Land Information New Zealand
Toitū te whenua

Crown Pastoral Land Tenure Review

Lease name : EREWHON

Lease number : PC 142

Conservation Resources Report – Part 1

As part of the process of Tenure Review, advice on significant inherent values within the pastoral lease is provided by Department of Conservation officials in the form of a Conservation Resources Report. This report is the result of outdoor survey and inspection. It is a key piece of information for the development of a preliminary consultation document.

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EREWHON PASTORAL LEASE

CONSERVATION RESOURCES REPORT

DEPARTMENT OF CONSERVATION

JULY 2014

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Cover Photograph: Looking up the Clyde River (Warren Chinn, 2009).

PART 1 INTRODUCTION

Erewhon pastoral lease is leased by Erewhon Partnership Limited. The pastoral lease covers approximately 13,575 hectares in the upper Rangitata valley in Canterbury, comprising steep mountainous country between the Havelock, Clyde and Lawrence rivers. Substantial parts of the pastoral lease lie above the natural timberline and are dominated by rock and scree. The pastoral lease ranges in altitude from 550m at its southeast corner at the Rangitata River to 2403m at Cloudy Peak on the Cloudy Peak Range and over 2300 m on the Arrowsmith Range. The pastoral lease is drained by Caroline Stream, the Havelock, Clyde and Lawrence rivers and many unnamed tributaries of these rivers, all of which are tributaries of the Rangitata River.

Erewhon pastoral lease lies predominantly in the Armoury and Arrowsmith ecological districts (EDs). A relatively small southern part of the pastoral lease on the valley floor lies within the Hakatere and Two Thumb EDs. Armoury ED lies within D'Archiac Ecological Region; Arrowsmith, Haketere and Two Thumb EDs lie within Heron Ecological Region (McEwen, 1987). Heron Ecological Region was surveyed as part of the Protected Natural Areas Programme in 1984/85 (Harrington *et al*, 1986).

The pastoral lease adjoins Rangitata/Rakaia Head Waters Conservation Area to the north, Hakatere Conservation Park to the east and Te Kahui Kaupeka Conservation Park across the Havelock River to the southwest. The main parts of the pastoral lease on the Cloudy Peak, Jollie and Potts ranges are separated by extensive areas of Unalienated Crown Land (UCL) on the broad braided beds of the Havelock and Clyde rivers. The pastoral lease shares a short boundary with Mt Potts Station at its southeast corner. Access to the pastoral lease is from State Highway 72 at Mt Somers via Hakatere Potts Road. Unformed legal access to the pastoral lease is available from the surrounding public conservation land and from UCL in the beds of the Havelock, Clyde and Lawrence rivers.

The initial tenure review inspection of lower-altitude 'front country' parts of the pastoral lease was undertaken during November 2009 and January 2010. Inspection of the remaining higher-altitude 'backcountry' parts of the pastoral lease was undertaken during March 2014. The results of those inspections are presented in specialists' reports (listed below) which form the basis of this Conservation Resources Report.

<u>Front Country (2009/2010)</u>

- Botanical Survey of Erewhon pastoral lease for Tenure Review, Nicholas Head, January 2010, 17p + maps.
- Assessment of the Bird and Lizard Values of Erewhon pastoral lease, Marieke Lettink, January 2010, 14p including photos + maps.
- Erewhon pastoral lease, A Report on the Aquatic Fauna Surveys, Scott Bowie, January 2010, 13p including photos + maps.

- Erewhon pastoral lease Tenure Review, Summary of Invertebrate Values, January 2010, Warren Chinn, 14p including photos + maps.

Back Country (2014)
- Erewhon pastoral lease Landscape Assessment, Blakely Wallace Associates, May 2014, 36p.
- Botanical Survey of Erewhon pastoral lease for Tenure Review, Nicholas Head, May 2014, 24p.
- Bird and Lizard Survey of Erewhon pastoral lease, South Canterbury, Marieke Lettink, April 2014, 11p including photos + maps.
- Erewhon pastoral lease, A Report on the Aquatic Fauna Surveys, Scott Bowie, May 2014, 11p.
- Erewhon pastoral lease Tenure Review, Invertebrate Survey, May 2014, Warren Chinn, 16p and photos + maps.
- Historic Assessment for Erewhon pastoral lease Tenure Review. Steve Bagley, May 2014, 23p.

Significant Inherent Values

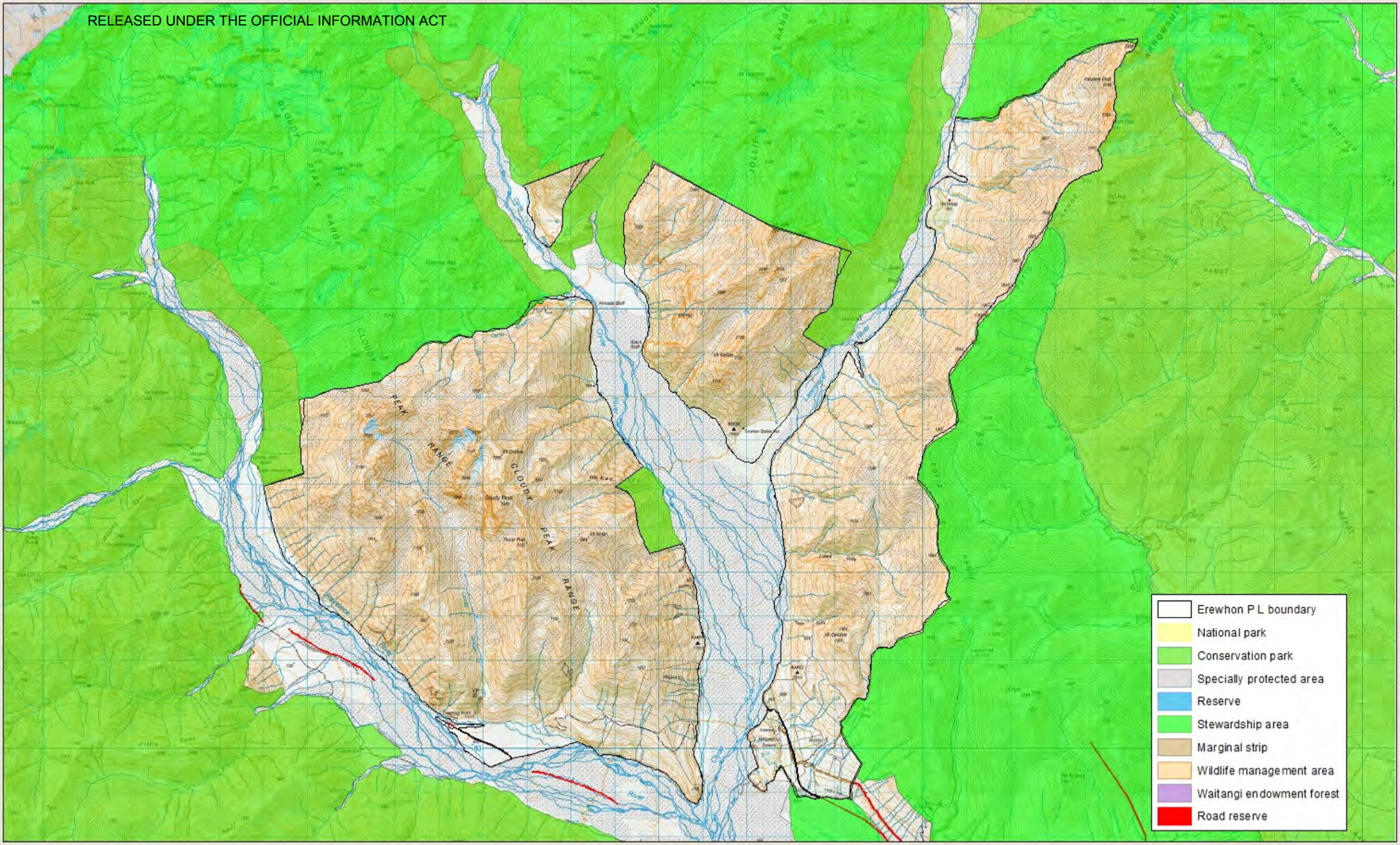
This Conservation Resource Report identifies the Significant Inherent values for Erewhon pastoral lease.

Significant inherent value is a term that is used in the Crown Pastoral Land Act 1998. It is defined as;

"in relation to any land, means inherent value of such importance, nature, quality, or rarity that the land deserves the protection of management under the Reserves Act 1977 or the Conservation Act 1987"

Neither the Reserves Act 1977 nor the Conservation Act 1987 are specific about which values deserve the protection of management under them. Guidance on significant inherent values and related matters under the tenure review programme, Crown Pastoral Land Act 1998 has been prepared by the Department of Conservation. This guideline was developed in 2004 and replaced by a revision developed in 2009 and accepted by Land Information New Zealand.

The 2009 revision sets out guidelines for the different value classes. These guidelines have been used to identify the significant inherent values of Erewhon pastoral lease.



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PART 2 INHERENT VALUES: DESCRIPTION OF CONSERVATION RESOURCES AND ASSESSMENT OF SIGNIFICANCE

2.1 LANDSCAPE

2.1.1 Landscape Context

Erewhon pastoral lease is situated on the mountain ranges leading into the main divide in the upper Rangitata valley, Mid Canterbury. The lease comprises approximately 13,575 hectares of steep mountainous country between the Havelock, Clyde and Lawrence rivers.

The lease comprises of four discrete blocks of land separated by open riverbeds of UCL status. The four blocks are the Potts Range faces which have a west and northwest aspect above the Clyde and Lawrence rivers; the south end of the Jollie Range and a small separate enclave northwest of the Sinclair River which have a southwest aspect; and the Cloudy Peak block forming the southern end of Cloudy Peak Range between the Clyde and Havelock rivers.

The upper Rangitata valley is one of three extensive high country intermontane valley/basin systems between the Canterbury front ranges and the main divide of the Southern Alps. The other two are the Rakaia and Waimakariri. The upper Rangitata valley is separated from the Canterbury Plains by the front ranges that form the backdrop to the plains.

Erewhon pastoral lease extends deep into the Southern Alps and is situated in the transition between the dry, largely treeless outwash basin of the upper Rangitata and Ashburton rivers and the high mountains of the Southern Alps. The imprint of glaciation is clearly expressed in the landforms of the basin. Features include extensive glacial terraces, moraine, lakes, kettleholes and broad alluvial terraces. The basin is an expansive glacial landscape with a high level of natural character.

The Rangitata basin is defined by the McLeod Range to the south, Sinclair and Two Thumbs ranges to the west, Cloudy Peak Range to the north and Potts and Harper ranges to the east. The ranges which surround the valley are generally steep, dissected mountain blocks with extensive scree and rock. The headwaters of the Rangitata are renowned for the scale and grandeur of the mountain lands, the wide braided riverbeds and the impressive views through to the Southern Alps.

The pastoral lease is a predominantly natural landscape, comprising steep, high, and extremely rugged mountainous ranges rising to Cloudy Peak at 2403m and numerous

other peaks over 2000m high. Bare rock, extensive scree slopes, truncated spurs, deeply incised side streams, wildly rugged topography and a wide range of vegetation types from alpine herbfield and rockland to subalpine shrubland and montane tussockland and beech forest. Other significant characteristics are the vast and grand expanses of gravel riverbeds, braided river channels, large low-angle alluvial fans of the tributary streams, and extensive ice worn landforms, such as Jumped Up Downs near Erewhon Homestead.

The upper Rangitata is protected by a Water Conservation Order and has been identified as an Outstanding Natural Feature and Landscape (ONF/L) in the Canterbury Regional Landscape Study Review (Environment Canterbury, 2010). Erewhon was romanticised by Samuel Butler in his writings on the area in the late 19th Century.

2.1.2 Landscape Description

The entire Erewhon pastoral lease is one landscape unit, as there is a high degree of similarity in the characteristics and features across the pastoral lease. However, for the purposes of this landscape assessment, it is divided into four sub-units, reflecting areas of similar landscape character:

1. Potts Range faces
2. Jollie Range
3. Cloudy Peak and River Flats
4. Jumped up Downs, Mt Caroline faces and developed flats

For each landscape sub-unit, landscape character is evaluated using the following criteria:

- Naturalness: the condition of the natural vegetation, patterns and processes and the degree of modification present.
- Legibility: expressiveness: how obviously the landscape demonstrates its formative processes.
- Aesthetic Factors: Distinctiveness is the quality that makes a particular landscape visually striking; frequently this occurs when contrasting natural elements combine to form a distinctive and memorable visual pattern. Coherence is based on characteristics including intactness, unity, continuity, and compatibility (intrusions, alterations, disruptions tend to detract from coherence).
- Historic Factors: historically valued attributes in the context of a high country landscape.
- Visibility: the visibility of the landscape from public vantage points.

Potts Range Faces

This area extends from the homestead to the northeast boundary of the pastoral lease at Ashburton Peak and includes all of the Potts Range faces. The southern faces above the Clyde River are west-facing slopes whereas the northern faces, above the Lawrence River, have a northwest aspect. The summit of the Potts Range within the pastoral lease

rises from an elevation of 2140m in the south to 2359m at Ashburton Peak in the north, forming an elongated block more than 15km long.

The high summits and peaks are characterised by ice steepened bare rock mantled with extensive shattered rock and scree. Snow cover occurs over long periods of the year and small permanent snowfields just adjacent to the pastoral lease on the highest peaks. Rock screes are a significant feature and while most prominent below the summit ridge, patches of scree also occur at almost any elevation. A conservative estimate is that approximately 25% of the Potts Range faces are scree covered.

Valley sides are also steep to very steep, with some extremely steep bluffed country in tributaries such as Lizard Gully. In general the tributary streams are predominantly narrow at the top, then widening with gravelfield extending down to the valley floor. Mid slope faces are ice smoothed and sculptured with some gentler areas, such as at the base of slopes above the confluence of the Clyde and Lawrence rivers. Glaciation and fluvially dissected slopes are clearly expressed and legible over the entire faces. Large scree slides, ice-smoothed spurs and buttresses, and lumpy gnarled topography alternating with smooth slopes are characteristic features.

Other topographical features include lateral terraces and fans. Hermitage Hut is located on a large landslide deposit of rock debris. This landform extends across the valley floor, narrowing the bed of Lawrence River. Other features around the hut are large scree slides, tussock-covered slopes, and mixed shrubland on toe slopes, fans and rock debris.

Vegetation patterns range from snowfield, bare rock and gravelfield to large tracts of tussockland intermingled with pockets of regenerating scrub and forest, including mountain beech and mountain totara. Forest is also associated with bluffs and watercourses. Lower gentler slopes above the river bed and below Mt Caroline show signs of grazing but in a landscape sense appear highly natural.

Table 1: Potts Range Faces: Evaluation Summary

Criteria	Value	Comment
Naturalness	High	Some modification on lower slopes and below Mt Caroline, otherwise high level of natural character likely to be similar to pre-European state.
Legibility	High	Landform features highly expressive of formative processes.
Aesthetic Factors	High	Extremely impressive landform and vegetation patterns and features at all altitudes. Distinctive and visually striking. Highly visually coherent. No discordant features.
Historic Factors	Medium	Associated with pioneering pastoral farming.
Visibility	Medium	Highly visible from riverbed but isolation limits number of viewers.

Jollie Range

This sub-unit covers two blocks of land on the south end of the Jollie Range, north of the confluence of Lawrence and Clyde rivers. The northern boundary of the larger block is two arbitrary straight lines intersecting at Mt Jollie then extending down either side to the bush line at approximately 1200m altitude. The lower boundary follows around the edge of the active riverbed. A low river terrace at the junction of the two rivers and adjacent to Erewhon pastoral lease Hut is within the block. Mt McRae (1737m) is the prominent foreground peak beyond which the ridge rises to Mt Jollie (2241m) at the northern boundary. The smaller triangular-shaped block lies west of Sinclair River and extends up a steep ridge from the Clyde riverbed.

The Jollie Range sub-unit is exceptionally steep and mountainous. It features blocky angular-shaped landforms with prominent spurs leading up to summit ridges and peaks. There is an abrupt transition from the flat braided riverbed to steep mountain slopes. Extensive areas of bare rock dominate summit ridges, upper slopes and basins. Vast rock screes descend in some places to the valley floor. Rocky ice-shorn bluffs, truncated spurs, steep watercourses and runnels, and precipitous slopes are characteristic, notably at Black Bluff.

Vegetation patterns vary from rockland to diverse tussockland and shrubland communities. Isolated pockets of forest occur on fans and toe slopes. Regenerating shrubland and forest are present on shady faces below Mt McRae. Large parts of the upper slopes below Mt Jollie are dominated by a combination of scree and rock interspersed with alpine herbfield and subalpine tussockland clinging precariously to steep slopes and rock.

The river terrace at the junction of the two rivers supports matagouri shrubland and grassland. Although partly modified, it is natural in appearance and contributes to the overall landscape character.

The smaller triangular-shaped block has similar characteristics. It includes part of a glacial bench above the Clyde River and contains a complex of tiny tarns and dense tussockland cover.

Table 2: Jollie Range: Evaluation Summary

Criteria	Value	Comment
Naturalness	High	Very high natural character. All natural processes and patterns intact.
Legibility	High	Glacial and fluvial processes highly legible.
Aesthetic Factors	High	Spectacular and visually impressive.
Historic Factors	Medium	Secondary to natural values.
Visibility	Medium	Highly visible from riverbed but isolation limits number of viewers.

Cloudy Peak Range

This large sub-unit at the south end of the Cloudy Peak Range lies between the Clyde and Havelock rivers and includes the high summits of Cloudy Peak (2403m), Mt Onslow (2203m), Ferrar Peak (2225m) and several other points over 2000m. This is rugged mountainous country with a high proportion of rock and scree at higher altitudes and small patches of permanent snow and ice.

Cattle Stream forms the northern boundary and is deeply dissected into the mountain block. Slips, rock screes, truncated bluffs, gnarly topography, and a glacial bench above Armada Bluff just south of Cattle Stream, are features of the northeast faces above Clyde River. Tussockland and herbfield is present at more stable areas, interrupting the predominant scree and rock.

Side tributaries on the Havelock River side are heavily glaciated, dissected and relatively elongated compared to other side streams. They form U-shaped valleys that curl round up to the high summit peaks and basins. Rugged rocky peaks and outcrops, and extensive scree are features of these tributaries. At the southern end a prominent landform (the 'Point') extends to the confluence of the Havelock and Clyde rivers, forming a distinctive ice-worn promontory.

On the Havelock side the topography from the promontory upstream to Cloudy Stream (below approximately 1000m) is less steep terrain (comparatively) and includes glacial benches and distinctive lumpy terrain. Up-valley from Cloudy Stream, the Havelock River faces rise steeply from the river bed with steep bluffs, slips, and ice-worn and fluvially dissected topography.

A large river terrace is present at the Cloudy Stream fan, extending down-valley from Freezing Point. It includes backwaters and low vegetation where the river has been pushed over to the right bank of the Havelock.

Pastoral farming has affected the vegetation on the promontory and on lower slopes and river terraces in the lower Clyde and Havelock valleys. There is a greater prevalence of exotic vegetation here, though in visual terms the effect is not dramatic.

Other disturbances are an access track extending from the Clyde valley across the promontory to the river terraces in the Havelock valley, a small woolshed and yards in the lower Clyde valley, and a hut north of Kea Spur in the Clyde valley.

Table 3: Cloudy Peak Range: Evaluation Summary

Criteria	Value	Comment
Naturalness	High	High over majority of block. Vegetation modified at southern end to varying degrees.
Legibility	High	Natural formative processes of glacial and fluvial processes highly legible.
Aesthetic Factors	High	Visually impressive in all respects. The modified vegetation and access track are not discordant elements

		and do not significantly detract from aesthetic values of the range as a whole.
Historic Factors	Medium	Not significant in terms of contribution to landscape values.
Visibility	High	Southern end of range is highly visible from viewpoints along Hakatere Potts Road and Mt Sunday.

Jumped Up Downs, Mt Caroline Faces and Flats

This sub-unit includes the Jumped Up Downs, station buildings, and the developed flats and hills on the southwest slopes of Mt Caroline.

The appropriately named Jumped Up Downs is a distinctive ice-sculptured land form protruding into the Clyde riverbed. It is a lumpy undulating landform, rising to an elevation of 668m, with small ephemeral tarns, wetlands and patches of exposed bedrock. Vegetation includes short tussockland, pasture and scattered matagouri shrubland, mainly on steeper faces. Overall, the vegetation is quite modified. A recently formed access track has resulted in fresh earthworks not yet grassed over. Outlying low isolated hillocks occur close to the riverbed rising above the fans and terraces of Caroline Stream.

