

Crown Pastoral Land Tenure Review

Lease name : BLACK FOREST

Lease number : PT 118

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.

Note: Plans which form part of the Conservation Resources Report are published separately.

These documents are all released under the Official information Act 1982.

May

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BLACK FOREST AND STONY CREEK PASTORAL LEASES



CONSERVATION RESOURCES REPORT

Department of Conservation

September 2007

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PART 1: INTRODUCTION

Black Forest Pastoral Lease (7942 ha) and Stony Creek Pastoral Lease (7490 ha) are adjoining leases, and are managed as one property. They are located on the lower eastern rim of the Mackenzie Basin.

Access to the property is from Haldon Road, which comes off State Highway 8 near Burke Pass, southwest from Fairlie. Haldon Road provides formed legal road access to the front country at the western end of the property, while Stony River Road provides formed legal road access up the Stony River valley. Black Forest Road is a formed legal road associated with the pylons from the Benmore dam to the south.

The properties extend 20 kms eastwards from Lake Benmore to include the Big Range, Little Range, and the south-western slopes of Grampian Mountains. The Black Forest Stream drains the western part of Black Forest Pastoral Lease, while the Stony River catchment, which includes the Balloon Stream, Preston Stream, Ross Stream and Innes Burn, dominates Stony Creek Pastoral Lease.

Altitude ranges between 370 m beside Lake Benmore to 1599 m on the upper slopes of the Big Range. The property is made up of river flats; steep and rocky faces, especially above Lake Benmore; and rolling slopes of Big and Little Range.

Black Forest and Stony Creek Pastoral Leases lie across the ecological district (ED) boundaries of Pukaki ED, Benmore ED and Grampians ED in the Mackenzie Ecological Region (ER); and of Kirkliston ED in the Waitaki ER. The majority of these pastoral leases are in the Grampians ED. The Mackenzie ER Protected Natural Areas Programme (PNAP) report (Espie *et al* 1984) shows one area of value, Grampians District #9: Big Range; this is promoted for its botanical values. The Waitaki ER has not been surveyed. A 'Sites of Special Wildlife Interest' (SSWI) slightly overlaps the property boundary along the Lake Benmore edge and a 'Wetlands of Ecological and Regional Importance' (WERI) adjoins the pastoral leases along the same boundary. Most of the Waitaki River is recognised as a 'Type II' in the Waters of National Importance (WONI) documentation (Chadderton *et al* 2004), and this includes all waterways on these pastoral leases. Recognition in WONI implies that the waterway contains special features of national significance; but only sections of 'Type II' catchments are of national importance. This significance is because it is in the top ten sites by Natural Heritage Value score in its biogeographical unit; and also for its threatened bird, plant and fish communities.

The property adjoins Streamlands Pastoral Lease to the north, Haldon Station to the north and west, Kirkliston Pastoral Lease to the east, Waitangi Pastoral Lease to the south-east and Te Akatarawa Pastoral Lease to the south. An area of retirement land under investigation for protection adjoins the property at the southeast boundary on Big Range.

The tenure review inspection of the property was undertaken during September 2006 and February 2007 by a range of specialists. These specialists' reports (listed below) form the basis of this Conservation Resources Report.

- High Country Tenure Review Programme Landscape Assessment, Black Forest and Stony Creek Pastoral Leases, Blakely Wallace Associates, December 2006, 14p + photos + maps.
- Black Forest and Stony Creek Vegetation Report, Mark Davis, April 2007, 38p + maps.
- Black Forest and Stony Creek Pastoral Leases: A Report on the Aquatic Fauna Surveys, Scott Bowie, April 2007, 11p + maps.
- Black Forest and Stony Creek Pastoral Leases: A Report on the Bird and Lizard Fauna Surveys, Scott Bowie, May 2007, 15p + maps.

- Black Forest and Stony Creek Pastoral Lease Tenure Review: Invertebrate Conservation Values. Warren Chinn, April 2007. 17p + maps.

Insert TOPO CADASTRAL MAP HERE

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

2.1 LANDSCAPE

Landscape Context

Black Forest and Stony Creek Pastoral Leases are located in the south east corner of the Mackenzie Basin. The two properties occupy a very large land area, extending 21 km from Lake Benmore in the west to the lower south western slopes of the Grampian Mountains in the east. The combined properties include lake faces of Lake Benmore and several catchments taking in Black Forest Stream, Ross Stream, Preston Stream and the Stony River. The majority of the properties consist of dry rocky mountainous country lying to the north and north-west.

The properties include all of the Big and Little ranges which are prominent features in this corner of the basin and are part of the mountain backdrop that includes the northern slopes of Mount Sutton.

The Mackenzie Basin is a vast intermontane basin bounded by high glaciated mountains to the north and west, and lower fluviably dissected block mountains to the south east (Boffa Miskell 1992). The properties are located on the dissected block mountains.

The Basin itself appears as a large open landscape where landforms are often huge and the vistas are wide and uncluttered. The properties drain either directly to Lake Benmore and the Waitaki River or via the Stony River to Lake Benmore. The high and dominant Benmore Range is located across the lake to the west of Black Forest Pastoral Lease

Landscape Description

For the purposes of this landscape assessment Black Forest and Stony Creek pastoral leases are divided into four landscape units, reflecting areas of similar landscape character (refer to the Landscape Values map). For each landscape unit, landscape character is evaluated using the following criteria:

- **Intactness** - refers to the condition of the natural vegetation, patterns and processes and the degree of modification present.
- **Legibility** - refers to its expressiveness - how obviously the landscape demonstrates the formative processes leading to it.
- **Aesthetic Factors** - include criteria such as distinctiveness - 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. A further criteria assessed under aesthetic factors is coherence. This is based on characteristics including intactness, unity, continuity, and compatibility. Intrusions, alterations, disruptions tend to detract from coherence.
- **Historic Factors** - refers to historically valued attributes in the context of a high country landscape.
- **Visibility** - refers to the visibility from public places such as highways, waterways or local vantage points.

- **Significance** - is the significance of the characteristics and features, or combination of characteristics and features within individual units. If they are locally, regionally or nationally significant.
- **Vulnerability** - is a measure of each landscape unit's susceptibility to further ecological deterioration, which would impact on landscape values.

Lake Benmore Faces - Landscape Unit 1 (LU1)

Character Description

The lake faces unit is entirely within Black Forest Pastoral Lease. It includes northwest trending ridges and gullies that extend from Beacon Hill in the north, then south along the ridgeline, across Black Forest Stream and back onto the ridge west of Black Forest Stream.

The lake edge is very indented and characterised by numerous coves and bays created when Lake Benmore was formed. Alluvial surfaces and deltas occur near the lake. The largest of these are Black Forest Stream and to a lesser extent Cattle Gully. Most of the alluvial flats have been cultivated and developed. The Black Forest Station buildings and facilities are located adjacent to Black Forest Cove. Amenity plantings are present within coves and bays adjacent to the lake.

Low hills are a feature close to Black Forest Cove, but elsewhere the unit is characterised by steep prominent ridges, and very broken topography descending down to the lake. The whole of the unit is most notable for its very dry rocky, barren 'moonscape' appearance. Broken 'shattered' rock covering the ground and rocky outcrops are features over the whole unit. On upper ridges rock tors protrude, creating a 'stonehenge' appearance in some places. Localised talus slopes occur on toe slopes in some areas.

Vegetation is highly modified especially on sunny faces and dry ridges. Lakeshore slopes consist of patchy bracken, brier, bare ground, sparse short tussock, hawkweed interspersed with weeds, pasture grasses and some native herbs and low shrubs. Grey shrubland is very scattered and often confined to tight gullies or steep rocky faces. Short tussock cover is very irregular. Within the narrow gullies, remnant silver tussock combined with some grey shrubland and sedges are often associated with alluvial surfaces and damper sites.

A small group of caravans is located at Poplar Gully and a hut is located at another bay.

Visual & Scenic Values

The lake faces contain visual and scenic values related to their context and location. The very steep, rugged and rocky ridges are a memorable and significant feature of the Lake Benmore landscape. They form the south eastern backdrop to Lake Benmore.

The rocky coves and bays set within a rugged rocky mountainous landscape are visually impressive and form a highly scenic interface with the lake.

In addition, views and vistas from the lakeshore (and most high places within the unit) across the lake and Mackenzie Basin to Aoraki/Mount Cook and ranges are outstanding.

Evaluation

Table One: Landscape evaluation of Lake Benmore Faces – LU1

Criteria	Value	Comment
Intactness	Low	Highly modified
Legibility	Medium	
Aesthetic Factors	Medium	Visually distinctive and memorable
Historic Factors	Low	

Visibility	Medium	Visible for lake users
Significance	Medium	Locally significant
Vulnerability	Low	Ecologically modified. Lake edge and lower slopes vulnerable to changes in landuse.

Mt Frazer –Staircase Saddle- Beacon Hill (LU2)

Character Description

This unit is immediately to the east of LU1, extending eastwards to a ridge that encompasses Beacon Hill, Staircase Saddle and Mount Frazer. It includes a portion of Black Forest Stream catchment.

Black Forest Stream is a locally significant stream with numerous side tributaries. The eastern side of the catchment rises to 1681m asl at Mount Frazer. The western side is considerably lower rising to 1008m asl. The valley is reasonably broad and the valley sides are dissected steep mountain slopes especially below Mount Frazer. Staircase Creek is a narrow side tributary extending to the northeast below Staircase Saddle.

Power pylons traverse the floor of the valley from the Benmore Power Station. The valley floor flats and lower slopes have largely been converted to pasture. Some remnant wetlands occur, but are impacted by cattle grazing. Exotic trees, including elderberry, pine, poplar and willow commonly occur on the valley floor.

Large basins occur on the western faces below Mount Frazer. Scattered snow tussocks are present around 950 m, and form continuous cover above about 1100 m. Tussock condition here is good. Screes and sub-alpine shrubland are significant features on the upper slopes below Mount Frazer. Mountain slopes are typically moderately steep fluviially dissected slopes on low and mid slopes to steep on upper slopes. Gully erosion is evident in some of the steeper gullies, which appears to have stabilised in recent times. Sweet brier and ‘induced’ grey shrubland are significant on lower slopes, along watercourses and on steep rocky terrain. Talus slopes on lower slopes are also a feature.

Staircase Stream comprises a mix of shrubland and brier on the valley floor and short tussock/pasture/hawkweed and shrubland on mountain slopes. Snow tussock is very patchy and more prevalent on south faces. The valley is narrow and entrenched below the saddle, with heavy shrubland and extensive rock exposure. Boulderfields and scree slopes occur within the head of the narrow gorge.

Visual & Scenic Values

This unit is typical of mountainlands in this part of the Mackenzie Basin. It is a reasonably coherent landscape but could not be described as visually distinctive or memorable. The south western parts of the unit are visible from Black Forest Road and have visual values. The majority of the unit is largely hidden from public viewing areas and accessible only by private farm track.

The upper slopes below Mount Frazer are visually the most distinctive, supporting reasonably intact tall tussock, scree and sub-alpine shrubland. The upper slopes and ridges form part of the ranges and high ground in the south east corner of the Mackenzie Basin.

Evaluation

Table Two: Landscape evaluation of LU2

Criteria	Value	Comment
Intactness	Medium	Reasonably depleted on lower slopes and valley floor but retains elements of natural patterns. Reasonably intact on upper slopes.
Legibility	High	Formative processes legible
Aesthetic Factors	Medium	Not visually distinctive or impressive but typical of area.
Historic Factors	Low	Associated with pastoral use
Visibility	Low	Largely hidden from public view apart from upper slopes and summit ridges.
Significance	Medium	Locally significant
Vulnerability	Medium	

Ross Stream catchment, Big Range and Little Range – Landscape Unit (LU3)

Character Description

This very large unit includes the central part of both Pastoral Leases and includes all of the Stony Creek catchment within Black Forest Pastoral Lease and a large part of Stony Creek Pastoral Lease.

The unit has been further broken down into the following sub-units:

- Ross Stream
- Big Range/Little Range
- Stony River flats and gorge

Landform patterns across the whole unit are reasonably consistent and comprise moderately steep to very steep dissected mountain slopes below Mount Sutton. Mountains tops and ridges are typically rounded or have flat-topped forms. Very dry north and west facing slopes dominate, with rock exposure common everywhere.

(a) Ross Stream

This sub-unit includes from the ridgeline between Mount Frazer and Beacon Hill to the Innes Burn. Staircase Saddle, at just below 1000 m, has very sparse short tussock, patchy snow tussock, hawkweed and bare ground. The upper basins and slopes above around 1200 m support snow tussock although tussock cover varies with aspect. Tussock stature is low and hawkweed is present.

The vegetation cover below 1200 m is highly modified. The main characteristics are very dry rocky and barren slopes with extensive shrubland within incised streams and lower slopes. Hawkweed cover is up to 50% in places.

The south face of Beacon Hill has a more consistent tussock cover compared to many other faces in the unit. Sweet brier is a feature on lower slopes and the valley floor. Poplars mark the site of old stockyards and musterers hut below Staircase Saddle within Ross Stream (though just outside the cadastral boundary of the property). Willows line Ross Stream and stand out against the dry hills.

(b) Big Range/Little Range

This sub-unit includes the dry west faces of Big Range, including the Ross Creek tributaries of Innes Burn and Brands Gully, as well as the summit ridge and mountain slopes of Big and Little Range and Preston Stream on the eastern side.

The western faces are all dry, barren, grey faces with scattered grey shrubland on the hillslopes and denser shrubland within gullies and waterways. Tussock cover is severely depleted and hawkweed is a significant component of the groundcover.

The summit ridge of Big and Little Ranges are distinctive examples of block mountain ranges with gently rounded and flat-topped ridges and inclined to the south. Within upper Preston Stream, the summit of Little Range and extending onto Big Range, tall tussock is in reasonable condition, though tussock stature and density is reduced. There is also much bare ground and hawkweed. Large lichen covered rock outcrops are a feature on the summit of Big Range.

Below 1100 m on Big Range and Little Range, tall tussock cover is sparse with depleted short tussock and mouse-ear hawkweed. Scattered patchy shrubland is present in gullies, and brier is thinly scattered.

Rocky knobs, craggy outcrops and shattered rock, and extremely barren dry slopes form the main patterns. North of Stony Creek, the landform is steep with similar landform and vegetation patterns.

(c) Stony River Gorge and Flats

The Stony River flats include the flats adjacent to the Stony River between Little Range and the Southern Grampian Mountains unit (LU4), and the Stony River gorge on the northern slopes of Big Range. The Stony river flats and low terraces are a mix of pasture, lucerne, along with willows, poplars and broom. The flats are widest at the southern end at the base of Little Range and narrowest within the gorge section.

Cut into the northern slopes of the Big Range is the Stony River gorge. Barren and often rocky and steep faces enclose the river. The willows lining the watercourse provide a green oasis like contrast to the dry barren hills.

The old Stony Creek homestead and buildings including an historic stone building are located near the confluence of Balloon Stream and Stony River. Wilding trees have spread from early plantings around the Station building onto the adjacent faces behind.

The river flats are generally highly modified and much of it appears to have been oversown and topdressed. The green valley floor creates a vivid contrast to the dry mountain slopes. Wetlands have been impacted by stock. Scree slides are a feature on the enclosing hill slopes.

The Stony River Road follows the valley floor. An additional cultural feature is the historic rabbit netted fence (situated on the true right hand bank of the Stony River) that was erected to keep rabbits from moving into Canterbury from Otago.

Visual & Scenic Values

Visual and scenic values over this large unit are variable in terms of extent and quality. A large part of the unit forms part of the mountain slopes below Mount Sutton including the visually distinctive flat-topped landforms of Big and Little Range that form the high ground and backdrop to this corner of the Mackenzie Basin (and Upper Hakataramea Valley). Visual values can also be attributed to very varied and impressive landform characteristics and patterns. The size and scale of the landforms is huge and vistas to the basin and surrounding mountains are grand and impressive. Landforms are often steep, very rocky and rugged. The Stony River Gorge is visually an impressive feature within a barren and rugged landscape.

The Stony River flats and valley as a whole forms a visually attractive backcountry landscape combining impressive landforms and a cultural landscape associated with the early settlers and pastoral use.

The natural vegetation patterns however are severely degraded over much of the unit apart from areas above about 1200 m. The level of degradation tends to impact on visual and scenic values present over some of the unit, especially in the Ross Stream catchment area.

Evaluation

Table Three: Landscape Evaluation of LU 3

Criteria	Value	Comment
Intactness	Overall low	Medium on summit ridge of Big and Little Range.
Legibility	High	Formative processes highly legible
Aesthetic Factors	Medium	Scale of landform and patterns are visually impressive.
Historic Factors	Medium	Cultural history associated with pastoralism and Old Stony Creek buildings.
Visibility	Medium	Large part of unit visible over a wide area in this part of basin. Other parts are visible from Stony River Road.
Significance	Medium	Regionally significant.
Vulnerability	Medium	Upper slopes vulnerable to further tussock depletion. Lower slopes have low vulnerability.

South-western Grampian Mountains - Landscape Unit 4 (LU4)

Character description

This topographically separate unit is wedged between the Stony River and Balloon Stream. It forms a corner of the western toe slopes of the Grampian Mountains. A terrace face rises abruptly above the Stony River on two sides of the unit up to a fluvially incised tilted tableland or sloping landform. The incised gullies flow either to Balloon Stream or have cut down into the steep terrace above the Stony River. The majority of this landform has a sloping surface with a northwest aspect.

The south eastern face above the Stony River is steep, with a series of rounded ridges and shallow gullies cutting into the sloping face and toe slopes above the river. The south-west face forms a steep terrace against the Stony River. Talus slopes are a feature at the southern end, where the river is cut in against the terrace face.

Natural vegetation patterns over the entire unit are generally highly modified. Depleted short tussock, extensive hawkweed, very scattered matagouri and exotic grasses and weeds form the main patterns over the whole of the unit.

Visual & Scenic Values

The landform characteristics are the main aspect of visual values within this landscape unit. The landform is visually distinctive within the context of the surrounding area and separate and different from the remainder of Stony Creek Pastoral Lease. The steep terrace faces and contrasting sloping upper surface are part of the landform that extends from the western side of the Grampian Mountains to Stony River. The landform type is contiguous with the adjoining properties of Streamlands and Curraghmore Pastoral Leases.

Evaluation

Table Four: Landscape Evaluation of LU4

Criteria	Value	Comment
Intactness	Low	Modified over entire unit
Legibility	High	Formative processes highly legible
Aesthetic Factors	Medium	Forms a visually distinctive landform
Historic Factors	Low	
Visibility	Low	Visible in distant views (lower part of the western slopes of the Grampian Mountains). Visible from Stony Creek Road
Significance	Low	
Vulnerability	Low	

Significance of Landscape Values

Areas forming the Lake Benmore backdrop, upper slopes of the properties and the Stony River gorge have been identified as having significant landscape values (refer Landscape values map).

The Lake Benmore Faces (LU1), although highly modified in terms of natural values, contain visual and scenic values as the backdrop and context to Lake Benmore. The very rocky and craggy landform is distinctive and a strong feature of this part of the Mackenzie Basin. The indented lakeshore, coves and bays are also significant features. Views from these areas across the lake and basin to the Main Divide are outstanding.

The upper slopes within LU2 and LU3 are identified as containing significant inherent landscape values. Remaining indigenous cover on the upper slopes is important to natural character. The high basins and slopes below Mount Sutton and Mount Frazer retain their natural features and characteristics. Although there is a degree of degradation, the dominant tussock cover is continuous and appears as a natural landscape. These areas are seen as part of the mountainous backdrop to Lake Benmore and Haldon Station area and are visible in distance views over a much wider area.

