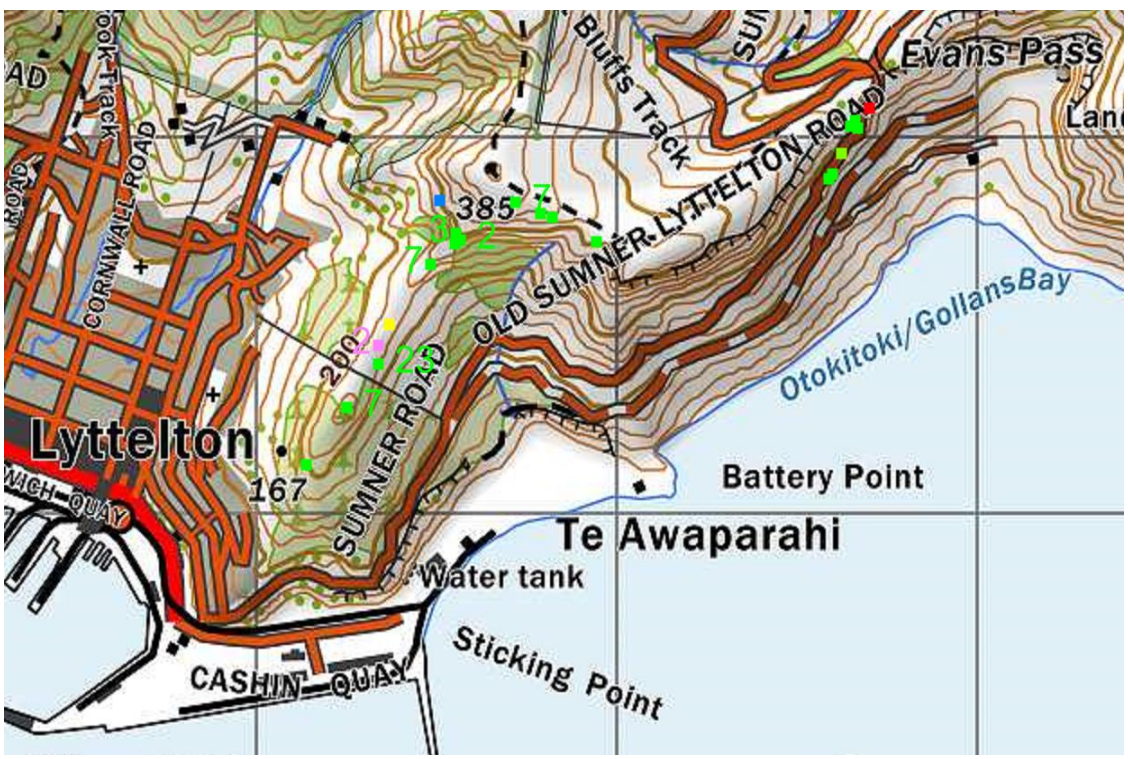
[3] The vegetation types are based on the structural classes of Atkinson (1985). Shrublands and scrub have been combined because the main area of shrubland and scrub in Buckleys Bay Scenic Reserve could not be visited and thus they could not be distinguished. Rock outcrops and bluffs should technically be described as lichenfield if they have 20-100% lichen cover, but because some road cutting bluffs do not reach this threshold and other bluffs could not be visited, a general term is used for simplicity. The types are defined as follows:

- Grassland (G) – the cover of grass in the canopy is 20-80%, and the grass cover exceeds that of any other growth form or bare ground.
- Shrubland and scrub (S) – these are combined as explained above. Scrub is otherwise where the cover of shrubs and trees in the canopy is > 80%, and shrub cover exceeds that of trees.
- Forest (F) – the cover of trees and shrubs in the canopy is > 80%, and tree cover exceeds that of shrubs.
- Rock outcrops and bluffs – denoted by rock (R), as explained above.

[4] Source of survey information - either Mark Davis survey of consent area, Nick Head/Mark Davis survey of adjacent land, Wilson (1992), Hugh Wilson's field cards or Kelly's Scenic Reserves of Canterbury.

**Attachment 2. Lizard photos and location map.**

Lizard species found in or near the consent area and their locations: Canterbury gecko (top left; green symbols), jewelled gecko (top right; blue symbol), common skink clade 5 (bottom left; red symbol) and McCann's skink (bottom right; yellow symbol). The pink symbol denotes unidentified skinks. Unless stated otherwise, locations on the map refer to observations of single individuals.



**Attachment 3. Invertebrates in the consent area.**

| Order, family, genus or species | Common name | Ecology or host plant | Conservation status |
|---|---|---|---|
| | | | |
| **Orthoptera** | | | |
| **Family Acrididae** | short-horned grasshoppers | | |
| *Sigaus campestris* | grasshopper | adults seen feeding on prostrate kowhai | locally common |
| *Locusta migratoria* | locust | dry ridges of Port Hills | locally common |
| | | | |
| **Family Gryllidae** | crickets | | |
| *Pteronemobius bigelowi* | field cricket | dry grassland | locally common |
| | | | |
| **Family Tettigoniidae** | katydids | | |
| *Conocephalus bilineatus* | grassland katydid | dry grassland | locally common |
| | | | |
| **Neuroptera** | lacewings | | |
| **Family Hemerobiidae** | | | |
| **Micromus tasmaniae* | Tasmanian lacewing | introduced predator | common |
| **Drepanacra binocular* | | introduced predator | common |
| | | | |
| **Hemiptera** | | | |
| **Family Tibicinidae** | cicadas | | |
| *Amphipsalta strepitans* | rock clapping cicada | rocky areas | locally uncommon |
| | | | |
| **Lepidoptera** | | | |
| **Family Nepticulidae** | leaf miners | | |
| *Stigmella erechtitus* | | larvae mine *Senecio* leaves | common |
| | | | |

| | | | |
|---|---|---|---|
| **Family Psychidae** | casemoths | | |
| *Scoriodyta sereinae* | | larvae on algae on rock faces | local on Port Hills |
| | | | |
| **Family Glyphipterigidae** | sedge moths | | |
| *Glyphipterix achlyoessa* | | larvae mine grass stems | common |
| *Glyphipterix oxymachaera* | | Type Locality is Port Hills | locally common |
| | | larvae mining silver tussock | |
| | | | |
| **Family Scythrididae** | | | |
| *Scythris epistrota* | | Type Locality is Port Hills | local on Port Hills |
| | | larvae on common broom | |
| | | | |
| **Family Gelechiidae** | | | |
| *Kiwaia brontophora* | | Type Locality Port Hills | locally common |
| | | larvae on moss *Grimmia pulvinata* | |
| *Athrips zophochalca* | | larvae on common broom | local on Port Hills |
| | | | |
| **Family Oecophoridae** | litter feeding moths | | |
| *Gymnobathra parca* | | larvae on leaf litter | common |
| *Leptocroca scholaea* | | larvae on freshly dead vegetation | common |
| *Leptocroca lindsayi* | | larvae on freshly dead vegetation | common |
| *Leptocroca* species (small) | | larvae on freshly dead vegetation | common |
| *Izatha convulsella* | | larvae on lichens on tree trunks | common |
| *Izatha huttonii* | | larvae in dead wood | common |
| *Tingena chloradelpha* | | larvae on leaf litter | common |
| *Tingena macarella* | | Type Locality is Port Hills | common |
| | | larvae on leaf litter | |
| *Trachypepla omphalota* | | day-flying; larvae on litter | common |