The homestead buildings and plantings are tucked against the eastern side of the Jumped Up Downs. Mature exotic trees create an oasis-like feel to the homestead area. The old McRae Homestead, other buildings and early plantings are reminders of early occupation and contribute to the historic character of the pastoral lease.

The lower slopes of Mt Caroline comprise fans and terraces associated with Caroline Stream. The terraces are entirely converted to pasture. Sown paddocks for grazing and haymaking are divided by exotic shelterbelts and fences. Steeper slopes have a mix of pasture and shrubland, with progressively denser shrubland and tussockland on higher slopes.

Table 4: Jumped Up Downs, Caroline Faces and Flats: Evaluation Summary

Criteria	Value	Comment
Naturalness	Low	Mainly converted to exotic pasture.
Legibility	High	The action of ice on Jumped Up Downs is very clearly expressed. Fluvial processes are clearly expressed on the lower slopes and terraces of Mt Caroline.
Aesthetic Factors	High	Jumped Up Downs is distinctive and visually impressive.
Historic Factors	High	History associated with early station buildings important.
Visibility	Medium	Visually prominent from a public road.

2.1.3 Visual and Scenic Values

The visual values of a landscape comprise the inherent visual values (the appearance of the landscape regardless of accessibility) and its visibility (the prominence of the landscape from public viewpoints). These values are discussed separately below.

Backcountry Mountains

The whole of the mountainous backcountry part of the pastoral lease has exceptionally high visual and scenic values. It is a spectacular landscape at a massive scale. The upper Rangitata valley is renowned for its impressive mountains, wide braided riverbeds and spectacular views up the valleys to the Southern Alps. There are striking glacial features, such as U-shaped valleys, cirque basins, truncated and ice shorn spurs and bluffs of immense proportions and rock outcrops at all altitudes. Impressive screes are a distinctive and recurring feature throughout the backcountry of the pastoral lease. These characteristics, combined with highly diverse and distinct vegetation types and patterns, are highly memorable.

The backcountry is enclosed by public conservation land and Crown-administered riverbed. Large parts are highly visible from these public places, although difficult access and isolation limit the number of viewers. There are distant views of this mountainous country from the Hakatere Potts Road.

Front Country

This part of the pastoral lease also has high visual and scenic values with impressive and highly visible landforms which retain natural character and are effectively the same landscape as the mountain backcountry. The only difference is greater vegetation modification, which is only one component of the landscape. The Cloudy Peak Range, including the promontory and Jumped Up Downs are highly distinctive and impressive landforms and classic examples of ice-shaped topography. The homestead flats and Mt Caroline faces also have high visual and scenic values as a farmed landscape in a spectacular mountain setting.

2.1.4 Landscape Vulnerability

The mountainous backcountry is inherently vulnerable to any form of human disturbance or alteration. These are some of the steepest and most fragile lands in the Canterbury high country. Extensive grazing and earlier burning has had some visible impacts on lower slopes and easier terrain. However, indigenous vegetation is recovering from these disturbances and enhancing natural landscape values. The back country is too fragile to sustain grazing, burning or other land uses and is best suited to conservation and recreation.

The lower-altitude front country at the confluence of the Havelock and Clyde rivers, at Jumped Up Downs and on the lower slopes of Mt Caroline are more modified. This gentler country is less vulnerable and may sustain some pastoral use, including existing

levels of grazing and farm management. However, these parts of the pastoral lease are more accessible and more frequently viewed by the public. This open country is vulnerable to landscape change by earthworks, tracking, structures and the spread of wilding trees and other exotic plants.

Landscape Significance

The significance of the landscape values are derived from guidelines developed by the Department of Conservation in 2009. Applicable guidelines are stated below with an explanation as to how the values fit the guideline.

88. The best remaining representative examples of landscapes that characterised original New Zealand.

- This area represents an important intact example of a Canterbury high country landscape at the transition between the plains and Southern Alps. It is an outstanding natural landscape. All natural patterns and processes are intact. The whole area is extremely diverse in landform and vegetation characteristics from high alpine zones to braided riverbeds. Impressive landform features and associated vegetation patterns are synonymous with the area. The area represents some of the best mountain landscapes in Canterbury and is contiguous, similar and complementary to adjoining land protected as public conservation land. Minor areas have been modified by pastoral use but these areas are small in scale compared to the wider area. From a landscape perspective these changes make little difference to the magnificence and grandeur of the landscape as a whole and in the long term have a high capacity to recover to pre-European condition.

89. The natural character of the margins of lakes and rivers must have protection.

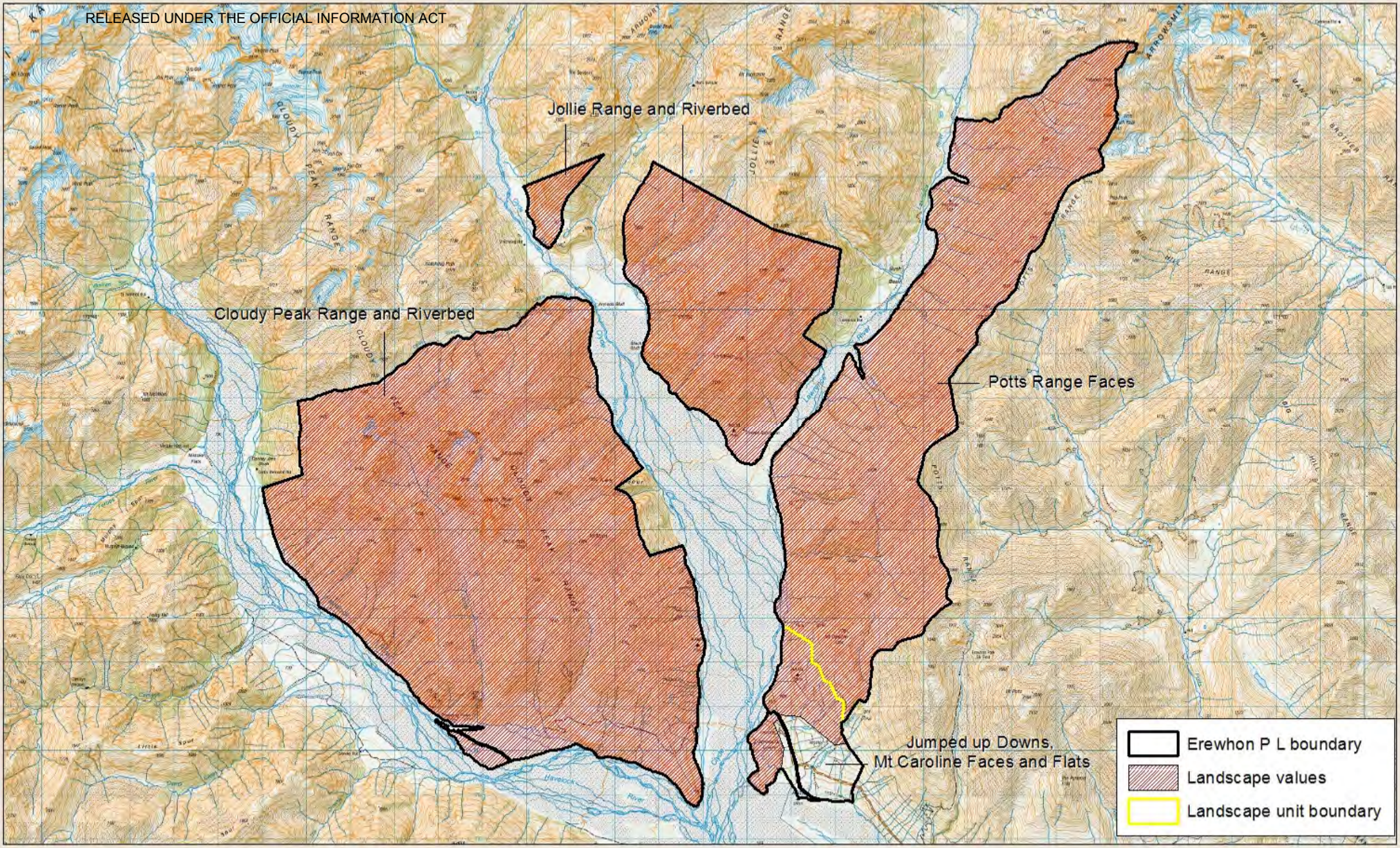
- This area lies adjacent to the Lawrence, Clyde and Havelock rivers and is an essential part of the natural character of these rivers.

91. Generally recognised iconic high country landscapes or scenery deserves protection. (To show general recognition or iconic status the assessor will need to cite evidence such as repeated use in calendars, artworks, "coffee table" publications, or promotional materials).

- The Cloudy Peak Range is a highly-visible and well-recognised high country landscape, dominating the landscape of the upper Rangitata valley. This area is now internationally recognised as one of the settings for the 'Lord of the Rings' films.
- Jumped Up Downs is a highly-visible and well-recognised high country landscape feature, comprising the focal point of the landscape of this part of the upper Rangitata valley.

95. Landscapes that have high qualities of coherence, pleasantness and intactness including working landscapes, deserve protection.

- The area is mountainous and rugged forming an extensive tract of back country that makes an important contribution to the special character of the Canterbury high country landscape.
- The area contains glaciated high country landforms where nature dominates the landscape.



Landscape Values

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2.2 GEOLOGY, LANDFORMS AND SOILS

2.2.1 Geology

The basement rocks of the main mountain ranges of Erewhon pastoral lease are Rakaia terrane rocks comprising non-schistose to schistose quartzofeldspathic sandstone (greywacke) inter-bedded with siltstone-mudstone (argillite) of Triassic age. Areas of angular unsorted rock debris (scree) and mixtures of rock debris, sand and silt (colluvium) are present throughout the pastoral lease. Areas of grey till deposited during the last glacial maximum are present on lower slopes, notably in the lower Havelock valley and between the Jumped Up Downs and Caroline Stream. Minor areas of grey river gravel, sand and silt are present on recent river flats within the pastoral lease. Several un-named faults traverse the pastoral lease, trending southwest to northeast across the mountain ranges (Cox and Barrell, 2007). Tank Gully and Lizard Gully, in the lower Clyde valley, are important fossil localities. Significant plant and shell fossil beds have been recorded here from Middle to Upper Triassic rocks (Campbell and Force, 1972).

2.2.2 Landforms

Three distinct landforms are present on Erewhon pastoral lease: the mountainous glaciated country, which dominates the pastoral lease; the broad braided beds of the Havelock and Clyde valleys, which are mostly adjacent to the pastoral lease; and the prominent Jumped Up Downs landform. The effects of recent glaciations and subsequent fluvial erosion are clearly illustrated by landforms on the pastoral lease. High summits and ridges of the Cloudy Peak, Jollie and Potts ranges are ice-steepened, shattered and mantled with broken rock and scree. These are large mountain ranges, contiguous with the high peaks of the Main Divide of the Southern Alps.

Valley sides are steep and incised by tributary streams. The front faces are ice-smoothed and sculptured, such as at the confluence of the Havelock and Clyde valleys. They dominate the views up the main valleys and comprise a substantial proportion of the mountain country within the pastoral lease. The glacial influence on the valley floor is clearly illustrated by the Jumped Up Downs landform. Moraines are present on lower slopes of the Cloudy Peaks Range in the Havelock valley, in the upper Clyde valley above the confluence of Sinclair River, at lower Wild Sheep Stream near the confluence of the Clyde and Lawrence rivers, and at the homestead between Jumped Up Downs and Mt Caroline. A spectacular rock debris deposit blocks the mid-Lawrence valley near Hermitage Hut.

The braided beds of the Havelock and Clyde rivers, while mostly outside the pastoral lease, are dominant landforms. They illustrate the extent to which fluvial processes have created landforms since the retreat of glaciers. The extensive gravel deposits have filled the valleys and created the extensive flats, parts of which lie within the pastoral lease.

2.2.3 Soils

Higher altitude parts of the pastoral lease on the mountain ranges have poorly-developed shallow soils along the summits and steepland soils on the upper slopes. Mid-altitude slopes mostly have shallow hill soils. Recent alluvium along rivers and streams has sandy loams.

Geology, Landforms and Soil Significance

The significance of the geology, landforms and soils values is derived from guidelines developed by the Department of Conservation in 2009. Applicable scientific value guidelines are stated below with an explanation as to how the values fit the guideline.

82. Places that could potentially reveal past landscape or evolutionary history deserve protection.

- Tank Gully and Lizard Gully, in the lower Clyde valley, are important fossil localities. Significant plant and shell fossil beds found within Middle to Upper Triassic rocks have been documented.

Summary of the Significance of Geology, Landforms and Soils.

The geology of Erewhon pastoral lease is representative of that of the eastern Southern Alps. The presence of fossil localities in Lizard Gully and Tank Gully, in the lower Clyde valley, is significant. The pastoral lease is dominated by spectacular mountain landforms similar to those of the surrounding mountains. Notable landforms are the ice-sculptured point at the confluence of the Havelock and Clyde valleys, the prominent Jumped Up Downs landform, and the rock debris deposit in the Lawrence valley.

2.3 CLIMATE

Erewhon pastoral lease lies within the rain-shadow of the Main Divide of the Southern Alps. Winds are predominantly from the northwest and are most frequent in spring and autumn. Summers are warm and dry. Winters are cold with frequent snow and severe frosts. Snow can fall at any time of the year, especially at higher altitudes, and can lie on the pastoral lease for several months. Average annual precipitation is probably between 4000 mm in the west and 2000 mm in the east (Tomlinson, 1976).

2.4 LAND ENVIRONMENTS OF NEW ZEALAND (LENZ)

LENZ is, as described by Leathwick *et al* (2003), "a classification of New Zealand's landscapes using a comprehensive set of climate, landform and soil variables chosen for their role in driving geographic variation in biological patterns." The classification units of LENZ, termed land environments by Leathwick *et al* (2003), aim to "identify areas of land having similar environmental conditions regardless of where they occur in New Zealand." Therefore "LENZ provides a framework that allows prediction of a range of biological and environmental attributes. These include the character of natural ecosystems, the vulnerability of environments to human activity, and the potential spread or productivity of new organisms" (Leathwick *et al* 2003). Leathwick *et al* (2003) present the LENZ information at four levels of detail, with Level I containing 20 environments, Level II containing 100 environments, Level III containing 200 environments and Level IV containing 500 environments. These LENZ classes are presented nationally to assist use at a range of scales.

In an analysis of the LENZ Level IV data, with consideration of the remaining indigenous vegetation cover and the legal protection of these environments, Walker *et al* (2005) proposed a threat classification for the remaining indigenous biodiversity in New Zealand's environments based on the two components of vulnerability (likelihood of loss): poor legal protection and risk of loss. This threat classification (Table 5) has become the recognised benchmark for the promotion of threatened LENZ conservation.

Table 5: LENZ threat categories and definitions (Walker *et al* 2005)

Category	Criterion
Acutely threatened	<10% indigenous cover remaining
Chronically threatened	10-20% indigenous cover remaining
At risk	20-30% indigenous cover remaining
Critically under-protected	>30% indigenous cover remaining <10% legally protected
Under-protected	>30% indigenous cover remaining 10-20% legally protected
Less reduced and better protected	>30% indigenous cover remaining >20% legally protected

There are several small areas present on the lease that have been classified as an acutely threatened land environment (see Lenz map). All except one of these areas occur on the river flats associated with Caroline Stream and in the paddocks near the homestead, with the other on the alluvial terrace on the true left of the Clyde River north of the Tank Gully/Clyde River confluence.

Other low-altitude areas of river terrace at Freezing Point in the Havelock Valley, at the confluence of the Lawrence and Clyde valleys, and small areas near the homestead, lie in an 'at risk' land environment. All other parts of the pastoral lease lie within 'less reduced and better protected' land environments.

The majority of the 'acutely threatened' LENZ sites associated with Caroline Stream have been cultivated and retain no indigenous plant communities or ecosystems.

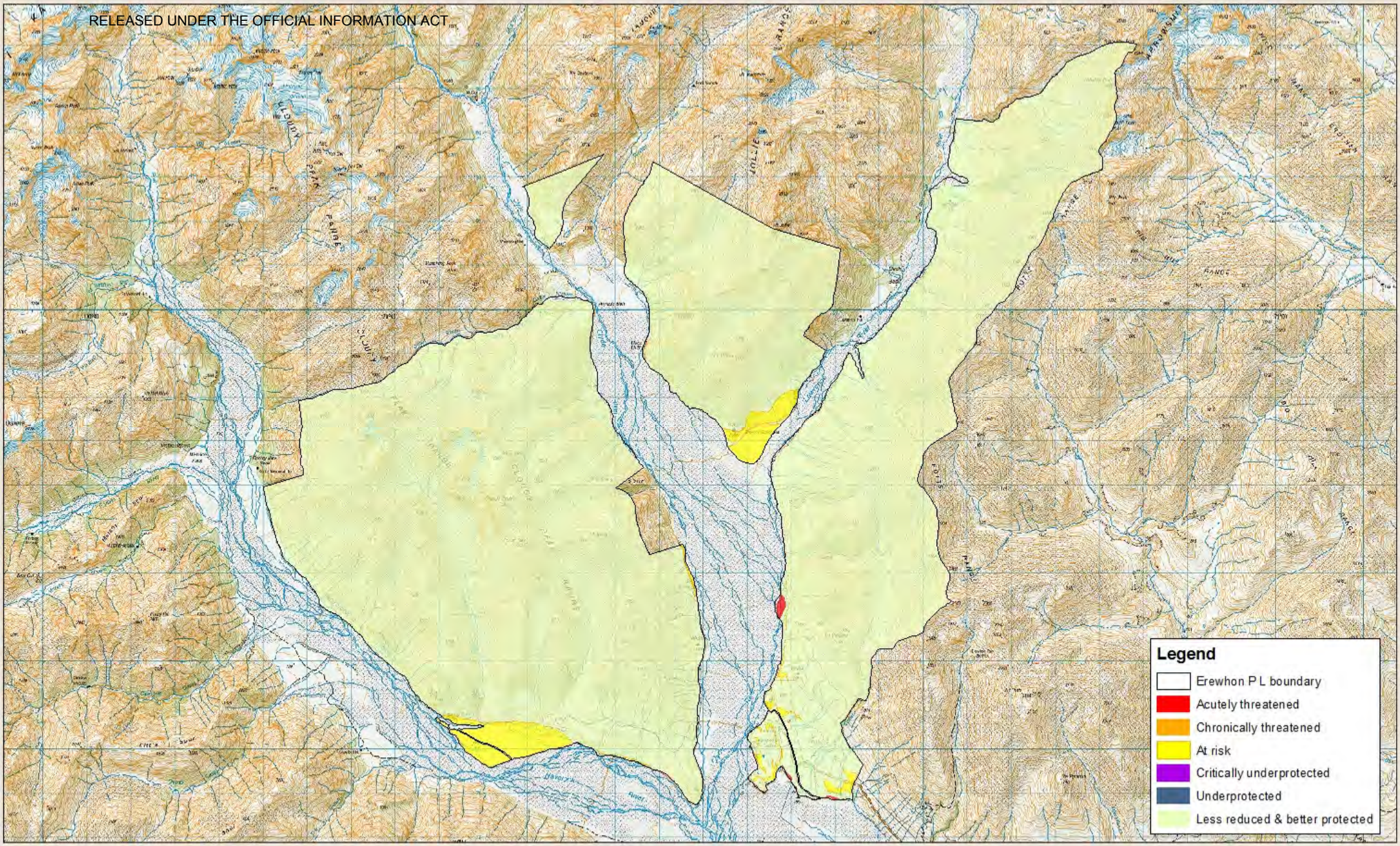
The area on the bed of the Clyde River north of Tank Gully supports sparsely-vegetated stonefield and herbfield dominated by indigenous plant species.

Significance of Land Environments

The significance of the LENZ values are derived from guidelines developed by the Department of Conservation in 2009. The applicable Lenz value guideline is stated below with an explanation as to how the values fit the guideline. The acutely threatened LENZ categories are depicted on the LENZ map, page 17.

49. Indigenous vegetation must have protection where it is associated with Level IV land environments that have 20% or less remaining in indigenous cover.

- Indigenous vegetation is present on an 'acutely threatened' LENZ environment north of Tank Gully on the true left of the Clyde River.



LENZ Threat Categories

N

0 1 2 3 4 5
Kilometres

Geospatial Services

Department of Conservation
Te Papa Atawbai

New Zealand Government

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08 Aug 2014

2.5 VEGETATION

2.5.1 Ecological Context

Erewhon pastoral lease covers steep mountainous country in the eastern part of the central Southern Alps. The original (pre-human) vegetation cover of this area is likely to have been similar to that which is present today, i.e. extensive rockland, gravelfield, herbfield, tussockland and low-shrubland plant communities at higher altitudes. Inaka-celery pine scrub and tall tussockland were probably dominant on mid-altitude slopes, with taller woody vegetation present in sheltered gullies. Closer to the valley-floor and in the main gullies, areas of forest dominated by mountain totara (*Podocarpus cunninghamii*) and/or mountain ribbonwood (*Hoheria lyallii*), broadleaf (*Griselinia littoralis*), kowhai (*Sophora microphylla*) and mountain beech (*Fuscospora cliffortioides*) would have been present. Mossfield, herbfield and tussockland would have dominated alluvial flats (Harding, 2009).