The upper slopes and summit of Big Range and Little Range (LU3), with their distinctive ‘inclined’ and flat-topped form, is a significant landscape feature in the area, and is visible over a wide area. Areas between 900-1200 m are important to the landscape and landform patterns, even though they may not have the ecological integrity of higher zones.

The Stony River Gorge within LU3 cuts into the northern slopes of the Big Range and represents an impressive gorge landscape with extremely barren and often rocky and steep faces enclosing the river. The river winds through this dry mountainous landscape. The willows lining the watercourse provide a green oasis like contrast to the dry barren hills.

Insert Landscape values map here

2.2 LANDFORMS, GEOLOGY AND SOILS

2.2.1 Geology

The basement rock of the Lake Benmore faces, as far east as Black Forest Stream, is schistose to non-schistose greywacke and argillite of Triassic age, of the Rakaia terrane.

The majority of the property (i.e. east of Black Forest Stream) has basement rock of schistose to non-schistose greywacke interceded with mudstone of Permian Age. This basement rock has been further metamorphosed around Beacon Hill, Staircase Creek and mid-lower Ross Stream, where strongly foliated and segregated Haast schist is present.

Valley floors near Black Forest homestead, Black Forest Stream, and Stony River have fluvial deposits of gravel, sand and mud of modern and postglacial flood plains.

Numerous faults and thrusts are present, generally trending NNE to SSW, e.g. along Black Forest Stream (Forsythe 2001).

2.2.2 Landforms

The Mackenzie/Waitaki basin forms a vast intermontane basin bounded by high glaciated mountains to the north and west, and lower fluvially dissected block mountains to the south east. The properties are located on these dissected block mountains.

The Benmore Lake faces are characterised by steep broken hillslopes, with broken 'shattered' rock covering the ground and rocky outcrops common. On upper ridges rock tors protrude. Localised talus slopes occur on toe slopes in some areas. These hillslopes are prominent landscape features which may contain active faults.

Further east, the mountain slopes of Mt Frazer are typically moderately steep fluvially dissected slopes on low and mid slopes, to steep on upper slopes. Screes are significant features on the upper slopes below Mt Frazer. Gully erosion is evident in some of the steeper gullies. Talus slopes on lower slopes are also a feature.

The mountain slopes below Mt Sutton are moderately steep to very steep and dissected while tops and ridges are typically rounded or have flat-topped forms. Very dry north and west facing slopes dominate, with rock exposure common everywhere. The summit ridge of Big and Little ranges are distinctive examples of block mountain ranges with gently rounded and flat-topped ridges.

Cut into the northern slopes of the Big Range is the Stony River gorge. Barren and often rocky and steep faces enclose the river.

A terrace face rises abruptly above the Stony River up to a fluvially incised tilted tableland or sloping landform. The incised gullies flow either to Balloon Stream or have cut down into the steep terrace above the Stony River. The majority of this landform has a sloping surface with a northwest aspect.

The south eastern face above the Stony River is steep, with a series of rounded ridges and shallow gullies cutting into the sloping face and toe slopes above the river. The south-west face forms a steep terrace against the Stony River. Talus slopes are a feature at the southern end, where the river is cut in against the terrace face.

2.2.3 Soils

Above about 1400 m asl Benmore steepland soils dominate the Big and Little ranges. Below this, extending down to mid altitude slopes, Omarama Steepland soils have developed over greywacke and colluvium, with some rock outcrops and a thin cover of loess present in places. The steep Lake Benmore faces and lower Black Forest Stream faces have Waitaki Steepland soils. These soils grade with Otematata Hill soils on the lower slopes of the Big Range between Ross Stream and Stony River, where the topography is easy rolling to rolling with rock outcrops. Pockets of mostly fine sandy loam Grampian alluvial soils occur on undulating to sloping fans at the mouth of Black Forest Stream, and on the valley flats near Balloon Stream and Stony River. Kirkliston soils occur on the easy rolling toe slopes of the Grampian Mountains beside Stony River at the north-eastern extent of Stony Creek Pastoral Lease.

A soil site of regional significance is present on colluvial mountain slopes and tops of Big Range. This site is significant because it is a large area with good examples of dry yellow-brown and yellow-grey earths with native vegetation; and because it included the only red tussockland in the district, and the only high altitude red tussockland in the ecological region, (RAP9), (Arand *et al.* 1991). Soils present are upland yellow-brown earths (Benmore) and yellow-grey earths (Omarama).

Significance of Geology, Landforms and Soils

The Mackenzie/Waitaki basin forms a vast intermontane basin bounded by high glaciated mountains to the north and west, and lower fluvially dissected block mountains to the south east. The properties are located on these dissected block mountains.

The majority of the property (i.e. east of Black Forest Stream) has basement rock of schistose to non-schistose greywacke interceded with mudstone of Permian Age. This basement rock has been further metamorphosed around Beacon Hill, Staircase Creek and mid-lower Ross Stream, where strongly foliated and segregated Haast schist is present. There are no geopreservation sites listed for the property.

Screes are significant features on the upper slopes below Mt Frazer. The summit ridge of Big and Little ranges are distinctive examples of block mountain ranges with gently rounded and flat-topped ridges.

The soil site at Big Range is significant because it is a large area with good examples of dry yellow-brown and yellow-grey earths with native vegetation; and because it included the only red tussockland in the district, and the only high altitude red tussockland in the ecological region (Arand *et al.* 1991).

2.3 CLIMATE

The Black Forest and Stony Creek Pastoral Leases have a semi-arid mountain climate with cold winters and very warm dry summers. Predominant winds are from the northwest, with occasional gales. Snow can affect all parts of the property and lie at higher altitudes for several weeks in winter. Average annual precipitation is between 375 and 1200 mm. The climate of the area is strongly influenced by the sheltering effects of the Southern Alps, resulting in drier conditions than occur in most of New Zealand's other mountain environments (Leathwick *et al.* 2003).

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; however, this data should be interpreted with caution, as the predicted extent and suggested vegetation types for each Land Environment (Leathwick *et al.*, 2003) have been extrapolated from limited field data.

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 1) has become the recognised benchmark for the promotion of threatened LENZ conservation.

Table Five 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
No Threat Category	>30% indigenous cover remaining >20% legally protected

LENZ environments present on the property are Acutely Threatened (0.04% of the property), Chronically Threatened (2.74%), At Risk (3.63%), Critically Underprotected (69.92%), Underprotected (0.028%) and No Threat Category (23.65%).

Two small areas of acutely threatened LENZ units are present, one adjacent to the Stony River/Hay Stream confluence, the other on a fan at the north-eastern end of Stony River gorge. LENZ units that are chronically threatened or at risk are located along rivers or streams (e.g. Black Forest Stream, Ross Stream and Stony River) and on the shores of Lake Benmore. A few isolated pockets of “At Risk” LENZ units are present on the foot slopes of Grampian Mountains. The majority of all remaining mid altitude country comprises of the “Critically Underprotected” LENZ Unit. A small Under-protected LENZ unit exists close to the boundary of Black Forest and Te Akatarawa pastoral leases. Most of the higher altitude country has no threat category (see LENZ Threat map).

Indigenous vegetation present on these LENZ units varies. Indigenous vegetation is present on some Chronically Threatened and At Risk LENZ units which have not been cultivated. These areas are significant because the percentage protected nationally for conservation purposes is less than 10 % for these level IV environments present on the properties.

Significance of Land Environments of New Zealand

LENZ units present on the property are Acutely Threatened, Chronically Threatened, At Risk, Critically Underprotected, Underprotected and No Threat Category.

Indigenous vegetation present on these LENZ units varies. Indigenous vegetation is present on some Chronically Threatened and At Risk LENZ units which have not been cultivated. These areas are significant because the percentage protected nationally for conservation purposes is less than 10 % for these level IV environments present on the properties.

Insert Lenz map here

2.5 VEGETATION

Common names are used in the text unless there is no common name, in which case the scientific name is used. Naturalness is rated using low, medium, and high.

Ecological context

The majority of the property is in Grampians Ecological District (ED), which is in the Mackenzie Ecological Region (ER). Espie *et al.* (1984) identified nine Recommended areas for Protection (RAPs) within the Grampians ED, of which one (RAP9: Big Range) lies within Stony Creek Pastoral Lease. This RAP at Brands Gully included a vegetation sequence from red tussock through snow tussock to valley floor matagouri and *Olearia*. It represented the only high altitude occurrence of red tussock in the ER.

The vegetation pattern on the property is similar to that on the nearby Grampian Mountains, Kirkliston Range and unnamed ranges to the south. Rockland communities occur on exposed alpine summits and ridges, with some slim snow tussock on high altitude shady slopes. Narrow-leaved snow tussock is widespread at mid to upper altitude, but is limited on sunny aspects. Short tussock occurs at mid to lower altitude, though exotic herbfield and grassland is more dominant and extensive. Grey shrublands occur in lower valleys, extending up rocky side slopes and around talus patches. Wetlands are mostly restricted to alpine and subalpine seepages and modified valley floor wetlands.

McGlone (2001) suggests that the pre-human vegetation of the intermontane basins of Central Otago and South Canterbury was mixed grasslands and shrublands, dominated by non-*Chionochloa* grasses and small-leaved shrubs. Low scrub-forest occurred on lower slopes with species such as mountain totara, mountain toatoa, bog pine, kowhai, *Coprosma*, *Myrsine* and *Dracophyllum* shrubs. Upslope, the scrub-forest gave way to snow totara and turpentine shrublands, with patches of narrow-leaved snow tussock on rocky habitats. The alpine slopes and tops were dominated by slim snow tussocklands. Components of the original woody vegetation that remain on the property include prostrate kowhai, *Olearia*, *Coprosma* and other small-leaved shrubs.

Vegetation and flora

Upper and mid slopes are characterised by tall tussocklands with slim snow tussock occurring in a narrow band at the highest altitudes and narrow-leaved snow tussock being widespread elsewhere. The tall tussocklands give way to very modified short tussock grassland, exotic herbfield and grasslands on mid to lower slopes. Exotic herbfield is also widespread on many ridges and spurs, extending into the alpine zone on rolling summit crests. The vegetation on many of these slopes is severely degraded. Rockland communities are mostly associated with rock outcrops, talus and scree throughout the property, though scree is uncommon and restricted to higher altitudes. Grey shrublands are widespread, but concentrated in valley floors, around rock outcrops and talus. Prostrate kowhai occurs at a number of localities on sunny lower slopes, but only in low numbers and small patches of turpentine shrubland occur on some mid-altitude shady slopes around rock outcrops and talus. Sweet brier shrublands are common on lower slopes, especially above Lake Benmore, but also on fans, terraces and lower slopes elsewhere. Wetlands are largely restricted to seepages, and modified valley floor sedgeland. A substantial number of threatened plant species occur on the property, including spring annuals.

The property has been divided into four units for vegetation description:

- Lake Benmore Faces
- Upper Black Forest and Ross Stream Catchments
- Big Range and Little Range
- South-western Grampian Mountains

Lake Benmore Faces

This area is comprised of the west-facing catchments above Lake Benmore and includes the catchments to the north between Black Forest Stream and Staircase Stream. The ground surface is very rubbly with widespread rock outcrops. The vegetation on most slopes is dominated by exotic herbfields and grasslands, with sparse short tussock grasslands on mid to upper slopes. Exotic shrublands dominated by sweet brier are common on lower slopes, but grey shrublands occur in gullies, around talus and rock outcrops. Rock outcrops support a characteristic dryland flora which includes a number of threatened plants. Threatened spring annuals occur in the lower valley of Black Forest Stream, within a chronically threatened land environment.

Lower Black Forest Valley

Two spring annual species and other threatened species occur within a chronically threatened land environment in the lower valley of Black Forest Stream, immediately southeast of the farm buildings. Several populations of *Ceratocephala pungens* (Nationally Critical) occur on both sides of the stream. The largest population (on the south-western side of stream) has an estimated population of more than 1000 plants, while another (on north-eastern side) has c. 100 plants present. Other threatened species on the north-eastern side include NZ mousetail (Nationally Endangered), *Lepidium solandri* (Nationally Endangered), *Carex decurtata* (Range Restricted) and *Convolvulus verecundus* (Sparse). These plants occur on intensively grazed terraces dominated by exotic dryland herbs and grasses, native moss and the lichen, *Chondropsis semiviridis*. Naturalness is low and significant inherent values are present.

Lake Faces

Alpine fescue short tussock grassland, with blue tussock, is present on upper west-facing slopes above Poplar Gully. Exotic species are common, including mouse-ear hawkweed, king devil, sweet vernal, sheep's sorrel, tall oat grass, sheep's burr and sweet brier, with native species golden speargrass, harebell, *Pimelea aridula*, *Thelymitra longifolia*, white fuzzweed (Data Deficient), *Carex breviculmis*, *Anisotome brevistylis*, plume grass, *Trisetum youngii*, and the shrubs mingimingi and *Olearia odorata* also present. Naturalness is low/medium. A similar community occurs in the second catchment to the north at a similar aspect and altitude, where fescue tussock replaces alpine fescue tussock and mouse-ear hawkweed is more common. Naturalness is low. Shady slopes and rock ribs to the northwest support sparse narrow-leaved snow tussock and scattered golden speargrass.

Lower shady slopes above the lake are dominated by exotic dryland grasses and herbs. Native species include Maori onion, *Prasophyllum colensoi*, mosses, harebell and orchid *Microtis unifolia*. Naturalness is low to low/medium at best. Fescue tussock and blue tussock occur locally (to 5% cover), while silver tussock is uncommon. Lower sunny slopes are rubbly and dominated by haresfoot trefoil, tall oat grass, mouse-ear hawkweed and sweet vernal, with scattered brier. Native species present include *Geranium sessiliflorum*, *Dichondra brevifolia*, porcupine shrub, rock fern, and *Convolvulus verecundus* (Sparse), which is locally abundant. Naturalness is low. Significant inherent values occur as points or in localised areas. Some cultivation has occurred on fans at the entrance to Cattle Gully.

In catchments between Cattle Gully and Poplar Gully, talus on lower shady slopes and around rock outcrops support extensive mosses and lichens, little hard fern, scrub pohuehue and porcupine shrub. Other native species include threatened coral broom (Gradual Decline), *Olearia odorata*, mingimingi, lawyer, prickly shield fern, blue tussock, thousand-leaved fern, *Asplenium richardii*, *Clematis marata*, *Parsonsia capsularis*, *Brachyglottis haastii*, threatened *Urtica aspera* (Sparse), and mountain wineberry, with dryland exotic grasses, herbs and sweet brier present. Naturalness is medium to medium/high and significant inherent values are present. On sunny slopes, talus is rubbly and less stable and its vegetation is more modified. Sparse prostrate kowhai is present in a few areas. Significant inherent values occur as points or in localised areas.

Rocky ridges near the lake are dominated by lichens, with hawkweed, exotic grasses and herbs common. Native species include mosses, fescue tussock, blue tussock, *Hebe pinguifolia*, porcupine shrub, *Brachyglottis haastii*, harebell, *Luzula banksiana* var. *rhadina*, scabweed, *Celmisia gracilentia*, rock fern, *Asplenium flabellifolium*, *Anisotome brevistylis*, *Helichrysum intermedium*, bristle tussock and white fuzzweed (Data deficient). Threatened *Carmichaelia curta* (Nationally Endangered) was found on one rock outcrop. Naturalness is medium and significant inherent values are present. Above Poplar Gully, rocky mid-altitude ridges support native shrub species including sparse prostrate kowhai, mingimingi, *Olearia odorata*, porcupine shrub, scrub pohuehue, occasional *Coprosma virescens* and *Clematis marata*. Other species include abundant mouse-ear hawkweed, and the native species white fuzzweed (Data deficient), threatened *Achnatherum petriei* (Range Restricted), plume grass, *Euchiton luteo-album*, blue tussock, blue wheatgrass, *Scleranthus uniflorus*, *Epilobium rostratum*, *Rytidosperma corinum*, harebell, *Poa lindsayi*, *Carex breviculmis*, *Lachnagrostis lyallii*. Haresfoot trefoil, sweet vernal, and stunted sweet brier are also present. Naturalness is low/medium to medium reflecting the impact of weeds, and significant inherent values are present.

Low altitude rock outcrops support native plants such as the grasses *Achnatherum petriei* (Range Restricted), blue tussock and *Rytidosperma pumilum*; ferns *Pleurosorus rutifolius* (Sparse), *Pellaea calidirupium*, rock fern, *Cystopteris tasmanica*, *Asplenium flabellifolia* and little hard fern; shrubs coral broom (Gradual decline), *Helichrysum intermedium* and *Hebe pimeleoides* var. *pimeleoides*; herbs *Crassula sieberiana*, white fuzzweed (Data deficient), *Euchiton luteo-album* and *Stellaria* sp. 'tall'; and sedge *Carex resectans*. Exotic mouse-ear hawkweed and sheep's sorrel are also present. Naturalness is medium/high and significant inherent values are present. Additional native species found on higher altitude rock outcrops in Poplar Gully include grasses bristle tussock, plume grass, blue wheat grass, and *Lachnagrostis lyallii*; the herbs harebell, *Dichondra brevifolia*, *Acaena caesiiglauca*, and the threatened *Senecio dunedinensis* (Sparse); shrubs *Pimelea aridula*, porcupine shrub, *Hebe pinguifolia*, the threatened *Carmichaelia vexillata* (Serious Decline), liane bush lawyer; and fern *Asplenium richardii*. Naturalness is medium to medium/high and significant inherent values are present.

Lower valleys between Cattle Gully and Poplar Gully support semi-continuous grey shrublands comprised of *Olearia odorata*, porcupine shrub, *Melicytus* sp. 'robust', lawyer, scrub pohuehue, mingimingi, *Parsonsia capsularis*, mountain wineberry and sweet brier. Exotic grasses dominate open patches within the shrublands. Naturalness is medium. A shrubland in upper Cattle Gully contains several threatened *Carmichaelia kirkii* (Nationally Endangered) among mingimingi, *Olearia odorata*, lawyer, scrub pohuehue, *Coprosma virescens*, widespread sweet brier and patches of bracken. Approximately 12 elderberries are also present in this shrubland. Significant inherent values are associated with these shrublands.

Sweet brier shrublands (to 40% cover) are extensive on lower sunny slopes, fans and terraces. Bare ground beneath them can be up to 30%. Exotic mouse-ear hawkweed, sheep's bur, viper's bugloss, verbascum, harefoots trefoil dominate, with occasional silver tussock present. Naturalness is low. The brier is densest on valley floor entrances and on fans.

Wetlands

Small modified seepages occur in some valley floors adjacent to the lake shore, and are commonly dominated by exotic species such as jointed rush, white clover, lotus, tarweed, Yorkshire fog, crested dogstail, ryegrass, the soft rush *Plantago lanceolatum* and creeping buttercup. Scattered native sedges and rushes pukio, *Carex coriacea*, and *C. buchananii* are present. Naturalness is low. The lake edge supports native plants such as *Carex buchananii*, pukio, and *Eleocharis acuta*, with monkey musk, scattered crack willow, willow weed and *Myosotis laxa* subsp. *caespitosa* common. Valley floor wetlands in Black Forest Stream are dominated by *Carex coriacea*, willows, and exotic grasses, with patches of pukio.