| | | | |
|---|---|---|---|
| **Family Tineidae** | detritus moths | | |
| *Sagephora phortegella* | | larvae on dead wood | common |
| | | | |
| **Family Elachistidae** | grass leaf miners | | |
| *Cosmiotes ombrodoca* | | larvae leaf mine grasses | common |
| | | | |
| **Family Lyonetiidae** | | | |
| *Bedellia psamminella* | | Type Locality is Port Hills | common |
| | | larvae mine *Calystegia* and *Convolvulus* | |
| | | | |
| **Family Plutellidae** | | | |
| *Plutella antiphona* | diamond back moth | larvae on *Cardamine* | common |
| *Orthenches chlorocoma* | | Type locality Christchurch | locally uncommon |
| | | larvae on common broom | |
| | | | |
| **Family Tortricidae** | | | |
| **Crocidosema plebejana* | | introduced species | common |
| **Epiphyas postvittana* | | larvae polyphagous on herbs | common |
| *Harmologa amplexana* | | larvae polyphagous on shrubs | common |
| | | | |
| **Family Pyralidae** | | | |
| *Patagoniodes farinaria* | | larvae on *Senecio* species | common |
| | | | |
| **Family Pterophoridae** | plume moths | | |
| *Aciptilia innotatalis* | | larvae on *Dichondra* species | locally common |
| | | | |
| **Family Crambidae** | moss, lichen and grass moths | | |

| | | | |
|---|---|---|---|
| *Deana hybreasalis* | | polyphagous larvae on lianes and herbs | common |
| *Eudonia aspidota* | | larvae on moss on rock faces | local |
| *Eudonia manganeutis* | | larvae on *Grimmia (moss)* on rock faces | locally common |
| *Eudonia oculata* | | | local |
| *Eudonia steropaea* | | larvae on moss on rock faces | local |
| *Eudonia sabulosella* | | larvae in soil in grassland | common |
| *Glaucocharis elaina* | | larvae on *Grimmia (moss)* on rock faces | locally common |
| *Glaucocharis lepidella* | | larvae on moss | common |
| *Gadira acerella* | | larvae on moss on rock faces | common |
| *Gadira petraula* | | Type Locality is Lyttelton, on hills | At risk: naturally uncommon, but |
| | | larvae on lichens on rock faces | locally common here |
| *Orocrambus flexuosellus* | | larvae on grasses | common |
| *Orocrambus vittellus* | | larvae on grasses | common |
| *Scoparia halopis* | | larvae in soil on roots? | common |
| *Scoparia exilis* | | open grassy area | common |
| *Udea flavidalis* | | polyphagous on herbs and lianes | common |
| *Uresiphita maorialis* | kowhai moth | larvae on kowhai foliage; day-flying adults | common |
| | | | |
| **Family Geometridae** | looper moths | | |
| *Declana egregia* | South Island zebra moth | larvae on *Pseudopanax* | locally common |
| *Dichromodes cynica* | | larvae on rock face lichens | local endemic - common |
| | | Type Locality Lyttelton | |
| *Helastia mutabilis* | | larvae on mosses on rock faces | locally uncommon |
| *Helastia cinerearia* | | larvae on mosses on rock faces | common |
| *Helastia corcularia* | | Type Locality is Christchurch | common |
| | | larvae on mosses and herbs | |
| *Homodotis megaspilata* | | larvae on leaf litter often of *Coprosma* | common |
| *"Hydriomena" deltoidata* | | larvae on *Plantago* | common |

| | | | |
|---|---|---|---|
| *Pseudocoremia ampla* | | larvae on *Olearia* species | locally common |
| | | | |
| **Family Noctuidae** | | | |
| *Agrotis ipsilon* | greasy cutworm | polyphagous larvae on herbs | common |
| *Aletia inconstans* | | larvae on grasses | locally common |
| *Bityla defigurata* | | larvae on *Muehlenbeckia* species | common |
| *Dipaustica epiastra* | | larvae on *Austroderia* | common |
| *Feredayia graminosa* | mahoe cutworm | larvae on porcupine shrub | common |
| *Graphania insignis* | | larvae on herbs | common |
| *Graphania mutans* | | larvae on herbs | common |
| *Graphania omoplaca* | | larvae on grasses | common |
| *Graphania phricias* | matagouri cutworm | Type Locality is Christchurch | common |
| | | larvae on matagouri | |
| *Graphania ustistriga* | | larvae arboreal on shrubs | common |
| *Proteuxoa comma* | | larvae on grasses and herbs | common |
| *Tmetolophota arotis* | | larvae on sedges | common |
| *Tmetolophota steropastis* | flax cutworm | Type locality is Christchurch | common |
| | | larvae on flax species | |
| *Tmetolophota unica* | | larvae on grasses | common |
| | | | |
| **Family Nymphalidae** | | | |
| *Vanessa itea* | yellow admiral butterfly | larvae on nettles (*Urtica*) | common |
| *Vanessa gonerilla* | red admiral butterfly | larvae on ongaonga (*Urtica ferox*) | common |
| *Danaus plexippus* | monarch butterfly | larvae on introduced milkweed | common |
| | | | |
| **Family Lycaenidae** | | | |
| *Lycaena* new species | common copper butterfly | larvae on scrub pohuehue | common |
| | | | |

| | | | |
|---|---|---|---|
| **Family Pieridae** | | | |
| **Pieris rapae* | white butterfly | larvae on introduced crucifers | locally common |
| | | | |
| **Coleoptera** | | | |
| **Family Byrrhidae** | | | |
| Species | | rock bluffs by night | |
| | | | |
| **Family Scarabaeidae** | chafer beetles | | |
| *Odontria* species | | larvae subterranean on roots | common |
| *Costelytra* species | | larvae subterranean on roots | common |
| | | | |
| **Family Brentidae** | giraffe weevils | | |
| *Rhadinosomus acuminatus* | | feed on *Haloragis erecta* | locally common |
| | | | |
| **Hymenoptera** | | | |
| **Family Pompilidae** | spider hunting wasps | | |
| *Priocnemis monachus* | | larvae feed on spiders in subterranean holes | locally common |
| | | | |
| **Mollusca** | | | |
| Slug | | medium-sized native slug on bluffs by night | |

**Explanatory notes**

An asterix denotes that an invertebrate is exotic.