Broadly speaking, the pastoral lease falls within the 'eastern beech gap' where beech forest has failed to colonise to the extent that it has elsewhere throughout the majority of the eastern South Island post the last glaciation (Wardle 1991). The original (pre-human) vegetation of the 'beech gap' is predicted to have been mountain totara and broadleaf forest (still present), with scrub, tussockland and herbfield occurring above tree line (Leathwick *et al*, 2003). Mountain beech remnants are also present in eastern parts of the pastoral lease suggesting a transitional zone between the two dominant forest types. However, mountain beech forest is replaced by mixed podocarp hardwood forests up valley, consistent with the beech gap theory.

Erewhon pastoral lease lies predominantly in the Armoury and Arrowsmith ecological districts (EDs). A relatively small southern part of the pastoral lease on the valley floor lies within the Hakatere and Two Thumb EDs. Armoury ED lies within D'Archiac Ecological Region; Arrowsmith, Haketere and Two Thumb EDs lie within Heron Ecological Region (McEwen, 1987). Heron Ecological Region was surveyed as part of the Protected Natural Areas Programme in 1984/85 (Harrington *et al*, 1986). Five areas, occurring either partly or wholly on the pastoral lease, were recommended for protection following the PNAP survey:

- Arrowsmith Priority Natural Area 1, Upper Lawrence: mountain totara forest, snow totara shrubland, tall tussockland, matagouri shrubland and fescue tussockland.
- Arrowsmith Priority Natural Area 2, Hermitage Boulderfield: mountain totara forest on stable rockfall debris, Lawrence valley.
- Arrowsmith Priority Natural Area 3, Lizard Gully: mountain beech forest, weeping mapou low-forest, matagouri-*Coprosma* spp.-mountain wineberry shrubland, *Senecio cassinioides*-turpentine shrub-snow totara shrubland, narrow-leaved snow-tussockland and rockland.
- Arrowsmith Priority Natural Area 4, Erewhon Beech Remnants: mountain beech forest and narrow-leaved snow-tussockland-cotton daisy.

- Arrowsmith Priority Natural Area 12, Cloudy Peak: altitudinal sequence of tussockland and shrubland communities, spanning both sides of the Cloudy Peak Range.

The pastoral lease adjoins Rangitata/Rakaia Head Waters Conservation Area to the north, Hakatere Conservation Park to the east and Te Kahui Kaupeka Conservation Park across the Havelock River to the southwest. The main parts of the pastoral lease on the Cloudy Peak, Jollie and Potts ranges are separated by extensive areas of Unalienated Crown Land (UCL) on the broad braided beds of the Havelock and Clyde rivers. The pastoral lease is effectively an enclave within an extensive area of relatively intact mountainous country protected as public conservation land.

2.5.2 Vegetation and Flora

The pastoral lease is divided into three main units for this description of the vegetation, comprising the main land parcels. Distinct areas within each unit are described under sub-headings.

Unit 1: Potts Range

The Potts Range unit includes the northwest faces of the Potts Range, from the Lawrence River to the crest of the range. It extends from Ashburton Peak (2359m) in the north to Mt Caroline (1384m) in the south. The entire unit occurs in Arrowsmith ED. Almost all the unit is within the Central Mountains LENZ (P1.2c, P1.2d), with the exception of small areas in the Central Dry Foothills LENZ (E4.1c, E4.2a), and Eastern South Island Plains (N2.1b) which relates to a very small area immediately above Tank Gully. The latter LENZ is classified as 'acutely threatened', whereas the remainder of the unit has no threat category and is well protected.

The Potts Range unit comprises steep mountain slopes with numerous rocky peaks above 1800m. Incised gullies and abundant screes that occasionally reach the valley floor are a feature of the unit, as they are of the entire pastoral lease. Alluvial fans and river terraces are present to a lesser extent. Shrubland and forest remnants dominate the vegetation of the lower slopes. These merge into intact narrow-leaved snow-tussock (*Chionochloa rigida*) grassland, then into slim snow-tussock (*Chionochloa macra*) grassland (hereafter referred to as snow-tussock grassland) and patchy shrubland of predominantly *Dracophyllum* species. Rock and scree covers extensive areas of the upper Potts Range.

The unit includes: RAP 1 (Upper Lawrence) for its mixed mountain totara remnant; RAP 2 (Hermitage boulder field), a unique rock fall community that supports remnant mountain totara and mixed hardwood forest; and RAP 3 (Lizard Gully) with the only weeping mapou (*Myrsine divaricata*) forest in the ED and good examples of celery pine (*Phyllocladus alpinus*), mountain beech forest and bluff communities.

Matagouri (*Discaria toumatou*) shrubland is the physiognomically dominant plant community on river terraces and alluvial fans. Matagouri forms both dense and scattered cover depending on soil depth and disturbance events. The oldest stands are

probably several decades old, if not older, and are taller than 4m. Other shrubs commonly present include mingimingi (*Coprosma propinqua*), *Coprosma rugosa*, mountain wineberry (*Aristotelia fruticosa*), and the climbers, lawyer (*Rubus schmidelioides*) and scrub pohuehue (*Muehlenbeckia complexa*).

Fescue tussock (*Festuca novae-zelandiae*) grassland is typically associated with river terraces and alluvial fans and forms large patches between matagouri shrubland. Numerous native species are associated with these ecosystems, such as blue tussock (*Poa colensoi*), dwarf heath (*Acrothamnus colensoi*), *Rytidosperma pumillum*, woolly moss (*Racomitrium pruinosum*), spineless bidibid (*Acaena inermis*), silver tussock (*Poa cita*), blue wheatgrass (*Elymus solandri*), harebell (*Wahlenbergia albomarginata*), grassland daisy (*Celmisia gracilenta*), creeping pohuehue (*Muehlenbeckia axillaris*), *Raoulia hookerii* and daphne (*Pimelea prostrata*). Species diversity on alluvial fans is notably higher and composition more natural than those on river terraces. Common native species in addition to those listed above include *Gaultheria crassa*, snowberry (*Gaultheria depressa*), *Raoulia subsericea*, mat coprosma (*Coprosma atropurpurea*), *Pentachondra pumila, Brachyglottis bellidioides, Celmisia angustifolia, Celmisia spectabilis, Celmisia sessiliflora, Pimelea oreophila* subsp. *oreophila,* everlasting daisy (*Anaphalioides bellidioides*), aniseed (*Anisotome aromatica*), mountain clubmoss (*Lycopodium fastigiatum*), *Kelleria dieffenbachii, Deyeuxia avenoides,* with scattered narrow-leaved snow-tussock, golden speargrass (*Aciphylla aurea*), inaka (*Dracophyllum longifolium*), turpentine shrub (*Dracophyllum uniflorum*), little hard fern (*Blechnum penna-marina*), *Scleranthus uniflorus* and large patches of cotton daisy (*Celmisia spectabilis*). Exotic species, such as browntop[1]* (*Agrostis capillaris*) and mouse-ear hawkweed* (*Pilosella officinarum*), are also common and can dominate the cover, especially under open matagouri canopy and in damp channels on river terraces, but less so on alluvial fans. Other common exotic species include sheep's sorrel* (*Rumex acetosella*), sweet vernal* (*Anthoxanthum odoratum*), catsear* (*Hypochoeris radicata*), purging flax* (*Linum catharticum*), mouse-ear chickweed* (*Cerastium fontanum*) and Yorkshire fog* (*Holcus lanatus*).

Mixed matagouri/*Coprosma* shrubland forms fairly consistent cover across lower mountain slopes. These shrublands have a higher diversity compared to those on terraces and fans described above. Mingimingi is typically the most common species, mixed with mountain wineberry, matagouri, *Coprosma dumosa, Coprosma rugosa, Coprosma rigida, Hebe traversii,* korokio (*Corokia cotoneaster*), cottonwood (*Ozothamnus leptophyllus*) and tutu (*Coriaria sarmentosa*). Often present is scattered mountain ribbonwood, broadleaf, tree daisy (*Olearia avicenniifolia*), kohuhu (*Pittosporum tenuifolium*), celery pine, mountain flax (*Phormium cookianum*), three-finger (*Pseudopanax colensoi*), lancewood (*Pseudopanax crassifolius*) and mountain totara. Shrublands typically merge into forest remnants in gullies, and into mixed narrow-leaved snow-tussock grasslands upslope.

Forest remnants include mountain totara and hardwood associations, mountain beech, and weeping mapou forest in Lizard Gully as identified in the description for RAP 7. The former tends to occur in gullies and on rocky areas, including on the Hermitage

[1]Naturalised (introduced) species are indicated with an asterisk*.

boulder field. Mountain totara is the dominant tree and typically occurs with broadleaf, celery pine, mountain ribbonwood and kohuhu, with lancewood, three-finger and weeping mapou to a lesser extent. These forests occur with a diverse range of native shrubs described above which they invariably merge into as part of a wider mosaic. Mountain beech remnants occur in a few places. These forests are less diverse than the mixed podocarp forests and typically occur with *Coprosma rhamnoides, Coprosma rigida,* weeping mapou and climbers, most notably bush lawyer (*Rubus cissoides*) which is often common. Ferns commonly present include thousand-leaved fern (*Hypolepis millefolium*), prickly shield fern (*Polystichum vestitum*), *Asplenium richardii, Asplenium appendiculatum* and little hard fern.

Snow-tussock grasslands occur on mid and upper slopes. Narrow-leaved snow-tussock forms a consistent cover, often above 50%, and typically more on shady faces. Other obvious native species commonly present include golden speargrass, inaka, turpentine shrub, matagouri, bracken (*Pteridium esculentum*), porcupine shrub (*Melicytus alpinus*) and fescue tussock, but these species rarely make up more than 5% of the cover. Numerous inter-tussock native species are present, including dwarf hearth, cotton daisy, daphne, blue tussock, creeping pohuehue, blue wheat grass, blue bidibid (*Aceana caesiiglauca*), harebell, grassland buttercup (*Ranunculus multiscapus*), native violet (*Viola cunninghamii*), snowberry, *Brachyglottis bellidioides*, sun orchid (*Thelymitra longifolia*) and onion orchid (*Prasophyllum colensoi*). Mountain flax and *Dracophyllum* species are common on shady aspects. Exotic species, in particular browntop* and mouse-ear hawkweed*, can comprise a substantial portion of the cover, especially below 1000m and on depleted spurs and dry faces where they typically occur with fescue tussock. With increasing altitude, narrow-leaved snow-tussock is replaced by slim snow-tussock at around 1400m. Concomitant changes also occur in native species composition, chiefly subalpine species become more prevalent, such as snow hollow grass (*Chionochloa oreophila*), *Dracophyllum pronum, Aciphylla monroi* to name a few. Naturalness also increases with increasing altitude, with fewer exotic species present.

Alpine rock and scree comprises a substantial part of the Potts Range unit. These ecosystems were not surveyed in detail, but from what was assessed, they remain highly original and natural and support numerous specialist bluff and scree plants. Alpine plants observed include *Leptinella atrata* subsp. *atrata, Epilobium pycnostachyum, Epilobium crassum, Anisotome pilifera, Lignocarpa carnosula, Haastia sinclairii*, bristle tussock (*Rytidosperma setifolium*), bidibid (*Aceana saccaticupula*), *Hebe cheesemanii, Hebe buchananii, Chionohebe pulvinaris, Poa buchananii, Myosotis traversii* var. *cantabrica, Grammitis poeppigiana, Colobanthus acicularis*, vegetable sheep (*Raoulia eximia*), *Pachycladon enysii, Kelleria cheesemanii, Geum uniflorum, Aciphylla dobsonii* and many more.

Lawrence Valley (lower slopes from Shingly Stream to ClydeRiver confluence)

A herbfield/grassland community is present on gentler lower-altitude slopes such as stream fans. It is dominated by cotton daisy, woolly moss, fescue tussock, browntop*, sweet vernal* and blue tussock. Other species commonly present are narrow-leaved snow-tussock, *Rytidosperma gracile, Lachnagrostis lyallii,* blue wheatgrass, mouse-ear hawkweed*, king devil hawkweed* (*Pilosella piloselloides* subsp. *praealta*), snowberry,

mountain clubmoss, little hard fern, *Raoulia subsericea, Ranunculus* sp., *Euphrasia* sp., aniseed, golden speargrass, purging flax*, *Gentianella corymbifera,* sun orchid, onion orchid, harebell, patotara (*Leucopogon fraseri*), red woodrush (*Luzula rufa*) and blue bidibid. Occasional shrubs of matagouri and turpentine shrub are present.

Shrubland/scrub is present at the base of steeper slopes, notably below open scree. It is dominated by matagouri, mingimingi and korokio. Other woody species present are *Coprosma rigida, Coprosma intertexta* (relict), porcupine shrub, kohuhu, *Pittosporum anomalum,* mountain wineberry, *Hebe traversii, Hebe subalpina,* mountain totara, snow totara (*Podocarpus nivalis*), dwarf mistletoe (*Korthalsella clavata*) and the climbers: scrub pohuehue, lawyer and *Clematis marata*.

Species present within the shrubland community are narrow-leaved snow-tussock, blue tussock, blue wheatgrass, plume grass (*Dichelachne crinita*), dwarf heath, *Asplenium appendiculatum, Asplenium richardii*, necklace fern (*Asplenium flabellifolium*), little hard fern, sheep's sorrel*, patotara, harebell, native violet, mouse-ear chickweed*, purging flax*, creeping pohuehue, *Anisotome filifolia, Epilobium* sp., woolly mullein* (*Verbascum thapsus*), hawksbeard* (*Crepis capillaris*), blue bidibid, *Hypnum cupressiforme*, wire moss (*Polytrichum juniperinum*) and seedlings of kohuhu, korokio and *Coprosma* species.

Open rock scree was surveyed on slopes just up-valley from Shingly Stream. Plant species present are creeping pohuehue, blue wheatgrass, *Lignocarpa carnosula, Geranium brevicaule* and, at the margin, bracken. Additional species observed elsewhere on finer scree were bristle tussock, *Raoulia glabra* and *Anisotome filifolia*.

Tussockland is the most extensive plant community on low to mid-altitude slopes. It is dominated by narrow-leaved snow-tussock. Other important species are golden speargrass, blue tussock, snowberry, cotton daisy and mouse-ear hawkweed*. Other species present are matagouri, inaka, turpentine shrub, mingimingi, native broom (*Carmichaelia australis*), korokio, cottonwood (uncommon), bracken, *Gaultheria crassa,* dwarf heath, king devil hawkweed*, sweet vernal*, browntop*, *Lachnagrostis lyallii, Deyeuxia* sp., Chewings fescue* (*Festuca rubra*), catsear*, *Helichrysum bellidioides,* patotara, sun orchid, grassland orchid (*Microtis unifolia*), *Pimelea oreophila, Raoulia subsericea, Gonocarpus aggregatus,* grassland daisy, sheep's sorrel*, *Carex breviculmis, Lycopodium scariosum*, woolly moss, *Geranium brevicaule, Gentianella corymbifera,* harebell and *Celmisia angustifolia*.

Stands of mountain beech forest are present in sheltered gullies and on steeper slopes. The canopies of these stands are dominated by mountain beech. Other canopy or subcanopy species are broadleaf, yellowwood (*Coprosma linariifolia*), lancewood, mountain ribbonwood and lawyer. Understorey species present are *Pittosporum anomalum,* mingimingi, *Coprosma dumosa,* korokio, kohuhu, bush snowberry (*Gaultheria antipoda*), turpentine shrub, koromiko (*Hebe salicifolia*) and mountain flax. Groundcover species are tussock hawkweed* (*Hieracium lepidulum*), cotton daisy, *Lagenifera strangulata, Anisotome filifolia,* snow totara, thousand-leaved fern, creeping pohuehue and selfheal* (*Prunella vulgaris*). Species commonly present at forest

margins, especially along streams are tutu, tree daisy, *Olearia arborescens*, *Hebe traversii*, *Coprosma dumosa*, korokio and dwarf heath.

The steep gravel beds of the small streams along the valley side have a distinctive flora. Commonly present on freshly-deposited gravel are *Epilobium melanocaulon*, creeping pohuehue, *Parahebe decora* and *Raoulia hookeri*. Occasionally present are plume grass, fescue tussock, *Raoulia glabra*, *Poa lindsayi*, white clover* (*Trifolium repens*), narrow-leaved plantain* (*Plantago lanceolata*), Yorkshire fog*, woolly mullein*, mouse-ear hawkweed*, Deptford pink* (*Dianthus armeria*), Californian thistle* (*Cirsium arvense*) and Scotch thistle* (*Cirsium vulgare*).

Clyde Valley (lower slopes from Lawrence confluence to Tank Gully)

Tussockland communities are similar to those described for the lower Lawrence valley. Important differences are a greater presence of bracken, cotton daisy, fescue tussock and pasture grasses (browntop*, sweet vernal* and Yorkshire fog*). Additional species recorded from tussockland communities here are silver tussock and cocksfoot* (*Dactylis glomerata*).

Shrubland and scrub are dominated by mingimingi and matagouri. Other species are *Coprosma rugosa*, *Coprosma dumosa*, inaka, turpentine shrub, *Hebe subalpina*, cottonwood, korokio, *Dracophyllum kirkii* (uncommon), manuka (*Leptospermum scoparium*), *Olearia bullata*, native broom, mountain wineberry, porcupine shrub, koromiko, bush snowberry, *Gaultheria crassa*, bracken, dwarf heath, prickly shield fern, mountain flax, tutu, and the climbers: lawyer, scrub pohuehue, pohuehue (*Muehlenbeckia australis*), native jasmine (*Parsonsia capsularis*) and *Clematis marata*. Occasionally emergent from scrub are kowhai (*Sophora microphylla*), broadleaf and mountain ribbonwood.

Intact low-forest is present on steep south-facing slopes in lower Lizard Gully. It is dominated by broadleaf and mountain ribbonwood. Other canopy species are mountain totara, kowhai, lancewood, tree daisy, mountain wineberry, inaka, korokio, mountain flax, prickly shield fern and lawyer.

Low forest/scrub is present on north-facing slopes of lower Lizard Gully. It is dominated by mingimingi, matagouri and korokio, with emergent trees of kowhai, broadleaf, lancewood, yellowwood and mountain ribbonwood. Other species present are *Hebe traversii*, tree daisy, *Helichrysum intermedium*, *Coprosma rigida*, weeping mapou, mountain wineberry, native broom, porcupine shrub, dwarf mistletoe (abundant on mingimingi and matagouri) and the climbers: native jasmine, lawyer, pohuehue and native bindweed (*Calystegia tuguriorum*). The significance of weeping mapou here is noted in the RAP description for this area.

Ground-cover species are *Asplenium richardii*, blue wheatgrass, harebell, *Wahlenbergia gracilis*, pennywort (*Hydrocotyle novae-zelandiae*), creeping pohuehue and bracken. Additional species present at rocky sites are *Hebe pinguifolia*, bristle tussock, toatoa (*Haloragis erecta*), *Asplenium trichomanes*, *Asplenium appendiculatum*, necklace fern, *Cystopteris tasmanica* and white fuzzweed (*Vittadinia australis*).

Beech forest is present on steep slopes in the gorged section of Lizard Gully. It is dominated by large old trees of mountain beech. Other canopy or subcanopy trees are lancewood, broadleaf, yellowwood and mountain totara. Understorey species are *Helichrysum intermedium*, *Coprosma dumosa*, mingimingi, *Coprosma rigida*, korokio, broadleaf, kowhai, lawyer and mountain flax.

Forest floor species are bush lily (*Astelia fragrans*), *Asplenium richardii*, *Asplenium appendiculatum*, little hard fern, mountain kiokio (*Blechnum montanum*), common shield fern (*Polystichum richardii*), prickly shield fern (uncommon), *Lagenifera strangulata*, cotton daisy, blue bidibid, aniseed, *Uncinia clavata*, *Poa imbecilla* and seedlings of *Coprosma dumosa*, broadleaf, yellowwood, mountain beech and korokio.

A single Russell lupin* (*Lupinus polyphyllus*) plant was observed at the stream edge in lower Lizard Gully. The plant was pulled, but seeds had already been dispersed from this season's pods.