Upper Black Forest and Ross catchments

This area includes the upper catchments of Black Forest Stream and Ross Stream, Mt Frazer and the upper slopes of Mt Sutton. Lower slopes and some mid slopes are very degraded and dominated by exotic herbfields and sweet brier shrublands. Grey shrublands occur in gullies and around rock outcrops, the most extensive ones being in the upper Ross catchment. Smaller patches of turpentine shrublands occur on some shady mid-slopes. Tall tussocklands occur in higher upper catchments, extending to mid slopes on shady aspects. Minor cushion and mat communities occur on higher altitude spurs, while rock outcrops, talus and scree support rockland plants. Wetlands are typically restricted to mountain slope seepages and small remnant valley floor wetlands.

Upper Eastern catchment of Ross Stream

Rubbly alpine sunny slopes, rock outcrops, screes and seepages are scattered through the upper valley, and support extensive tall tussocklands. Narrow-leaved snow tussock dominates (15-40% tussock cover) with native golden speargrass, and exotic mouse-ear hawkweed, king devil and sheep's sorrel also common. Other native species include grasses *Poa lindsayi*, blue wheatgrass, blue tussock and *Deyeuxia avenoides*; herbs *Euchiton luteo-album*, *Epilobium glabellum*, *Acaena caesiiglauca*, *A. fissistipula*, *Geranium sessiliflorum*, *Raoulia subsericea* and white fuzzweed (Data deficient); shrubs *Coprosma cheesemanii*, *Olearia odorata*, coral broom (Gradual decline), and red woodrush. Tussock hawkweed is present. Naturalness is medium. Small mossy seepages support native species: silver tussock, purging flax, threatened *Euchiton paludosus* (Sparse), Maori onion, bog rush, *Celmisia gracilentia*, *Brachyscome radicata* and *Acaena caesiiglauca*. Naturalness is medium to medium/high. Significant inherent values are present on all these slopes.

Talus is common on shady toe slopes. These and adjacent rock outcrops provide habitat for native mosses, lichens, shrubs (*Coprosma* aff. *pseudocuneata*, *C. cheesemanii*, turpentine shrub, *Gaultheria crassa*, creeping mapou, and coral broom); herbs (false speargrass, golden speargrass, *Stellaria gracilentia*, *Celmisia angustifolia*); grasses (blue tussock, blue wheatgrass, and ferns, little hard fern and *Cystopteris tasmanica*). Naturalness is high. Localised patches of turpentine shrubland are present dominated by turpentine shrub (40% cover) and snow tussock (20% cover), with herbs (*Celmisia angustifolia*, golden speargrass, *Aciphylla montana*, *Lobelia linnaeoides*); grasses (blue tussock, fescue tussock); mosses and lichens. Naturalness is high. Significant inherent values occur in all of these rockland habitats.

Shady subalpine slopes support snow tussockland (20-40% cover). Additional species not seen on sunny slopes include *Lobelia linnaeoides*, threatened *Agrostis muelleriana* (range restricted), snowberry and *Leptinella sericeo-villosa*. Naturalness is medium. Slim snow tussock becomes dominant above 1300 m, while additional species are *Kelleria dieffenbachii*, mountain clubmoss and *Dracophyllum prunum*. Naturalness is medium to medium/high. Seepages are dominated by bog rush and mosses. Tall tussockland is generally widespread, but becoming confined to shady faces on the true left of the stream. The adjacent eastern catchment contains snow tussock on all but lower sunny slopes and spurs. The spurs are major access ways for stock and are dominated by mouse-ear hawkweed, with scattered fescue tussock, blue tussock, sweet vernal, *Pimelea aridula*, *Carex breviculmis*, scabweed, *Raoulia parkii*, browntop, harebell, blue wheatgrass and plume grass. Naturalness is low/medium. Significant inherent values are present across these slopes, though they are localised on lower sunny slopes and spurs.

Middle Ross Valley and western tributaries

Grey shrubland is present in the middle valley and two western tributaries of the Ross Stream catchment, occupying the riparian zone and adjacent hillslopes, especially where talus or rock outcrops occur. The riparian shrublands are particularly dense in the tributary valleys, and dominated by mountain wineberry, mingimingi, matagouri and *Olearia odorata*. Other species include native broom, *Carmichaelia kirkii* (Nationally Endangered), *Olearia bullata*, *Clematis marata*, *Scandia geniculata*, scrub pohuehue, native jasmine and lawyer. *Corokia cotoneaster* was seen occasionally. *Carmichaelia kirkii* is abundant in the upper tributary, comprising 20% ground cover in places with more than 300 plants being present. *Carmichaelia kirkii* is also present in the shrublands of the lower

tributary. The shrublands are patchier on adjacent slopes and have a similar composition, though *Olearia odorata* is more common around seepages. *Carmichaelia kirkii* is also present around talus patches, with additional *Hebe treadwellii* and bracken. All the shrublands are of high naturalness and significant inherent values are present.

Grey shrublands of similar species composition, but less dense, extend along the middle Ross Stream valley, alongside the stream, around rock outcrops and talus patches. *Carmichaelia kirkii* is reasonably common among shrublands in the central valley. The shrublands extend up side slopes where they become patchy, but dense shrublands remain around talus and rock outcrops where prostrate kowhai and *Hebe rakaiensis* are additional species.

Stream margins support toetoe, pukio, bog rush, golden speargrass, giant speargrass, monkey musk, Maori onion, *Carex buchananii*, purging flax, exotic grasses, *Myosotis laxa* subsp. *caespitosa*, yarrow and cleavers. Open rocky parts of stream beds support *Epilobium pycnostachyum*, creeping pohuehue, tall oat grass, haresfoot trefoil and matagouri.

Sweet brier becomes prominent in the riparian shrublands of the lower valley. On sunny slopes above Ross Stream hut, prostrate kowhai occurs with native broom, *Olearia odorata*, mingimingi, matagouri, lawyer and *Clematis marata* with around 10% sweet brier. Significant inherent values are associated with all these shrublands.

Beyond the shrublands, the valley floor is dominated by exotic grasses, mouse-ear hawkweed, yarrow, scattered fescue tussock, and blue tussock. On stony terraces creeping pohuehue, tall oat grass, *Scleranthus uniflorus*, *Epilobium melanocaulon* and *Acaena inermis* are prominent. Lower valley slopes are characterised by mouse-ear hawkweed, exotic grasses, haresfoot trefoil, scattered short tussock, scattered sweet brier and indigenous grey shrubs. The naturalness of these slopes is low/medium. Species of small valley floor seepages and streamsides include mosses, bog rush, *Ranunculus* sp., *Carex petriei*, monkey musk, Maori onion and pukio. Male fern occurs occasionally and one small crack willow was seen near the 4WD track.

Upper Western Catchment of Ross Stream

The upper western tributary generally supports a similar range of communities to that described above. However, the northern summit faces of Mt Frazer support a slim-leaved tussockland, where tussock cover is <25%, mouse-ear hawkweed is 25% and fescue tussocks are common. Other species include blue tussock, golden speargrass, *Pimelea oreophila*, tauhinu, *Raoulia subsericea*, sheep's sorrel and king devil. Naturalness is medium. Slim snow tussock is soon replaced by narrow-leaved snow tussock with decreasing altitude. At 1470 m narrow-leaved snow tussock has a cover of 30%, and mouse-ear hawkweed is 15%. Slim snow tussock is still present and additional species include golden speargrass, patotara, *Celmisia gracilentia*, *Raoulia subsericea*, *R. hookeri*, *Kelleria dieffenbachia*, harebell, *Anisotome imbricata*, *Scleranthus uniflorus*, fescue tussock, blue tussock, *Carex breviculmis*, red woodrush and king devil. Naturalness is medium. Disturbed areas by the 4WD track support species such as *Raoulia hectori*, *Poa lindsayi*, *Acaena inermis* and *Rytidosperma pumilum*. Steep sunny slopes below have a tall tussock cover of 30-50%, with hawkweeds comprising 30% cover. Additional species include *Carmichaelia vexillata*, *Leptinella pectinata* subsp. *villosa*, *Colobanthus buchananii*, *Coprosma perpusilla*, threatened *Kirkianella novae-zelandiae* (Sparse), *Lobelia linnaeoides* and mountain clubmoss. Naturalness is medium. Narrow-leaved snow tussock extends down to about 1100 m on sunny slopes. Significant inherent values are associated with all these communities.

Steep rubbly shady faces at 1150 m are dominated by narrow-leaved snow tussock (40% cover), hawkweed (10%) and little hard fern. Additional species include fescue tussock, everlasting daisy, *Craspedia uniflora*, *Brachyscome sinclairii*, *Lobelia linnaeoides*, *Epilobium* sp., *Brachyglottis bellidioides*, *Forstera sedifolia*, *Aciphylla montana*, *Hydrocotyle tripartita*, *Agrostis muelleriana*, snowberry, *Pimelea oreophila*, and red woodrush. Naturalness is high and significant inherent values are present. The lower limit of snow tussocklands on shady slopes is about 800 m.

Seepages within them are dominated by snow tussock and bog rush. Other species include Maori onion, golden speargrass, *Celmisia gracilentia*, *Hydrocotyle novae-zealandiae* var. *montana*, *Raoulia subsericea*, *Ranunculus multiscapus*, *Epilobium brunnescens*, *Lagenifera cuneata*, *Prasophyllum colensoi*, *Luzula pumila*, *Isolepis aucklandica*, *Uncinia divaricata*, *Juncus novae-zealandiae*, snowberry, *Coprosma dumosa*, *Olearia bullata*, *O. odorata* and tauhinu. Mouse-ear hawkweed, catsear, sweet vernal and white clover are present and naturalness is high. Significant inherent values are present.

Below the tall tussocklands, degraded exotic hawkweed herbfield occurs down to about 700m. Bare ground and gravel comprise 35% of cover, and mouse-ear hawkweed has a cover of 50%. Other species include king devil, fescue tussock, blue tussock, blue wheatgrass, sweet vernal, sheep's sorrel, *Poa maniototo*, scabweed, *Raoulia parkii*, *R. subsericea*, *Scleranthus uniflorus*, *Carmichaelia vexillata* (Serious decline), creeping pohuehue, *Pimelea aridula*, *P. oreophila*, *Carex breviculmis*, *C. muelleri* (Sparse), occasional silver tussock, threatened *Deyeuxia youngii* (sparse) and *Lachnagrostis lyallii*. Rock outcrops provide habitat for species such as *Pimelea aridula*, *Muehlenbeckia axillaris*, patotara and *Carmichaelia vexillata*. Naturalness is low, though threatened plants are scattered throughout. Significant inherent values occur as points or in localised areas.

Rock outcrops are scattered through the tall tussocklands, supporting a characteristic rockland community. Species include *Helichrysum intermedium*, *Brachyglottis haastii*, *Celmisia gracilentia*, golden speargrass, *Anisotome brevistylis*, *Thelymitra longifolium*, blue tussock, narrow-leaved snow tussock, *Deyeuxia avenoides*, harebell, *Coprosma* aff. *pseudocuneata*, *Carmichaelia vexillata*, creeping mapou, *Celmisia angustifolia*, *Colobanthus acicularis*, *Lobelia linnaeoides*, *Brachyglottis bellidioides* and *Hebe pimeleoides* subsp. *pimeleoides*. Naturalness is high.

Patches of turpentine shrubland occur locally around rock outcrops on shady slopes, and are of high naturalness. They are similar to those in the eastern headwaters of Ross Stream. On sunny slopes, additional species on rock outcrops include *Olearia odorata*, porcupine shrub, coral broom, *Pimelea aridula*, scrub pohuehue, necklace fern, little hard fern, rock fern, *Asplenium richardii*, plume grass and blue wheatgrass. Significant inherent values are associated with these rockland habitats.

Staircase Saddle – East Side

On the eastern side of Staircase Saddle, rock outcrops and ribs support an extensive but sparse prostrate kowhai shrubland, where seedlings are present. Hawkweed cover is 30% and sweet brier is up to 10%. A ribbon of grey shrubland occurs in the valley floor, extending up valley sides, especially on rubbly northern slopes with rock outcrops and talus. Shrub species include matagouri, porcupine shrub, *Olearia odorata*, mingimingi, mountain wineberry, *Coprosma virescens*, native broom, sweet brier, lawyer, scrub pohuehue, native jasmine and *Clematis marata*. Naturalness is medium. Rock outcrops support a diversity of rockland plants including coral broom (Gradual decline), mingimingi, blue tussock, *Brachyglottis haastii*, *Olearia odorata*, bristle tussock, *Rytidosperma pumilum*, red woodrush, *Crassula sieberiana*, rock fern, *Pellaea calidirupium*, *Asplenium richardii*, plume grass, *Scleranthus uniflorus*, scabweed, *Carex breviculmis*, lichens, mosses, harebell, sweet vernal, mouse-ear hawkweed, tall oat grass, sheep's sorrel and woolly mullein. Naturalness is medium. *Pimelea aridula* and *Hebe pimeleoides* var. *pimeleoides* occur on rubbly sunny slopes with fescue tussock, silver tussock, exotic herbs and grasses. Upper shady slopes support mouse-ear hawkweed, sweet vernal, tall oat grass, scattered fescue tussock and a few snow tussocks. Naturalness is low. Significant inherent values occur as points or in localised areas.

Staircase Saddle – West Side

On the western side of Staircase Saddle, mid shady slopes are characterised by numerous rock outcrops, talus and patchy snow tussockland, characteristic of shady slopes. A few *Olearia odorata* are scattered through the tussockland and naturalness is low/medium to medium, reflecting the prominence of exotics. Bluffs support typical rockland plants such as coral broom (Gradual decline), lichens, bristle tussock, *Rytidosperma pumilum*, scabweed, king devil, *Helichrysum intermedium*,

Carex breviculmis, *Carex resectans*, *Pimelea aridula*, blue tussock, harebell and white fuzzweed (Data deficient). *Urtica aspera* (Sparse) was found at the base of a rock outcrop. Significant inherent values are locally present. Open areas, and upper slopes below Beacon Hill are dominated by exotic herbs and grasses, while spurs and gentle tops are severely degraded and dominated by mouse-ear hawkweed. Lower slopes are dominated by exotic herbs, grasses and sweet brier, and elderberry occurs quite frequently.

Dense grey shrublands occupy the gully floor of Staircase Stream. Species composition is similar to those in the upper Ross Stream catchment and little sweet brier is present. About 25 *Carmichaelia kirkii* (Nationally Endangered) were seen and more are likely to be present. The shrubland extends onto north-east facing slopes, where rock outcrops are common and *Carmichaelia kirkii* is present among bracken, *Olearia odorata* and scrub pohuehue. This shrubland extends into the top two gullies adjacent to Staircase Saddle. The naturalness of these shrublands is high and significant inherent values are present. In lower Staircase Stream the shrubland becomes more open and weedy towards the main north-facing tributary, and some spraying has occurred. Sweet brier has a cover of 5-10%, exotic grasses and herbs are widespread and elderberry is scattered through the shrubland. The lower valley floor is within a chronically threatened land environment. The tributary shrubland is similarly modified with widespread sweet brier.

The lower gently sloping ridge from Staircase Saddle towards Mt Frazer is degraded. The hawkweed herbfield present is extensive, and has a similar species composition as that described in Upper Western Catchment of Ross Stream section. Naturalness is low, though the threatened plants *Carmichaelia vexillata* (Serious decline), *Acaena buchananii* (Gradual decline), *Carex muelleri* (Sparse), *Raoulia beauverdiei* (Sparse) are scattered throughout. Significant inherent values occur as points or in localised areas.

East of the ridge, patches of narrow leaved snow tussock occur on higher slopes, usually associated with seepages. Tussock cover is up to 40% with open areas being dominated by mouse-ear hawkweed. Indigenous species diversity is surprisingly high and naturalness is medium. West of the ridge, higher shady slopes have a snow tussock cover of 50% and mouse-ear hawkweed is about 10%. Rock tors on spurs support plume grass, blue tussock, *Rytidosperma pumilum*, blue wheatgrass, *Helichrysum intermedium*, porcupine shrub, *Luzula crinita*, *Anisotome brevistylis*, and sparse hawkweeds. Significant inherent values are associated with these tall tussocklands and rocklands.

Mt Frazer Summit

Dense slim snow tussockland occupies gentle summit spurs and upper slopes west of Mt Frazer. Slim snow tussock has a 55-65% cover, hawkweeds 5%, with scattered fescue tussock, blue tussock, native violet, *Epilobium alsinoides*, *Anaphaloides bellidioides*, *Colobanthus buchananii*, *Stellaria gracilentia*, *Anisotome imbricata*, golden speargrass, *Aciphylla montana*, *Poa lindsayi*, *Agrostis muelleriana*, *Rytidosperma pumilum*, *Luzula pumilum*, *Carex muelleri*, occasional narrow-leaved snow tussock, scattered catsear and sheep's sorrel. Naturalness is high. Scattered rock outcrops support species such as *Aciphylla montana*, *Scleranthus uniflorus*, blue tussock, *Colobanthus acicularis* and *Raoulia subsericea*. On rubbly southwest-facing slopes, patchy snow tussocklands are dominated by mouse-ear hawkweed (40%), slim snow tussock (30%) and *Carex muelleri* (25%). Additional species not seen on western slopes include *Raoulia hookeri*, *Leptinella pectinata*, *Luzula rufa*, *Pimelea oreophila*, patotara, *Coprosma pumilum*, *Colobanthus buchananii*, *Scleranthus uniflorus*, *Anisotome aromatica*, *Celmisia gracilentia* and *Hebe pimeleoides* subsp. *pimeleoides*. Localised areas have been browsed, and naturalness is medium. Significant inherent values occur in all these communities and habitats.

Narrow-leaved snow tussock replaces slim snow tussock on sunny rocky slopes. Here narrow-leaved snow tussock has 20% cover, golden speargrass and fescue tussocks are common, and hawkweeds have a cover of around 5%. Other species include *Carmichaelia vexillata* (Serious decline), *Celmisia angustifolia*, *Carex muelleri* (Sparse), *Hebe pimeleoides* subsp. *pimeleoides*, *Colobanthus acicularis*,

Pimelea oreophila, blue tussock, patotara, *Leptinella pectinata* and sheep's sorrel. Naturalness is medium-high. Rubbly areas support *Helichrysum intermedium* and *Kelleria dieffenbachii*, while species associated with talus include slim snow tussock, blue tussock, *Acaena caesiiglauca*, *Acaena buchananii* (Gradual decline), native violet, mingimingi and mountain flax. Narrow-leaved snow tussockland extends down to 1200m on sunny slopes, and 900m on shady slopes. Significant inherent values are present in all these communities.

Black Forest Stream Valley

Shrublands in the catchment gullies northwest of Mt Frazer support similar grey shrublands to those described previously. They are quite dense in the upper gullies, and no *Carmichaelia kirkii* were seen. Their lower reaches contain sweet brier and elderberry, particularly below the main stream junction. Naturalness is high in the upper shrublands, and medium below. Significant inherent values are present.

Lower west-facing slopes above Black Forest Road are dominated by sweet brier (20-50% cover) and mouse-ear hawkweed (6-20%), with haresfoot trefoil also common. Scattered rock outcrops and talus around the valley floor support native species including white fuzzweed, scabweed, *Carex breviculmis*, porcupine shrub, matagouri, mingimingi, mountain wineberry, lawyer, *Clematis marata*, native jasmine, harebell, plume grass, blue tussock, blue wheatgrass, *Asplenium richardii*, necklace fern, prickly shield fern and rock fern. Significant inherent values are restricted to some rock outcrops.