**Attachment 4: Significance definition and criteria.**

## 1 Banks Peninsula District Plan definition of significant indigenous vegetation

Means indigenous (native) trees, forest, scrub, tussock grassland, coastal vegetation, wetland and saltmarsh and other indigenous vegetation in any of the following forms:

a) Indigenous trees, forest and scrub:

- Any old-growth podocarp/hardwood forest or beech forest which contains *Dacrycarpus dacrydioides* (kahikatea), *Podocarpus totara* (totara), *P hallii* (totara) *Prumnopitys taxifolia* (matai), *Prumnopitys ferruginea* (miro), *Libocedru bidwillii* or *Nothofagus* spp trees; or any mature individual trees of these species.
- A contiguous area of 0.5ha or more of regenerating podocarp/hardwood forest or beech forest or mixed hardwood forest dominated by native trees e.g. *Melicytus ramiflorus* (mahoe), *Pseudopanax arboreus* (fivefinger), *Pittosporum eugenioides* (lemonwood), *Fuchsia excorticate* (fuchsia), *Hoheria angustifolia* (lacebark), *Plagianthus regius* (ribbonwood), *Pennantia corymbosa* (kaikomako), *Sophora microphylla* (kowhai), *Hedycarya arborea* (pigeonwood), *Myoporum laetum* (ngaio).
- Mature and regenerating kanuka forest (*Kunzea ericoides*) in the Port Hill Ecological District with any individual kanuka plant more than 4m tall and occupying a contiguous area of 0.25 hectares or more.[57]
- Mature and regenerating kanuka forest (*Kunzea ericoides*) in Herbert, Akaroa or Ellesmere Ecological Districts, with any individual kanuka plant more than 6m tall and occupying a contiguous area of 0.5 hectares or more.
- Lower altitude mixed scrub – contiguous area of 0.5ha or more in which mature specimens of any of the following genera: Olearia, Hebe, Pseudopanax, Fuchsia, Griselinia, *Pseudowintera* and *Coprosma* form the dominant cover.
- Subalpine mixed scrub with generally continuous canopy of native species in which mature specimens of any of the following genera: *Dracophyllum, Olearia, Hebe*, form the dominant cover.
- Lower altitude small-leaved shrubland dominated by small-leaved Coprosma species, *Muehlenheckia complexa, Helichrysum lanceolatum, Melicytus alpinus, Carmichaella australis* and/or *Discaria toumatou* (matagouri) occupying a contiguous area of 0.1 hectares or more and where canopy cover of all native shrub species exceeds 15%.
- Communities of boulder fields, bluffs and talus slopes (i.e. rock), that have rock cover that is over 40% and 30% or more indigenous vegetation cover that is made up of mosses and lichens and/or any of the following species: *Sophora prostrate, Podocarpus hallii, Phormium tenax, P cookianum, Carmichaelia australis, Muehlenbeckia complexa, Melicytus alpinus, Corokia cotoneaster, Fuchsia excorticata, F perscandens, F excorticate X perscandens, Hebe strictissima, H salicifolia, Coprosma spp.*
- Mixture of significant indigenous vegetation types described above, occupying an area of 0.5ha or more.[58]

b) Indigenous tussock grassland

- Tall tussockland and/or tall tussock shrubland in which native snow tussock (Chionochloa) and/or Dracophyllum accounts for 15%.[59]
- A contiguous area of short tussockland in which native fescue/hard tussock (Festuca novae-zelandiae) and native inter-tussock species accounts for 20% or more of canopy cover.[60]
- A contiguous area of over 1.0 hectare of short tussockland in which native silver tussock (P*oa cita*) and native inter-tussock species account for 30% or more of canopy cover.

c) Indigenous coastal vegetation

- Coastal dunes, interdunes, and foreshore communities, including those with *Desmoschoenus spirals* (pingao)
- Coastal shrubland communities, such as those at Okains Bay, Lake Forsyth/Wairewa, Birdlings Flat and on the Kaitorete Barrier/Spit, and those providing habitat and the yellow-eyed penguin.

d) Indigenous wetland vegetation

- Naturally occurring freshwater marsh, fen, swamp, flush and aquatic vegetation, including closely associated riparian vegetation, in which native species of the following genera are present: *Typha* (raupo), *Cortaderia* (toetoe), *Phormium* (flax), *Carex* (sedges), *Eleocharis* (spike rush), *Potamogeton* (pond weed), *Sphagnum* (sphagnum moss), *Isolepis, Schoenus.*
- Saltmarsh vegetation in which any of the following native species are present: *Zostera* (seagrass), *Plagianthus divaricatus* (saltmarsh ribbonwood), *Juncus kraussii* (sea rush), *Apodasmia similis* (jointed rush), *Selliera radicans*, *Samolus repens* (sea primose), *Sarcocornia quinqueflora* (glasswort), *Mimulus repens* (native musk), *Puccinellia distans* (saltmarsh grass), *Schoenoplectus spp*

e) Threatened indigenous plant species

- An area of vegetation which provides a habitat of threatened indigenous plant species found within the Banks Peninsula District as listed in Appendix III or the latest version of the national threatened species listing.

## 2 Banks Peninsula District Plan Significance Criteria

The criteria will be applied at the Ecological District scale in a way that recognises that the majority of ecosystems on the Banks Peninsula are secondary and/or induced. The importance of the 'commonplace' is central to recognising the full range of biodiversity values[14]. The criteria should include but not necessarily be limited to:

1 The ecological values of an area or group of areas- the values of the places themselves.

- *Representativeness* - Supporting indigenous vegetation, habitats, physical features[15] or ecological processes which are typical of their ecological district, including the commonplace.
- *Rarity* - Supporting, or important for the recovery of, an indigenous species, habitat, physical feature, or community of species which is threatened nationally or is rare at a local level (i.e. within the Ecological District).
- *Distinctiveness*[16] - The type and range of unusual features of the area itself including:
  - presence of indigenous species at their distribution limit
  - levels of endemism (e.g. the presence of endemic species)
  - the type locality for a plant or animal
  - the occurrence of relict distributions
  - physical features (which provide atypical habitat)

2 The *ecological context* of the area or a group of areas including the relationship with their surroundings. This recognises that ecological processes affecting indigenous ecosystems extend beyond their obvious physical boundaries, e.g. hydrology, pollination and dispersal.

- Size, shape, buffering connectivity and linkages. The extent to which an area has ecological value due to its configuration, location and ecological functioning in relation to its surroundings.[17]

## 3 Canterbury Regional Policy Statement Significance Criteria

*Representativeness*

1. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.
2. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.

*Rarity/Distinctiveness*

3. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.
4. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.
5. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.
6. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.

*Diversity and Pattern*

7. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.

*Ecological Context*

8. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.
9. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.
10. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.

**Attachment 5: Statutory and non-statutory policies.**

**New Zealand Coastal Policy Statement**

*Objective 1:*

*To safeguard the integrity, form, functioning and resilience of the coastal environment and sustain its ecosystems, including marine and intertidal areas, estuaries, dunes and land, by:*

- *maintaining or enhancing natural biological and physical processes in the coastal environment and recognising their dynamic, complex and interdependent nature;*
- *protecting representative or significant natural ecosystems and sites of biological importance and maintaining the diversity of New Zealand's indigenous coastal flora and fauna;*

*Policy 11 – Indigenous biological diversity:*

*To protect indigenous biological diversity in the coastal environment:*

*a .avoid adverse effects of activities on:*

*i. indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists;*

*ii. taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened;*

*iii. indigenous ecosystems and vegetation types that are threatened in the coastal environment, or are naturally rare;*

*iv. habitats of indigenous species where the species are at the limit of their natural range, or are naturally rare;*

*v. areas containing nationally significant examples of indigenous community types; and*

*vi. areas set aside for full or partial protection of indigenous biological diversity under other legislation; and*

*b. avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on:*

*i. areas of predominantly indigenous vegetation in the coastal environment;*

*ii. habitats in the coastal environment that are important during the vulnerable life stages of indigenous species;*

*iii. indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh;*

*iv .habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes;*

*v .habitats, including areas and routes, important to migratory species; and*

*vi. ecological corridors, and areas important for linking or maintaining biological values identified under this policy.*

**Proposed NPS on indigenous biodiversity**

*Objective:*

*To promote the maintenance of indigenous biological diversity by protecting areas of significant indigenous vegetation and significant habitats of indigenous fauna, and to encourage protection and enhancement of biodiversity values more broadly while:*