Tank Gully

Tank Gully contains an unstable stream bed which drops steeply from a precipitous rocky upper basin to a steeply-sloping fan at the Clyde River. The active stream bed supports a range of typical riverbed species, including *Raoulia tenuicaulis*, *Raoulia haastii*, silver tussock, *Epilobium melanocaulon*, harebell, woolly mullein*, catsear*, Yorkshire fog*, tutu and Scotch thistle*.

Adjacent areas of more stable streambed and valley side support scrub and shrubland dominated by matagouri. Other species present in this shrubland/scrub are korokio, mingimingi, mountain wineberry, *Olearia odorata*, lawyer, scrub pohuehue, native jasmine, *Clematis marata*, bracken, golden speargrass and occasional emergent kowhai and broadleaf. A notable feature is the abundance of dwarf mistletoe (*Korthalsella clavata*) on matagouri.

A small area of kowhai forest lies adjacent to the scrub on the south side of the stream. This forest is dominated by small trees of kowhai with trunk diameters (at breast height) between 15 and 25cm. Other canopy species are bush lawyer, scrub pohuehue and native jasmine. The forest understorey is open. Ground-cover species are *Cystopteris tasmanica*, necklace fern, little hard fern, *Dichondra repens*, *Cardamine debilis* and hairy pennywort (*Hydrocotyle moschata*). Species present at the forest margin are tutu, mingimingi, mountain wineberry, thousand-leaved fern, prickly shield fern, horehound* (*Marrubium vulgare*), *Scandia geniculata* and dwarf mistletoe (on matagouri).

A small patch of hardwood forest lies on the north side of the stream. Canopy species are broadleaf, yellowwood and kowhai. Ground-cover species are necklace fern, *Asplenium richardii*, *Cystopteris tasmanica*, cotton daisy, tussock hawkweed*, *Cardamine debilis* and seedlings of broadleaf. Species present at the forest margin are matagouri, *Hebe traversii*, mingimingi, *Coprosma rigida*, tree daisy, korokio, native broom, porcupine shrub, native jasmine and tutu.

Beech forest occupies steep slopes on the north side of the gully. The forest canopy comprises mountain beech. The forest understorey is open, with scattered plants of mingimingi, turpentine shrub, *Helichrysum lanceolatum* and occasional beech saplings. Ground-cover species are *Anisotome filifolia*, aniseed, cotton daisy, prickly shield fern, *Asplenium richardii* and seedlings of mingimingi and mountain beech. Species present at the forest margin are mountain ribbonwood, *Coprosma rugosa* and narrow-leaved snow-tussock.

Moderately-steep slopes on the north (south-facing) side of the lower valley are dominated by tussockland-shrubland. Important species here are fescue tussock, cotton daisy and dwarf heath. Other species present are turpentine shrub, cottonwood, mountain clubmoss, little hard fern, prickly shield fern, sweet vernal* and browntop*. Old beech logs are present.

Moderately-steep slopes on the south (north-facing) side of the lower valley support grassland. Important species here are mouse-ear hawkweed*, patotara and fescue tussock. Also present are sweet vernal*, browntop*, bracken, matagouri, *Pimelea oreophila*, suckling clover (*Trifolium dubium*), sheep's sorrel*, *Coprosma petriei*, *Ranunculus multiscapus*, blue bidibid, narrow-leaved snow-tussock and rarely sweet brier* (*Rosa rubiginosa*). A steep rock bluff at the top of these slopes (just north of spot-height 959) supports matagouri, cottonwood, golden speargrass, narrow-leaved snow-tussock, korokio, native broom, kowhai, prostrate kowhai (*Sophora prostrata*), mingimingi, porcupine shrub, lawyer, *Helichrysum intermedium*, necklace fern, *Asplenium trichomanes*, little hard fern and *Raoulia glabra*.

Scattered mountain totara trees are present on steep bluffs on the slopes of Mt Caroline.

Clyde Valley (lower slopes from Tank Gully to Caroline Stream)

This area comprises moderately steep slopes between approximately 800m altitude and the upper fence along the mid-slopes of Mt Caroline (between 900 and 1000m altitude), between Tank Gully and the pastoral lease boundary at Caroline Stream. Land below this area is substantially modified, with cultivated or over-sown and top-dressed pasture.

Lower altitude parts of this area and the western part of the area (between spot-heights 959 and 791) have lower inherent natural values. This part of the area supports grassland, dominated by pasture grasses*, with narrow-leaved snow-tussock, fescue tussock and cotton daisy. Other species present are white clover*, patotara, everlasting daisy, sheep's sorrel*, mouse-ear hawkweed*, snowberry, dwarf heath, wire moss, little hard fern, scattered to dense low-stature matagouri and occasional golden speargrass and turpentine shrub. The composition of this grassland community appears strongly influenced by farm management, notably over-sowing, top-dressing and grazing pressure.

In the eastern part of this area, this community grades upslope to tussockland dominated by narrow-leaved snow-tussock, matagouri, cotton daisy, fescue tussock, golden speargrass, tutu, dwarf heath and pasture grasses*. Other species present are

snowberry, mountain clubmoss, white clover*, patotara, turpentine shrub, inaka, native broom, cottonwood and Yorkshire fog*. Snow tussock ranges in cover from approximately 25 to 50% and in height from 70 to 90cm. Substantial areas of bog rush (*Schoenus pauciflorus*) are present in seepages on the upper slopes. Within this area are forest and rockland communities, described below.

Exposed areas of rock are present on the western sides of the small ridges (roches moutonnées) near the centre of this area. The rock faces are steep, ice-smoothed and bare. Areas of broken rock and gravelfield at the top of these rock faces support an interesting suite of plant species adapted to shallow soils and exposed conditions. Stunted mountain beech and mountain totara trees dominate some areas. Species present elsewhere on the crest of the bluff are bush snowberry, *Gaultheria crassa*, *Pimelea traversii*, native broom, cotton daisy, narrow-leaved snow-tussock, slim snow-tussock, *Exocarpus bidwillii*, *Coprosma acerosa* ('at risk', declining), *Helichrysum intermedium*, *Hebe pinguifolia*, everlasting daisy, harebell, native violet, patotara, *Raoulia glabra* and mouse-ear hawkweed*.

Small areas of forest are present at the base of the bluffs. One area is dominated by mountain ribbonwood. Another, in a small ravine, is dominated by mountain beech. Also present here are broadleaf, tree daisy, *Olearia arborescens* and bush lily.

Forest is also present alongside the upper reaches of a small stream between the roches moutonnées and Caroline Stream. It is dominated by mountain beech but, interestingly, has a high component of mountain totara in the canopy and subcanopy. Both mountain beech and mountain totara are regenerating strongly in the surrounding tussockland: saplings and seedlings of both species are common for some distance from the forest margin. Other species present within the forest are broadleaf, prickly shield fern, mingimingi, bush lily, mountain kiokio and little hard fern. Species commonly present at the forest margin are matagouri, bush snowberry, mingimingi, *Coprosma dumosa*, *Coprosma rigida* and mountain flax. Scattered plants and clumps of broom* (*Cytisus scoparius*) are present in this area.

A relatively large area of beech forest is present at the eastern boundary of the pastoral lease alongside Caroline Stream. The forest canopy is dominated by mountain beech. Other canopy or subcanopy species are broadleaf, mountain ribbonwood and lancewood. Understorey species are mountain wineberry, broadleaf, tree daisy, lancewood, three-finger, *Helichrysum lanceolatum*, *Coprosma rhamnoides*, prickly mingimingi, lawyer, bush lawyer, scrub pohuehue, and saplings of mountain beech and mountain totara. Ground-cover species are prickly shield fern, *Cystopteris tasmanica*, blue bidibid, *Asplenium richardii*, bush lily and seedlings of mingimingi and porcupine shrub. Other species present at the forest margin are koromiko, bush snowberry, dwarf heath, tutu and native jasmine. Species present alongside the stream in a narrow chasm are mountain kiokio, little hard fern, *Asplenium appendiculatum* and hound's tongue fern (*Microsorum pustulatum*). This area of forest grades down-valley (below a weir and water intake) to matagouri scrub and shrubland. This remnant beech forest area has been previously identified in the Heron Ecological Region PNAP survey report as Arrowsmith Priority Natural Area 4, Erewhon Beech remnants.

Fans Adjoining Caroline Stream

This area comprises the alluvial fans adjacent to lower Caroline Stream. Most parts of this area are highly modified through cultivation and/or over sowing and top-dressing and are dominated by exotic pasture species. However the lower reaches of Caroline Stream between the road and Rangitata River support a relatively intact riparian shrubland that occupies an active alluvial fan.

Matagouri is the dominant species with some specimens up to 4m tall. Other common plants are porcupine shrub, mingimingi, lawyer, scrub pohuehue and *Clematis marata*. Small trees of mountain ribbonwood are also present. The shrubland understory is open and supports a variety of native and exotic species, including little hard fern, necklace fern, browntop*, sweet vernal*, white clover*, sheep's sorrel*, blue bidibid and creeping pohuehue. In recent channels and on lobes of stone, silver tussock is common. Other species are patotara, spineless bidibid, scabweed (*Raoulia australis*), creeping pohuehue, mat coprosma and mouse-ear hawkweed*.

East of the confluence of Caroline Stream and Rangitata River, matagouri-dominated shrublands similar in composition to that described above occupy the terrace risers and small incised gullies that adjoin the floodplain of the Rangitata River. An open matagouri shrubland also occurs across the fan at the southern end of the pastoral lease.

Jumped Up Downs

The Jumped Up Downs landform is an area of complex hilly topography at the confluence of the Clyde and Rangitata rivers.

The vegetation is dominated by modified silver tussock and fescue tussock grassland. Tussock cover tends to be sparse (typically less than 10%). The inter-tussock vegetation is highly modified and dominated by exotic herbs and grasses, including browntop*, sweet vernal*, ryegrass* (*Lolium perenne*), white clover*, catsear*, sheep's sorrel* and mouse-ear chickweed*. Indigenous species present are creeping pohuehue, harebell and *Oxalis exilis*. Matagouri shrubs occur throughout, forming dense thickets up to 3m tall in places. Other shrub species present are mingimingi, *Olearia bullata* and porcupine shrub. Large trees of mountain ribbonwood are also occasionally present. The climbers *Clematis marata*, scrub pohuehue and lawyer are present among clumps of shrubs.

The best and most natural shrublands here occur around the rocky bluffs that adjoin the Rangitata and Clyde rivers. In particular, the steep faces on the southern end are notable for their diversity. Species present are mountain wineberry, mingimingi, *Coprosma rugosa, Coprosma dumosa, Olearia bullata*, mountain ribbonwood, mountain flax, native broom, golden speargrass, narrow-leaved snow-tussock, tree daisy, native jasmine, prickly shield fern and mountain kiokio. Present on rock bluffs are blue tussock, snowberry, *Cardamine "s*cree race" (Dr Peter Heenan *pers. comm.*), blue wheatgrass, *Senecio quadridentatus*, *Cystopteris tasmanica* and necklace fern.

Ponds, kettleholes and bogs are all present on the Jumped Up Downs, forming a relatively diverse collection of wetlands. The largest wetland occurs in a basin which is dominated by bog rush and scattered fescue tussock. Other wetlands occur in local depressions, some of which appear to hold permanent standing water. These wetlands support pukio (*Carex secta*), with swards of bog rush and rautahi (*Carex coriacea*) at their margins. Other species commonly present are *Carex gaudichaudiana*, *Eleocharis acuta*, *Ranunculus amphitricus*, *Hydrocotyle hydrophila* and *Potentilla anserinoides*. Common exotic species present are jointed rush* (*Juncus articulatus*), Yorkshire fog*, *Myosotis laxa* ssp. *caespitosa**, red clover* (*Trifolium pratense*) and *Sagina procumbens**. Most of these wetlands are highly modified by cattle pugging and disturbance.

Two ponds occur at the southern end of the area adjacent to the floodplain of the Rangitata River. The larger of the two ponds is surrounded by grey willow* (*Salix cinerea*) and has surprisingly low species diversity, with the exception of scattered *Carex flagellifera* in the adjoining damp exotic grassland. The other pond has fewer willows and contains relatively low diversity turf around its margins which merges into modified fescue tussock grassland. Native species are *Carex gaudichaudiana*, rautahi, bog rush, *Eleocharis acuta*, *Ranunculus foliosus*, *Juncus novae-zealandiae* and red pondweed (*Potamogeton cheesemanii*). Exotic species are common, in particular jointed rush* and *Callitriche stagnalis**.

Bluffs and steep rock faces present in the area support interesting communities that include the specialist bluff species, *Helichrysum intermedium*. Other common species on bluffs are blue tussock, porcupine shrub, creeping pohuehue, pohuehue, tree daisy, *Rytidosperma* sp., patotara, matagouri, lawyer, little hard fern, *Pellaea calidirupium*, *Grammitis poeppigiana*, *Asplenium richardii*, *Asplenium trichomanes* and necklace fern.

An area of Russell lupin* occupies the lower flanks adjoining the Clyde River. The high potential for this species to spread into the braided river ecosystem is of major concern and should be given highest priority for control. Other weeds of concern within this area are broom* and gorse* (*Ulex europaeus*), both of which have sporadic occurrence and a high risk of spread. Flowering currant* (*Ribes sanguineum*), rowan* (*Sorbus aucuparia*) and silver birch* (*Betula pendula*) are present near a conifer plantation on an area of dunes.

Unit 2: Mt McRae

This unit comprises the southern end of the Jollie Range between the Lawrence and Clyde rivers. It also includes an isolated part of the pastoral lease in the upper Clyde valley immediately west of the Sinclair River gorge. Public conservation land surrounds the unit.

The entire unit lies within Armoury ED. Most of the unit occurs in the Central Mountains (LENZ P1. 2a, P1. 2c, P1. 2d) and Southern Alps (LENZ R1.1c), with minor proportions occurring in the Central Dry foothills (LENZ E4.1c, E4.2a). These LENZ are not threatened and are well protected. The alluvial terrace at the confluence of the

Lawrence and Clyde Rivers is in Central Uplands Recent Soils LENZ (K1.1a, K1.1b) which is classified as 'at risk'.

The Mt McRae unit consists of steep and deeply incised mountain slopes with rock and scree comprising the majority of the area. Alluvial fans and river terraces are scarce with the exception of the large terrace at the confluence of the Lawrence and Clyde rivers. Lateral moraines are also present in the upper Clyde north of the Sinclair River. For the most part the unit comprises a complex mosaic of highly natural indigenous plant communities representative of the original ecological patterns of the ED. Shrublands and forest remnants dominate the vegetation of the lower slopes. These merge into intact and complex mosaics of snow-tussock grassland and extensive shrubland of predominantly *Dracophyllum* species, with dense matagouri associations in gullies and on recent fans. Specialised alpine vegetation (scree plants, cushion field etc.) occurs at higher altitudes.

The composition of the vegetation changes depending on aspect and slope variation. Snow-tussock grassland tends to dominate the sunny faces where it often comprises more than 40% of the cover, and more than 80% cover in depressions. Inaka and turpentine shrub tend to dominate the shady faces with cover typically exceeding 40%. Mountain kiokio and matagouri/*Coprosma* shrubland commonly forms large patches throughout. Vegetation cover is typically dense, waste-high and difficult to walk through, especially on the shady aspects.

A high diversity of species is present within the mixed snow-tussock and *Dracophyllum* complexes. Common species present include mountain flax, blue tussock, *Gaultheria crassa*, everlasting daisy, *Coprosma cheesemanii, Coprosma dumosa, Coprosma* aff. *pseudocuneata*, false speargrass (*Celmisia lyallii*), cotton daisy, *Celmisia semicordata, Celmisia angustifolia, Celmisia walkeri, Hebe traversii*, golden speargrass, mountain clubmoss, dwarf heath, *Raoulia subsericea,* red woodrush, blue wheatgrass, daphne, *Gonocarpus micranthus, Pentachondra pumila,* snowberry, comb sedge (*Oreobolus pectinatus*). Less commonly present are *Rytidosperma gracile*, Haast's carrot (*Anisotome haastii*), and *Ourisia macrocarpa* subsp. *calycina*. Shrubs of *Olearia cymbifolia, Olearia arborea,* celery pine, mountain totara, three-finger and mountain ribbonwood, occur sporadically throughout the lower slopes (below 1200m). A notable feature of these plant communities is the paucity of exotic species. Those very occasionally present are sheep's sorrel*, Yorkshire fog*, jointed rush*, browntop* and mouse-ear hawkweed*.

Several kettle holes occur on the moraine terrace above the Sinclair River at about 1000m. These are highly natural and have turf and sedge assemblages around their margins. Bog rush, *Carex gaudichaudiana*, comb sedge, *Carex echinata, Celmisia glandulosa*, sundew (*Drosera arcturi*), *Kelleria dieffenbachii, Deschampsia chapmanii* and three 'at risk' (naturally uncommon) species: *Lobelia ionantha, Montia angustifolia* and *Juncus pusillus*. A 'threatened' (nationally vulnerable) species, *Isolepis basilaris,* is common in one kettle hole. Red tussock (*Chionochloa rubra*) and comb sedge are common around kettle holes on imperfectly drained sites. Other species here include *Dracophyllum kirkii,* snow totara, *Coprosma cheesemanii*, blue tussock, little hard fern, mat coprosma, woolly head (*Craspedia* aff. *minor*) and *Celmisia alpina*.

Mountain totara forest occurs in gullies and as sporadic pockets around bluffs. The best stands occur at the confluence of Sinclair River. Here mountain totara trees attain a height of 10 metres and occur with old growth mountain ribbonwood, broadleaf, celery pine and the occasional manuka. Possum damage on mountain totara was noticeable and the understory is quite bare, with occasional prickly shield fern, *Asplenium hookerianum,* necklace fern, *Asplenium richardii,* little hard fern, thousand-leaved fern, hairy pennywort and wall lettuce* (*Mycelis muralis*). These forests merge with dense matagouri shrubland down slope, and with *Dracophyllum* and snow-tussock grassland complexes upslope.

Dense matagouri/*Coprosma* shrublands occurs on convex alluvial fans and in stream gullies along the lower slopes below c.1200m. Matagouri, mingimingi, *Coprosma dumosa, Coprosma rugosa, Coprosma* aff. *pseudocuneata*, mountain wineberry, porcupine shrub, *Gaultheria crassa*, golden speargrass, *Hebe traversii*, tutu, feathery tutu (*Coriaria angustissima*) and lawyer are the dominant species. Composition varies depending on altitude and adjoining vegetation with which it merges. Often present are young plants of mountain totara, broadleaf, mountain ribbonwood, celery pine, tree daisy, inaka and narrow-leaved snow-tussock. An interesting shrubland association occurs on the terrace-like gentle fan on the true right of the Lawrence River near the confluence with the Clyde. This shrubland contains several *Dracophyllum* species, including inaka, turpentine shrub, *D. kirkii, D. pronum* and what appear to be hybrids between *D. pronum* and *D. uniflorum*. A high diversity of native species is present including narrow-leaved snow-tussock, fescue tussock, blue tussock, bristle tussock, snowberry, cottonwood, matagouri, golden speargrass, *Gaultheria crassa, Raoulia subsericea,* cotton daisy, mountain heath, dwarf heath, everlasting daisy and little hard fern. Exotic species are relatively infrequent, but include browntop*, catsear*, mouse-ear hawkweed*, sheep's sorrel* and one plant of gorse* (*Ulex europaeus*).

Recent alluvial fans support patchy matagouri and 'dry land' moss and herbfield species, such as creeping pohuehue, harebell, woolly moss, blue tussock, dwarf heath, *Stellaria gracilenta, Rytidosperma pumilum, Raoulia glabra,* scabweed, *Epilobium melanocaulon,* spineless bidibid, fescue tussock, silver tussock, *Parahebe decora, Coprosma acerosa* ('at risk', declining) and *Helichrysum filicaule*. The large flat terrace at the confluence of the Lawrence and Clyde rivers supports excellent mossfield with extensive old growth matagouri. Matagouri tends to occur in patches and includes large plants above 3m tall. The mossfield occupies large areas of the terrace and is dominated by woolly moss. Also present are scattered scabweed, daphne, porcupine shrub, *Stellaria gracilenta*, *Raoulia monroi* ('at risk', declining), *Rytidosperma pumilum*, creeping pohuehue, blue tussock, mat coprosma, harebell, aniseed, *Luzula rufa* var. *albicomans, Colobanthus strictus* and spineless bidibid. Mouse-ear hawkweed* and browntop* are locally common, with the latter especially prominent under the matagouri canopy.