Valley floor alluvial surfaces are within chronically threatened land environments. Recent stony terraces are dominated by haresfoot trefoil and creeping pohuehue, with sweet vernal, Chewing's fescue, scabweed, sweet brier, scattered silver tussock, *Epilobium melanocaulon*, *Acaena inermis*, Californian thistle, nodding thistle, uncommon matagouri and other exotic herbs and grasses. Naturalness is low/medium. Some higher terraces are totally dominated by haresfoot trefoil or tall oat grass. Fans that have not been sprayed or cultivated are dominated by sweet brier (to 40% cover), mouse-ear hawkweed, haresfoot trefoil and exotic grasses. Naturalness is low. Patches of grey shrubland are very sparse and support matagouri, mingimingi and a little *Olearia odorata*.

Black Forest Valley wetlands

Wetland ribbons occur on the floodplain, dominated by *Carex coriacea*, exotic grasses and herbs, and localised pukio. The main wetland occurs opposite Staircase Stream and has the additional native species *Eleocharis acuta*, and raupo. Exotic grasses are widespread and large crack willows are scattered through the wetland. Naturalness is low/medium to medium and minimal significant inherent values are present.

Higher east-facing slopes above Black Forest Stream support a thin band of narrow-leaved snow tussockland (25% cover) extending down to about 800 m on shady slopes. Species diversity is quite low and similar to that of other open, degraded snow tussocklands. Occasional coral broom is present and naturalness is low-medium. Significant inherent values are restricted to points. Mid to lower slopes are dominated by mouse-ear hawkweed and exotic grasses, with sweet brier being common on toe slopes and fans, extending to higher altitude in gullies.

Big Range and Little Range

This area includes Big and Little Ranges, the lower floodplains of Ross Stream and Stony River, and the isolated slopes north of Stony River Gorge. Tall tussocklands are restricted to higher ridges and slopes, extending to mid altitude on some shady slopes. These tall tussocklands are comprised of narrow-leaved snow tussock, with a little slim snow tussock and a tiny patch of red tussock. Talus and rock outcrops are scattered across the area and stonefields occur on higher ridgetops. Grey shrublands are found in valley floors, around rock outcrops and talus patches. Sweet brier shrublands are widespread on lower slopes and in lower valleys, while broom shrublands occur in the lower Stony River. Lower to mid

slopes, and some higher slopes are severely degraded and dominated by exotic herbfields. Wetlands are restricted to seepages and modified valley floor sedgeland.

Big Range Summit

Big Range summit supports a mosaic of rockland communities and patchy tall tussockland. Stonefields on the higher parts have induced cushionfield communities containing plants such as *Raoulia hectorii*, *Dracophyllum muscoides*, *Colobanthus bueharianii*, *Chionohebe pulvinaris*, *Luzula pumila*, lichens, *Phyllachne colensoi*, *Anisotome flexuosa*, *A. imbricata*, *Kelleria dieffenbachii*, blue tussock, *Agrostis muelleriana* (Range Restricted), sheep's sorrel, *Brachyglottis bellidioides*, mouse-ear hawkweed, patotara and *Celmisia gracilentia*. Naturalness is medium/high.

Patches of depleted slim snow tussockland are affected by grazing, with moribund tussocks common. Species include mouse-ear hawkweed and king devil, sheep's sorrel, *Scleranthus uniflorus*, *Kelleria dieffenbachii*, blue tussock, *Carex muelleri* (Sparse), *Anisotome flexuosa*, *Raoulia subsericea*, *Rytidosperma pumilum*, *Euphrasia zelandica* agg. and lichens. Further down the ridge, slim snow tussock soon gives way to narrow-leaved snow tussockland (10-30% cover), which is also heavily grazed and moribund. Mouse-ear hawkweed dominates (50-60% cover), with fescue tussock, *Carex muelleri* (Sparse), blue tussock, *Scleranthus uniflorus*, *Colobanthus acicularis*, *Prasophyllum colensoi*, *Craspedia incana*, patotara, snowberry and *Raoulia subsericea* also present. Naturalness is low/medium.

Inspection of the 'RAP 9: Big Range' found the red tussockland to comprise hybrid red-snow tussocks with 10-20% cover. Hawkweed dominates (to 60%). Native species include hard tussock, *Acaena bueharianii* (Gradual decline), *Carex muelleri* (Sparse), *C. breviculmis*, *Raoulia subsericea*, golden speargrass, red woodrush, *Scleranthus uniflorus* and *Rytidosperma pumilum*. The best patches occur in depressions with wire moss and browntop. Some tussock seedlings are present, but mature tussocks are dying. Sheep droppings are abundant and naturalness is low to low/medium. Significant inherent values are associated with the upper ridge rocklands and tall tussocklands.

East of the upper summit ridge, narrow-leaved snow tussock cover is 25-30% on upper sunny slopes, with mouse-ear hawkweed and fescue tussock. Additional species are blue tussock, snowberry, red woodrush, catsear, *Lagenifera petiolata*, *Dracophyllum pronum*, golden speargrass, *Carex breviculmis*, *Deyeuxia avenoides* and *Celmisia gracilentia*. Naturalness is medium. On eastern aspects snow tussock cover is locally up to 50% and naturalness is better. The tall tussocklands extend across the upper catchments of Preston Stream to the Little Range.

Substantial seepages are also present which are dominated by mosses, bog rush and *Carex gaudichaudiana*. Additional species include *Psychrophila novae-zelandiae*, *Ranunculus multiscapus*, *Epilobium komarovianum*, *Euchiton mackayi*, *E. traversii*, *Juncus novae-zelandiae*, *Carex muelleri* (Sparse), *Plantago novae-zelandiae*, *Oreobolus pectinatus*, browntop, fescue tussock, *Acaena caesiiglauca*, *Rytidosperma nigricans*, *Viola cunninghamii*, white clover, mouse-ear hawkweed, king devil, *Hydrocotyle novae-zeelandiae* and *Lagenifera* sp. 'wet'. Their naturalness varies from medium to high. Significant inherent values are present in these upper catchments. Snow tussock occurs as far down as the middle valley, but only on upper shady slopes. The great majority of these slopes are characterised by degraded exotic herbfield and grassland.

Upper Innes Burn

An extensive cover of tall tussockland is present. In the eastern branch, upper SW-facing slopes support patchy slim snow tussock with a cover of around 40%. Mouse-ear hawkweed has a cover of 15-20%, while other prominent species are blue tussock, mountain clubmoss and alpine fescue tussock. Additional species include mosses, lichens, harebell, king devil, *Raoulia subsericea*, threatened *Aciphylla montana* var. *gracilis* (Range Restricted), *Carex muelleri* (Sparse), snowberry, *Scleranthus uniflorus* and *Celmisia gracilentia*. Naturalness is medium. Adjacent west-facing slopes support narrow-leaved snow tussock, while blocky talus provides habitat for blue tussock, little hard fern and *Dracophyllum pronum*. Sunny alpine slopes in the western branch have a cover of narrow-leaved snow

tussock of 35-40%, while other prominent species are mouse-ear hawkweed, king devil, blue tussock, fescue tussock, *Carmichaelia vexillata* (Serious decline) and *Raoulia subsericea*. Species composition is similar to that in the upper Ross, with additional species being *Koeleria novozelandica*, *Craspedia lanata*, alpine fescue tussock, *Colobanthus acicularis* and *Prasophyllum colensoi*. Naturalness is medium to medium/high.

Subalpine rock outcrops support species such as coral broom (Gradual decline), *Brachyglottis haastii*, bristle tussock, threatened *Acaena buchananii* (Gradual Decline) and white fuzzweed. Sparse *Olearia odorata*, *O. bullata*, *Carmichaelia petriei* and coral broom occur on the valley floor. The lower eastern branch contains good shrublands of *Olearia odorata*, mingimingi, matagouri, porcupine shrub and prickly shield fern. Below the confluence of the two branches, northeast-facing slopes are very depleted and rubbly with widespread rock outcrops and scattered grey shrublands, which are denser on lower slopes and in gullies. Scattered coral broom (Gradual decline), *Carmichaelia vexillata* (Serious decline) and white fuzzweed (Data deficient) are present on these slopes. Shady slopes across the valley are dominated by mouse-ear hawkweed, with less fescue tussock and patchy snow tussock. Toe slopes in the middle valley support dense patches of shrubland containing mingimingi, matagouri, lawyer, *Clematis marata*, porcupine shrub, *Olearia odorata*, sweet brier, scrub pohuehue, native jasmine, *Aristotelia fruticosa* and native broom. Sweet brier becomes very common among grey shrublands in the lower valley, where additional species include *Hebe rakaiensis*, golden speargrass, prickly shield fern and two small patches of threatened *Coprosma intertexta* (Sparse). Small valley floor wetlands contain pukio, jointed rush, soft rush, creeping buttercup, *Carex coriacea*, white clover and Yorkshire fog. Significant inherent values occur in the upper valley, on sunny mid valley slopes and in shrublands of the lower valley.

While a similar vegetation pattern occurs in Brands Gully, degradation is more severe, with mouse ear hawkweed (to 60%) and less snow tussock. Sunny upper slopes are dominated by mouse-ear hawkweed with sparse snow tussock, *Raoulia subsericea*, golden speargrass, *Carmichaelia vexillata* (Serious decline), blue tussock and fescue tussock. *Acaena buchananii*, (Gradual decline) was also found. Sheep droppings, tracks and trampling are widespread and naturalness is low/medium. Adjacent shady slopes have a snow tussock cover of around 40%, with mouse-ear hawkweed (10-25%), lichens, fescue tussock and blue tussock. Naturalness is medium.

On the north side of the catchment, snow tussock occurs among rock ribs on a shady slope near spot height 1121m. Tussock cover is 20-30%. The rock ribs provide habitat for plants such as blue tussock, snow tussock, lichens, mosses, red woodrush, patotara, *Luzula traversii*, *Anisotome aromatica*, *Aciphylla montana* var. *gracilis* (Range Restricted), alpine fescue tussock, bristle tussock, hawkweeds, *Brachyglottis bellidioides*, *Celmisia gracilentia*, blue wheatgrass and edelweiss. Naturalness is medium/high. In the main valley, grey shrublands occur on toe slopes and riparian margins. They contain matagouri, mingimingi, *Olearia odorata*, porcupine shrub, scrub pohuehue, some mountain wineberry, native jasmine, tauhinu, occasional *Coprosma virescens* and much sweet brier. They are of medium naturalness, declining to low/medium in the lower valley where they are grassier and sweet brier is widespread. A couple of willows are also present. Sunny slopes in the lower valley are dominated by mouse-ear hawkweed, tall oat grass, sweet brier and scattered fescue tussock, while shady slopes are dominated by hawkweed, browntop, sweet vernal, sparse fescue tussock and blue tussock. Significant inherent values occur in localised parts or points in this catchment. The adjacent Ross Stream Valley is much modified with widespread exotic grasses and tall crack willows.

Sunny spurs northwest of Brands Gully are characterised by low shattered bedrock and bare soil. Their vegetation is dominated by mouse-ear hawkweed (30%), with harebell, *Scleranthus uniflorus*, blue tussock, *Poa lindsayi*, *P. maniototo*, scabweed, sheep's sorrel, sandwort, creeping pohuehue, *Carmichaelia vexillata* (Serious decline), *Carex breviculmis*, sweet vernal, plume grass, *Stellaria gracilentia* and fescue tussock. Naturalness is low to low/medium. Adjacent shady slopes are dominated by mouse-ear hawkweed (50%), fescue tussock (10%), blue tussock, patotara, sweet vernal and browntop. Naturalness is low to low/medium. *Olearia odorata* is scattered around low rock outcrops and in gullies. Sunny slopes are very bare and are dominated by mouse-ear hawkweed (10%), exotic

grasses and herbs, and native short tussock. *Convolvulus verecundus* (Sparse) is present. Naturalness is low. Heavily browsed and moribund prostrate kowhai occurs with mingimingi and scrub pohuehue.

Shattered rock outcrops support mouse-ear hawkweed, sweet brier, exotic woolly mullein, sweet vernal, rock fern, *Lachnagrostis lyallii*, *Raoulia* spp., sheep's sorrel, porcupine shrub, lichens, haresfoot trefoil, mingimingi, bristle tussock, *Pimelea aridula*, matagouri, *Geranium sessiliflorum*, *Carex breviculmis*, *C. resectans*, *Brachyglottis haastii*, *Olearia odorata*, scrub pohuehue and occasional coral broom. Naturalness is low/medium. Gentle toe slopes near Stony River are dominated by exotic dryland grass and herb species, and sweet brier. All of these slopes are heavily grazed or browsed by sheep and rabbits, and significant inherent values are restricted to point localities.

Lower Ross Stream valley floor

The chronically threatened land environment present here supports a mosaic of exotic dryland grasses and herbs, native matagouri shrubland, and localised damp areas dominated by *Carex coriacea*, and exotic herbs. Large crack willows are widespread. Cattle pugging is extensive in damp areas; overall naturalness is low.

Stony River

The floodplain and riparian margins of Stony River gorge are dominated by broom and willows, with exotic grasses and sweet brier. Broom is spreading up adjacent slopes and gullies on all aspects, and wilding pines are sparsely scattered through the gorge. Sunny slopes above and upstream of, the gorge support a degraded exotic herbfield community. Sweet brier is widespread on lower to mid slopes, and in gullies. Grey shrublands extend up gullies and on rocky gorge sides, and are comprised variously of sweet brier and mingimingi, *Olearia odorata*, mountain wineberry, matagouri, lawyer, *Clematis marata*, native jasmine, scrub pohuehue and broom. *Olearia odorata* and porcupine shrub are less common and mountain wineberry is rare. Coral broom (Gradual decline) is present on talus and rock outcrops of steep south-facing slopes in the central gorge. Naturalness of shrublands is low/medium to medium.

Chronically threatened land environments are present on the floodplain as far as Balloon Stream, and fans at the north-eastern end of Stony River gorge, are dominated by crack willows and broom, and exotic dryland herbs and grasses, with scattered native short tussocks present. Damp areas and wetlands present are dominated by exotic species. Several fans are cultivated. A pine plantation occurs between Stony River Road and the north-eastern property boundary. Terraces at Balloon Stream support exotic grassland and herbfield. A wetland occurs at the confluence of Balloon Stream, between the road and an alluvial terrace on Streamlands Pastoral Lease. It is dominated by native *Carex coriacea*, with exotic herbs and grasses common. Additional species include pukio, *Carex gaudichaudiana*, *Eleocharis acuta*, *Montia fontana*, *Azolla filiculoides*, Russell lupin, crack willow, broom, creeping buttercup and monkey musk. Naturalness is low/medium to medium. Significant inherent values are associated with this wetland, despite its modification.

At risk and chronically threatened land environments located on fans on the true left of Stony Stream at the eastern end of Stony Creek Pastoral Lease are dominated by exotic dryland grass and herbfield, with scattered native shrub and short tussock species present. Naturalness is low. Shallow gullies and former creek channels contain matagouri shrublands with widespread exotic grasses and herbs. Several *Coprosma intertexta* occur in a gully close to Stony River. Naturalness in the shrublands is low/medium, and low in the other communities. Significant inherent values are restricted to a few point localities.

Steep rocky north and northeast-facing slopes opposite Moffat Stream are dominated by tall oat grass, sweet brier and mouse-ear hawkweed, with patches of bracken, and scattered native shrubs, including sparse prostrate kowhai. Wilding pines and broom are also present.

Little Range

The north-eastern slopes of the Little Range are highly degraded and dominated by exotic herbfield and grassland, with brier and native shrub species largely confined to gullies. Towards the south end, upper slopes support a thin band cap of modified narrow-leaved snow tussock. Naturalness is low/medium to medium. Significant inherent values are restricted to a few point localities.

Exotic herbs and grasses dominate the lower ridge top of Little Range. At 1000 m fescue tussock herbfield is widespread on the gently rolling ridge. On gentle west-facing slopes mouse-ear hawkweed dominates (40-70%), with fescue tussock (10%), blue tussock (<5%) and king devil (<5%) common. Other species include scabweed, haresfoot trefoil, *Oxalis exilis*, sheep's sorrel, *Carex breviculmis*, *Geranium sessiliflorum*, *Pimelea oreophila*, blue wheatgrass, plume grass, sweet brier and *Scleranthus uniflorus*. Naturalness is low/medium.

The lower to middle reaches of Preston Stream valley are highly degraded on all slopes and dominated by exotic herbs and grasses, with introduced broom being present on the valley floor. Snow tussock below the Big Range extends onto upper slopes from around spot height 1226m, especially on shady aspects, but it only extends to the valley floor in the headwaters. Discontinuous grey shrublands containing sweet brier occur on the valley floor, with patches on concave slopes, in side gullies, and around rock outcrops and talus. The most extensive shrubland is associated with talus on northeast-facing slopes directly above the valley floor in the upper valley, and likely comprises typical grey shrubland species. Wilding pines are present in the middle reaches.

Snow tussockland occupies shady slopes from about 1200 m asl and comprises snow tussock (30%), mouse-ear hawkweed (30%), blue tussock, lichens, patotara and fescue tussock. Additional species not seen lower down the ridge include *Deyeuxia avenoides*, *Celmisia gracilentia*, *Luzula banksiana* var. *migrata*, snowberry, *Epilobium glabellum* and *Prasophyllum colensoi*. Naturalness is low/medium to medium. Open snow tussock continues along the ridge top to the Big Range, with patches of stonefield. Significant inherent values are restricted to the upper ridge, the valley headwaters and point localities.

South-western Grampian Mountains

This area includes all the land northeast of Stony River. Terraces, fans and most low to mid slopes are dominated by exotic grasslands and herbfields, with widespread sweet brier and scattered grey shrublands. Grey shrublands are most common in gullies, around talus patches and rock outcrops. The headwaters of the main north-eastern valley and some south-eastern slopes above Stony River support narrow-leaved snow tussockland. Chronically threatened land environments occur on terraces and fans near the former Stony Creek homestead, and an acutely threatened land environment occurs at the confluence of Stony River and Hay Stream.

Stony Creek Homestead

The chronically threatened land environment around the former Stony Creek homestead is dominated by exotic grasses and herbs, poplars, conifers and sweet brier. Willows and broom are widespread adjacent to Balloon Stream. The acutely threatened land environment opposite Hay Stream is largely dominated by browntop, Kentucky bluegrass and red clover with patches of matagouri, yarrow, *Carex muelleri* (Sparse) and *C. coriacea*. Significant inherent values are restricted to point localities.

Balloon Stream

Sunny lower slopes of Balloon Stream are very degraded and dominated by exotic grasses and herbs. Scattered grey shrublands occur around rock outcrops and by the stream, and are dominated by sweet brier with porcupine shrub, scrub pohuehue, mingimingi, matagouri, *Coprosma virescens*, *Olearia odorata*, prostrate kowhai, *Clematis marata* and *Parsonsia capsularis*, and occasional *Coprosma intertexta* (Sparse). Introduced broom is scattered along the floodplain, in gully entrances and on some toe slopes.

Hillslopes beside Stony River Road

Shady south-western slopes along Stony River Road support exotic grasses, herbs and scattered native short tussocks. Low scattered shrubs of sweet brier, matagouri, mingimingi and *Olearia odorata* are present and become more common towards Balloon Stream.