- *supporting best practice of local authorities*
- *recognising the positive contribution of landowners as guardians/kaitiaki of their land*
- *recognising that the economic, social and cultural well-being of people and communities depends on, amongst other things, making reasonable use of land.*

*Policy 1*

*For the purpose of this national policy statement, an area of significant indigenous vegetation or a significant habitat of indigenous fauna is an area or habitat whose protection is important for the maintenance of indigenous biological diversity.*

*Policy 2*

*In considering the effects of any matter, local authorities shall, in addition to any area of significant indigenous vegetation or a significant habitat of indigenous fauna identified in, or by, provisions of any relevant regional policy statement, or regional or district plan, regard the following as significant indigenous vegetation or significant habitat of indigenous fauna:*
*a. the naturally uncommon ecosystem types listed in Schedule One*
*b. indigenous vegetation or habitats associated with sand dunes*
*c. indigenous vegetation or habitats associated with wetlands*
*d. land environments, defined by Land Environments of New Zealand at Level IV (2003), that have 20 per cent or less remaining in indigenous vegetation cover*
*e. habitats of threatened and at risk species.*

*Policy 5*

*In addition to the inclusion in plans of any other provisions that the plan has or is required to have relating to section 6(c) of the Act, local authorities must manage the effects of activities through district and relevant regional plans (or be satisfied that the effects are managed by methods outside of district or regional plans) to ensure 'no net loss' of biodiversity of areas of significant indigenous vegetation and significant habitats of indigenous fauna by:*
*a. avoiding adverse effects*
*b. where adverse effects cannot be avoided, ensuring remediation*
*c. where adverse effects cannot be remedied, ensuring mitigation*
*d. where adverse effects cannot be adequately mitigated, ensuring any residual adverse effects that are more than minor, are offset in accordance with the principles set out in Schedule 2.*

*For the avoidance of doubt, in accordance with the principles of Schedule 2, there are limits to what can be offset because some vegetation or habitat and associated ecosystems, is vulnerable or irreplaceable. In such circumstances off-setting will not be possible and local authorities will need to take full account of residual adverse effects in decision-making processes.*

***Policy 6***

*To promote the maintenance of biodiversity outside of identified areas of significant indigenous vegetation and significant habitats of indigenous fauna, and to support the resilience and viability of populations and species assemblages within identified areas and habitats, decision-makers should:*

*a. recognise the contribution that all remaining areas of indigenous vegetation make to the maintenance of indigenous biodiversity and encourage the retention of as many elements as possible*

*b. recognise the full range of potential adverse effects on indigenous biodiversity including, but not limited to, population fragmentation, degradation of non-living components (eg, water and soil), interruption to breeding cycles and migratory pathways, and increased exposure to invasive introduced plant and animal species that pose a threat to indigenous biodiversity.*

*c. encourage the retention of existing vegetation, whether indigenous or not (but not including recognised pest plants), that provides:*

*i. habitat for indigenous species*
*ii. seasonal food sources for indigenous species*
*iii. ecological linkage between areas and habitats identified in accordance with Policy 4*
*iv. a buffer to indigenous vegetation for areas and habitats identified in accordance with Policy 4*

*d. when the retention of existing vegetation and habitat will not achieve sustainable management, encourage measures that mitigate and offset adverse effects on indigenous species during, and subsequent to, removal or modification of that vegetation or habitat through harvest or clearance or other activity that may threaten the survival of affected species populations*

*e. encourage the planting of naturally occurring, locally sourced indigenous species and the creation of habitats for indigenous species as well as plant and animal pest control*

*f. encourage the establishment of additional indigenous riparian vegetation as a means of increasing connectivity and enhancing freshwater habitat for indigenous species*

*g. ensure human-made structures do not adversely impact on indigenous species by interfering with their natural migratory movements*

*h. consider both regulatory incentives (such as bonus development rights in exchange for protection and enhancement of vegetation and habitats) and non-regulatory incentives, (such as technical advice and practical help) to support and encourage landowners to make appropriate land management decisions.*

***Schedule 2: Principles to be applied when considering a biodiversity offset***

*1. **No net loss:** A biodiversity offset should be designed and implemented to achieve in situ, measurable conservation outcomes which can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.*

*The offset design will demonstrate that:*

*a. the key biodiversity components affected by the activity are identified, and an explanation provided as to how this was done, the basis for doing so, and how the key biodiversity components have been included in the offset design*

*b. the anticipated losses of biodiversity at the site of the activity and the anticipated gains at the offset site have been calculated to determine "no net loss" and preferably "net gain" and documented*

*c. appropriate measures/metrics that address the quality and quantity of biodiversity have been identified and used in the loss-gain calculations*

*d. a suitable basis for assessing a 'like-for-like-or-better' approach to equivalence has been identified and used for the offset design*

*e. any temporal loss of biodiversity between the time of the project's impact and the time the offset will mature has been considered and addressed*
*f. intended conservation outcomes for biodiversity components within the offset are explicitly described*
*g. uncertainty and risk is explicitly built into the loss-gain calculations.*
*2.* ***Additional conservation outcomes:*** *A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.*

*The offset design will demonstrate that:*
*a. conservation gains have been predicted without the offset project ("without-offset") and with the offset, and on this basis, evidence is provided to show that the anticipated conservation outcomes would not have occurred without the offset.*
*3.* ***Adherence to the mitigation hierarchy:*** *A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimisation and on-site rehabilitation measures have been taken according to the mitigation hierarchy.*

*The offset design must demonstrate:*
*a. how the activity addresses direct and indirect effects on specific components of biodiversity by:*
*i. avoidance measures*
*ii. minimisation measures*
*iii. on-site rehabilitation measures*
*b. that the biodiversity offset only addresses the residual effects of the activity, namely those effects left after all the appropriate avoidance, minimisation and rehabilitation actions have been taken.*
*4.* ***Limits to what can be offset:*** *There are situations where residual effects cannot be fully compensated for by a biodiversity offset because the biodiversity affected is vulnerable or irreplaceable.*

*These situations will be demonstrated when:*
*a. a comprehensive assessment has been undertaken to determine whether, and if so which, highly vulnerable and irreplaceable biodiversity components are present and are affected by the activity. In determining when offsetting is not appropriate local authorities should have regard to whether the vegetation or habitat:*
*i. represents a non-negligible proportion of what remains of its type*
*ii. is now so rare or reduced that there are few options or opportunities for delivering the offset*
*iii. is securely protected and in good condition so there is little opportunity to offset the biodiversity components in a reciprocal manner*
*iv. is threatened by factors that cannot be addressed by the available expertise.*

*If there are residual effects on biodiversity that are not, or seem likely not, to be capable of being offset, any measures taken to address them, by way of environmental compensation or otherwise, should not be considered to be a biodiversity offset for the purposes of Policy 3.*
*5.* ***Landscape context:*** *A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.*

*The offset design will demonstrate that:*
*a. it contributes to and complements biodiversity conservation priorities/goals at the landscape and national level.*

*6. **Long-term outcomes:** The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.*