Extensive areas of mountain beech forest occur around the lower flanks of Mt McRae between the Clyde and Lawrence rivers. Core areas of forest are quite simple with scattered broadleaf and lancewood present in the subcanopy. Bush lawyer is common, especially on edges, as is celery pine, kowhai, broadleaf and kohuhu, especially on

sunny aspects in the Lawrence valley. The understory is often damaged by stock, fairly bland and open, with occasional yellowwood, *Coprosma rigida*, *Coprosma dumosa* and *Pittosporum divaricatum*. Sapling mountain beech is dense under open canopy and light gaps. The ground layer contains typical herbs and ferns, such as, hook grasses (*Uncinia rupestris* and *Uncinia clavata*), prickly shield fern, little hard fern and hairy buttercup (*Ranunculus foliosus*).

Extensive scree and rock makes up a substantial part of the unit. These ecosystems were not surveyed in detail, but they are original surfaces and most likely to be highly natural and support specialist bluff and scree plants. Plant communities are likely affected by thar and chamois, both of which were seen.

Unit 3: Cloudy Peak Range

This unit comprises the Cloudy Peak Range between the Clyde and Havelock rivers. The entire unit is within Armoury ED. Public conservation land adjoins the unit west of the pastoral lease boundary. Most of the unit occurs in the Central Mountains (LENZ P1. 2a, P1. 2c, P1. 2d) and Southern Alps (LENZ R1.1c), with minor proportions occurring in the Central Dry foothills (LENZ E4.1c, E4.2a), and Permanent Snow and Ice (T1.1a). These LENZ are not threatened and are well protected. The alluvial terraces in the Havelock are in Central Uplands Recent Soils LENZ (K1.1a, K1.1b) and are classified as 'at risk'.

This unit consists of steep and deeply incised mountain slopes with rock and scree comprising much of the unit. It includes several peaks above 2000m, the highest being Cloudy Peak at 2403m. Alluvial fans and river terraces are scarce with the exception of the 'stable' river flats in the Havelock valley, and at the confluence of the Clyde and Havelock rivers, although this latter area is predominantly Crown land.

For the most part the unit comprises a complex mosaic of native plant communities that are highly natural and representative of the original ecological patterns of the ED. It is characterised by diverse and highly natural assemblages of snow-tussock grassland and shrublands of predominantly *Dracophyllum* species. Composition varies markedly across short distances owing to diverse environmental gradients (aspect, slope, altitude and disturbance). These merge with dense matagouri/*Coprosma* associations in gullies and recent fans. Mountain totara forest remnants are also present, most notably at Armada Bluff in the Clyde valley and at Cloudy Stream in the Havelock valley. Specialised alpine vegetation (scree plants, cushion field etc.) occurs at higher altitudes. The vegetation in this unit is similar to that described for similar ecosystems earlier in this report.

The densest shrublands on the Cloudy Range unit occur in steeply incised streams and along lower slopes. They tend to be dominated by mountain wineberry, matagouri and mingimingi, but commonly include many other species such as *Hebe traversii*, mountain ribbonwood, *Coprosma rugosa, Coprosma dumosa,* turpentine shrub, inaka, golden speargrass, giant speargrass (*Aciphylla scott-thomsonii*), *Olearia bullata*, tutu, thousand-leaved fern and prickly shield fern. Broadleaf, celery pine, mountain totara, mountain wineberry and kowhai are also occasionally present and can form fairly

extensive patches in places. Bog pine (*Halocarpus bidwillii*) occurs in a few places on midslope benched terraces, typically at areas of impeded drainage.

Shrublands extend across adjoining slopes where they mix with a high diversity of herbaceous native species, including patches of red tussock, narrow-leaved snow-tussock, fescue tussock and cotton daisy herbfield. Inaka, turpentine shrub, *Dracophyllum pronum*, mountain kiokio and mountain flax become increasingly prevalent and dominant toward the west and on shady slopes. Other common species throughout include blue tussock, woolly moss, bush snowberry, snowberry, mountain heath, *Hebe odora, Coprosma* aff. *pseudocuneata*, *Pimelea oreophila*, *Pentachondra pumila*, mountain clubmoss, *Kelleria dieffenbachii*, aniseed, cottonwood, little hard fern and several species of mountain daisy, as previously recorded. *Pittosporum anomalum* is occasionally present, as is the occasional tree of kowhai and mountain totara. These plant communities are remarkably free of exotic species and are highly natural.

Forest remnants of old growth mountain totara and hardwood associations occur in places. The most impressive examples occur in the Clyde valley around Armada Bluff and in Cloudy Stream in the Havelock valley. These remnants support numerous large trees of mountain totara, with trunk diameters (at breast height) or more than 100cm, and typically occur with kowhai, kohuhu, broadleaf, mountain ribbonwood, lancewood, yellowwood, celery pine and a wide variety of small-leaved shrubs. A small stand of mountain beech is also present in the Clyde valley, as is an extensive area of regenerating mountain totara and associated hardwood species on the large alluvial fan near the hut on the true right of the valley. Forest merges into mixed scrub and tussockland mosaics similar to that described for the MacRae unit. The general structure and associated understory species are similar to those described earlier in this report for similar ecosystems.

Several large bluffs adjoin the river. These support interesting assemblages of species, including tree daisy, giant buttercup (*Ranunculus lyallii*), koromiko, mountain flax, *Chionochloa conspicua*, inaka, turpentine shrub, golden speargrass, *Helichrysum intermedium* and mountain kiokio, along with the more common shrubs listed above. Armada Bluff itself contains an interesting array of specialist bluff plants, such as *Helichrysum intermedium, Libertia ixioides, Craspedia* "Havelock" ('at risk', naturally uncommon), tree daisy*, Colobanthus strictus*, leather-leaf fern (*Pyrrosia eleagnifolia*), bristle tussock, plume grass, feathery tutu and native broom. It is otherwise surrounded by mountain totara forest and diverse shrubland.

There are noticeable differences in the broad vegetation patterns most probably related to aspect differences between the Clyde (sunny) and the Havelock (shady) valleys. The Havelock valley contains denser vegetation of highly diverse snow tussockland and shrubland mosaics, whereas the Clyde valley tends to contain a higher component of tussock compared to scrub, although is equally diverse. Mountain kiokio and mountain flax are particularly prevalent in the upper Havelock valley compared to the sunnier Clyde faces. Other species, such as giant buttercup and giant speargrass are noticeably more common on the Havelock faces.

The composition of the plant communities in both valleys becomes more modified toward the confluence of the Clyde and Havelock rivers. Increasing modification of the vegetation probably corresponds with decreasing rainfall gradient from the upper valleys in the west to the lower valleys in the east. Most noticeably, midslope tussocklands become more prevalent losing much of their subalpine component. Shrublands also become less extensive and more restricted to gullies, lower slopes, river margins and around bluffs, although patches of scrub and scattered trees of broadleaf, kowhai and mountain ribbonwood remain present throughout. Narrow-leaved snow-tussock also becomes more open with a higher proportion of fescue tussock, exotic herbs and grasses, especially on the sunnier faces of the lower Clyde valley compared to the shadier Havelock valley which remains more intact overall.

Stable river flats within the pastoral lease boundary occur in the Havelock valley. These comprise open matagouri shrubland and scattered fescue tussock. Matagouri cover is generally patchy to around 2m tall. Woolly moss, scabweed, *Raoulia haastii, Raoulia tenuicaulis*, spineless bidibid, *Pimelea oreophila*, creeping pohuehue and harebell are common native species. These typically occur among an exotic sward dominated by browntop*, with mouse-ear hawkweed*, sheep's sorrel*, white clover* and sweet vernal* being common.

Stable river gravels are highly natural. Species present are scabweed, *Raoulia hookerii, Raoulia haastii, Raoulia glabra, Scleranthus uniflorus, Epilobium melanocaulon, Epilobium microphyllum, Luzula rufa* var. *albicomans, Poa lindsayi,* spineless bidibid, *Stellaria gracilenta,* bristle tussock, *Parahebe decora, Helichrysum depressum* and occasionally *Coprosma acerosa* ('at risk', declining), *Luzula celata* ('at risk', declining) and *Myosotis uniflora* ('at risk', naturally uncommon). Woolly moss occupies extensive areas of well-stabilised river gravels, with scattered silver tussock. *Gunnera dentata* is common along stream margins, along with *Carex buchananii*, musk* species (*Mimulus guttatus* and *Mimulus moschatus*), *Lobelia ionantha, Juncus pusillus, Montia angustifolia* and slender spike sedge (*Eleocharis acuta*).

Adjacent riverbeds comprise recently-disturbed stonefield and gravelfield with very sparse plant cover. Smaller areas of stable riverbed support a gravelfield-herbfield community with the following species: *Raoulia tenuicaulis, Raoulia hookeri, Raoulia haastii*, scabweed, *Scleranthus uniflorus*, creeping pohuehue, *Epilobium melanocaulon, Epilobium microphyllum, Helichrysum depressum,* spineless bidibid, Yorkshire fog*, white clover* and sheep's sorrel*.

Notable Flora

'Threatened' and 'at risk' species identified on the pastoral lease are listed in Table 6 below. The protection of habitats for 'threatened' and 'at risk' species is a national priority. An historic record of *Hebe armstrongii* from near the confluence of the Lawrence and the Clyde rivers could not be found and it is highly likely that its habitat has been lost or degraded. However, bog pine, for which *Hebe armstrongii* is typically associated with, was recorded at a few localised sites nearby. Several other species, although not ranked as nationally threatened, are notable in a regional and local context. Species such as bog pine, *Scandia geniculata, Korthalsella clavata, Rumex*

flexuosus and *Cardamine* 'scree race', are not common in the ecological district or ecological region. Although they are not currently threatened with extinction, generally species in these categories have very small, widely scattered populations and their population characteristics mean a new threat could rapidly deplete their populations.

Table 6: Notable Plant Species, Erewhon pastoral lease

'Threatened' Species (de Lange *et al,* 2012)		**Habitat**
Isolepis basilaris	nationally vulnerable	Kettle hole in upper Clyde valley on lateral moraine
'At Risk' Species (de Lange *et al,* 2012)		**Habitat**
Coprosma acerosa	declining	Exposed rock and gravelfield between Tank Gully and Caroline Stream
Coprosma intertexta	relict	Scrub on Potts Range adjoining Clyde River
Craspedia 'Havelock'	naturally uncommon	Stable river terraces in the Clyde and Havelock and at Armada Bluff
Juncus pusillis	naturally uncommon	Wetland turf
Lobelia ionantha	naturally uncommon	Kettlehole and depression wetlands turf
Luzula celata	declining	Alluvial river flats in the Havelock valley
Montia angustifolia	naturally uncommon	Wetland turf
Myosotis uniflora	naturally uncommon	River gravels on recent but stable surfaces in Havelock River
Raoulia monroi	declining	Terrace at Clyde and Lawrence confluence
Other species of note (uncommon in ED)		
Cardamine "scree race"		Bluff gravels adjoining Rangitata River
Halocarpus bidwillii		Benched terraces in Clyde and Havelock
Helichrysum intermedium		Bluffs throughout
Korthalsella clavata		Scrub in Tank Gully and Lizard Gully
Pimelea traversii		Rock, Tank Gully to Caroline Stream
Pittosporum anomalum		Scrub on slopes above Havelock and Clyde
Rumex flexuosus		Damp river flats and stream margins
Scandia geniculata		Scrub in Tank Gully
Sophora prostrata		Rock bluffs in Tank Gully

Botanical Significance

The significance of the botanical values are derived from guidelines developed by the Department of Conservation in 2009. Applicable botanical value guidelines are stated below with an explanation as to how the values fit the guideline. The significant inherent values area is depicted on the botanical values map.

Species and their habitats

42. Species listed as National Priority 4 in "Protecting Our Places", or in any revision of those tables, deserve protection, along with their habitat. Species listed in DOC's (new in 2007) "Threatened" categories (nationally critical, nationally endangered and nationally vulnerable) and their associated habitats, must have protection.

- Kettle holes on lateral moraine in the upper Clyde valley in this area support a population, of a threatened (nationally vulnerable) plant species: *Isolepis basilaris*.

46 Indigenous species not listed in "Protecting our Places" and their associated habitats at the extremities of the species' range.

- This area supports populations of eight uncommon plant species at the inland extent of their range: *Cardamine "Scree race"*; *Halocarpus bidwillii*; *Helichrysum intermedium*; *Korthalsella clavata*; *Pittosporum anomalum*; *Rumex flexuosus*; *Scandia geniculata*; and *Sophora prostrata*.

47. Species listed in DOC's (new in 2007) "At Risk" categories (declining, recovering, relictual and naturally uncommon) deserve protection.

- River flats and terraces support populations of three 'at risk' (declining) plant species: *Coprosma acerosa*; *Luzula celata*; and *Raoulia monroi*.
- River flats and terraces support populations of two 'at risk' (naturally uncommon) plant species: *Craspedia* "Havelock and *Myosotis uniflora*.
- Wetlands support populations of three 'at risk' (naturally uncommon) plant species: *Juncus pusillis*; *Lobelia ionantha*; and *Montia angustifolia*.
- Terraces and lower slopes support populations of one 'at risk' (relict) plant species: *Coprosma intertexta*.

Ecosystems, habitats and communities

50. Diverse woody indigenous vegetation communities in the high country deserve protection.

- The area contains plant communities highly representative of the original vegetation of the area: forest remnants (mountain beech and mountain totara) and shrublands.
- Tank Gully is dominated by diverse indigenous scrub and shrubland, remnant forest communities, including kowhai, hardwood (broadleaf), mountain beech and mountain totara forest.
- Lizard Gully contains forest remnants, mountain beech, and *Myrsine divaricata* which were noted in the PNAP report as the only example of that forest type in the Arrowsmith Ecological District.
- Native shrubland communities are present throughout the area and are more predominant on the steeper rocky riparian faces that adjoin the Rangitata and Clyde rivers. These bluff vegetation communities include specialist bluff species as well as the more common species.
- Matagouri shrubland is representative of the vegetation originally present at riparian sites and on alluvial fans.

52. Continuous altitudinal sequences of indigenous vegetation deserve protection.

- This area is dominated by complete intact altitudinal sequences from the montane to alpine zones, e.g. Havelock riverbed at 700m to Cloudy Peak at 2400m.

53. Wetlands and sand dunes (as set out in "Protecting our Places") must have protection where it is practical and realistic to manage and sustain their values.

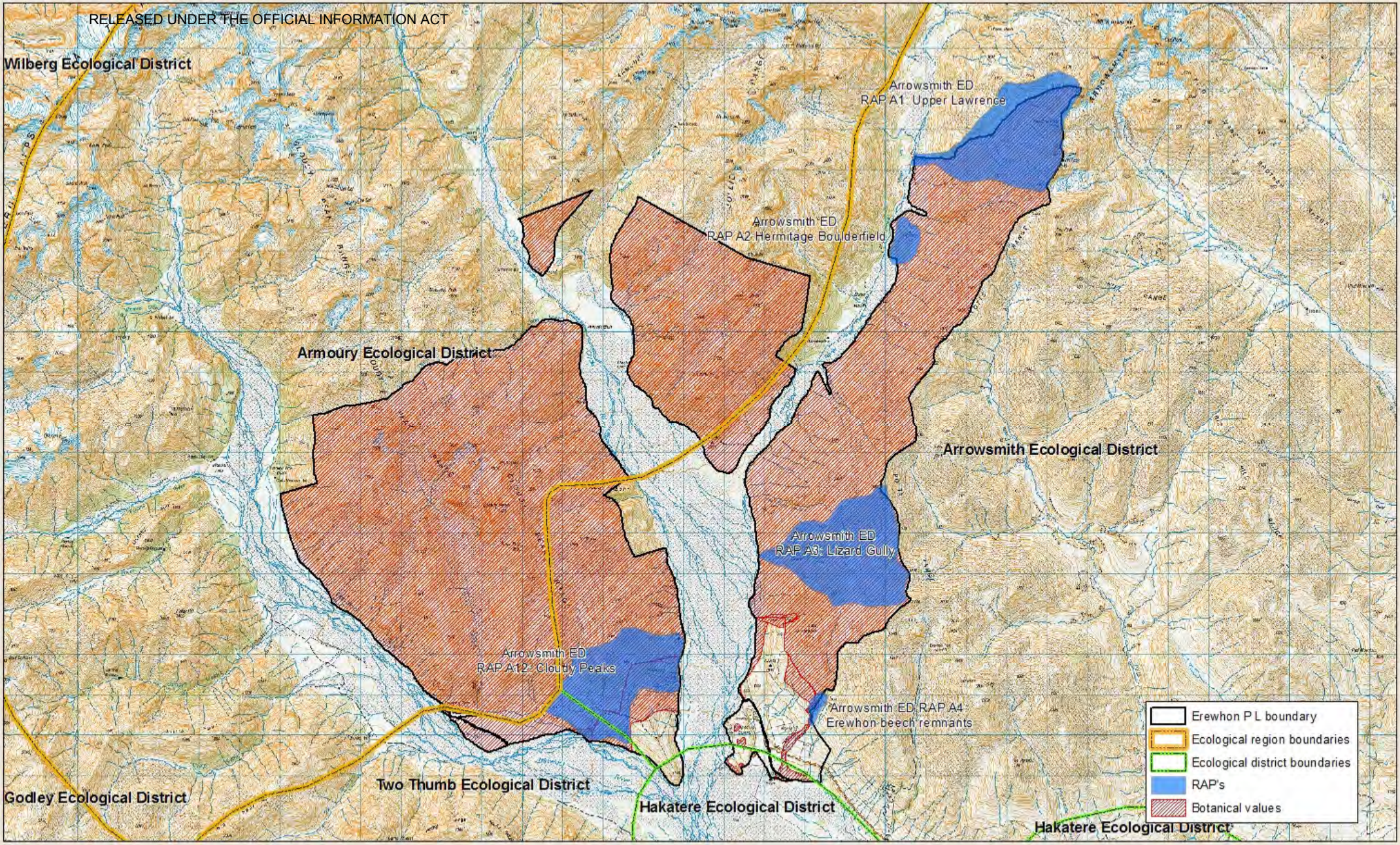
- This area includes intact sequences of unusual and/or rare and/or naturally uncommon significant ecosystems that support highly representative native plant communities, including: alpine fellfield; snowbank; flushes and seepages; kettleholes; moraines; upland conifer forest/shrubland; alluvial floodplain tussock; stony fans; and terraces.

55. Indigenous vegetation associated with wetlands, waterways and the margins of the lakes listed in paragraph 90, deserves protection.

- Indigenous vegetation in this area is adjacent to Lawrence, Clyde, and Havelock rivers and also buffers many named and smaller un-named streams and gullies.

56. Areas recommended for protection under the PNAP deserve protection if the values upon which the recommendation is based are still present.

- Covers part of an area recommended for protection by the PNA Programme, Arrowsmith Priority Natural Area 1, Upper Lawrence, (mixed mountain totara/hardwood forest).
- Includes an area recommended for protection by the PNA Programme, Arrowsmith Priority Natural Area 2, Hermitage Boulderfield, (mosaic of grassland and forest species within an old stable rockfall).
- Includes an area recommended for protection by the PNA Programme, Arrowsmith Priority Natural Area 3, Lizard Gully, (contains the only example of *Myrsine divaricata* forest in the ecological district).
- Covers part of an area recommended for protection by the PNA Programme, Arrowsmith Priority Natural Area 4, Erewhon Beech Remnants, (mountain beech remnant that is a relict of the former extent of this community).
- Covers part of an area recommended for protection by the PNA Programme, Arrowsmith Priority Natural Area 12, Cloudy Peaks, (an altitudinal sequence representing vegetation on both southwest and northeast faces of the Cloudy Peak Range).



Botanical values

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Kilometres

Geospatial Services

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08 Aug 2014

2.5.3 Problem Plants

Numerous exotic plant species are present on the pastoral lease but relatively few are of conservation concern. Many are plants of agricultural importance or are common pastoral weeds. Otherwise, weed infestations are mostly confined to areas adjacent to the homestead and on the lower hill slopes adjacent to the lower eastern Clyde valley (near the pine plantations) and at the south end of the Jumped Up Downs.

Significant infestations of Russell lupin* and broom*, and occasional wilding pines*, are present on slopes adjacent to the riverbed in the lower eastern Clyde valley. Rowan* is present as scattered plants at the lower (south) end of the Jumped Up Downs, adjacent to the riverbed. Gorse* and broom* are also present in this area. Grey willow* is dominant around the larger lake on the Jumped Up Downs. Flowering currant* occurs within pine plantations near the homestead.