Shady south-eastern slopes above Stony River (east of the locked gate on Stony River Road) support an induced short tussockland dominated by Cheewing's fescue and fescue tussock, with mouse-ear hawkweed, sweet vernal, *Carex muelleri* (Sparse), *Agrostis muelleriana* (Range Restricted), golden speargrass, *Coprosma petriei*, *Anisotome aromatica* and *Olearia odorata*. Naturalness is low/medium. Adjacent sunny slopes are dominated by mouse-ear hawkweed and king devil where naturalness is low. Adjacent developed fans are characterised by exotic grasses and clovers, with patches of *Carex muelleri* (Sparse) and matagouri. Naturalness is low. Significant inherent values are restricted to some patches of shrubland and point localities.

Gentle west and north-facing slopes located to the northeast at mid altitude are dominated by exotic grasses and herbs. Native species include blue tussock, fescue tussock and *Poa maniototo*. At higher altitude these degraded slopes are dominated by mouse-ear hawkweed with sparse fescue tussock, blue tussock and browntop. Other species include *Pimelea oreophila*, harebell, *Carmichaelia vexillata* (Serious decline), patotara, *Scleranthus uniflorus* and *Raoulia subsericea*. Naturalness is low.

Near the summit NE-SW trending ridge, narrow-leaved snow tussock becomes dominant (to 60%), though this is atypical. Other prominent species are golden speargrass, mouse-ear hawkweed, sweet vernal, browntop and king devil. Species composition is similar to the short tussock community below with additional species being *Carex muelleri* (Sparse), red woodrush, tauhinu and *Rytidosperma pumilum*. Naturalness is medium/high where the snow tussock cover is densest. Significant inherent values are very localised or restricted to point localities.

The generally south-facing shady slopes in the upper Stony River valley support a fairly open snow tussock community which extends onto fans. Upper slopes have a snow tussock cover of around 40%, while other prominent species are fescue tussock, mouse-ear hawkweed, golden speargrass and king devil. Additional species include *Carex muelleri* (Sparse), *Raoulia subsericea*, *Anisotome flexuosa*, *A. aromatica*, snowberry, sheep's sorrel, blue tussock, *Brachyglottis bellidioides*, *Lobelia linnaeoides*, *Carmichaelia vexillata* (Serious decline), *Craspedia lanata* and *Celmisia gracilentia*. Patches of mouse-ear hawkweed and fescue tussock occur on lower slopes and scattered rock outcrops. Wilding pines are also present. Naturalness is medium/high, and significant inherent values are present. Further west, snow tussock is confined to shady slopes where it has a cover on toe slopes of 50-60%. Fescue tussock has a cover of about 30% and species diversity is quite high. Other species include *Deyeuxia avenoides*, *Rytidosperma pumilum*, blue tussock, *Gentianella* sp., harebell, *Brachyglottis haastii*, *Ranunculus multiscapus*, *Raoulia subsericea*, matagouri, snowberry, mouse-ear hawkweed, browntop and sweet vernal. The south-western limit for snow tussock on the fans is near spot height 879m where dominant inter-tussock species are exotic grasses and white clover. Further to the southwest, the slopes are dominated by short tussock grasslands as described earlier. Ribbons of matagouri shrubland occur in some south-eastern gullies above Stony River. Other native species include shrubs *Olearia bullata*, *O. odorata* and native broom; giant speargrass and Maori onion, *Carex kaloides*, bog rush and little hard fern. *Coprosma intertexta* (Sparse) occurs in a gully near spot height 879 m. Naturalness in these gullies varies from medium to high and significant inherent values are present.

Rocklands near Stony River

The rocky southern corner adjacent to the last ford across Stony River before the locked boundary gate, supports substantial grey shrublands in gullies, around talus patches and rock outcrops. The gully shrublands contain matagouri, mingimingi, porcupine shrub, *Olearia odorata*, mountain wineberry, lawyer, scrub pohuehue, native broom and native jasmine, with scattered sweet brier and gooseberry. Naturalness is medium to medium/high and significant inherent values are present. Talus supports extensive lichens, mosses, patches of scrub pohuehue, blue tussock, *Acaena caesiiglauca*, cleavers, a few golden speargrass, Maori onion and gooseberry. Broom is also present here. Adjacent grassy slopes

support exotic grasses and clovers, fescue tussock, blue wheatgrass, scattered mingimingi, matagouri, *Olearia odorata* and sweet brier. Some rocky ledges on a very steep shady slope provide habitat for at least 50 *Carmichaelia curta* (Nationally endangered). Exposed rocky spurs support species such as *Colobanthus buchananii*, *C. acicularis*, *Scleranthus uniflorus*, mingimingi, scabweed, harebell, *Stellaria gracilentia*, *Coprosma petriei*, threatened *Raoulia beauverdii* (Sparse), *R. parkii*, white fuzzweed (Data deficient), blue tussock and fescue tussock. Naturalness is medium and significant inherent values are associated with all these habitats.

Midway along the Stony River Road faces there are two larger gullies containing similar shrublands. The southern shrubland is quite open and weedy with more sweet brier and grasses in the lower valley and gooseberry again being present. Shrubland density improves up the gully, especially around talus patches and rock outcrops, with additional *Clematis marata*, *Hebe rakaiensis* and koromiko present. Naturalness varies from medium to medium/high. The rock outcrops support typical rockland plants including coral broom (Gradual decline). Adjacent shady slopes are characterised by scattered fescue tussock, blue tussock, exotic grasses, hawkweeds, harebell, patotara, golden speargrass, *Celmisia gracilentia* and a few scattered shrubs. Naturalness is low/medium. Sunny rocky slopes support sparse prostrate kowhai, mingimingi, matagouri, porcupine shrub, *Olearia odorata*, sweet brier, exotic dryland grasses and herb species, native short tussock species and scabweed. Naturalness is low/medium. Two wilding pines and one elderberry were seen in this gully. Significant inherent values are present in both gullies.

Unnamed tributary of Balloon Stream

The headwaters of the main north-eastern catchment support narrow-leaved snow tussock. On rubbly western slopes its cover is up to 40%, while other prominent species are mouse-ear hawkweed, mountain clubmoss, king devil, patotara, *Carmichaelia vexillata* (Serious decline), *Raoulia subsericea* and *Aciphylla montana*. Additional species include *Leucopogon suaveolens*, golden speargrass, matagouri, red woodrush, blue tussock, *Pimelea oreophila*, *Microtis unifolia*, *Celmisia gracilentia*, coral broom (Gradual decline), harebell, *Kelleria dieffenbachii*, *Brachyglottis bellidioides*, *Craspedia lanata*, *Poa lindsayi*, *Agrostis muelleriana* (Range restricted) and *Deyeuxia youngii* (Sparse). Naturalness is medium/high. A similar cover of snow tussock occurs on upper shady slopes. On mid slopes snow tussock is replaced by mouse-ear hawkweed and fescue tussock irrespective of aspect. Rock outcrops are common and coral broom and *Hebe cheesemanii* are present on some. *Olearia* shrublands are widespread in gullies and around rock outcrops, especially on lower sunny slopes. Good shrublands occur in the valley floor containing mingimingi, matagouri, *Coprosma virescens*, porcupine shrub and *Olearia odorata*. Significant inherent values are present in this valley.

Notable Flora

Of the native vascular plant species present, at least 22 species are listed as threatened in the most recent threat classification system (Hitchmough *et.al.* 2007), one species is data deficient, and several species are of conservation interest. A list of these species with their threat of extinction status and distribution within the Lease is provided below in Table six.

Table Six: Threatened, data deficient and notable plants at Black Forest/Stony Creek Pastoral Leases

Threat Division	Threat Category	Species	Location on lease
Acutely threatened	Nationally Critical	<i>Ceratocephala pungens</i>	River terraces in lower Black Forest valley.
	Nationally Endangered	<i>Carmichaelia kirkii</i>	Common in grey shrubland in tributaries of middle Ross Stream; and talus slopes; upper Cattle Gully; upper Staircase Creek.

		<i>Carmichaelia curta</i>	On rock outcrops overlooking upper Stony River; rock outcrop on ridge above Lake Benmore.
		<i>Myosurus minimus</i> subsp. <i>novae-zelandiae</i> (NZ Mousetail)	River terraces in lower Black Forest valley.
		<i>Lepidium solandri</i>	River terraces, lower Black Forest valley
Chronically Threatened	Serious Decline	<i>Carmichaelia vexillata</i>	Scattered throughout degraded hawkweed herbfield; sunny slopes; ridges, terraces and fans.
	Gradual Decline	<i>Acaena buchananii</i>	Upper Innes Burn on rock outcrops and in depleted herbfield; in degraded red tussock on Big Range; in degraded herbfield in Brands Gully; among depleted short tussockland of ridge in upper Ross Stream catchment and south of Staircase Saddle
		<i>Carmichaelia crassicaule</i> (Coral broom)	Scattered across property on sunny slopes, rock outcrops, in stream gorges and a few on fans and terraces.
At Risk	Sparse	<i>Carex muelleri</i>	Degraded hawkweed herbfield, tall tussockland to 1550 m asl, in developed paddocks in upper Stony River catchment.
		<i>Convolvulus verecundus</i>	Western slopes above Lake Benmore; lower Black Forest Stream valley; sunny slopes above lower Ross Stream.
		<i>Coprosma intertexta</i>	In matagouri shrubland on terraces of lower Innes Burn; fans above Stony River near Basin Stream and a lower gully on SE slopes above Stony River. Lower slopes of Balloon Stream.
		<i>Deyeuxia youngii</i>	Degraded herbfield in western tributary of upper Ross Stream valley; headwaters of main NW catchment above Balloon Stream.
		<i>Euchiton paludosus</i>	Seepage in upper Ross Stream valley.
		<i>Kirkianella novae-zelandiae</i>	In open tall tussockland in upper Ross Stream catchment
		<i>Pleurosorus rutifolius</i>	Rock outcrops on west-facing slopes above Lake Benmore.
		<i>Raoulia beauverdii</i>	Rocky spur above Stony River (True right); degraded herbfield on ridge between Staircase Saddle and Mt Frazer.
		<i>Senecio dunedinensis</i>	Rock outcrop on west facing slopes above Lake Benmore.
			<i>Urtica aspera</i>
	Range Restricted	<i>Achnatherum petriei</i>	Rock outcrops on west-facing slopes above Lake Benmore.
		<i>Aciphylla montana</i> var. <i>gracilis</i>	In tall tussocklands of upper Innes Burn, and on rock outcrops in mid reaches of Brands gully.
		<i>Agrostis muelleriana</i>	Tall tussocklands in head of Ross Stream; headwaters of main NW catchment above

			Balloon Stream; lower slopes of upper Stony River; stonefield on upper Big Range.
		<i>Carex decurtata</i>	River terraces lower Black Forest valley.
	Data deficient	<i>Vittadinia australis</i> agg. (white fuzzweed)	Sunny rocky ridges and rubbly slopes across the property.
	Regionally uncommon; original shrub	<i>Sophora prostrata</i> (prostrate kowhai)	Sparsely scattered across property on sunny rocky lower slopes.
	Locally uncommon	<i>Scandia geniculata</i>	Occasionally in grey shrublands in Ross Stream tributaries.
		<i>Corokia cotoneaster</i>	Uncommon on property

Significance of Vegetation Values

Areas of Black Forest and Stony Creek Pastoral Leases that have been identified as having significant botanical values are shown on the Botanical values map.

Of highest significance is the presence of large populations of the Nationally Critical spring annual *Ceratocephala pungens*. This is one of eight records for the Mackenzie Basin and adds to the list of six modern South Island populations (Rogers *et al.* 2002, Rogers *et al.* in prep). The populations on the Lease have between 100 and 1000+ individuals present. Most of the Central Otago populations have 1 – 10 individuals (Rogers *et al.* 2002) while other recently found populations in the Mackenzie Basin have 3000-4000 plants (Rogers *et al.* in prep).

Also of high significance is the occurrence of several populations of climbing broom *Carmichaelia kirkii* (ranking of Nationally Endangered) in the upper Ross Stream catchment, Staircase Creek and the upper Cattle Creek. These are the first records for the ranges east of its stronghold on the Benmore Range (Wardle 2000), and include at least one large population (300-400 plants) within a western tributary of Ross Stream. The grey shrubland habitats in which these plants are present are dense, with few exotic woody species present, and provide secure habitat for the species.

Two small patches of the Nationally Endangered New Zealand mousetail (*Myosurus minimus* subsp. *minimus*) were found on the Lease. This is one of four records for the Mackenzie Basin and adds to the list of 33 existing populations (Rogers *et al.* 2002; Rogers *et al.* in prep), the majority of which occur in Otago.

Two populations of the Nationally Endangered broom *Carmichaelia curta* occur on rock outcrops on the property: on the Lake Benmore faces, and in the upper Stony River valley. The latter site supports around 50 healthy plants, and represents an extension to the south eastern distributional limit around Lake Benmore (see Grove 2001).

Lake Benmore Faces

The significant inherent values of this area occur in localised areas or point localities, some of which occur in the lowland bioclimatic zone. Numerous rock outcrops provide habitat for original rockland flora, some of the outcrops being quite large. Grey shrublands are scattered through some gullies, around rock outcrops and talus patches, and prostrate kowhai is present on some sunny slopes and ridges. Both represent elements of the original woody communities. A substantial number of threatened plants are scattered through the area including *Ceratocephala pungens*, *Carmichaelia kirkii*, *Carmichaelia curta*, *Myosurus minimus* subsp. *novae-zelandiae*, *Carmichaelia vexillata*, *Acaena*

buchananii, coral broom, *Lepidium solandri*, *Convolvulus verecundus*, *Pleurosorus rutifolius*, *Senecio dunedinensis*, *Urtica aspera*, *Achnatherum petriei*, *Carex decurtata* and data deficient white fuzzweed. A chronically threatened land environment in lower Black Forest Stream valley supports some of these threatened plants, including two spring annual species.

Upper Black Forest and Ross Stream Catchments

This area supports the greatest diversity of communities on the property. Original rockland communities occur on rock outcrops, talus and uncommon scree, while exposed summits support minor but diverse cushion and mat communities, partly induced from grazing of slim snow tussock. Remnant slim snow tussocklands represent an original community type and are largely restricted to higher ridges and shady slopes, the best ones occurring around Mt Frazer. Narrow-leaved snow tussockland is extensive on mid to upper slopes. They are often rather open, but those on shady slopes are denser and in better condition. Grey shrublands occur in lower to mid valleys, and prostrate kowhai is sometimes present on sunny slopes. Small patches of turpentine shrubland occur on some shady slopes around rock outcrops and talus. The shrublands are representative of original woody communities. Wetlands are restricted to seepages and a few valley floor sedgeland. Chronically threatened land environments contain highly modified communities including patches of grey shrublands and a willow sedgeland. Threatened plants in the area include *Carmichaelia kirkii*, *Carmichaelia vexillata*, *Acaena buchananii*, coral broom, *Carex muelleri*, *Deyeuxia youngii*, *Euchiton paludosus*, *Kirkianella novae-zelandiae*, *Raoulia beauverdii*, *Urtica aspera*, *Agrostis muelleriana* and white fuzzweed.

Big Range and Little Range

Significant inherent values are largely restricted to upper catchments, as much of the area is severely degraded. Upper ridges support rockland communities on rock outcrops, stonefields and talus. Remnant patches of slim snow tussock also occur on these ridges, while moderate condition narrow-leaved snow tussockland is present in the headwaters of Innes Burn and Preston Stream. Grey shrublands occur in some mid to lower valleys, around rock outcrops and talus patches. Wetlands are restricted to seepages and a valley floor sedgeland near Balloon Stream in a chronically threatened land environment. Chronically threatened land environments otherwise support highly modified plant communities, including matagouri shrublands on fans. RAP9: Big Range has been modified resulting in loss of significant inherent values once associated with it. Threatened plants in the area include *Carmichaelia vexillata*, *Acaena buchananii*, coral broom, *Carex muelleri*, *Convolvulus verecundus*, *Coprosma intertexta*, *Aciphylla montana* var. *gracilis*, *Agrostis muelleriana* and data deficient white fuzzweed.

South-western Grampian Mountains

The south-western Grampian Mountains contain moderate condition narrow-leaved snow tussocklands on some shady slopes above upper Stony River, and in the upper north-eastern catchment above Balloon Stream. Rock outcrops and talus are scattered through the area, supporting elements of the original rockland flora. Grey shrublands occur in valleys, around rock outcrops and talus, supporting elements of the original woody communities. Prostrate kowhai is present on some sunny slopes. Threatened plants in the area include *Carmichaelia curta*, *C. vexillata*, coral broom, *Carex muelleri*, *Coprosma intertexta*, *Deyeuxia youngii*, *Raoulia beauverdii*, *Agrostis muelleriana* and data deficient white fuzzweed.

Insert botanical values map here

2.5.1 Problem Plants

There are many exotic plant species present on the lease but relatively few are of conservation concern. Many are plants of agricultural importance or are common pastoral weeds.

Sweet brier (*Rosa rubiginosa*) is the main problem plant on the property. It is widespread on all lower slopes and in lower valleys, extending to mid slopes and valleys where it is less common. It is particularly abundant on lower slopes above Lake Benmore, in Black Forest Stream valley, on sunny slopes above the lower Ross Valley, and adjacent to Stony River gorge and Balloon Stream. Control of this species is probably impractical.

Broom (*Cytisus scoparius*) is widespread beside Stony River, from Balloon Stream down to the Stony River gorge, where it is particularly dense. It is spreading onto adjacent slopes and up gullies. Broom is also present further up Stony River, near the last ford before the locked boundary gate, at the base of rocky slopes. One plant was seen north of Brands Gully. Broom also occurs in the bed of Balloon Stream, on adjacent toe slopes and in lower gullies, and in a wetland at the confluence of Stony River and Balloon Stream. These infestations pose a significant threat to riverbeds, disturbed ground and grassland plant communities.

Wilding pines (*Pinus spp.*) are not common on the property. A few are present in the upper Ross catchment, Brands Gully, Stony River Gorge, on northeast facing slopes near the entrance to the gorge, on upper Stony River hillslopes, and to midway up Prestons Stream. Pines are also associated with the former Stony Creek homestead, and the Lake Benmore shoreline. The presence of wilding conifers threatens conservation and landscape values.

Willows (*Salix spp.*), including crack willow, are associated with waterways on the property. They are present along Black Forest Stream (especially the lower valley); widespread in the lower Ross Stream and Stony River valley; scattered in the lower Preston Stream; and are associated with the Lake Benmore shoreline and old Stony Creek homestead. Crack willows are also present in a small wetland at the confluence of Stony River and Balloon Stream.

Elderberry is scattered through the Benmore lake face gullies e.g. Cattle Gully; south-western toe slopes of Black Forest Stream, but also in the lower Ross Stream valley. It is commonly associated with grey shrubland e.g. in lower Staircase Gully, lower catchment northwest of Mt Frazer, and gully midway along Stony River Road valley. The fleshy fruits of this species are readily dispersed by birds.

Gooseberry (*Ribes uva-crispa*) is scattered in shrublands and on talus margins in the upper Stony River. The fleshy fruits of this species are readily dispersed by birds.

Gorse (*Ulex europaeus*) is present on a spur northwest of Mt Frazer.

Male fern (*Dryopteris filix-mas*) occurs in riparian shrubland in the middle reaches of the upper Ross catchment, and on talus margins in a lower gully above Lake Benmore. This species is now widespread in the high country. Removal or containment is probably impractical.

Thistles are scattered across the property, including nodding thistle e.g. on upper slopes above Lake Benmore and in Black Forest Valley.

Russell lupins are present in the wetland at the confluence of Stony River and Balloon Stream.

Poplars and gums are associated with the Lake Benmore shoreline near hut and camp sites. There are poplars present at the old Stony Creek homestead site.