*The offset design will demonstrate that:*
*a. management arrangements, legal arrangements (eg, covenants) and financial arrangements (eg, bonds) are in place that allow the offset to endure as long as the effects of the activity, and preferably in perpetuity*
*b. a biodiversity offset management plan is prepared and implemented which:*
*i. contains specific, measurable and time-bound targets for the biodiversity offset*
*ii. predicts when no net loss/net gain will be achieved*
*iii. provides mechanisms for adaptive management of the offset, using the results of periodic monitoring and evaluation against identified milestones to determine whether the offset is on track and rectify if necessary*
*iv. establishes roles and responsibilities for managing, governing, monitoring and enforcing the offset*
*c. where milestones are not achieved, an analysis is undertaken to identify the causes of non-achievement and to revise the offset management plan to avoid similar occurrences*
*d. a decision-making process has been established to correct problems that arise and enable adaptive management of the biodiversity offset for the timeframe over which the offset's measurable conservation outcomes will be achieved and maintained.*

*7. **Transparency:** The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner*

**SUMNER ROAD RE-OPENING PROJECT**

**ECOLOGY MANAGEMENT PLAN**

**Contents**


**1 Introduction**.....1

**2 Indigenous biodiversity summary**.....1

**3 Constraints**.....2

**4 Goals and objectives**.....2

**5 Construction phases**.....3

5.1 Pre-construction phase.....4

5.2 Construction phase.....5

5.3 Post-construction phase.....8


**References and bibliography**


Mark Davis, Brian Patrick, Marieke Lettink


March 2014

## 1 Introduction

As described in the Ecology AEE, the Christchurch City Council is proposing to re-open the 2.6 km section of Sumner Road between Evans Pass and Lyttelton. Resource consents are needed to reconstruct and maintain the road, and to undertake rock risk mitigation works above the road.

The Ecology Management Plan (EMP) is intended to work in conjunction with any resource consent conditions that are set for the project. The broad purpose of the EMP is to prescribe how activities associated with the project should be undertaken if consents are granted. The overall intention is to minimise the damage done to indigenous biodiversity within the consent area, and to maximise its recovery once the project has been decommissioned. The EMP will help to ensure the key issues affecting indigenous biodiversity are addressed, by prescribing clear courses of action that need to be followed.

The content of the EMP is largely derived from the effects and mitigation issues described in the Ecology AEE. It is a live document, and further material is likely to be added to the EMP as new information comes to light during the course of the project. This adaptive management approach is necessary as there is incomplete information about the indigenous biodiversity present, the nature and extent of some construction activities, and how they will affect indigenous biodiversity.

## 2 Indigenous biodiversity summary

The consent area is located in the Port Hills Ecological District (ED). Originally the ED would have been almost entirely forested with podocarp/hardwood forest, but after Polynesian fires and European settlement, logging, burning and farming, only tiny old growth forest remnants remain (Wilson 1992). The ED is now dominated by grasslands, although there are substantial areas of mixed hardwood forest and rock outcrops supporting plants adapted to open habitats as well as a scattering of other plants such as trees and shrubs. The consent area is dominated by bluffs and other rock habitats, with remnant second growth mixed hardwood forest, scrub, shrublands and exotic-dominated grasslands. One critically threatened plant species, 10 at risk species and one locally uncommon species are present. It is likely that further threatened, at risk and locally uncommon species are present as additional ones occur on nearby bluffs and rock habitats north-east and northwest of the consent area. Five regionally endemic plant taxa also occur in the consent area.

Terrestrial habitats of the ED support at least 66 indigenous bird species (Lettink 2013) and five indigenous lizard species (Lettink & Whitaker 2004, Whitaker 2008, DOC Herpetofauna Database). Approximately 40 indigenous bird species are thought to breed in the ED (Wilson 2009). Twenty-two bird species (10 indigenous and 12 introduced) and four lizard species were recorded in or near the consent area. A total of 65 individual lizards were found, consisting of 60 Canterbury geckos, one jewelled gecko, one common skink, one McCann's skink and two unidentified skinks (common or McCann's skinks).

From an invertebrate perspective, the consent area contains a range of ecosystems typical of the ED. Its rock habitats support nationally important invertebrates as well as a wide range of other invertebrates that are confined to such habitats. Rock bluffs on the edge of the consent area revealed all the 12 known specialist rock bluff moths of Banks Peninsula, three of these being significant because of their rarity, threat status and restricted distribution.

Indigenous forest in Buckley's Bay Scenic Reserve (BBSR) occurs as a mosaic with rock bluffs providing ideal habitat for a range of indigenous invertebrates as there are many edges and micro-habitats to maximise invertebrate diversity. The grasslands support many indigenous insects typical of this habitat, including a suite of specialist moths on common broom and an at risk moth on *Aciphylla subflabellata*. Other indigenous shrubs also support specialist insects including niniao, korokio, porcupine shrub, matagouri and prostrate kowhai.

A visit to 'Sumner Stream' revealed it to be an ephemeral stream that is mostly dry and does not appear to support any indigenous freshwater fauna values. While the channel seems to carry substantial volumes of water following storm events, the flows are not permanent and do not maintain the life history stages of aquatic invertebrates which could potentially occupy shallow pools at several localities.

## 3 Constraints

The main constraint which limits the effectiveness of the EMP is that access was restricted to approximately one third of the consent area, due to localised geotechnical hazards. This means that the indigenous biodiversity of localities most likely to be affected by rock stabilisation measures could not be directly assessed, i.e. rock habitats and forest. Assessments of forest margins were however supplemented by other ecological reports, including one for BBSR. Additional vegetation surveys and limited fauna observations were undertaken on adjoining land as surrogates for habitats in the consent area that could not be surveyed.

A particular concern is that there is very limited knowledge about the abundance and locations of vulnerable plant and animal species, how they will be affected by project activities and how they can be managed to minimise their losses. For these reasons the EMP follows a broad approach in terms of prescribing management actions. This also emphasises the importance of gathering as much baseline information as is safely possible prior to construction, as this is essential for subsequently clarifying if prescribed management actions are working.

A further concern is the project timelines. While the Armitage Schedule is in a draft form, it is difficult to see how adequate baseline monitoring and reporting could be setup once consents are granted and before construction activities begin. By way of example, no useful baseline monitoring of existing invertebrate populations seems possible in the pre-construction period based on the current project timeline. The timeline allows for holdpoints so monitoring can take place at appropriate times. An Environmental Advisor will be appointed to manage the monitoring requirements and allow for hold points during pre-construction.

## 4 Goals and objectives

The following goals provide the framework for managing indigenous biodiversity in the consent area.

1. *Minimise losses and damage to indigenous biodiversity from construction activities within the consent area.*
2. *Manage remaining indigenous biodiversity after project decommissioning, to maximise its recovery and its self-sustainability.*

The objectives below are intended to enable the achievement of the goals. They identify what management results are sought for specific issues or threats. Objectives derived from the first goal have 1 as their base number, while those derived from the second goal have a base number of 2. Actions to achieve the objectives are described in Section 5.

1.1 *Where practical, minimise disturbance resulting from construction activities by fine tuning the location of infrastructure, avoiding over-spill and avoiding critically important sites.*

1.2 *Produce an approved fire management plan prior to construction being undertaken.*

1.3 *Minimise the spread of weeds resulting from construction activities and to control those weeds so they do not degrade indigenous biodiversity values.*

1.4 *Undertake the rehabilitation of disturbed areas in a manner that minimises weed spread and the introduction of exotic plants generally.*

1.5 *Undertake a baseline inventory of indigenous biodiversity as much as is practicable prior to construction.*

1.6 *Undertake limited salvage and transfer of Canterbury geckos from accessible parts of the site prior to construction, if other mitigation or compensation is not provided*.