Weed species recorded from the 'backcountry' part of the pastoral lease during the March 2014 survey and during an earlier weed survey (Harding, 1998) were:

- cherry trees, gorse and sweet brier at an old occupation site at the confluence of Lawrence and Clyde rivers
- broom at Hermitage Hut, Lawrence valley (single plant, removed)
- gorse (one plant), lower Lawrence valley
- broom at the hut down-valley from Armada Bluff in the Clyde valley (single plant, dead)
- Russell lupin (one plant), lower Lizard Gully
- One false tamarisk plant and several Russell lupin plants (removed) from a newly bulldozed track across the Clyde River bed.
- alder, crack willow, elderberry, columbine, Douglas fir and pines at an old hut/stock-yards site in the Havelock valley, though the extent of any spread of these species is not clear

Didymo (*Didymosphenia geminata*) is present in Deep Stream not far from the pastoral lease boundary. This poses a threat to waterways on and adjacent to the pastoral lease.

2.6 FAUNA

2.6.1 Birds and Lizards

The Arrowsmith Ecological District (ED) contains a wide range of habitats for fauna, including tussockland, rockland (particularly scree and boulderfield), rivers and streams, shrubland and small forest remnants (Harrington *et al*, 1986). Two areas of fauna habitat were recommended for protection by Harrington *et al* (1986): Erewhon Beech Remnants (RAP 4) contains a small, relict stand of mountain beech forest that provides important habitats for forest birds and invertebrates; and Cloudy Peaks (RAP 12) contains an altitudinal sequence of shrubland and tussockland ranging from 700 to 1700m altitude.

In addition, a large area of braided riverbed adjacent to the pastoral lease, comprising the lower Havelock and upper Rangitata rivers was recommended for protection (Rangitata River, RAP 21). This area is considered to be of outstanding value for threatened bird species that breed on braided riverbeds, particularly black-billed gull (nationally critical), black-fronted tern (nationally endangered), banded dotterel (nationally vulnerable), wrybill (nationally vulnerable) and South Island pied oystercatcher (declining) (Robertson *et al*, 2013). Riverbed bird surveys undertaken throughout Canterbury have revealed the presence of exceptionally high numbers of wrybill, black-fronted tern and banded dotterel in the upper Rangitata valley (DOC, *unpublished data*), including c.60% of the estimated New Zealand breeding population of wrybill (O'Donnell and Schmechel, 2001).

High riverbed bird values also resulted in the identification of the upper Rangitata and lower Havelock, Clyde and Lawrence rivers as a Significant Site of Wildlife Interest (SSWI) by the Fauna Survey Unit of the former New Zealand Wildlife Service (DOC, *unpublished data*). In particular, the area below the confluence of the Clyde and Havelock rivers was deemed 'outstanding' (the highest possible score under a set of standard criteria used to rank wildlife habitats).

Other notable ('threatened' and 'at risk') bird species known from alpine and wetland habitats in Arrowsmith ED and/or adjacent pastoral leases include Australasian bittern (nationally endangered), black shag (naturally uncommon), blue duck (nationally vulnerable), Caspian tern (nationally vulnerable), eastern falcon (recovering), grey duck (nationally critical), kea (nationally endangered), marsh crake (relict), New Zealand pipit (declining), pied stilt (declining) and South Island pied oystercatcher (Harrington *et al*, 1986; (DOC, 2002; DOC, 2003). One additional bird species of note, rock wren (nationally endangered), has been observed in the nearby Frances River valley (Kennedy Lange, Canterbury Regional Council, Timaru, *pers. comm.*).

Erewhon pastoral lease is not far from a nationally-significant site for lizards: scree gullies on Mt Harper (c.25 km southwest of the pastoral lease) support eight lizard species, representing the greatest lizard diversity known for any site on the South Island mainland (Whitaker, 2008; Lettink, 2012; DOC, Herpetofauna Database). Notable lizard species present at that site are Rangitata skink (nationally critical), scree skink (nationally vulnerable), Central Canterbury spotted skink (nationally vulnerable),

southern long-toed skink (declining) and common skink clade 4 (an undescribed member of the common skink species complex, hereafter 'common skink'; declining). Three of these species (scree skink, Central Canterbury spotted skink and common skink) also occur on the Potts Range, south of the pastoral lease boundary (DOC, Herpetofauna Database).

Bird and lizard species observed on Erewhon pastoral lease and associated riverbeds are described separately for five geographic areas of the pastoral lease. Observations of notable bird species from riverbeds are included under the description of the nearest area to which they were found.

Area 1: Cloudy Peak Range

This area is bounded by Cattle Stream to the north, the Clyde River to the east and the Havelock River to the southwest. The highest point is Cloudy Peak (2403m). It is steep mountainous country with extensive rockland, tussockland and indigenous shrubland, with forested areas on some of the lower slopes.

Native bird species recorded from this area were black shag (one sighting of a lone bird from the Clyde River), black-fronted tern (one sighting of a pair of birds foraging on the Havelock River flats), eastern falcon (three sightings of lone birds), kea (two sightings from the Cloudy Stream catchment: one of an adult with two juveniles, the other of a group of five birds), New Zealand pipit (two sightings of lone birds in scree and riverbed habitats), bellbird, grey warbler, paradise shelduck, silvereye, South Island fantail, South Island rifleman, southern black-backed gull, yellow-breasted tomtit and white-faced heron. Introduced bird species observed in this area were blackbird, Canada goose, chaffinch, dunnock, greenfinch, redpoll, skylark and yellowhammer.

Lizard species recorded from this area were common skink (two individuals from the Cattle and Cloudy stream catchments), Southern Alps gecko (19 individuals from rocky areas throughout) and McCann's skink (two individuals).

Area 2: Jollie Range

This area contains the southern end of the Jollie Range from Mt Jollie (2241m) south to the confluence of the Clyde and Lawrence rivers. It consists of two land parcels that flank the lower Sinclair River catchment. This area contains steep mountainous country with extensive rockland, tussockland and indigenous shrubland. Forest is present on some of the lower slopes. The river flats near Erewhon pastoral lease Hut are also included.

Native bird species recorded from this area were black shag (one bird observed on an alpine tarn), eastern falcon (one bird seen opposite Armada Bluff), kea (one bird heard calling from slopes above Lawrence Hut), New Zealand pipit (three sightings: one of a lone bird in alpine tussocklands and two sightings of five and eight individuals, respectively, from riverbed habitat), bellbird, grey warbler, paradise shelduck, silvereye, South Island rifleman, spur-winged plover, swamp harrier and yellow-breasted tomtit.

Introduced bird species observed in this area were blackbird, chaffinch, dunnock, greenfinch and redpoll.

Lizard species recorded from this area were common skink (one individual from a rocky fan and grassland near Erewhon pastoral lease Hut), Southern Alps gecko (six individuals from various rocky areas) and McCann's skink (six individuals: five from a river terrace and one from mossfield near Erewhon pastoral lease Hut).

Area 3: Potts Range

This area contains the western slopes of the Potts Range, which extend to a maximum elevation of 2359m at Ashburton Peak. It is bounded to the north and east by an unnamed stream draining Ashburton Peak and by the Lawrence River, respectively. The southern boundary bisects the southwest slopes of Mt Caroline between Tank Gully and Caroline Stream. This area contains steep mountainous country with extensive rockland, tussockland, indigenous shrubland and patches of forest on some lower slopes.

Native bird species recorded from this area were banded dotterel (two sightings: one of 14 birds on the Lawrence riverbed and one of eight birds on the Clyde riverbed), black-fronted tern (four sightings: one of a lone bird foraging near Shingly Stream and three of groups of five, 12 and 20 terns, respectively, foraging above stream channels in the Lawrence and Clyde riverbeds), kea (one individual in the headwaters of Lizard Gully), New Zealand pipit (three sightings: two of lone birds and one of a group of five birds), bellbird, grey warbler, silvereye, South Island fantail and South Island rifleman. Introduced bird species observed in this area were blackbird, greenfinch and redpoll.

Lizard species recorded from this area were common skink (one individual from the Shingly Stream fan), Southern Alps gecko (five individuals from various rocky habitats) and McCann's skink (one individual).

Area 4: Jumped Up Downs

This area contains the Jumped Up Downs, Erewhon Homestead and lower southwest slopes of Mt Caroline (Potts Range), including the lower reaches of Caroline Stream. It is bounded to the west by the Clyde River, the south by the Rangitata River and to the north and east by a fence that traverses the lower slopes of Mt Caroline. The maximum altitude of the area is approximately 950m.

Low-lying areas contain developed paddocks, miscellaneous farm buildings, several large ponds, pine forest, river flats, degraded short tussockland and wetlands, shrubland and outcropping rock. The Clyde riverbed was briefly surveyed for the presence of threatened bird species that breed in braided river beds (i.e. banded dotterel, black-fronted tern, black-billed gull and wrybill).

Native bird species recorded from this area were black-fronted tern (one sighting of three individuals feeding over a newly-cultivated paddock, one sighting of two individuals flying up Caroline Stream and one sighting over the riverbed south of

Jumped Up Downs), eastern falcon (one individual seen near the Erewhon Homestead), grey teal, grey warbler, South Island pied oystercatcher (one individual sighted in a paddock), New Zealand scaup, New Zealand shoveler, paradise shelduck, silvereye, South Island rifleman (two individuals recorded in mature pine forest), southern black-backed gull, spur-winged plover, swamp harrier, welcome swallow and white-faced heron. A banded dotterel exhibiting nesting behaviour was observed (2009) near the causeway on the Clyde riverbed, adjacent to the pastoral lease, (Mike Harding, *pers. comm.*).

Introduced bird species observed were Australian magpie, Australian coot, blackbird, California quail, chaffinch, dunnock, goldfinch, greenfinch, mallard, redpoll, skylark, song thrush, starling and yellowhammer.

Two lizard species were found in this area: McCann's skink (two sightings from rocky habitat beside Caroline Stream) and Southern Alps gecko (20 sightings from rockland habitats, (talus, rock outcrop) and river flat) throughout.

Area 5: The Point (lower Cloudy Peak Range)

This area contains the southeast corner of the Cloudy Peak Range and is located immediately above the confluence of the Clyde and Havelock rivers. It is bounded to the east and south by these rivers and to the west and north by a fence. The maximum altitude of the area surveyed is approximately 1500m. Short tussockland, tall tussockland, rockland and herbfield dominate at higher altitudes, grading to exotic pasture, degraded short tussockland, occasional rock outcrops and indigenous shrubland at lower altitudes.

Native bird species recorded from this area were banded dotterel (one individual observed on the Havelock riverbed), black-fronted tern (one sighting of a pair of birds feeding above the Clyde riverbed and one sighting of a single bird flying above the Clyde River bed), eastern falcon (two sightings of lone birds in the vicinity of the woolshed), grey warbler, New Zealand pipit (four sightings of single birds on the Clyde and Havelock riverbeds), paradise shelduck, silvereye, southern black-backed gull, spur-winged plover, swamp harrier and welcome swallow. Introduced bird species observed in this area were Australian magpie, blackbird, Canada goose, greenfinch, redpoll, skylark, song thrush, starling and yellowhammer.

Common skink (five sightings), McCann's skink (one sighting) and Southern Alps gecko (38 sightings) were recorded in this area. Southern Alps gecko was only found in rockland habitats (talus, rock outcrop, stream bed and riverbed), whereas skinks were seen in a wider range of habitats (rockland, shrubland and tussockland).

Bird Species Recorded

Thirty three bird species were recorded from the five areas surveyed on Erewhon pastoral lease, consisting of 18 native species (Table 7) and 15 introduced species. Introduced bird species recorded were Australian coot, Australian magpie, blackbird,

California quail, Canada goose, chaffinch, dunnock, goldfinch, greenfinch, mallard, redpoll, skylark, song thrush, starling and yellowhammer.

Table 7: Native bird species recorded from or near Erewhon pastoral lease, 2010 and 2014

Species	Threat status	Distribution on/near pastoral lease
Threatened and At Risk species		
banded dotterel	nationally vulnerable	Main riverbeds
black-fronted tern	nationally endangered	Throughout, mostly on riverbeds
black shag	naturally uncommon	Wetlands throughout, small colony near the Clyde/Havelock confluence
eastern falcon	recovering	Throughout
kea	nationally endangered	Subalpine-alpine areas throughout
South Island pied oystercatcher	declining	Paddock at Jumped Up Downs
New Zealand pipit	declining	Riverbeds and alpine areas throughout
Non-threatened species		
bellbird		Forested areas throughout
grey warbler		Forest and shrubland throughout
paradise shelduck		Riverbeds throughout
South Island rifleman		Forest and shrubland throughout
silvereye		Forest and shrubland throughout
south Island fantail		Forest and shrubland (uncommon)
southern black-backed gull		Throughout
spur-winged plover		Riverbeds throughout
swamp harrier		Throughout
yellow-breasted tomtit		Forested areas throughout
white-faced heron		Wetlands on Jumped Up Downs

Lizard species recorded

Forty-five lizards of three species were recorded from 28 sites on the pastoral lease during the recent (2014) survey (Table 8). This total consisted of five common skinks, nine McCann's skinks, 30 Southern Alps geckos and one unidentified lizard (most likely a common skink). Southern Alps geckos were restricted to rock lands (scree, talus, rock outcrops, alluvial fans and streambeds). Skinks were found in rocklands, grasslands and mossfield habitats.

Table 8: Lizard species recorded from Erewhon pastoral lease, March 2014.

Species	Threat status	Distribution on pastoral lease
common skink clade 4	declining	Rockland and grassland
McCann's skink	not threatened	Rockland, grassland and mossfield
Southern Alps gecko	not threatened	Rockland

Bird and Lizard Fauna Significance

The significance of the bird and lizard values are derived from guidelines developed by the Department of Conservation in 2009. Applicable bird and lizard value guidelines are stated below with an explanation as to how the values fit the guideline.

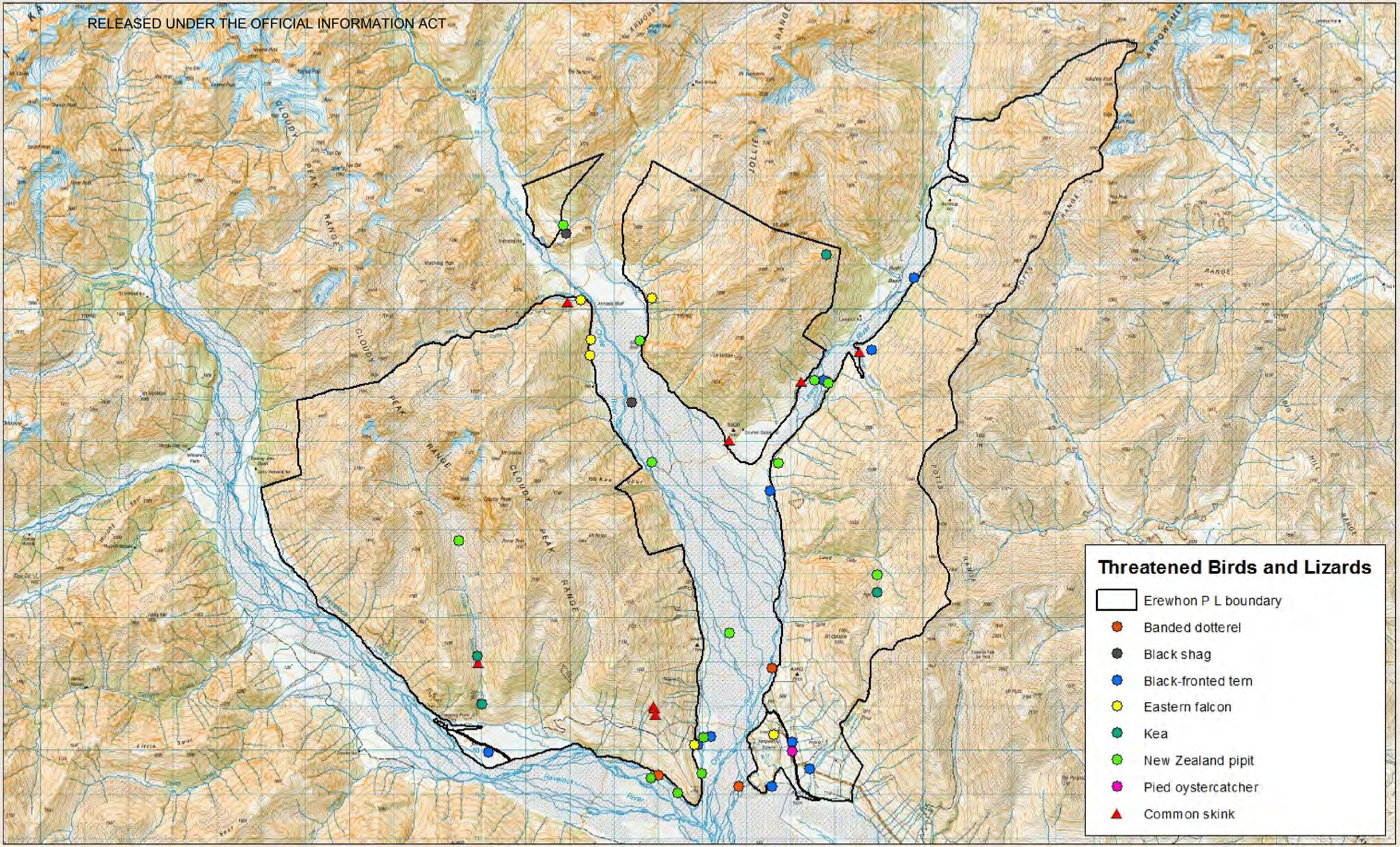
Species and their habitats

42. Species listed as National Priority 4 in "Protecting Our Places", or in any revision of those tables, deserve protection, along with their habitat. Species listed in DOC's (new in 2007) "Threatened" categories (nationally critical, nationally endangered and nationally vulnerable) and their associated habitats, must have protection.

- Mountainous country in this area provides feeding and breeding habitat for one threatened (nationally endangered) bird species: kea.
- River valleys in this area provide feeding and breeding habitat for three threatened bird species: black-fronted tern (nationally endangered); banded dotterel (nationally vulnerable); and wrybill (nationally vulnerable).

47. Species listed in DOC's (new in 2007) "At Risk" categories (declining, recovering, relictual and naturally uncommon) deserve protection.

- This area provides habitat for one 'at risk' (declining) bird species: South Island pied oyster catcher.
- Mountainous country in this area provides feeding and breeding habitat for two 'at risk' bird species: New Zealand pipit (declining) and eastern falcon (recovering).
- River valleys in this area provide feeding and breeding habitat for one 'at risk' (naturally uncommon) bird species: black shag.
- This area provides good habitat for one 'at risk' (declining) lizard species: common skink clade 4.



Bird and Lizard Values

Kilometres 0 1 2 3 4 5

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Geospatial Services

2.6.2 Aquatic Fauna (fish and invertebrates)

Erewhon pastoral lease is drained by Caroline Stream, the Havelock, Clyde and Lawrence rivers and many named and unnamed tributaries of these rivers, all of which are tributaries of the Rangitata River. The Rangitata River is free of the large barriers present in some other South Island rivers. This has two important effects on the fish communities: they are more likely to include diadromous species (species with a sea phase in their lifecycle) and fish species are able to migrate between streams.

The Rangitata River, including all tributaries on the pastoral lease, is recognised as a 'Type I' Waters of National Importance (Chadderton *et al,* 2004), meaning that the waterways in this catchment contain special features of national significance. Type 1 waters are in the top ten sites by Natural Heritage Value score in its biogeographical unit and have catchment vegetative cover that is still largely natural. The Rangitata River is protected by the Rangitata Water Conservation Order 2006.

The New Zealand Freshwater Fish Database (NZFFD) has 70 records from the Rangitata River (at 4th April 2014). Species recorded are shortfin eel, longfin eel, torrentfish, koaro, inanga, alpine galaxias, upland longjaw galaxias, Canterbury galaxias, lamprey, upland bully, common bully, giant bully, bluegill bully, rainbow trout, Chinook salmon, perch, black flounder, brook char, Atlantic salmon, brown trout and Stokell's smelt. One of these species is listed as 'threatened', upland longjaw galaxias (nationally vulnerable), and eight are listed as 'at risk': longfin eel (declining); torrentfish (declining); koaro (declining); inanga (declining); lamprey (declining); bluegill bully (declining); and alpine galaxias (naturally uncommon); and Stokell's smelt (naturally uncommon) (Goodman *et al,* 2014).

Further survey work in the Lawrence, Clyde and Havelock rivers has produced records for upland longjaw galaxias in the lower Lawrence River, lower Clyde River and the Havelock River. The records from the upper Rangitata show that this is a very important catchment for upland longjaw galaxias as it is one of only three catchments with current records of this species, the Waitaki and Rakaia rivers being the other two. Three of the upland longjaw records are sited within the pastoral lease in the Clyde River. The habitat these native fish occur in is a contiguous unit with, or in close proximity to similar habitat on the pastoral lease. Consequently upland long jaw galaxias may be present in waterways within the lease from time to time.