2.6 FAUNA

2.6.1 Birds and Lizards

A 'Sites of Special Wildlife Interest' (SSWI) slightly overlaps the property boundary along the Lake Benmore edge and a 'Wetlands of Ecological and Regional Importance' (WERI) adjoins the property along the same boundary. The deltas of the rivers that flow into Lake Benmore provide important wildlife habitat. Black Stilt/Kaki use Lake Benmore. The shallow margins, mudflats and willows are also important to other waterbirds.

Ecological Context

The Grampians, Benmore and Pukaki Ecological Districts (ED) of the Mackenzie Ecological Region (ER) and the Kirkliston ED of the Waitaki ER are affiliated with block mountain ranges, and are virtually devoid of forest. They are defined as ranging between semi-arid and semi-humid climates (McEwen 1987). Today's landscape is dominated by pastoral land.

Prior to the Maori settlement of New Zealand, the bird fauna of the inland South Canterbury lowlands contained more than 87 species (Worthy 1997). This large diversity of birds was attributed to the survival of grassland-shrubland mosaics into the Late Holocene period. This complex ecosystem has since been greatly modified, and no longer represents the previous habitat type. The current bird fauna is characterized by endemic and introduced species that inhabit open country, farmland, riverbeds, shrublands and farmland. The threatened bird species recorded from the neighbouring Pastoral Leases of Kirkliston Pastoral Lease (Elkington 1995) and Streamlands and Curraghmore Pastoral Lease (Lettink 2007) include banded dotterel (Gradual Decline), New Zealand falcon (Gradual Decline) and black shag (Sparse).

The Herpetofauna Database (Department of Conservation) lists several threatened species of lizards in these and adjacent ED's including: jewelled gecko (Gradual Decline), long-toed skink (Sparse), scree skink (Gradual Decline) and spotted skink (Gradual Decline). Nearest localities for these species are Hakataramea Pass and Cave (jewelled gecko); Tekapo River (long-toed skink); the upper Tekapo River and Curraghmore Pastoral Lease (spotted skink); and Sawdon, Curraghmore and Mt Dalgety Pastoral Leases (scree skink).

Description of Bird and Lizard Fauna and Habitats

Bird and lizard species observed on Black Forest and Stony Creek Pastoral Leases are described for four geographic areas of the property, based on their location and topographic characteristics:

- Lake Benmore Faces
- Mt Frazer and upper Ross Stream Catchments
- Big Range and Little Range (south of Stony River Road)
- South-western Grampian Mountains

Lake Benmore Faces

This area includes the Black Forest Homestead, the lower part of Black Forest Stream and the Lake Benmore faces. This area mainly supports exotic herbfields, with grasslands, rocklands, shrublands and wetlands also present. Lakeshore plantings of pine, willow, poplar and gum are present. Rock outcrops are very common throughout the area, commonly with shrubs growing on them. Some rock outcrops, particularly along the summit ridge, however, are quite exposed and surrounded by exotic

herbfields. Wetlands are only found in the lower stream gullies, particularly in the lower parts of Black Forest Stream.

Native birds species recorded were Australasian harrier, black shag, grey warbler, New Zealand falcon, New Zealand pipit, paradise shelducks, silvereyes, southern black-backed gull and spur-winged plover. Introduced birds noted were Australian magpies, blackbirds, Californian quail, chukor, dunnoek, goldfinch, greenfinch, house sparrow, little owl, peafowl, pheasant, red-legged partridge, redpoll, rock pigeon, skylark, turkey and yellowhammer. Of the threatened species, black shag (Sparse) were found in the lower parts of Black Forest Stream and New Zealand Falcon (Gradual Decline) were found near a rock outcrop on the mid slopes of the faces.

Lizard species noted were common skink, McCann's skink and Southern Alps gecko. These occurred throughout the area, from rock outcrops, grasslands and shrub communities along the summit of the ridge, to boulderfields, grasslands and shrublands along the lake shore. Rocky outcrops were common here and provided habitat for most of the Southern Alps gecko found. McCann's skinks were quite sparse and found only in grasslands but common skinks were found in a myriad of habitats throughout this area.

Mt Frazer and upper Ross Stream Catchments

This area incorporates the middle reaches of Black Forest Stream, including Staircase Stream, the lower northwest faces of Mt Sutton, including the upper parts of Ross Stream, and the ridgeline from Beacon Hill to Mt Frazer including Staircase Saddle. This area supports a mosaic of vegetation communities, mainly grasslands and exotic herbfields, but with shrublands, rocklands and scree-fields also present. Scree-fields are generally vegetation-free, except along the margins where they merge into the surrounding communities, commonly grasslands and exotic herbfields. This area has the best examples of scree-fields found on the property, and is best characterized by the steep hill-slopes feeding into rutted stream gullies. These gullies commonly contain dense shrublands.

Native birds recorded were Australasian harrier, grey warbler, New Zealand falcon, New Zealand pipit and silvereyes. Introduced birds noted were Australian magpies, blackbirds, Californian quail, dunnoek, goldfinches, greenfinch, house sparrows, rock pigeons, skylark, and yellow hammers. The threatened New Zealand falcon (Gradual decline) was found in a shrubland tributary of upper Ross Stream; upper slopes of Mt Sutton; and in the rocky Staircase Stream gully.

Three lizard species were found: common skink, McCann's skink and Southern Alps gecko. These species were found throughout the area, although common skink was most common. Rocky outcrops and other typical lizard habitat were reasonably common and widespread, although larger concentrations of rock outcrops were found along the range ridge crests, rather than in the side gullies.

Big Range and Little Range (south of Stony River Road)

This area includes the lower northern slopes of Mt Sutton including Big Range and Little Range, and the stream gullies of Preston Stream, Brands Gully, the lower true right of Ross Stream and the mid true left of Stony River. This area supports mainly grasslands, with scattered shrublands, exotic herbfields, rocklands and wetlands. Rock outcrops are present, but are generally only found along the summit and upper slopes of the main ridgelines. Wetlands are in the lower parts of some streams. The true left side of Stony River abuts the toe-slopes of Little Range.

Native birds recorded were Australasian harrier, grey warbler, New Zealand pipit, silvereyes and South Island fantail. Introduced birds noted were Australian magpies, blackbirds, dunnoek, goldfinches, greenfinch, house sparrows, skylark, and yellow hammers.

Three lizard species were found: common skink, McCann’s skink and Southern Alps gecko. These species were found throughout the area with common skink being the most common. Rocky outcrops and other typical lizard habitat are common and widespread, although rock outcrops were more often found along the range crests rather than in side gullies.

South-western Grampian Mountains

This area covers that part of the Stony Creek Pastoral Lease that occurs on the south-western side of the Grampians Mountains. This area includes the Stony Creek buildings, old meteorological station site, middle parts of the true right of Stony River and the lower parts of Balloon Stream and Moffat Stream. The vegetation cover comprises a mosaic of grasslands, exotic herbfIELDS, shrublands, and rocklands; commonly with no clear boundary between them. Rock outcrops are uncommon along ridgelines but do protrude into some of the stream gullies. The shrublands tend to be along the toe-slopes, particularly in the bottom of the stream gullies. Stony River has a broad terrace, running from the boundary with Kirkliston Pastoral Lease to about level with the Stony Creek farm buildings.

The native birds recorded were Australasian harrier, grey warbler, New Zealand falcon, New Zealand pipit, silvereys and spur-winged plover. Introduced birds noted were Australian magpies, blackbirds, dunnoek, goldfinches, greenfinch, house sparrows, mallard, rock pigeons, skylark, and yellow hammers.

Three lizard species were found: common skink, McCann’s skink and Southern Alps gecko. These species were found throughout the area in similar numbers. Rocky outcrops and other typical lizard habitat are reasonably common and widespread, although most rock outcrops were found in side gullies.

Bird Species Recorded

Twenty-eight bird species were recorded on Black Forest and Stony Creek Pastoral Leases during this inspection; 10 native species (Table 7) and 18 introduced species.

Table Seven: Native bird species recorded from Black Forest and Stony Creek Pastoral Leases, February 2007.

Species	Threat status	Distribution on properties
Australasian harrier	Not threatened	Throughout
Black shag	Sparse	Lower Black Forest Stream
Grey warbler	Not threatened	In most shrublands
New Zealand falcon	Gradual decline	Around rock outcrops and gullies, particularly around Mt Sutton
New Zealand pipit	Not threatened	Along many of the ridgelines
Paradise shelduck	Not threatened	On the flats near Lake Benmore
Silvereys	Not threatened	In most shrublands
South Island fantail	Not threatened	Shrublands in the Stony River gorge
Southern black-backed gull	Not threatened	Around the edges of Lake Benmore
Spur-winged plover	Not threatened	In the larger river and stream valleys

Introduced bird species observed on the property include Australian magpie, blackbird, Californian quail, chukor, dunnoek, goldfinch, greenfinch, house sparrow, little owl, mallard, peafowl, pheasants, red-legged partridge, redpoll, rock pigeons, skylark, turkey and yellowhammer.

Lizard Species Recorded

Lizards were recorded from 84 locations, comprising three species (Table 8). Common skink was the most common (as groups of up to three individuals although more than 10 were found at one location near the Ross Stream hut); Southern Alps geckos and McCann’s skink were commonly in groups of up to three individuals.

Table Eight: Lizard species recorded from Black Forest and Stony Creek Pastoral Leases, February 2007

Lizard Species	Threatened Status	Known Distribution on Property
Common skink (<i>Oligosoma polychroma</i>)	Not threatened	Found throughout, mainly in grasslands but also often rocklands
McCann’s skink (<i>Oligosoma maccanni</i>)	Not threatened	Found throughout; mainly in grasslands but occasionally rocklands
Southern Alps gecko (<i>Hoplodactylus "Southern Alps"</i>)	Not threatened	Found throughout; mainly in rock outcrops

Significance of Bird and Lizard Values

The property provides feeding habitat for one chronically threatened species: New Zealand falcon (Gradual Decline), and one at risk species: black shag (Sparse). It is likely that the property also provides breeding and roosting habitat for New Zealand falcon.

The property also provides extensive feeding and breeding habitats for 8 non-threatened native bird species and three lizard species. Most of these bird species were found along the Lake Benmore faces indicating good diversity of birds in this area.

The property has small areas of SSWI and WERI associated with the lake shore.

Insert Bird and Lizard values map here

2.6.2 Freshwater Fauna (fish and invertebrates)

All catchments on the Pastoral Leases drain into Lake Benmore. These include Poplar Gully, Cattle Gully, Black Forest Stream, Staircase Stream, Innes Burn, Ross Stream, Brands Gully, Preston Stream and the Stony River, with a number of unnamed tributaries also present. All are within the Waitaki River catchment.

One of the distinguishing features of the Waitaki Catchment is the presence of hydro-electric dams. This has two major effects on fish communities. The first is that fish communities upstream from the dams are generally composed of only non-diadromous species (those species without a marine phase in their lifecycle), although some exceptions do occur (e.g. longfin eel may still be present, and common bully and koaro have become non-diadromous substituting lakes for the sea). The second effect is that fish communities are separated into discrete populations, preventing re-colonization of previously dewatered streams. All catchments on the property are upstream of dams.

The New Zealand Freshwater Fish Database (NZFFD) has 1090 records from the Waitaki River catchment (at 23rd of March 2007). Upland bully (*Gobiomorphus breviceps*) and brown trout (*Salmo trutta*) are recorded from the Black Forest Stream catchment, while Canterbury galaxias, upland bully and brown trout are recorded from the Stony River catchment. This mirrors the results from the tenure review survey of Streamlands and Curraghmore Pastoral Leases (Bowie 2007). Species recorded from nearby waterways and Lake Benmore include longfin eel, koaro, lowland longjaw galaxias, bignose galaxias, common bully, sockeye salmon, rainbow trout and Chinook salmon. The following species are considered threatened (Hitchmough *in press*): lowland longjaw galaxias (Nationally Critical), and longfin eel and bignose galaxias (both in Gradual Decline).

Most of the Waitaki River is recognised as a ‘Type II’ in the Waters of National Importance (WONI) documentation (Chadderton *et al* 2004), and this includes all waterways on these Pastoral Leases. Recognition in WONI implies that the waterway contains special features of national significance; but only sections of ‘Type II’ catchments are of national importance. This significance is because it is in the top ten sites by Natural Heritage Value score in its biogeographical unit; and also for its threatened bird, plant, and fish communities.

Description of Freshwater Fauna and Habitats

The property comprises four main catchments of freshwater habitat. These habitats and the fish and macro-invertebrate species recorded are described below for each of these catchments:

- Lake Benmore Faces
- Black Forest Stream Catchment
- Ross Stream Catchment
- Stony River Catchment

Lake Benmore Faces

This area incorporates the western parts of the property adjacent to Lake Benmore, flowing directly into the Lake, but does not include Black Forest Stream or any of its tributaries. Water bodies in this area are small, usually ephemeral streams that are sourced from within the area, and feed into the lake. There are also occasional springs and wetlands spread along the length of this area, generally on the toe slopes, near the lake shore. The wetlands appear to be palustrine – ephemeral (Johnson & Gerbeaux 2004) (i.e. not directly associated with lakes or rivers).

Vegetation cover adjacent to waterways comprises mainly exotic herbfields, with grasslands, rocklands and shrublands also present. Exotic herbfields comprise hawkweeds, with scattered introduced and exotic grasses present. Grasslands are made up of introduced grasses, native grasses, hawkweeds and occasional shrubs such as matagouri and sweet brier. Rock outcrops can also contain shrubs such as olearia (*Olearia* sp.), coprosmas (*Coprosma* sp.), scrubby pohuehue, bush lawyer (*Rubus* spp.) and some ferns. Riparian shrublands comprise matagouri, coprosma, olearia, sweet brier and native broom. Exotic trees include pines (either as wilding spread across the upper slopes, or as plantings along parts of the toe slopes), gum trees along the lake shore; willows and poplars in the lower stream valleys. The wet streambeds and wetlands also have riparian species include rushes, sedges and monkey musk present. Stock and wild animal access appears unrestricted. Vehicle tracks cross some streams by ford.

The permanent streams vary in width, up to one metre. Wetland areas are up to 60 m long and five metres wide. Depth of flowing streams range from 100 to 200 mm of water, with holes up to 400 mm deep. Dry streams appear to carry less than 100 mm of water during rain events. Wetland depth is about 100 mm in areas of open water. Stream substrates are predominantly soil or silt; some permanent streams have larger rocks present.

One site (Lake Benmore Hut Stream) was electro-fished; koaro was the only fish species recorded. There are no NZFFD records for waterways in this block.

Macro-invertebrates observed in this area were mayflies: *Deleatidium lillii*-group and *Deleatidium myzobranchia*-group; the caddisfly: *Hydrobiosis* sp.; the flatworm: *Cura* sp.; and the worm: *Oligochaete* sp., indicating reasonable water quality.

Black Forest Stream Catchment

This area incorporates the entire watershed of Black Forest Stream within the property, and includes Staircase Creek and numerous unnamed tributaries. Valley floor wetlands are present. Black Forest Stream is a large permanent stream; its tributaries include permanent and ephemeral streams. The wetlands appear to be “riverine–shallow water” (Johnson & Gerbeaux 2004) (i.e. have continually or intermittently flowing freshwater in open channels; generally less than a few metres deep and have standing water for most of the time). All streams, except the main Black Forest Stream, are sourced from within this area.

The streams commonly flow through riparian shrubland that extends onto the lower slopes, surrounded by exotic herbfields, grasslands and rocklands. The lower parts of Black Forest Stream, including wetlands, flow through dense vegetation of raupo, pukio, willows, poplars, rushes and sedges. Monkey musk is commonly present throughout, with lotus present in most of the wetlands. Stock and wild animals have access to all streams. Vehicle tracks cross many of the streams by ford or culvert.

Black Forest Stream is about two metres wide, while other permanent waterways are up to one and half metres wide. The largest wetland is 100 m long and 50 m wide and is located opposite Staircase Stream. Black Forest Stream carries between 100 mm and 300 mm of water, with deep holes of over 500 mm in places. Stream depth of other streams range from 100 mm to 300 mm, with holes up to 700 mm deep. All ephemeral streams appear to have no more than 100 mm of water during rain events. The depth of the wetlands range from 100 mm to 500 mm. The permanent stream substrates are composites of bedrock, boulders and cobbles; substrates of ephemeral streams and wetlands are generally silty.

Seven sites were electro-fished in this area. Brown trout were found at six sites, upland bully at three sites, and Canterbury galaxias at two sites, (Black Forest Stream (Mid Upper) and Staircase Stream (Lower)). Upland bullies co-exist with brown trout at all sites. Canterbury galaxias co-exist with brown trout and upland bully at one site only, Black Forest Stream (Mid Upper). Canterbury

galaxias was found at Staircase Stream (Lower) with no other fish. The NZFFD has two records (upland bully and brown trout) from Black Forest Stream.

Macro-invertebrates observed in this area are indicative of excellent water quality and include: mayflies: *Coloburiscus humeralis*, *Deleatidium lillii*-group and *Deleatidium myzobranchia*-group; the caddisflies: *Aoteapsyche* sp., *Helicopsyche* sp., *Hydrobiosis frater*, *Hydrobiosis* sp.; Hydropsychidae sp., *Olinga feredayi* and *Pycnocentria* sp.; the dobsonfly: *Archichauliodes diversus*; the two-winged fly: *Austrosimulium* spp.; the snail: *Potamopyrgus* sp.; the flatworm: *Cura* sp.; and the worm: *Oligochaete* sp.

Ross Stream Catchment

This area incorporates the entire watershed of Ross Stream within the property. The main water bodies are Ross Stream, Innes Burn and Brands Gully, with numerous unnamed tributaries. All waterways drain the steep hill slopes of Big Range, Mt Sutton, Mt Frazer and Beacon Hill, and most are sourced from within the property.

The streams flow through patchy inaka (*Dracophyllum* sp.) shrubland on upper slopes, grasslands, rocklands, exotic herbfields and grey shrubland. Riparian shrublands include matagouri, coprosma, olearia, native broom and inaka. Scattered wilding pines are present. Monkey musk is present in some of the lower altitude streams. Stock and wild animals have access to all streams. Vehicle tracks cross some stream channels, particularly along the middle reaches of Ross Stream.

The waterways vary in width. The upper parts of Ross Stream are about one and a half metres wide, and up to four metres wide following the convergence of many tributary streams; and two to four metres wide in the lower gorge. Tributary streams are generally one to two metres wide; Innes Burn and Brands Gully are approximately one and a half metres wide.

Ross Stream, Innes Burn and Brands Gully are about 150 mm deep in their upper sections. The lower reaches vary between 150 mm and 300 mm depth, with the lower sections of Ross Stream being about 300 mm deep. Tributary streams vary in depth between 100 mm and 200 mm. Most streams had pools present of 600 mm to one metre depth. Ephemeral streams appear to be no more than 100 mm deep during rain events. Permanent stream substrates are predominantly large boulders and cobbles, with some bedrock present in places; substrates of ephemeral streams are silt based over bedrock.

Eleven sites were electro-fished. Brown trout were found at seven sites; and Canterbury galaxias at five sites. These species co-occur at two sites in the mid and mid upper Ross Stream, one site (Big Range Stream) had fish species present. The NZFFD has no records for the waterways in this area.