2.1 *Manage threatened, at risk and uncommon species in a manner that enhances their remaining populations.*

2.2 *Control weeds within the consent area, thus reducing the habitat threat to indigenous biodiversity in the consent area and in adjacent protected areas.*

2.3 *Undertake restoration planting and weed control in BBSR and the adjacent Lyttelton Port Company land, to improve indigenous habitat values and buffering of the reserve.*

2.4 *Carry out long-term ecological monitoring of indigenous biodiversity to better understand the recovery processes involved and the long term effects of the project.*

2.5 *Implement compensation[1] measures that address the residual adverse effects on indigenous biodiversity arising from the project.*

## 5 Construction phases

A number of management actions will occur in more than one construction phase. For clarity, the phase where most of the management action will occur is where the prescription for that action will be detailed. Where an action occurs in other phases as well, it will also be acknowledged there. The relevant objectives (e.g. Objective 1.1) are listed for each action.

[1] A biodiversity offset cannot be used to address residual adverse effects because the indigenous biodiversity affected is highly vulnerable or irreplaceable, and is not capable of being offset. For this reason compensation is proposed to address residual adverse effects. Compensation is measures taken to recompense for the loss of biodiversity caused by a project. It is not synonymous with 'biodiversity offset' as the latter is a no net loss (or net gain) conservation outcome. Situations where compensation is appropriate include where the residual losses of biodiversity are not quantified, where it is impossible to offset the losses because the damage is too severe or where pre-impact data is lacking (BBOP 2012b).

## 5.1 Pre-construction phase

### 5.1.1 Baseline inventory and monitoring

The collection of baseline inventory data has a dual purpose of describing what indigenous biodiversity occurs where, what condition it is in, and to collect the information in such a way that it can be reassessed by monitoring during and after construction. Data will be collected on a habitat basis at specific localities and adjacent to construction sites, with locations for key species being recorded by GPS waypoints. Representative sites that can be located again after construction will be set-up, and baseline information about their indigenous biodiversity will be collected. Photo points should also be set-up to provide photographic records. Monitoring is required for the Crater Rim Cliffs, the grassland ridge above, bluffs elsewhere in the consent area, and in forest / scrub in BBSR; monitoring of Sumner Stream is not required as there are no known indigenous faunal values associated with it.

Ecologists will need to gather this data before construction activities begin. In addition the boundaries of building sites, roads and storage sites need to be clearly identified on the ground using flags, poles or coloured tape. Access to as many areas as possible is important, to enable the collection of the required baseline data.

To assess the effects of construction activities, affected localities and controls need to be set-up. The location of these controls needs to be agreed with geotechnical consultants and mapped using GPS waypoints. These plots or transects need to be monitored before construction, during construction and after construction is completed. Depending on safe site access, a total of 12-26 affected plots or transects and 5-7 control plots or transects are likely to be required (including 2 or 3 restoration plots). It may also be possible, where safe site access allows, to undertake oblique photography from some positions above the Sumner Road to provide a before and after construction 'picture'.

Because the monitoring covers a range of habitat types and restoration plantings, the site management team should include a member with relevant knowledge of flora and fauna to work with the specialist contractors undertaking the monitoring.
[Objective 1.5 applies].

*Explanation*
*The ecological information collected for the AEE was often not site specific, so collecting data for particular locations will enable better assessment of construction effects and site management. It is essential to collect some baseline information to enable ecological monitoring after decommissioning of the project. If baseline data cannot be collected, the provisions of the EMP will have limited application and future monitoring will be futile.*

### 5.1.2 Provision of ecological advice

Suitably qualified ecologists should provide advice about the presence of ecological values associated with proposed construction footprints. This will include the possibility of micro-siting road lines and building sites to avoid important biodiversity values where possible. To enable this to happen, the boundaries of building sites and roads need to be accurately marked on the ground and ecologists need sufficient time to undertake the surveys. Examples of important values include the occurrence of uncommon habitats in the local area, the presence of threatened, at risk or uncommon species or the presence of ecotones.
[Objective 1.1 applies here, and to the construction phase].

*Explanation*
*The purpose of this action is to try and minimise the likely loss or degradation of indigenous biodiversity as much as possible before the various construction site footprints are finalised.*

### 5.1.3 Fire management

Fire management needs to be addressed formally through the preparation of a fire management plan by a suitably qualified specialist. The plan needs to be submitted and approved by the CCC Rural Fire Team prior to any construction activities taking place. It will need to cover the full range of relevant issues including the use of vehicle spark arresters and ensuring there is enough freshwater available for fire-fighting close to the consent area. The use of sea water for fire-fighting is not appropriate because of its adverse effects on indigenous plants and animals.
[Objective 1.2 applies here, and to the construction and post-construction phases].

*Explanation*
*It is crucial to prevent fire from occurring within or adjacent to the consent area, to avoid additional destruction of indigenous biodiversity values. Similarly, if an accidental fire does break out, it is essential that appropriate contingency measures are in place to control and extinguish the fire as soon as possible.*

### 5.1.4 Lizard salvage

Undertake limited salvage and translocation of Canterbury gecko as described in the Lizard Management Plan. Lizard salvage is an expensive and difficult undertaking that will at best recover only a small portion (most likely <5%) of the affected populations present in the consent area. This type of off-site mitigation is being included as last resort. The remediation approach for the Crater Rim Bluff is to continue investigating the stability of the Bluffs (core drilling to inform the scope and method for benching works), and remove only unstable material. Where practicable create a hold-point in the construction to re-evaluate the scope with a "do minimum" approach, and a view to reducing habitat loss. Lizard salvage and transfer can only be carried out when lizards are active (approx. October to April). It will require Wildlife Act Authority and/or a translocation permit from DOC. Wildlife Act permit applications are generally processed within 3-6 weeks. Translocation permit applications may take longer and require iwi consultation. These permits are being prepared and submitted so they are in place for October 2014.
[Objective 1.6 applies].

*Explanation*
*The long-term aim of this undertaking is to establish a viable population of Canterbury geckos at a secure site, in part making up for losses incurred during construction.*

## 5.2 Construction phase

### 5.2.1 Minimising disturbance

It is important to ensure construction activities do not occur beyond the footprints that are required to construct a road or erect a building etc. During the construction process any unnecessary disturbance, including 'over-spill' must be avoided. This means that issues such as the storage of equipment, vehicle parking, and vehicle turning needs to be restricted to

designated areas or is carefully controlled by the site manager. Similarly, the construction of roads and building sites should be subject to regular assessments to ensure that any 'over-spill' is avoided. During construction, ecological advice should also be sought as a means of minimising ecological impacts. Regular communication will be required to achieve this.
[Objective 1.1 applies].

*Explanation*
*The combined effects of benching, scaling, roading and other activities will have severe effects on indigenous biodiversity, and any 'over-spill' will simply increase the effects. While this may seem like a minor issue compared to the overall level of disturbance, any biodiversity losses that can be avoided are important because so much will be lost through this project. The input of ecological advice at strategic times is an important element of this process.*

### 5.2.3 Security fence construction

If a security fence is required along the ridge from Evans Pass, it needs to be erected in a manner that causes minimal disturbance and damage. The fenceline should not be cleared of vegetation by earth-moving machinery as this will cause unnecessary physical disturbance. In contrast the approach which should be used is to limit disturbance to fence post drilling. The proposed location of the fenceline should also be reviewed by ecologists before it is erected, so that important biodiversity values can be avoided if possible. As an example, the western end of the fence appears to extend onto the top of hazard zone 207 which supports at least five at risk plant species. If post holes are to be drilled here they need to avoid these plants or this end of the fence should be shifted.
[Objectives 1.1 and 1.5 apply].