Fish species recorded recently from the adjacent Mt Potts Pastoral Lease are koaro, alpine galaxias, upland longjaw galaxias, Canterbury galaxias, upland bully, rainbow trout, Chinook salmon, brook char and brown trout.

Freshwater fish fauna communities were surveyed within six geographic units. These habitats and the fish and invertebrate species recorded are described below.

Potts Range

This area of approximately 4055ha incorporates the west facing slopes of the Potts Range. This unit drains to the Lawrence River at the northern end and into the Clyde River below the Lawrence-Clyde confluence. Waterways in this unit drain the Potts Range and include Shingly Stream, Wild Sheep Stream, Lizard Gully, Tank Gully and many unnamed streams.

Streams in this unit flow through rockland, scree, herbfield, tussockland, scrub, shrubland, beech forest and, at lower altitudes, grassland. Naturalness increases upstream and at higher altitudes. A range of riparian plant communities are present along the streams. The braided channels of the Lawrence and Clyde rivers are more dynamic, with bare or sparsely vegetated stonefield at their margins. All water bodies are accessible to stock or wild animals. Vehicle tracks are mostly restricted to the beds of the main rivers, adjacent to the pastoral lease.

The gravel bed of the Lawrence River is between 20 and 600m wide. The braided channels of the river are up to 15m wide and 500mm deep, with an average depth of approximately 200mm. The bed of the Clyde River is more than two kilometres wide in places. The braided channels are up to 15m wide and one metre deep. Tributary streams, including Lizard Gully and Tank Gully, are up to four metres wide with pools over one metre deep, though are mostly smaller, particularly in their upper reaches. The waterways generally have a boulder and cobble substrate with some gravel and sand present.

Three sites were surveyed in the Lawrence River adjacent to the lease, using the electrofishing method and general observations. Alpine galaxias (naturally uncommon) were recorded at all sites. Upland long jaw galaxias were recorded at one site, which was previously identified from previous surveys and unidentified galaxias juveniles were recorded in a river braid that was drying out. Canterbury galaxias were recorded at the lowest site. There are 11 additional records of these galaxias species from the NZFFD and other surveys adjacent to this geographical unit including one record of upland longjaw galaxias.

Macro-invertebrate fauna assemblages indicate that streams within this unit have very good water quality. Species recorded were: mayflies (*Deleatidium lillii*-group and *Deleatidium myzobranchia*-group); the caddisflies (*Aoteapsyche* sp., *Hydrobiosis* sp., *Olinga feredayi* and *Pycnocentria* sp.); *Chironominae* sp.; flatworm (*Cura* sp.); and worm: (*Oligochaete* sp.).

Cloudy Peak Range

This area of approximately 6552ha incorporates the southern end of the Cloudy Peak Range. It drains to the Havelock River along its south and west sides and to the Clyde River along its east and north sides. Waterways in this unit drain the Cloudy Peak Range and include Cloudy Stream, Cattle Stream and many unnamed streams.

Streams in this unit flow through rockland, scree, herbfield, tussockland, scrub, shrubland, beech forest and, at lower altitudes, grassland. Naturalness increases upstream and at higher altitudes. The south-facing Havelock valley faces have a greater cover of shrubland and scrub, whereas the northeast-facing Clyde valley faces have more tussockland and grassland. The effects of farm development are more apparent on the lower slopes and terraces between Cloudy Stream and the confluence of the Havelock and Clyde rivers. A range of riparian plant communities are present along the streams. The braided channels of the Havelock and Clyde rivers are more dynamic, with bare or sparsely vegetated stonefield at their margins. All water bodies are accessible to stock or wild animals.

The bed of the Havelock River is between 500m and two kilometres wide. The braided channels of the river are up to 20m wide and one metre deep, with occasional deeper pools. The bed of the Clyde River is more than two kilometres wide in places. The braided channels are up to 15m wide and one metre deep. Tributary streams, including Cloudy Stream are up to four metres wide with pools over one metre deep, though are mostly smaller, particularly in their upper reaches. The waterways generally have a boulder and cobble substrate with some gravel and sand present. Some steeper streams flow over bedrock.

One site was surveyed in this unit and three species recorded: alpine galaxias (naturally uncommon); Canterbury galaxias; and upland bully. There are 31 additional records in the NZFFD including three other fish species: upland longjaw galaxias; brown trout; and rainbow trout recorded within and adjacent to this geographical unit.

Macro-invertebrate fauna assemblages indicate that streams within this unit have very good water quality. Species recorded were: mayflies (*Deleatidium lillii*-group, *Deleatidium myzobranchia*-group and *Nesameletus* sp.); the caddisflies (*Aoteapsyche* sp., *Hydrobiosis* sp., *Olinga feredayi* and *Pycnocentria* sp.); *Chironominae* sp.; two-winged flies (*Austrosimulium* spp.); flatworm (*Cura* sp.) and worm (*Oligochaete* sp.).

Jollie Range

This area of approximately 2017ha incorporates the southern end of the Jollie Range. It drains to the Clyde River along its south and west sides and to the Lawrence River along its east side. Steep unnamed streams drain most of this unit. It includes a large flat river terrace in the confluence of the Clyde and Lawrence rivers.

Plant communities in this unit are similar to those in adjacent units, except that beech forest is more common. Otherwise, streams flow through rockland, scree, herbfield, tussockland, scrub, shrubland and, at lower altitudes, grassland. Naturalness increases upstream and at higher altitudes. A range of riparian plant communities is present along the streams. The braided channels of the Lawrence and Clyde rivers are more dynamic, with bare or sparsely vegetated stonefield at their margins. All water bodies are accessible to stock or wild animals. Vehicle tracks are mostly restricted to the beds of the main rivers, adjacent to the pastoral lease.

The bed of the Lawrence River is between 200 and 600m wide. The braided channels of the river are up to 15m wide and 500mm deep, though have an average depth of approximately 200mm. The bed of the Clyde River is more than two kilometres wide in places. The braided channels are up to 15m wide and one metre deep. Tributary streams are up to two metres wide with pools over one metre deep, though are mostly smaller, particularly in their upper reaches. The waterways generally have a boulder and cobble substrate with some gravel and sand present. Some steeper streams flow over bedrock.

No sites were surveyed in this unit. There are nine records in the NZFFD, listing three fish species: alpine galaxias (naturally uncommon); Canterbury galaxias; and upland bully within and adjacent to this geographical unit. Additional records included in the Potts Range geographic unit also lie adjacent to this geographic unit.

Macro-invertebrate fauna assemblages indicate that streams within this unit have very good water quality. Species recorded were: mayflies (*Deleatidium lillii*-group, *Deleatidium myzobranchia*-group and *Nesameletus* sp.); caddisflies (*Aoteapsyche* sp., *Hydrobiosis* sp., *Olinga feredayi* and *Pycnocentria* sp.), *Chironominae* sp.; two-winged flies (*Austrosimulium* spp.); flatworm (*Cura* sp.) and worm (*Oligochaete* sp.).

Armoury Range

This area of approximately 141ha incorporates the southern end of the Armoury Range. It drains into the Clyde River along its western side. Freshwater habitats in this unit include a series of small tarns perched on a moraine terrace and small unnamed streams.

Plant communities of this block are mainly tussockland and shrubland, with wetland plant communities at the tarns. The tarns are accessible to stock. No vehicle tracks are present within the unit.

The tarns range from 10m^2 to over 500m^2. The largest tarn lies just outside the pastoral lease boundary. It has a boulder, cobble, gravel and mud base, whereas the other tarns have a mud base with a few large boulders.

Two sites were surveyed at the tarns, but no fish species were recorded. Macro-invertebrate species observed in the tarns were: water boatmen (*Sigara* sp.); back swimmers (*Anisops* sp.); and damselflies (*Anisoptera* spp. and *Zygoptera* spp.).

Mt Caroline and Jumped Up Downs

This area of approximately 615ha comprises the southeast part of the pastoral lease on the southwest end of the Potts Range. The main water bodies in this area are the small, often steep streams draining into the Clyde River, and the palustrine wetlands, tarns and ponds associated with Jumped Up Downs and the slopes of the Potts Range. Caroline Stream forms the eastern boundary of this area and Tank Gully forms the northern boundary.

Streams in this area flow through tussockland, grassland, shrubland and smaller areas of mountain beech forest. Wetlands lie within tussockland, grassland and rushland, (bog rush and *Juncus* sp.). Willows are present around tarns on Jumped Up Downs. All water bodies are accessible to stock and some are crossed by vehicle tracks.

Caroline Stream is approximately one and a half metres wide for the majority of its length within the pastoral lease. Tank Gully and most other permanent streams are approximately one metre wide. Streams vary in depth from 100 to 300mm, with pools up to 600mm deep. Streams have mainly gravel and cobble substrates, with boulders and bedrock in the steeper areas and muddy substrates in areas of developed pasture. Wetlands range in size from approximately 100 to 1000m^2.

Four sites were surveyed in this area, upper, middle and lower Caroline Stream and Erewhon Homestead stream. Alpine galaxias (naturally uncommon), Canterbury galaxias and unidentified galaxias juveniles were found in Caroline Stream; and upland bully were found in the stream near Erewhon Homestead. Caroline Stream is a main source of water for the wetlands and stream channels in the area downstream of the pastoral lease between Mt Sunday and the southern end of the Potts Range. This area is locally referred to as 'Deep Stream'. Upland long jaw galaxias (nationally vulnerable) have been recorded in Deep Stream. Consequently upland longjaw galaxias may be present in Caroline Stream due to its hydrological connection with Deep Stream.

Macro-invertebrate fauna assemblages indicate that the larger streams in this area have very good water quality. Species recorded were: mayflies (*Deleatidium lillii*-group, *Deleatidium myzobranchia*-group, *Nesameletus* sp. and *Rallidens mcfarlanei*); stoneflies (*Stenoperla prasina* and *Zelandobius* sp.); caddisflies (*Aoteapsyche* sp., *Beraeoptera roria*, *Hydrobiosis* sp., *Olinga feredayi* and *Pycnocentria* sp.); two-winged flies (*Austrosimulium* spp. and *Chironominae* sp.); flatworm (*Cura* sp.); and worm (*Oligochaete* sp).

The Point

This area of approximately 404ha comprises that part of the pastoral lease on the southeast end of the Cloudy Peak Range, between the lower Havelock and Clyde rivers. The main water bodies of this area are small streams draining the steep slopes of the Cloudy Peak Range and small wetlands (palustrine seepages). The streams flow through tussockland, shrubland, rockland and talus. Wetlands lie within tussockland, with some areas of rushland and sedgeland. All water bodies in this area are accessible to stock and some are crossed by vehicle tracks.

Streams on the hill slopes are generally less than one metre wide and 100 to 200mm deep, with occasional pools up to 400mm deep. Stream substrates are typically boulders with smaller cobbles and gravels present. Wetlands are approximately 20m^2 in size, with little or no surface water. All wetlands all have silt or dirt substrates.

No sites were surveyed in this area due to logistical constraints. Two small streams adjacent to the pastoral lease boundary and Havelock River were hand-netted. Small unidentified galaxias were recorded in both streams.

Macro-invertebrate fauna assemblages indicate that the larger streams in this area have very good water quality. Species recorded were: mayflies (*Deleatidium lillii*-group, *Deleatidium myzobranchia*-group and *Nesameletus* sp.); stonefly (*Stenoperla prasina*); caddisflies (*Aoteapsyche* sp., *Olinga feredayi* and *Pycnocentria* sp.); two-winged flies (*Austrosimulium* spp. and *Chironominae* sp.); flatworm (*Cura* sp.); and worm (*Oligochaete* sp.).

Species Recorded

Four fish species were recorded during this survey of Erewhon pastoral lease (Table 9).

Table 9: Fish species recorded at Erewhon pastoral lease

Fish Species	Threatened Status	Known Distribution on Pastoral lease
alpine galaxias	Naturally uncommon	Waterways throughout the lease
upland bully	not threatened	Havelock River catchment
upland longjaw galaxias	nationally vulnerable	Generally waterways adjacent to the lease. Rare on lease.
Canterbury galaxias	not threatened	Some of the waterways within the lease.

Macro-invertebrate fauna communities were reasonably similar across the pastoral lease. No 'threatened' or 'at risk' species were recorded.

Table 10: Macro-invertebrate species recorded at Erewhon pastoral lease

Macro-invertebrate Species	Known Distribution on Pastoral lease
Phylum: Arthropoda	
Class: Insecta	
Order: Diptera (Two-winged Flies)	
Austrosimulium spp.	Most flowing waterways
Chironominae sp.	Most waterways
Order: Ephemeroptera (Mayflies)	
Deleatidium lillii-group	Most flowing waterways
Deleatidium myzobranchia-group	Most flowing waterways
Nesameletus sp.	Most flowing waterways
Order: Trichoptera (Caddisflies)	
Aoteapsyche sp.	Most flowing waterways
Hydrobiosis sp.	Most flowing waterways
Olinga feredayi	Most flowing waterways
Pycnocentria sp.	Most flowing waterways
Phylum: Annelida	
Class: Oligochaetae	

Oligochaete spp. (worms)	Throughout
Cura sp. (flat worm)	Throughout

Aquatic Fauna Significance

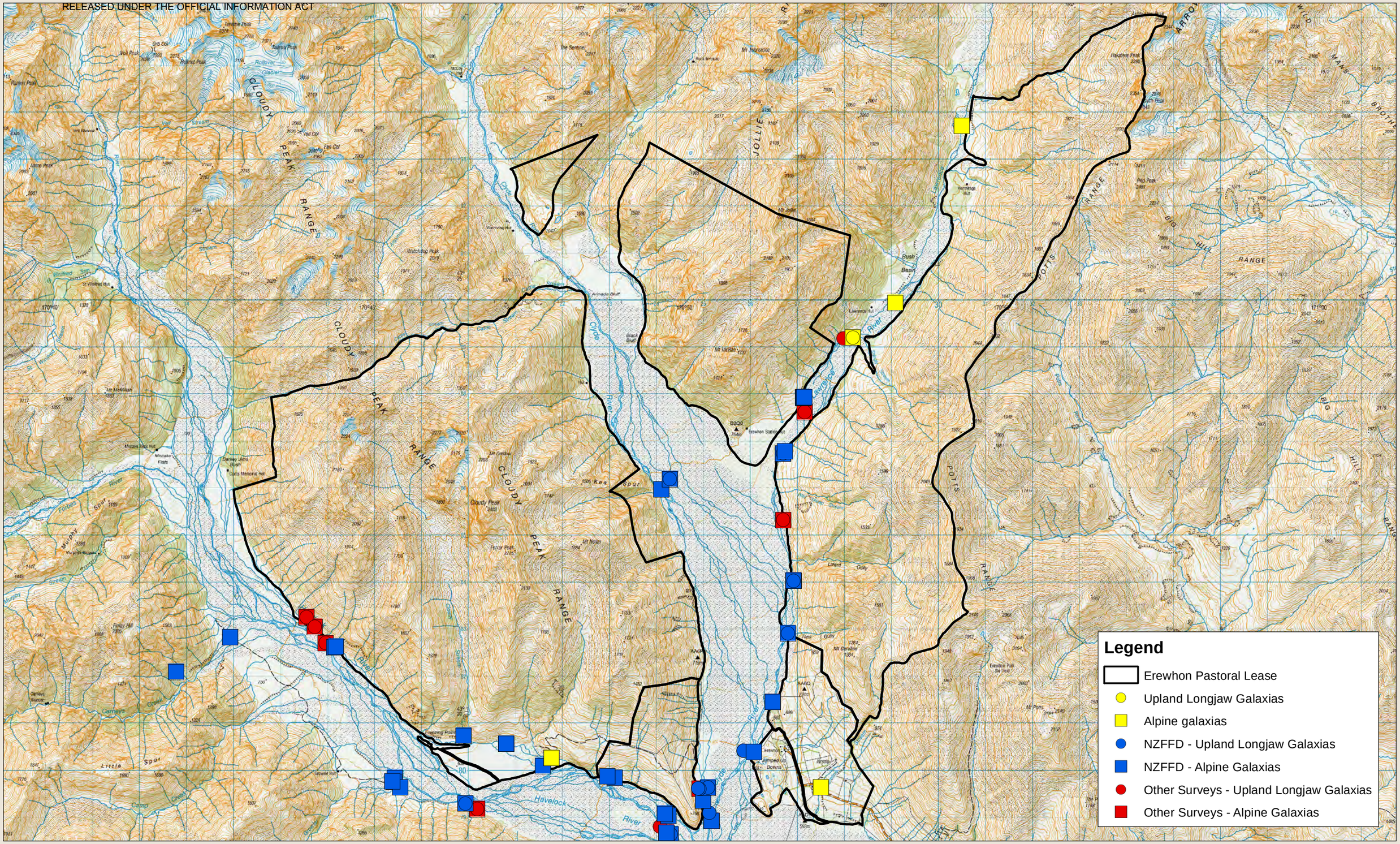
The significance of the aquatic fauna values are derived from guidelines developed by the Department of Conservation in 2009. Applicable aquatic fauna value guidelines are stated below with an explanation as to how the values fit the guideline.

43. Habitat that is available for those threatened species to move into of their own accord deserves protection likewise.

- Waterways on the pastoral lease provide habitat for a threatened (nationally vulnerable) fish species: upland longjaw galaxias. This species is also present in waterways adjacent to the pastoral lease.

47. Species listed in DOC's (new in 2007) "At Risk" categories (declining, recovering, relictual and naturally uncommon) deserve protection.

- This area provides good habitat for one 'at risk' (naturally uncommon) fish species: alpine galaxias.



Aquatic Values

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29 Jul 2014

2.6.3 Terrestrial Invertebrates

Erewhon pastoral lease straddles the D'Archiac and Heron ecological regions and includes four ecological districts (Armoury, Arrowsmith, Hakatere and Two Thumb). Combined, these districts are recognised as a distinct biogeographical zone supporting endemic species of insect, spider and millipede. The biota of the pastoral lease is influenced by three significant effects: extensive glaciation during late Pleistocene and early Holocene; an ancestral stock of organisms that re-colonised the area during glacial retreat; and, the present day abiotic environment of severe climatic and altitudinal gradients.

Many of the invertebrates known from the pastoral lease are typical of the high country and found throughout the eastern flanks of the central Southern Alps. However, many common invertebrates show a diversity of morphology (i.e. colour, size, call and even behaviour) and the distribution of this variation may occur across neighbouring ranges or even catchments. This is important because it complicates taxonomy and management since it is not clear where one form ends and another begins. To that extent, all endemic taxa and indigenous habitats occurring on the pastoral lease have conservation value and are all worth protecting.

Examples of locally common taxa with conservation value that are present on the pastoral lease include; grasshoppers (specifically the *Brachaspis* and *Paprides* species), tree, scree and cave weta species, and high-altitude and riverbed spiders. Many species of iconic butterfly and moth also occur on the pastoral lease and these reflect the variety of host plant habitats and environmental conditions. Previous tenure review surveys have identified invertebrates of conservation interest on properties in the neighbouring Rangitata/Heron basin including Mt Potts (DOC, 2003) and Mesopotamia (DOC, 2002) pastoral leases.

At least six distinct ecosystems occur on the pastoral lease: subalpine shrubland and tussockland basins, outwash river flats, pockets of hardwood forest and beech forest, scree slopes, rocky mountain tops, and the nival zone (permanent snow and ice above 1800 m altitude). Invertebrates are found in all of these habitats. Noteworthy examples include the alpine jumping weta (*Pharmacus montanus*) on the western flanks of the Potts Range, (Morris, 2003) and species of *Brachaspis* grasshoppers, a group which includes the endangered *Brachaspis robustus* from the Mackenzie Basin.

The invertebrate fauna of the pastoral lease is described below for ten areas.

Tarn block

This small (approximately 200ha), triangular-shaped block is situated at the northwest corner of the pastoral lease and encompasses the toe slopes of The Sentinel, a peak on the Armoury Range, immediately above the bed of the Clyde River. The area includes a large roche moutonnée at the confluence of Sinclair Stream and the true left of the Clyde River. This glacial feature has a level surface at the 1000m contour and supports

at least four tarns (glacial kettle holes) and significant snow-tussock, shrubland and ephemeral wetland habitats.

Invertebrates were sampled from around the kettle holes, amongst the tussock, shrubland, from under rocks and amongst rock outcrops. All species collected were native and included many mountain stone weta (*Hemideina maori*), grasshoppers (*Sigaus* and *Paprides* spp.), Opiliones (*Phalangium* sp.), many spider types (wolf, orb weaver, nursery web and prowling types) and moths (Geometridae, Lycaenidae and Nymphalidae). Beetles were also found here, including scarabs (*Odontria*, *Pyronota* and *Costelytra* spp.) and tiger beetles (*Neocicindela* sp.: Cicindelidae), the latter on bare loess and rocky surfaces.