Macro-invertebrates observed in this area are indicative of excellent water quality and include: mayflies: *Coloburiscus humeralis*, *Deleatidium lillii*-group, *Deleatidium myzobranchia*-group, and *Nesameletus* sp.; the stonefly: *Stenoperla prasina*; the caddisflies: *Aoteapsyche* sp., *Helicopsyche* sp., *Hydrobiosis frater*, *Hydrobiosis* sp.; Hydropsychidae sp., *Olinga feredayi*, *Pycnocentria* sp., *Pycnocentroides aeris*; the dobsonfly: *Archichauliodes diversus*; the beetle: Elmidae sp.; the two-winged flies: *Austrosimulium* spp. and Chironominae sp.; the snail: *Potamopyrgus* sp.; the flatworm: *Cura* sp.; and the worm: *Oligochaete* sp.

Stony River Catchment

This area incorporates the watershed of Stony River above the convergence with Ross Stream near Slip Panels Corner. Water bodies in this area include the large drainage channel of Stony River, Moffat Stream, Balloon Stream and Preston Stream; and small wetland systems in the valley floor of the lower Preston Stream, lower Balloon Stream and just above the gorge in Stony River. These

wetlands appear to be “riverine-shallow water” (Johnson & Gerbeaux 2004). A deeply incised gorge is present in the lower part of Stony River. The waterways, with the exception of Preston Stream, are generally sourced from outside the Pastoral Lease.

The vegetation communities of this area include predominantly native grasslands adjoining exotic herbfields, shrublands, rocklands and grasslands. Wilding pines are present, particularly along Stony River. Introduced broom (*Cytisus scoparius*) and Russell lupin (*Lupinus polyphyllus*) are common along Stony River, starting above the Stony Creek Pastoral Lease boundary in the Balloon Stream catchment and running through the gorge and out along the river at Slip Panels Corner. Willow, poplar and monkey musk are found in many stream valleys, particularly along Stony River. The wetlands generally have pukio, sedges and rushes present. The lower Preston Stream wetland also has lotus; the lower Balloon Stream wetland also has Russell lupin; and the wetland above the gorge in Stony River also has raupo. Vehicle tracks cross many of the stream channels, particularly along Stony River.

Stony River is about two metres wide in its upper reaches, and eight metres wide at the top of the gorge. Balloon Stream is five metres wide; Moffat Stream about two metres wide, and Preston Stream about one metre wide. Other tributary streams are generally about one metre wide. The lower Preston Stream wetland is about 300 m long and 50 m wide; lower Balloon Stream wetland 150 m long and 100 m wide (most occurring on adjoining Streamlands Pastoral Lease), and the wetland at the top of the gorge in Stony River is 600 m long and 60 m wide. Stony River is 100 mm to 300 mm deep; other streams range between 100 mm and 200 mm in depth. Most streams have pools to 500 mm deep; some pools in Stony River are over one metre deep. Ephemeral streams appear to be no more than 100 mm deep during rain events. Little standing water is present in wetlands. The lower Preston Stream and lower Balloon Stream wetlands are no more than 100 mm deep, while occasional holes in the Stony River wetland above the gorge are over one metre deep. The permanent stream substrates are predominantly boulders and cobbles, with some bedrock present in places, substrates of ephemeral streams are generally silty.

Nine sites were electro-fished from within the area, with three sites also included from Streamlands and Curraghmore Pastoral Leases (Bowie 2007). Brown trout were recorded in ten sites, and Canterbury galaxias were recorded in three sites (in the lower and mid-lower Balloon Stream and mid Preston Stream). Upland bully was recorded at four sites (in the lower and mid-lower Balloon Stream, mid Preston Stream and Moffat Stream). Upland bullies co-exist with Canterbury galaxias at three sites, (in the lower and mid-lower Balloon Stream and mid Preston Stream). Additional species from near this area in the NZFFD are Canterbury galaxias, upland bully and brown trout.

Macro-invertebrates observed in this area are indicative of excellent water quality and include: mayflies: *Coloburiscus humeralis*, *Deleatidium lillii*-group and *Deleatidium myzobranchia*-group; the caddisflies: *Aoteapsyche* sp., *Helicopsyche* sp., *Hydrobiosis* sp.; Hydropsychidae sp., *Olinga feredayi* and *Pycnocentria* sp.; the dobsonfly: *Archichauliodes diversus*; the two-winged fly: *Austrosimulium* spp.; the snails: *Lymnaea* sp. and *Potamopyrgus* sp.; the flatworm: *Cura* sp.; and the worm: *Oligochaete* sp.

Species Recorded

Four fish species were recorded during this survey (see Table Nine). The macro-invertebrate fauna communities were quite diverse reflecting the mosaics of freshwater habitats present on these Pastoral Leases.

Table Nine: Fish species recorded from Black Forest and Stony Creek Pastoral Leases, February 2007.

Fish Species	Threatened Status	Known Distribution on Property
Koaro (<i>Galaxias brevipinnis</i>)	Not threatened	Only in small streams draining Lake Benmore Faces
Canterbury galaxias (<i>Galaxias vulgaris</i>)	Not threatened	In some permanent streams; generally only in upper reaches above locations with trout present
Upland bully (<i>Gobiomorphus breviceps</i>)	Not threatened	Many permanent streams, although generally in lower reaches only
Brown trout (<i>Salmo trutta</i>)	Introduced	Common; in all large waterways and lower sections of smaller tributary streams

Significance of Freshwater Fauna Values

No threatened fish species were recorded in freshwater habitats on the property. All waterways on the property are recognized as a 'Type II' WONI (Chadderton *et al* 2004) because they are in the top ten sites by Natural Heritage Value score in their biogeographical unit; and also for their threatened bird, plant, and fish communities.

2.6.3 Terrestrial Invertebrates

Ecological Context

The leases adjoin Curraghmore and Streamlands Pastoral Leases, which were inspected for invertebrate values during a December 2006 tenure review survey (Emberson and Syrett, 2006). This survey identified four threatened insect species, including the beetles; *Artystona lata* (Range Restricted) and *Holcaspis bidentella* (Nationally Critical) and two grasshoppers; *Brachaspis* 'Hunter Hills' (Range Restricted) and *Sigaus minutus* 'blue' morph (Gradual Decline). Several other insects of conservation interest were also identified, the majority of which were located on higher elevations (above 1200 m).

The boundary between Stony Creek Pastoral Lease and Streamlands Pastoral Lease follows the valley floor of Balloon Stream and Stony River. In their report, Emberson and Syrett (2006) make specific mention of the diversity of habitats and range of native insects along the length of Balloon stream, from the headwaters out to the confluence with Stony River itself. The upper slopes of Balloon Stream catchment adjoining Stony Creek Pastoral Lease were identified as having invertebrate habitat values for their distinctive beetle fauna (Emberson and Syrett, 2006).

Description of the Invertebrate Fauna

Invertebrate species composition from the property is described for the following collection areas:

- Lake Benmore Faces (west of Black Forest Stream)
- Mt Frazer and upper Ross Stream Catchments
- Big Range, Little Range; south of Stony River
- South-western Grampian Mountains

Lake Benmore Faces (West of Black Forest Stream)

This area includes the foreshore of Lake Benmore and ascending hill faces above the lake. These slopes rise to 1009 m before dropping in a south-easterly direction to Black Forest Stream. The lake faces are dissected by at least 11 small side streams and gullies whose valley floors are dominated by sweet brier and matagouri. Native shrublands are also present in the gullies, dominated by mingimingi, *Olearia odorata* and scattered matagouri.

A diverse range of native invertebrates were recorded from the five collection sites in this area. Three spider species of interest were identified from the area. The data deficient 'stealthy' spider *Taieria erebus* was collected from beneath schistose stones near the lake shore. *Taieria erebus* is found from Wellington to Stewart Island and has a characteristically silvery sheen and is a night hunter. Little is known about their biology. A 'scuttling' spider (*Cycloctenus* sp.) was found near the lake shore. These spiders are very agile and are more usually found at higher altitudes, particularly in the Otago mountains. They have a distinctive eye pattern and apart from Australian species (in the same genus) they are unique to New Zealand. Also of interest was the nursery web spider (*Dolomedes minor*), which was relatively common throughout the lower section of Poplar Gully and an adjacent un-named tributary. *Dolomedes minor* constructs characteristic nursery webs around branches of shrubby vegetation or tall tussock, usually near a body of water.

Beetle taxa were represented by the range restricted darkling beetle *Artystona lata*, which was collected amongst a rock outcrop. *Artystona lata* is a Mackenzie Basin endemic (the holotype is from Mt John) and this find may well be a new distribution record. The larger and more common endemic darkling beetle *Mimopeus opaculus* was also found beneath stones from the lake shore to approximately 700 m asl. Another beetle of interest collected in the area was the tiger beetle *Neocicindela dunedinense*. This Carabid species is known from North Canterbury to Otago and is associated with loess habitats of the drier hill country. Specimens were collected from the lakeshore and were observed flying and running during a foot traverse of the lake shore road between Poplar and Cattle Gullies.

Several interesting Diptera (flies) were observed or collected at Poplar Gully. In addition to several airborne Ranger dragonflies (*Procordulia* sp.), a crane fly was collected from tall tussock, and the stiletto fly *Anabarhynchus innotatus* from *Coprosma* shrubs. These are all endemic species associated with fresh water.

During the time of inspection, the lake faces were active with several common New Zealand insects including; grasshoppers (*Phaulacridium marginale* and *Sigaus australis*), cicada (*Kikihia muta*), southern blue butterflies (*Zizina otis oxleyi*), native bees (*Leioproctus* sp. Colletidae) and the seed bug *Rhyphodes triangulus* (Lygaeidae).

Mt Frazer and upper Ross Stream Catchments

This area includes the remainder of the Black Forest Pastoral Lease that was not included in the Lake Benmore Faces (West of Black Forest Stream). It includes the catchments of Mt Sutton, Mt Frazer and Beacon Hill that are situated in the Black Forest Pastoral Lease.

Most of this area is dominated by modified semi-arid ecosystems, comprising extensive hawkweed, silver tussock and speargrass. On the higher and/or shadier slopes sub-alpine vegetation occurs with snow tussock, turpentine scrub (*Dracophyllum* sp.), golden speargrass and snowberry (*Gaultheria depressa*). The headwaters of most the catchments also support woody shrublands including native broom, *Hebe* sp., several *Coprosma* species along with tauhinu (*Ozothamnus leptophylla*). Invertebrates were found within all of these habitats, as well as rocky outcrops, talus slopes, streams and within the heavily grazed areas.

Staircase Stream supported a rich fauna of native invertebrates, none of which are endangered but all of which are indicative of an intact habitat consisting of native vegetation. Copper butterflies (*Lycaena salustius*), manuka beetles (*Pyronota festiva*), dragonflies (*Procordulia* sp.) and cicada (*Maoricicada clamitans* and *Kikihia angusta*) were abundant in this gully.

At least three species of common endemic spider were collected from the higher elevations. Taxa included the wolf spider *Anoteropsis hiliaris* (Lycosidae) and a 'big-jawed' spider *Tetragnatha* sp. (Tetragnathidae) which were abundant. Tetragnathids are orb web spiders that often spin their webs in speargrass. The common large brown prowling spider *Uliodon frenatus* (Zoropsidae) was also collected from several sites beneath rocks. Prowling spiders are characteristic of semi-modified high country environments and their presence indicates that sufficient habitat exists to support viable populations.

Beetles were well represented throughout this part of the Lease. The range restricted darkling beetle *Artystona lata* was scattered throughout the Lease. Similarly, two species of the larger darkling beetles (*Mimopeus impressifrons* and *M. opaculus*) were found in the area. *Mimopeus impressifrons*, found near the summit of Mt Frazer, is locally endemic to the Mackenzie Basin and Central Otago while the more common and widespread *Mimopeus opaculus* was collected from Beacon Hill, near Staircase Saddle and on the north east facing gully of Mt Frazer. These locations were all very dry, sparsely vegetated and the beetles were found beneath flat stones and rocks where they feed on lichen and organic detritus.

Additional beetles of interest included small speargrass weevils (*Irenimus* sp.), which feed at the tiller bases of the host plant, tiger beetles (*Neocicindela dunedinense*) and small carabids (*Bembidion* sp.).

The upper reaches of Ross Stream supports extensive riparian shrublands of *Coprosma*, *Olearia* and matagouri. Invertebrates were sampled from this stream habitat and an abundance of black mountain stoneflies (*Austroperla cyrene*) and caddis flies (*Diplectrona* sp.) were identified. Several native beetles were also present including ladybirds, carabids (*Bembidion* sp.) and manuka beetles (*Pyronota festiva*). Predatory flies were well represented by native damselflies (*Austrolestes colenonis*), green soldier flies (*Beris* sp.: Stratiomyidae), the common robber fly *Neoitamus melanopogon*: Asilidae) and a crane fly (*Leptotarsus* sp.).

Holocaspis bessatica (small ground beetle) was collected from pockets of vegetation in a stream gully adjacent to Hut Spur. The distribution of this local endemic is restricted to the eastern side of Lake Benmore.

Big Range, Little Range; south of Stony River

This area includes that part of the Stony Creek Pastoral Lease on the true left hand side of Stony River. It includes the Big Range and Little Range.

Alpine snow grasshoppers (*Brachaspis nivalis*) were present in the headwaters of Innes Burn below Mt Sutton at 1640 m. These large grasshoppers are restricted to higher elevations of the eastern Southern Alps and during this survey were only found here and a nearby un-named tributary of Ross Stream.

Ten invertebrates were collected from pockets of montane vegetation in a stream gully (1100 m). The attractive orange-winged Geometrid moth *Paranotoreas brephisota* was active amongst the snow tussock. Native crab spiders (Thomisidae), big-jawed spiders (Tetragnathidae), jumping spiders (Salticidae) and flower beetles (*Dasytes* sp.: Melyridae) are a typical suite of invertebrates from *Olearia odorata*. Cicadas were represented by two species; Campbells cicada (*Maoricicada campbelli*) and the little grass cicada (*Kikihia muta*). The habitat in which these invertebrates occurred was strictly confined to the valley floor.

Little Range Block, which includes Preston Stream, produced a suite of invertebrates that are characteristic of montane tussock and riparian habitats of the ecological area. The range restricted darkling beetle *Artystona lata* was again collected from beneath stones at approximately 1200 m asl. A large native spider hunting wasp (*Priocnemis* sp.: Pompilidae) was also caught. Several interesting moth and butterfly species were present in the upper Preston Stream. For example, the attractive 'large striped carpet' Geometrid moth (*Asaphodes clarata*) was active along with tussock ringlet butterflies (*Argyrophenaga antipodum*) in a gully of comparatively intact native tussock and *Dracophyllum uniflorum* shrublands. The heavy speargrass owlet moth *Graphania nullifera* was found within the flower spikes of several large *Aciphylla scott-thompsonii* speargrasses growing amongst a shrubland.

By contrast, lower Preston Stream presented a highly modified habitat with willow trees dominating the valley floor, although substantial *Coprosma* and matagouri occurred on the valley flanks. The native Red Admiral butterfly (*Bassaris gonerilla*) was seen within this habitat, near the confluence with Stony River, as were several native bugs (Hemiptera). Examples of these include; the soldier bug *Cermatulus nasalis hudsoni* and a species of the tussock damsel bug (*Nabis* sp.).

The threatened grasshopper *Sigaus minutus* (Gradual Decline) was noted near point 942 m at the northern property boundary. This was an unexpected find given the degree of surface modification (almost 100% *Hieracium* sp.), altitude (942 m) and the topography. *Sigaus minutus* tends to prefer stony river flats with native cushion plants. This was the only location that *S. minutus* was found on these leases and may represent the limit of the grasshoppers range within the Mackenzie Basin.

South-western Grampian Mountains

This part of the property supports some of the least modified habitats and some of the more interesting invertebrates. Notable taxa included two large, flightless speargrass weevils (*Lyperobius carinatus* (Sparse) and *Inophloeus sucifer*). Both weevils were associated with *Aciphylla aurea* and were collected from snow tussock habitat at approximately 1200 m asl. These large weevils are both susceptible to mammalian predation and there is little doubt their survival at each location is due to low predator pressure. For the most part, this area supports comparatively intact and functional natural ecosystems.

The unnamed tributary of Balloon Stream provided a rare example of an altitudinal sequence from a montane environment dominated by snow tussock, speargrass, *Dracophyllum pronum* and *Gaultheria* sp. Lower down the stream riparian strip comprised dense *Olearia odorata*, *Coprosma* sp., speargrass and scattered matagouri.

The south-western faces situated above Stony Creek Road included several small gullies which support native shrublands. Native insects of interest include the stiletto fly *Anabarhynchus innotatus* (Therividae) and lawyer owlet moth *Metarana diatmeta*.

Snow tussocklands extend down to approximately 780 m asl on the south eastern faces near the upper Stony River. Here, a range of native invertebrates characteristic of semi-modified snow tussock habitat is present including: cicadas (*Kikihia* sp.); copper and southern blue butterflies; crickets (*Bobilla* sp.) and grasshoppers (*Sigaus australis*) and long horned grasshoppers (*Conocephalus* sp., Tettigonidae).

Table Ten: Notable invertebrate species collected from Black Forest / Stony Creek Pastoral Lease, February 2007.

Threat Division	Threat Category	Species	Location on Lease/ Comments
Chronically Threatened	Gradual Decline	<i>Sigauss minutus</i> Small alpine grasshopper	Point 942 m, northern boundary of Stony Creek Pastoral Lease.
At Risk	Sparse	<i>Lyperobius</i> c.f. <i>carinatus</i> Giant speargrass weevil	Unnamed tributary of Balloon Stream.
	Range restricted	<i>Artystona lata</i> Darkling beetle	Throughout higher elevations of the leases.
	Data deficient	<i>Taieria erebus</i> Koch L. (Stealthy spider)	On Lake Benmore faces to 700 m asl.
Local Endemic		<i>Holcaspis bessatica</i> Ground beetle	Confined to the hills surrounding Lake Benmore (Johns 2003). Adjacent to Hut Spur.
		<i>Mimopeus impressifrons</i>	Mackenzie Basin and Central Otago only. Near Mt Frazer.
Of conservation interest in terms of taxonomic distinctiveness, patchy distributions (both altitudinal and horizontal), susceptibility to predators and habitat loss.		<i>Brachaspis nivalis</i> ; Alpine grasshopper	Below Mt Sutton.
		<i>Inophloeus sulcifer</i> Speargrass weevil	Big Range and southern Grampian Mountains.

Significance of Invertebrate Values

During this survey, 83 invertebrate species were collected. Eight notable species were recorded: three are threatened, one is data deficient; two are local endemics, and the two remaining species are each large flightless insects of conservation interest.

The invertebrates of conservation interest are distributed across the entire property. To the west, the data deficient spider *Taieria erebus* occurs near the shores of Lake Benmore while the grasshopper *Sigauss minutus* (Gradual Decline) was found in the northern most corner of the property. On higher elevations, large grasshoppers, weta and beetles were found amongst extensive patches of snow grass and shrublands.

The properties support several varied invertebrate habitats, this is reflected by the species found and the range of ecological niches that these species require.

Insert Invertebrate fauna map here

2.6.4 Problem Animals

Rabbits and hares

Hares were observed throughout the property and rabbits were observed at lower-altitudes. Their browsing and scuffing contribute to the degradation of ecosystems present. Both activities can have negative impacts on native bird and lizard fauna (Norbury 2001).

Cats and mustelids (ferrets, stoats and weasels):

While commonly few in number, they are direct predators of indigenous invertebrates, lizards and birds. They can devastate communities in a very short time. Cat scats were observed, and a stoat was seen in upper Preston Stream.

Hedgehogs:

Hedgehogs are very common. They prey on native birds, their eggs, lizards and invertebrates. Scats (droppings) of hedgehogs were observed on the property.