*Explanation*
*It is important to minimise the effects of construction given the overall severe effects on indigenous biodiversity. While erecting a fence may seem like a minor issue compared to the overall level of disturbance, any biodiversity losses that can be avoided are important because so much will be lost through this project. At least one of the habitats crossed by the fence supports important indigenous biodiversity and there may be other examples too.*

### 5.2.4 Minimising the scaling of hazard zones with important habitat values

Hazard zones 101, 102, 107 and 207 are examples of bluffs known to support important habitat values. In the case of 101/102, the fern *Asplenium trichomanes* is present and this is the only known record for the ED. The top of 207 supports five at risk plant species and others are likely to be present on the bluffs below. The top of 107 supports six at risk plant species, and more may be present on the bluff itself. It is certain that other bluffs not visited during field work will support threatened or at risk species, which may be identified when gathering baseline data.
[Objectives 1.1 and 1.5 apply, the latter indirectly through 5.1.1].

*Explanation*
*These examples show why it is important to minimise the scaling of bluffs where possible, and to try and do it in a way that minimises damage to known habitat values such as threatened or at risk plants and animals. By applying this approach, it will help to retain important indigenous biodiversity for recolonising scaled bluffs over time.*

### 5.2.5 Advice on retrieving targeted indigenous biodiversity

Advice can be provided about the retrieval of indigenous plant material prior to and during construction. This would effectively be restricted to threatened plants, unless an at risk or uncommon species was locally rare in the ED, e.g. *Asplenium trichomanes*. In the case of threatened plants that are encountered before construction, it may be possible to collect seeds for on-growing the species concerned. If their habitat is likely to be destroyed, entire plants could be removed and potted up for later transplanting though this approach is less likely to be successful. In the case of the Lyttelton forget-me-not, any known habitats must not be damaged because the species is so rare and vulnerable.
[Objectives 1.1 and 1.5 apply, the latter indirectly through 5.1.1].

*Explanation*
*Translocation of indigenous animals or on-growing indigenous plants is a last a last resort for the most uncommon species, which is inferior to avoiding the destruction of their habitat in the first place. In combination, these approaches may help to retain important biodiversity values and allow recolonisation of nearby disturbed areas over time.*

### 5.2.6 Vehicle/machinery cleaning

All vehicles and machinery entering the consent area will be ultra-clean before entering the site, and returning to 'home base' This is to be based on best practise advice from a suitably qualified and experienced advisor, so that the most effective methods are used to ensure the removal of any plant material from vehicles and machinery.
[Objective 1.3 applies]

*Explanation*
*This should minimise the chances of additional weeds being introduced to the consent area, and the surrounding protected areas.* Rigorous *cleaning and inspections should help to reduce the spread of weeds already present in the consent area, by minimising the transfer of weeds from one locality to another.*

### 5.2.7 Road metal

Road metal for surfacing tracks and roads should be sourced from local rock where possible to reduce its potential to spread weeds. Road metal from outside the consent area or immediate environs should be avoided so that additional weeds that are not known in the consent area are not introduced.
[Objective 1.3 applies].

*Explanation*
*It is important to prevent the introduction of new weed into the consent area, or to facilitate the spread of existing weeds. This is because weeds have the potential to reduce the naturalness of habitats, and to outcompete or smother indigenous plants.*

### 5.2.8 Weed monitoring and control related to disturbance

Disturbed surfaces and their immediate environs need to be monitored at 6 month intervals (spring and autumn) by suitably qualified plant ecologists using the list of targeted weeds below. In addition a watching brief is needed for any other troublesome weeds that may appear. Suitably trained site personnel can assist by helping to record the targeted weed

species as they come across them during construction activities. This will require inventory and monitoring of habitats within the construction footprints and in the consent area generally. Undertaking a baseline weed inventory is necessary before construction to clarify what weeds are already present in and adjacent to construction areas.
[Objective 1.3 applies].

| | |
|---|---|
| Gorse | Elderberry |
| Broom | Karo |
| Hawthorn | Tree lupin |
| Barberry | Taupata |
| Spindleberry | Flowering currant |
| Boneseed | Exotic conifers |
| Spur valerian | Macrocarpa |
| Common polyplody | Pride of Madeira[1] |
| Male fern | Pig's ear[1] |
| Stonecrop | Marguerite[1] |
| Old man's beard | *Hebe strictissima* (or *H. salicifolia*) x *H. speciosa*[1] |
| All ivy species | |

[1] *A watching brief should be kept by ecologists, the Environmental Advisor and construction crew for these weeds, which occur in the area though their extent is currently unknown. An identification guide and photographs will be provided to facilitate this. If monitoring shows them to be more widespread or spreading, they should be controlled.*

Ongoing monitoring will be required to determine the extent of weed spread and the effectiveness of weed management. It may be that certain weeds become particularly problematic and monitoring will help to clarify if this is the case. The location of key weeds is to be recorded by GPS.

All identified weeds are to be removed using the most appropriate methods, with the proviso that weed removal must cause minimal damage to adjoining indigenous plants. This is especially important in the case of uncommon or rare species.
[Objective 1.3 applies].

*Explanation*
*Weed spread is facilitated by disturbance, so cleared or excavated surfaces are likely to be colonised by weeds. Disturbed areas need to be monitored to clarify the extent of weed spread and to control troublesome weeds accordingly. This should help to reduce the likelihood of weed spread elsewhere in the consent area (primarily two scenic reserves), and into other protected areas adjacent to the consent area.*

### 5.3 Post construction phase

#### 5.3.1 Rehabilitation of disturbed areas

Disturbed areas are to be rehabilitated to a state as close as possible to what they were like before construction. Rehabilitation is required for Haul Road A, access tracks, magazines, the soil storage area, Site Office B and car parks etc. If hydro-seeding is used, seeds of visually prominent species previously present should provide the basis of the seed mix e.g. browntop, sweet vernal and silvery hairgrass, but not the more aggressive exotic grasses such as cocksfoot and Chewing's fescue. The possibility of using seed from indigenous grasses should also be investigated, e.g. plume grass, *Rytidosperma clavatum*, *Anthosachne*

*solandri* (blue wheatgrass) and *Microlaena stipoides* (meadow rice grass). Sparse plantings of silver tussock and native shrubs into these areas should be undertaken once the grasses are established, if they are present nearby. Suitable shrubs include matagouri, porcupine shrub, common broom and scrub pohuehue. All indigenous plants should be sourced locally within the ED, with special care being taken not to mistake *Poa labillardierei** for silver tussock as this introduced tussock occurs on damper slopes of the Port Hills (Alice Shanks, pers.comm.).

Colonisation by troublesome weeds will be subject to monitoring under 5.2.8 and any of the specified weeds will need to be controlled or removed.
[Objectives 1.3 and 1.4 apply].