The invertebrate habitat and assemblage of species in the Tarn block represent a typical subalpine biota with little or no apparent disturbance by stock or recent fires. The area is highly significant for these ecological values in addition to being a classical example of glacial geomorphology.

McRae block

The McRae block is steep mountainous country covering approximately 2300ha. It straddles the toe of the Jollie Range, between Sinclair Stream and the true right of the Lawrence valley. A relatively old (c. several hundred years) alluvial surface exists, at the confluence of the Lawrence and the Clyde rivers. At this location there is about a hectare of scattered old growth matagouri, short tussock and extensive mossfield dominated by woolly moss. There is an old Erewhon pastoral lease hut on this terrace. Mountain beech forest extends behind the hut and upslope toward the Jollie Range.

Considerable time was spent collecting invertebrates from the slopes behind the hut and from the terrace. Many endemic spiders were identified from this area including species of *Cambridgea* (sheetweb spiders), tunnel web spiders (*Porrthele antipodiana*), prowling spiders (*Uliodon frenatus*), a wolf spider (*Anoteropsis arenivaga*; range restricted) and the nursery web spider *Dolomedes minor*. Arachnids were not limited to spiders, with two species of endemic harvestman also collected (*Phalangium* sp. and *Nuncia* sp.).

Common native insects collected from around the hut included three common species of mountain cockroach (*Celatoblatta vulgaris*, *Celatoblatta montana* and *Parellipsidion inaculeatum*). Cicada (*Kikihia* sp.), seed bugs (*Rhypodes* sp.) and Crambid moths (*Orocrambus flexuosellus*) were abundant as well. Scarab beetles were common in the area (*Odontria* sp. and *Pyronota* sp.) along with tiger beetles (Cicindellidae) and small carabids (*Holcaspis* sp.).

Collections were also made from the lower reaches of an unnamed creek draining the Jollie Range, near the confluence with the Sinclair River. Aquatic and wet-habitat invertebrates were common in the riparian vegetation of the unnamed creek. Numerous millepedes (*Icosidesmus* sp.), crane flies (*Leptotarsus* sp.) and mayflies (*Coloburiscus humeralis*) were collected in this part of the block.

In several places the Clyde River bed is within the boundary of the pastoral lease. At these locations, the invertebrate fauna is dominated by predators, specifically wolf spiders (*Anoteropsis arenivaga*), tiger beetles and native wasps (Pompillidae). The riparian margin is significantly more stable than the riverbed and supports a community of mat forming plants (*Raoulia* and *Muehlenbeckia*), grasses and other early colonising plants. Invertebrates typically associated with these habitats include seed bugs (*Rhypodes* sp.), Lycaenid butterflies (coppers, boulder coppers and common blues) and grasshoppers (*Phaulacridium marginale* and *Brachaspis* sp.).

Potts Range

At approximately 3800ha the Potts Range block is the largest described for the pastoral lease. It faces northwest for almost the full length of the Potts Range and is probably the driest aspect on the pastoral lease given its position in the rain shadow of the Jollie Range.

It terminates at Ashburton Peak (2359m), a steep alpine summit with extensive bluffs, screes and cirque basins (the highest point on the range is Mt Arrowsmith, a 2780m peak, and a mere three kilometres from the lease boundary). The block extends southwest for approximately 21kms with a 1700m elevation range, the majority of which is alpine scree, crags and steep, incised gullies. The toe slopes, stream outwash fans and flats of the Lawrence River support grassland, tussockland and shrubland.

Isolated patches of mountain beech, celery pine and snow totara are present in some gullies. A helicopter drop off at 1500m above Lizard Gully (at the southeast end of the block) allowed for a brief but adequate over view of the invertebrate fauna. Many common alpine insects were noted, specifically the mountain stone weta (*Hemideina maori*), grasshoppers (*Sigaus australis*), cicada (*Maoricicada nigra*), *Mecodema* ground beetles and the cockroach *Celatoblatta montana*. Numerous hunting spiders were also present including *Neoramia* sp., *Anoteropsis alpina* and an undescribed but known endemic jumping spider (family Salticidae).

Also present, at a point overlooking the Clyde/Lawrence confluence were several snow grasshoppers (*Brachaspis nivalis*), more *Hemideina maori* weta, the common copper butterfly (*Lycaena salustius*) and tussock ringlet (*Argyrophenga antipodum*: Nymphalidae). Both butterfly species depend on specific host plants: snow tussock (*Chionochloa*) for the tussock ringlet; and *Muehlenbeckia* species for the common copper butterfly.

Havelock faces (Cloudy Peak Range)

A helicopter drop off near Curtis Memorial Hut provided for a walked inspection of the Havelock faces, on the true left of the Havelock River. The inspection was generally confined to the Havelock riverbed. Vegetation assemblages are characteristic of Canterbury high country slopes with a cold southern aspect.

The invertebrate community is typical of the location and elevation (approximately 700m). Cockroaches (*Celatoblatta vulgaris*, *Parellipsidion* sp.) were abundant where

found, either under rocks or at the margins of vegetation mats. In more rocky areas, small carabid beetles (*Holcaspis* sp.), water spiders (*Dolomedes aquaticus*) and endemic millipedes were relatively common while the mountain stone weta was the most frequently observed of the large insects.

Shrublands support at least two species of orb weaver spider (*Coloranea* and *Tetragnatha* spp.) and the nursery web spider *Dolomedes minor*. No flying insects were active at the time of the inspection, although Crambid moths were disturbed during sweep-netting and walking through tussock grasses.

Cloudy Stream (Cloudy Peak Range)

Cloudy Stream was traversed on foot in sunny conditions from the headwaters to the Havelock River. Invertebrates were collected from the saddle between Cloudy Stream and Cattle Stream (between the Clyde and Havelock Rivers) at 1900m. The saddle and environs are best described as ecologically pristine. Greywacke buttresses and tors form the main ridge above slopes of frost shattered pavement which give way to steep loose screes on the Cloudy Stream side and rolling gentle terrain above the Clyde Valley.

The invertebrate community at the saddle comprises alpine species known only from above 1500m. Several high altitude spiders were present particularly the large black *Anoteropsis alpina* wolf spider and the smaller grey mountain jumping spiders. Similarly, the black mountain ringlet butterfly (*Percnodiamon merula*) was relatively common as were the following three species of grasshopper; *Brachaspis nivalis, Sigaus villosus* and *Paprides nitidus*. The giant scree weta *Deinacrida connectens* and a specimen of cave weta (Rhaphidophoridae) were recorded from the saddle. An alpine specialist, the giant scree weta is usually only found in the absence of introduced mammalian predators (rodents, mustelids, hedgehogs and cats), a situation demonstrating the high natural condition of the Cloudy Peak Range.

Invertebrates were also collected from the upper cirque basin of Cloudy Stream. The majority of specimens were associated with warm scree surfaces, rocky terrain or ephemeral snow melt seepages and their attendant herbfields. At these locations, ringlet butterflies, cicada and grasshoppers are the dominant invertebrate groups as is typical of the natural alpine ecosystem.

A large rock avalanche off Ferrar Peak (2225m) has buried Cloudy Stream for about two kilometres, midway down valley. The rock debris is perhaps no more than 150 years old and presents chaotic terrain of large jumbled boulders. At the time of the inspection, it was clear that rock movement remains active, however, the vegetation is now colonising the downstream toe of the debris. At these locations, snow totara, snow-tussock, golden speargrass and patchy shrublands are common and the invertebrate fauna reflects this increase in plant diversity. Specifically, grass moths (Crambidae), tussock ringlets and day flying moths (*Paranotoreas ferox*) were active while two species of cicada were prolific (*Kikihia* sp. and *Maoricicada* sp.).

At about the 900m contour, near the confluence with the Havelock River, Cloudy Stream drops into a deeply incised gorge. Above the gorge, on the true left, is an old terrace formed by the Havelock glacier and is now extensively vegetated with subalpine shrubland. The invertebrates associated with this vegetation were, again, typical of the location and community structure. Many flying insects were active (on the few plants in flower) including the native bees *Hylaeus* sp. and *Leioproctus fulvescens*. Again, grasshoppers were abundant (*Sigaus australis*), as were cicada and numerous spider taxa (orb weavers and nursery web spiders). Several native beetles were collected from areas of bare ground or beneath rocks, including darkling beetles (*Artystona* sp.), tiger beetles (*Neocicindela latecincta*) and the speargrass beetle *Selenopalpus aciphyllae*.

Clyde Valley faces (Cloudy Peak Range)

This section of the pastoral lease extends from the confluence of Cattle Stream and the Clyde River southeast to a point across the valley from Erewhon Homestead, approximately eight kilometres. Conditions during the inspection were cold and wet. However, many specimens of previously observed invertebrate species were able to be collected and identified. Surveying began at an unnamed creek immediately upstream of Armada Bluff. The plant community at this location was diverse, woody and in excellent condition.

The river flat invertebrate fauna is a replicate of communities elsewhere on the pastoral lease and includes cockroaches, carabid beetles, *Icosidesmus* millipedes, grasshoppers (*Phaulacridium marginale* and *Brachaspis* sp.) and cicada (although activity was much reduced due to the cold conditions).

Invertebrate species collected from grasslands near the hut opposite Black Bluff were several large tunnel web spiders (*Porrothele antipodiana*), sheetweb, nursery web and orb weaver spiders. Many of the spiders had been feeding on beetles including *Mecodema* and *Holcaspis* carabids, *Artystona* darkling beetles and *Odontria* and *Pyronota* scarab beetles. Crambid moths and tussock ringlets were also relatively common.

Down valley, toward the Erewhon Homestead, inspections were made of the tussock hillsides and within the many small gullies draining the Cloudy Peak Range. As conditions warmed, the following species of native butterfly emerged: common coppers (*Lycaena salustius*), boulder coppers (*Lycaena boldenarum*), common blue (*Zizina otis labradus*) and occasional tussock ringlet (*Argyrophenga antipodum*). The presence of these butterflies is significant because it demonstrates that host plants are present within grasslands of the Clyde faces. Furthermore, given the proximity of the Erewhon Homestead (2km east), any competitive effect of the introduced cabbage butterfly and ragwort moth may not be ecologically significant.

Native spiders present were *Dolomedes aquaticus*, *Dolomedes minor*, prowling spiders (*Uliodon frenatus*) big jawed spiders (Tetragnathidae) and wolf spiders, including the 'range restricted' *Anoteropsis arenivaga* (a riverbed specialist, previously recorded from the upper Havelock River). The presence of these spiders and other native invertebrates

on this part of the lease illustrates the high degree of ecological naturalness on the pastoral lease.

The Point (lower Cloudy Peak Range)

Invertebrate habitats at this lower-altitude part of Cloudy Peak Range (at the Havelock/Clyde confluence) are wetland, shrubland, tussockland, scree/talus and riverbed. Ranger dragonfly (*Procordulia smithii*), redcoat damselfly (*Xanthocnemis zealandica*), tussock ringlet butterfly (*Argyrophenga antipodum*) and native robber fly (*Neoitamus melanopogon*) were collected from wetlands on the Clyde riverbed (UCL) adjacent to the pastoral lease. This suite of insects is typical of native wetland areas, especially those with tall stands of tussock.

Cryptic orb web spiders (*Cryptaranea* sp.), nursery web spider (*Dolomedes minor*) and ringlet butterfly (*Argyrophenga antipodiana*) were collected from shrubland above the Havelock River. Above the 900m contour, several characteristic invertebrates were found in the tussockland habitat, including tunnel web spider (*Porrhothele antipodiana*), scarab beetles (*Odontria* sp.) and a ground beetle endemic to Canterbury: *Metaglymma aberrans*.

Common big-jawed spiders (*Tetragnatha* sp.), small ubiquitous stem-boring weevils belonging to the tribe Eugnomini, common South Island grasshopper (*Sigaus australis*) and the less common but large *Sigaus campestris* were collected from speargrass habitats on the Havelock faces.

Mt Caroline Slopes

The slopes of Mt Caroline supported native vegetation in reasonable condition which improved with altitude. Exotic grasses (clover and rye) were widespread although mixed with silver and snow tussock throughout the top dressed slopes below the 1000 m contour. Invertebrates of interest found in this area included tiger beetles (*Neocicindela* sp.), the large mountain dragonfly (*Uropetala chiltoni*) and cicada (*Maoricicada nigra* and *Kikihia subalpina*).

Caroline Stream

Invertebrate habitats here are predominantly riparian matagouri shrublands, scattered mat forming plants of the *Raoulia* species and grasses While many insects were present in the area(bees, flies and cabbage butterflies), the assemblage of native taxa was remarkably diverse. Among the more interesting species found in the lower Caroline Stream were the mountain stone weta (*Hemideina maori*), the large water spider (*Dolomedes aquaticus*), wolf spiders (*Anopteropsis hilaris*) and darkling beetles (Artystona sp). Moths and butterflies were also abundant and included the boulder copper (*Lycaena boldenarum boldenarum*), common blue (*Zizina labradus labradus*) and the native grass moth, *Orocrambus flexuosellus*.

This diverse assemblage of native species in some of the most modified parts of the lease indicates that the ratio of natural to modified habitats is high and that in its present ecological state, the front country of the lease continues to support conservation values.

Jumped Up Downs

Invertebrate habitats here are predominantly grassland, shrubland and wetland. These habitats typically provide host plants for a range of native moth larvae, pollen-feeding flies and beetles.

Species Recorded

Fifty eight species of invertebrate were identified from the pastoral lease, all of which were native or endemic to the South Island high country. Taxa collected are typical of those found in the Canterbury high country and include a high proportion of flightless forms like beetles, orthoptera (includes grasshoppers, crickets and locusts) and spiders. Notable species collected (Table 11) were the stealthy spider *Matua valida* (data deficient) and wolf spider *Anoteropsis aresecens* (sparse). Both spider species were found on the Havelock River faces and the stony riverbed habitats of the Clyde and Havelock rivers. *Matua valida* is confined to Canterbury and Otago while *Anoteropsis aresecens* has been collected throughout New Zealand. Both species are representative of ecologically intact habitats. Similarly, the grasshopper *Sigaus campestris* which was collected on the Havelock River faces is also an indicator of subalpine habitats that show little or no human modification. A mountain stone weta was recorded from Caroline Stream at approximately 570m altitude above sea level which is close to its lowest altitude for this taxon. Native shrublands on the true right hand side of the Clyde River recommended for protection by Harrington *et al* (1986) remain ecologically intact and provide good habitat for indigenous moths, beetles, flies and non flying invertebrates.

The high proportion of indigenous invertebrate species on Erewhon pastoral lease reflects the position of the pastoral lease in an area of regional endemism between the high mountains of the Southern Alps and the lower Rangitata River/Lake Heron basin. The Rangitata/Heron Basin region has lower levels of indigenous taxa, 55% native and 30% endemic compared to that collected on the pastoral lease. Ecologically intact areas on the pastoral lease provide good habitat for invertebrate species.

Table 11 Notable invertebrate species recorded from Erewhon pastoral lease

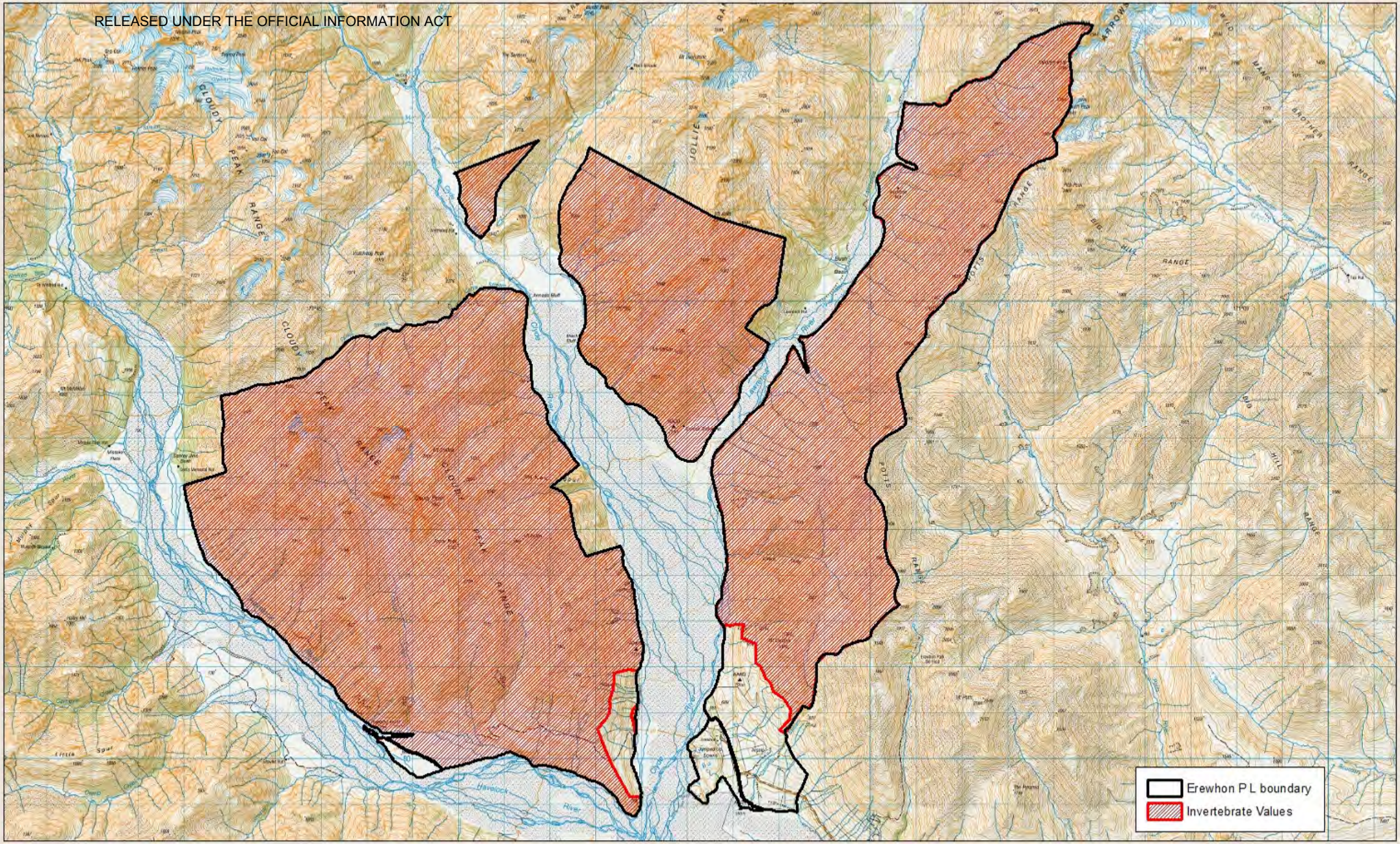
Species	Significance (Hitchmough *et al*, 2007)	Distribution on Pastoral lease
Anoteropsis alpina alpine wolf spider	'sparse'; South Island high alpine endemic	High alpine moraine
Anoteropsis arenivaga riverbed wolf spider	'range restricted'; endemic cryptic riverbed spider	Havelock River faces; McRae Block river flats
Argyrophenga antipodum mountain ringlet	endemic to the South Island high country	Common throughout, snow tussock and rocky scree
Brachaspis nivalis alpine grasshopper	endemic to eastern South Island high country	Throughout, tussock and rocky habitat above 600m
Deinacrida connectens giant scree weta	South Island alpine endemic; restricted to rocky scree habitats above 1600m	Cloudy Stream, talus slopes and moraine debris
Hemideina maori mountain stone weta	indicator of high natural condition of habitat; population is close to lowest altitude for this taxon (570 m)	Common, rocky habitats up to 1500m and as low as Caroline Stream
Matua valida stealthy spider	'data deficient'	Clyde and Havelock riverbeds; Cloudy Peak Range
Paprides nitidus alpine grasshopper	endemic to eastern South Island high country	Throughout, tussock and rocky habitat above 600m
Percnodaimon merula	endemic to the South Island high country	Common throughout, snow tussock and rocky scree
Sigaus campestris southern grasshopper	rare throughout range (Hanmer to Otago)	Havelock River faces
Sigaus villosus alpine grasshopper	endemic to eastern South Island high country	Throughout, tussock and rocky habitat above 600m

Invertebrate Fauna Significance

The significance of the invertebrate fauna values are derived from guidelines developed by the Department of Conservation in 2009. Applicable invertebrate fauna value guidelines are stated below with an explanation as to how the values fit the guideline.

47. Species listed in DOC's (new in 2007) "At Risk" categories (declining, recovering, relictual and naturally uncommon) deserve protection.

- This area supports good populations of two 'at risk' spider species: *Anoteropsis arenivaga* (range restricted) and *Anoteropsis alpina* (sparse).



Invertebrate Values

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Kilometres

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Geospatial Services

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