*Explanation*
*Bare ground after excavation or construction activities is often rehabilitated or re-vegetated, sometimes using hydro-seeding. In this case the land in question is within a scenic reserve and it is considered appropriate to try and rehabilitate the land to a similar state to what it was prior to construction. This approach is supported by the landscape architects involved in the project.*

### 5.3.2 Threatened species management

It should be possible to at least partly assess the presence of threatened species on bluffs and other rock habitats after scaling and benching has been completed. Seed from critically threatened plant species (*Myosotis lytteltonensis*, *Leptinella nana*) should be collected and on-grown by the DOC nursery. After the plants have reached an appropriate level of development, they can be planted into specified locations on the advice of the DOC plant ecologist. This is very much an inferior option in comparison to retaining existing threatened plants in their natural habitats.

Monitoring and weed control will be needed in the vicinity of any threatened plants that are planted, and also in the vicinity of naturally occurring threatened plants, depending on what the weed species are. In the case of the Banks Peninsula forget-me-not, grasses encroaching into its habitat could displace it and therefore need to be controlled.
[Objectives 2.1 and 2.2 apply].

*Explanation*
*Threatened species management is a focus for mitigation as these plants have a restricted distribution and are only found in very low numbers. At risk plants are generally not considered here because there are substantially more species involved and they are relatively more 'abundant'.*

### 5.3.3 Monitoring of construction effects

This needs to continue in the post-construction phase as construction effects are expected to be ongoing. Using the baseline monitoring data obtained before construction, the first post-construction monitoring should take place as soon as practical in spring or autumn following the opening of the Sumner Road. This should continue twice a year for two years, and thereafter annually for a further three years. After the five year period is reached the need for further monitoring should be reviewed. Advice will be taken during the project to determine the most effective options for ongoing monitoring.

Because the project will have such a severe effect on the Port Hills environment, monitoring should also focus on the specialised moth fauna of the cliff faces and bluffs. This is important as a means of learning about the rate of recolonisation of raw rock habitats by moths and other invertebrates. This mitigation measure is part of the wider monitoring programme that should occur through all phases of the project.
[Objective 2.4 applies].

*Explanation*
*If monitoring is to influence management, it needs to be implemented as soon as possible after the Sumner Road opens. Initial six monthly monitoring followed by annual monitoring reflects the likely changes in weed spread. Woody weeds in particular may have a severe effect on indigenous invertebrates, though other weeds capable of invading rock habitats could also be problematic e.g. succulents and pride of Madeira. A particular concern is the potential colonisation of raw rock faces directly above the benches by woody weeds, as these areas are important for the development of lichens and mosses which are used by invertebrates.*

*Despite the severe impacts on invertebrate habitats, the project also provides an opportunity to clarify the rate of invertebrate recolonisation from nearby refugia, and this information will be valuable for assessing the effects of other large scale projects of a similar nature.*

### 5.3.4 Weed monitoring and control in the consent area

On-going weed control in the consent area that is not directly related to construction sites or construction activities is a mitigation measure. The intention is to eliminate or reduce the abundance of key specified weeds (see 5.2.8), so they are less of a threat to indigenous biodiversity in the consent area (and in the adjacent DOC reserves). Weed monitoring needs to take account of the possibility of new weeds appearing in the area, and if this happens, they will need to be removed before they become problematic.
[Objective 2.2 applies].

*Explanation*
*Weed monitoring and control in the wider consent area is a mitigation measure designed to limit the spread of weeds within the consent area and into adjoining protected natural areas.*

### 5.3.5 Restoration planting of LPC land and BBSR

Discussions with the LPC and DOC about undertaking restoration plantings on LPC land west of BBSR, and in the BBSR have commenced. This is one of the few mitigation options available within the consent area to compensate for the severe adverse effects of the project on indigenous biodiversity, including within BBSR.

If negotiations are successful, a restoration plan will be prepared by a suitably qualified and experienced restoration ecologist. The plan should take account of the climate of the area, the difficulties posed by planting into dense grassland and the diversity of weeds present in the area. The intention of restoration is to plant suitable indigenous shrubs and trees in the area to provide additional habitat adjacent to the BBSR. The planting locations need to be chosen so that as they mature, they will help to buffer the reserve from weed spread from Lyttelton and the pine plantation. Existing exotic trees on the land are to be removed in the medium term, unless the ecologist decides to retain some as shelter trees for plantings.

The LPC land covers approximately 10.9ha (Tom Revell, Aurecon, pers.comm.), and it is proposed that 4ha should be planted. A plant survival rate of at least 60% should be achievable for the plantings, and replacement plants will be required in each successive year to replace those that did not survive. There will be a delay of two or three years before planting for collecting seeds and growing the plants. If up to 1.5 hectares per year is planted, that should mean the plantings will be completed after six or seven years. Possums and other animal pests may need to be controlled, and on-going maintenance will be needed until the plants are established and have attained sufficient height or canopy closure to be self-sustaining. Maintenance work is to continue until year 10, when the project will be reviewed. If maintenance is still required, this should continue until the plants are self-sustaining.

In addition, the open grassland at the bottom of BBSR should also be planted in trees and shrubs. This grassland covers approximately 0.75ha (Tom Revell, Aurecon, pers.comm.). Seeds will be sourced for both plantings from BBSR and Mt Cavendish Scenic Reserve. Some examples of the main tree species to be planted include mahoe, ngaio, kowhai, narrow-leaved lacebark and kohuhu, plus less common red mapou, broadleaf, lemonwood and weeping mapou. Common shrubs to plant include *Coprosma crassifolia*, mikimiki, niniao and common broom, while less common ones are *Coprosma rotundifolia*, *Coprosma virescens*, *Coprosma wallii* and *Olearia fragrantissima*.
[Objective 2.3 applies].

*Explanation*
*Restoration planting is a mitigation measure designed to provide a modest increase in forest and shrubland habitat. This should provide additional habitat for indigenous fauna over time, and it will help to at least partly buffer BBSR from the west and south-west. Associated weed control will also reduce the likelihood of weed spread into the reserve.*

**5.3.6 Compensation** (O2.5).

Compensation needs to focus on protecting other areas that would benefit the species and habitats most affected by residual adverse effects, and it could include the setting up of a Trust to achieve these ends.
[Objective 2.5 applies].

*Explanation*
*Residual adverse effects need to be addressed by compensation measures, because the indigenous biodiversity affected is highly vulnerable and irreplaceable, and is not capable of being offset.*

**Acknowledgements**

Thanks to Alice Shanks for her helpful comments about grasses on the Port Hills.

**References and bibliography**

Boffa Miskell 2011. Transmission Gully project: proposed ecological management and monitoring plan. Prepared for NZ Transport Agency and Porirua City Council. Report No: W09034G.

Business and Biodiversity Offsets Programme (BBOP) 2012a. Biodiversity offset design handbook – updated. BBOP, Washington D.C.

Business and Biodiversity Offsets Programme (BBOP) 2012b. Glossary – second updated edition. BBOP, Washington D.C.

Lettink M 2013. Flora and fauna habitats on Banks Peninsula, Canterbury. Unpublished Report, Canterbury Regional Council, Christchurch. 40 pp.

Lettink M & Whitaker T 2004. Lizards of Banks Peninsula. Department of Conservation, Christchurch.

Whitaker AH 2008. Conservation of lizards in Canterbury Conservancy. Department of Conservation, Canterbury Conservancy. Canterbury Series 0308.

Wilson HD 1992. Banks ecological Region: Port Hills, Herbert and Akaroa Ecological Districts. *Protected Natural Areas Programme survey report No 21*. Department of Conservation, Christchurch.

Wilson HD 2009. Natural history of Banks Peninsula. Canterbury University Press, Christchurch.