Brushtail possums:

These are very common; some sign was found in grassland and shrubland communities. They can prey on native birds and lizards, and cause damage to woody vegetation.

Wallaby:

Wallaby were observed in Ross Stream and Preston Stream, and are likely present elsewhere on the property. They impact on shrubland communities through heavy browsing and by compaction of the ground under shrubs.

Red deer

Red deer were occasionally sighted in the vicinity of Mt Sutton. They can heavily browse shrublands, resulting in significant modification and understorey degradation.

Fallow deer

Fallow deer were sighted in an unnamed stream west of Staircase Saddle. These introduced herbivores browse native vegetation resulting in significant modification and understorey degradation.

2.7 HISTORIC

2.7.1 European Heritage Values

Black Forest was first leased by Hugh Fraser in 1858, who already ran Ben Ohau Station. By the end of 1864, James Fraser was in charge of Black Forest, until he left for New Caledonia in June 1869. By 1875, rabbit numbers were increasing, and in June of that year, Black Forest was sold to Duncan Sutherland of Omarama and Edmund Hodgkinson. A. MacDonald managed the property for them and also controlled the river crossings between Canterbury and Otago.

In the hard times of 1881, Black Forest was transferred to James MacDonald. However, in 1883, he sold it to John Alfred Sutton, who also held Te Akatarawa and The Grampians at varying times. The property quickly changed hands in 1884 to Peter Donaldson and David Gunn. Peter Donaldson turned to drink, and behaved so badly that pressure was put on him to go, which he did in 1889. In 1892 the trustees formally took over Black Forest from Donaldson and Gunn, and James Durward was promoted from head shepherd to manager. The winter of 1895 was exceptionally severe and snow lay for 10 weeks. Although the rabbits had received a check, the property was financially stretched. In 1900, Black Forest was sold to James Henry Preston, owner of Haldon Station. These two properties were run together. When James Preston had a very bad accident, the family sold Black Forest to R.K. Smith, who also continued to manage Morven Hills in Central Otago (Pinney, 1971).

In 1910, J.H. Preston bought back Black Forest Station, and ran it in conjunction with what he still had left of Haldon Station. His son took over, but as men became scarce during the 1914 war, rabbit numbers boomed.

Haldon Station was split up in 1911, and Stony Creek Pastoral Lease (along with Kirkliston Pastoral Lease) was created from it (Pinney 1971).

In 1917, Simon Mackenzie took over Black Forest Station, and ran it with Haldon Station. At the end of 1919, he sold his shares in the Black Forest Company to the Innes family. As James Innes himself held the third division of Haldon, the whole Haldon and Black Forest Stations became combined under his management. The formation of Lake Benmore in the 1960s has submerged the old Black Forest homestead and covered their flats and gorge. A new homestead has been built.

Historic Sites

Stony Creek hut, located at the junction of Balloon Stream and Stony River, off Stony River Road, was probably built by Henry Fort of Grampians Hills Station around 1860. It was initially inhabited by George McRae who was appointed as boundary keeper for the station. In its earliest days, the hut was known as "McRae's Hut". McRae was responsible for caring for the station's sheep and ensuring they did not wander over the boundary to Grays Hill Station. The hut was later home to the noted artist Edmund Norman, who is noted for the accurate but pale sketches he produced while working on various early runs. The hut has also been used by various owners of the pastoral leases over the years.

The hut is registered as a Category One Historic Place with the New Zealand Historic Places Trust. The walls are made of greywacke taken from nearby Stony Creek, and are packed and supported with clay. The roof is corrugated iron and is supported by squared timber framing and wire mesh. The hut is in poor condition with structural sagging and clay falling out of the stone work.

The historic rabbit fence, built in the 1890s, which extended from the Waitaki valley to Lake Pukaki, traverses the property. The fence runs along the northern side of Stony River in an east-westerly direction, at the foot of the hillslopes. It appears to be in reasonable condition, and remains an integral part of fencing on the property. The fence was approximately 42 miles long in total and

materials for it (valued at 3600 pounds) were purchased in 1888. Men and huts were located every ten miles along the fence for maintenance purposes.

Significance of Historic Values

Stony Creek Hut at the junction of Balloon Stream and Stony River is the only boundary keeper's hut in the Mackenzie Basin to have survived almost complete from the 1860's. Whelan (1989) ranks it as of national importance, as the hut is still standing, and is a unique example of the long dead occupation; boundary keeping. The hut is registered as a Category One Historic Place with the New Zealand Historic Places Trust.

The historic rabbit fence is significant as it provides impressive historical testimony to the magnitude of the rabbit problem and the government's active financial involvement in the problem.

2.8 PUBLIC RECREATION

2.8.1 Physical Characteristics

Black Forest and Stony Creek Pastoral Leases are located in the south east corner of the Mackenzie Basin. The two properties occupy a large land area and extend from Lake Benmore in the west covering more than 21 kilometres in an eastward direction to include the lower south western slopes of the Grampian Mountains. The combined properties include lake faces of Lake Benmore and several catchments taking in Black Forest Stream, Ross Stream, Preston Stream and the Stony River. Almost all of it is dry rocky mountainous country lying to the north and north-west.

The property can be divided into three main recreation units:

- Lake Benmore Faces
- Black Forest – Stony Creek catchments
- South-western Grampian Mountains

Lake Benmore Faces

This unit covers that part of the property that covers the Lake Benmore faces. It includes northwest trending ridges and gullies that extend from Beacon Hill in the north then south along the ridgeline, across Black Forest Stream and back onto the ridge west of Black Forest Stream.

The lake edge is very indented and characterised by numerous coves and bays created when Lake Benmore was formed. Low hills are a feature close to Black Forest Cove but elsewhere the unit is characterised by steep prominent ridges, and very broken topography descending down to the lake. The whole unit is notable for its very dry rocky barren "moonscape" appearance.

The vegetation is highly modified especially on sunny faces and dry ridges. Grey shrubland is a component but is very scattered and often within tight gullies or steep rocky faces.

This unit, although highly modified in terms of natural values, contains visual and scenic values as the backdrop to Lake Benmore. The very rocky and craggy landform is distinctive and a strong feature of this part of the Mackenzie Basin. The indented lakeshore, coves and bays are significant features. Views and vistas from the lakeshore (and most high places within the unit) across the lake and Mackenzie Basin to Aorangi/Mount Cook and ranges are outstanding.

Four camping areas exist at bays adjacent to Lake Benmore. A range of facilities (e.g. seating, barbeques, tables, toilets and showers) are provided at some of these camping areas. A small group

of caravans is located at Poplar Gully and a hut is located at another bay north of Poplar Gully. Farm houses, holiday houses and shearers quarters are present on the flatter land close to Black Forest Cove.

Vehicle tracking, fencing and gates exist within the unit.

The setting for this unit is predominantly cultural due to the farming influence.

Black Forest –Stony Creek catchments

This large unit is east of the Lake Benmore Faces through to the Stony River Road. It includes a section of the Black Forest Stream catchment and part of the Stony River catchment.

Landform patterns across most of the unit are reasonably consistent and comprise moderately steep to very steep dissected mountain slopes throughout the unit. Mountain tops and ridges are typically rounded or flat topped forms. The majority of the unit is very dry north and west facing slopes with rock exposure common.

The natural vegetation patterns are degraded over much of the unit, apart from areas above 1200m where tussock and alpine plant associations are largely intact. Below this altitude level tussock is depleted, scattered shrubland exists on hillslopes with denser shrubland within gullies and waterways and hawkweed is common. Sweet brier is present at lower altitudes and in valley floors. The Stony River flats and low terraces are a mixture of pasture, exotic trees, grass and weed species.

The Black Forest Stream valley floor flats and lower slopes have been, for the most part, converted to pasture. Exotic trees and vegetation occur on the valley floor in many locations.

Staircase Creek comprises a mix of shrubland and brier on the valley floor and short tussock/pasture/hawkweed and shrubland on mountain slopes. Snow tussock is very patchy and more prevalent on south faces. The valley is narrow and entrenched below the saddle with heavy shrubland and extensive rock exposure. Boulderfields and scree slopes occur within the head of the narrow gorge.

A farm hut in good condition is situated adjacent to Ross Stream close to where the Stony Creek Pastoral Lease adjoins the Black Forest Pastoral Lease.

Tracking, fencing, and gates exist across the unit. Power pylons and lines traverse the floor of the Black Forest Stream valley. A formed gravel road exists adjacent to Black Forest Stream that continues past the Pastoral Lease to the south to the Lake Benmore Dam.

The setting for this unit is predominantly cultural due to the influence of farming and power utilities, however above 900 m asl there is a merging in of more intact vegetative cover which provides a more natural appearance.

South-western Grampian Mountains

This topographically separate unit is wedged between the Stony River and Balloon Stream. It forms a corner of the western toe slopes of the Grampian Mountains. The majority of the landform has a sloping surface with a northwest aspect. The south-east face above the Stony River is steep with a series of rounded ridges and shallow gullies cut into the sloping face and toe slopes above the Stony River. The south-west face forms a steep terrace against the Stony River. Talus slopes are a feature at the southern point where the river is cut in against the terrace face.

Natural vegetation is primarily short tussock, hawkweed, scattered matagouri, exotic grasses and weeds. Tall tussockland is prevalent on hillslopes in the south eastern upper Stony River catchment. The river flats are modified with exotic trees (willow, poplars and pines) present. The green valley floor creates a vivid contrast to the dry mountain slopes.

The old Stony Creek homestead and buildings including the historic stone building are located on the true left bank of Balloon Stream. The historic rabbit fence is adjacent to the Stony River Road. Stony River Road (with associated fords and bridges), other farm tracking, fencing and gates are present within the unit.

The setting for this unit is predominantly cultural due to the influence of farming.

2.8.2 Legal Access

Roads

Land access to the property is from Haldon Road, which comes off State Highway 8 near Burke Pass, 70 km southwest from Fairlie. Haldon Road provides formed legal road access to the front country at the western end of the property, while Stony River Road is a formed legal road adjacent to the Stony River. Black Forest Road is a formed legal road associated with the pylons from the Benmore dam to the south and for the most part appears to follow the legal road. There is also water access available to Black Forest Pastoral Lease via Lake Benmore. Access within the property is mainly by farm tracks. There are no other formed or unformed legal roads on the two properties.

Adjoining Crown and Public Conservation Land

Kirkliston Retirement Area, Black Forest Retirement Area and Waitangi Retirement Area (Conservation Management Strategy Land Units I39018, I39019 and I39020) adjoin Stony Creek and Black Forest Pastoral Leases near Mt Sutton. These lands are under investigation for addition to the public conservation estate.

Marginal Strips

Several streams should qualify for Part IVA Conservation Act 1987 marginal strip protection: Black Forest Stream, Ross Stream, the Stony River and some tributaries of these waterways. The extent of rivers or streams over three metres in width have not been shown on any plan lodged in the Chief Surveyors Office.

2.8.3 Activities

There is a current recreation permit issued for Black Forest Pastoral Lease to operate a tourist accommodation operation using two lake shore houses and the shearer's quarters.

Known recreational activities include four wheel driving, motorbike riding, mountain biking, hunting, walking, tramping, fishing, lakeside camping and scenic appreciation. Higher altitude parts of the property provide good opportunities for tramping, hunting, nature study, scenery appreciation and in winter months may provide good opportunities for ski touring. Lower altitude parts of the property provide good opportunities for walking, picnicking, fishing, camping (especially by the lake shore), mountain biking, horse riding, nature study and scenic appreciation.

A four wheel drive opportunity including high and low altitude areas exists from Stony Creek via the Little Range, Ross Stream, Staircase Saddle, Staircase Stream and Black Forest Road using existing farm tracks. This is presently used by four wheel drive groups. This route is also suitable for mountain biking and horse trekking offering a multi day opportunity. Multi day opportunities are limited in Canterbury for these activities.

Lake Benmore, Stony River and tributaries provide opportunities for fishing.

Hunting can be carried out over the majority of both Pastoral Leases. Tramping clubs do frequent the area primarily using the lakefront or the Balloon Stream area. Stony Creek Pastoral Lease provides good access to Mt Sutton via the Little Range.

The lakefront area has high significance for recreation because of the range of activities this land/water interface provides and the scenic appreciation that can be gained. The views and vistas from the lakeshore across Lake Benmore and the Mackenzie Basin to Aorangi/Mount Cook and adjacent ranges are outstanding. Camping already occurs with campers using various forms of accommodation, e.g. tents, camper vans, caravans. Some facilities are already provided at the four camping areas, e.g. seating, barbeques, tables, toilets and showers). The farm track adjacent to the lakeshore is significant for access and as a mountain bike/horse trekking opportunity. Walking adjacent to the lake shore and fishing are activities carried out by some campers. Providing unrestricted access on the land between the lake and the farm track is highly desirable.

Black Forest Road and Stony River Road are significant in that they provide access to other locations within and beyond the two properties. The formed roads may not always follow the legal road line. Black Forest Road access is controlled by a locked gate. Black Forest Road provides a four wheel drive, mountain bike and horse trekking opportunity. Black Forest Road continues through to the Benmore Dam via other properties.

The Balloon Stream area adjacent to the historic hut is significant for recreation because it offers an area for picnicking, camping, historic appreciation and is a starting point for other recreational opportunities.

Significance of Recreation Values

The lakefront area has high significance for recreation because of the range of activities this land/water interface provides and the scenic appreciation that can be gained. The views and vistas from the lakeshore across Lake Benmore and the Mackenzie Basin to Aoraki/Mount Cook and adjacent ranges are outstanding. The farm track adjacent to the lakeshore is significant for access and as a mountain bike/horse trekking opportunity. Providing unrestricted access on the land between the lake and the farm track is highly desirable.

The Balloon Stream area adjacent to the historic hut is significant for recreation because it offers an area for picnicking, camping, historic appreciation and is a starting point for other recreational opportunities.

Black Forest Road and Stony River Road are significant in that they provide access to other locations within and beyond the two properties. Black Forest Road provides a four wheel drive, horse trekking and mountain bike opportunity. Black Forest Road continues through to the Benmore Dam via other properties.

The farm track traversing the two properties starting from Stony River Road and finishing at Black Forest Road is significant for the multi day opportunity it provides for mountain biking and horse trekking. It is also a significant four wheel drive opportunity.

PART 3: OTHER RELEVANT MATTERS AND PLANS

3.1 CONSULTATION

Information-gathering meetings were held with representatives of non-governmental organisations (NGOs) at Christchurch on the 4th September 2006, and at Geraldine on the 5th September 2006. Comments made at those meetings are summarised below.

- Shrubland vegetation along Ross Stream provides habitat for native bird fauna. Other shrubby gullies are present close to the lake.
- Property is of landscape significance.
- There are good areas of tussocklands up Stony River Road, and on the Haldon/Kirkliston area
- Water quality is important
- Property has rabbit and soil conservation agreements.
- The retired Mt Sutton area has no boundary fence and should be destocked.
- There are a couple of historical sites with a pastoral reference on the Historic Places Trust database; including a rabbit proof fence on Stony Creek.
- Are there any shepherd's huts around the properties?
- Regular tramps are made from the homestead at Stony Creek up Moffat River, to Stony hut by Streamlands boundary.
- There is a locked gate across the legal road that crosses the property, at the Benmore end.
- Mountain bike access through Black Forest to Te Akatarawa would be a good route.
- Black Forest is not used for tramping but the owners are agreeable to anyone wanting to use it.
- Lakeside protection is needed.
- The track around the lake edge to the hut appears interesting for recreation, then continuing up the spur for a round trip.
- Access up Stony River needs investigating; apparently over freehold land. Access up Stony River to the boundary would give good access
- Marginal strip of Stony River- would this provide adequate access?
- The recreational values of these properties need adding onto the bigger picture of adjoining Pastoral Leases.

3.2 DISTRICT PLANS

The northwest parts of Black Forest and Stony Creek Pastoral Leases lie within the Rural Zone of the Mackenzie District.

The Mackenzie District Plan contains a number of rules relating to land use activities within sites of natural significance, within riparian areas and in high altitude areas (i.e. areas above 900 m):

The southeast parts of Black Forest and Stony Creek pastoral leases lie within the Rural Zone of the Waimate District. One Site of Natural Significance is present on the property:

- Big Range on the northern end of the Big Range (Grampians RAP 9)

Lake Benmore adjacent to Black Forest Pastoral lease is listed as a site of natural significance in both the Mackenzie District Plan and the Waimate District Plan.

The Waimate District Plan contains a number of rules that restrict or control activities in the Rural Zone, covering activities such as the clearance of indigenous vegetation, tree planting and set-backs from waterways.

3.3 CONSERVATION MANAGEMENT STRATEGIES

Black Forest and Stony Creek Pastoral Leases lie within the Waitaki Place Unit of the Canterbury Conservancy. Relevant priority objectives for this unit listed in the CMS (Department of Conservation 2000) are:

- To identify, maintain and seek to enhance the natural landscapes and natural landscape values of the Waitaki Unit.
- To identify the significant indigenous vegetation and threatened species of the Waitaki Unit.
- To use a range of effective methods to protect the indigenous biodiversity of the Waitaki Unit.
- To protect and enhance the viability of priority threatened species populations and their habitat(s) in the Waitaki Unit.
- To improve the range of viable riparian habitats for indigenous species in the Mackenzie Basin.
- To encourage landholders to cooperate in protecting braided river systems.
- To prevent the loss of natural and landscape values from wilding trees on land managed by the Department.
- To liaise with land managers and regulatory agencies to control and contain wilding trees.
- To reduce and maintain rabbit and thar densities to levels that ensure their adverse effects on natural values are minimised.
- To provide new recreational facilities and opportunities by the Department and other organisations and concessionaires where natural and historic values are not compromised.
- To liaise with adjacent landholders to resolve conflicts over access for recreation to land managed by the Department.
- To provide quality interpretation at priority sites in the Mackenzie Basin.
- To increase public awareness of the natural and historic values of the Waitaki.

3.4 NEW ZEALAND BIODIVERSITY STRATEGY

The New Zealand Government is a signatory to the Convention on Biological Diversity. In February 2000, Government released the New Zealand Biodiversity Strategy which is a blueprint for managing the country's diversity of species and habitats and sets a number of goals to achieve this aim. Of particular relevance to tenure review, is goal three which states:

- Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments, and do what is necessary to:
- Maintain and restore viable populations of all indigenous species across their natural range and maintain their genetic diversity.

PART 4: ATTACHMENTS

4.1 ADDITIONAL INFORMATION

4.1.1 Scientific Names of Species

Plant Species referred to in text

Species names follow those in the published volumes of New Zealand Flora and the name changes listed in A Checklist of Indigenous Vascular Plants of New Zealand, 10th Revision (*Unpublished Document*, S. Courtney, Department of Conservation, Nelson). Maori names are included for taonga species listed in Schedule 97 of the Ngai Tahu Claims Settlement Act 1998. Naturalised species are indicated by an asterisk (*).

Common name	Scientific name
Alpine fescue tussock	<i>Festuca matthewsii</i>
Blue tussock	<i>Poa colensoi</i>
Blue wheatgrass	<i>Elymus solandri</i>
Bog pine	<i>Halocarpus bidwillii</i>
Bog rush	<i>Schoenus pauciflorus</i>
Bracken/Aruhue	<i>Pteridium esculentum</i>
Bristle tussock	<i>Rytidosperma setifolium</i>
Broom	<i>Cytisus scoparius</i> *
Browntop	<i>Agrostis capillaris</i> *
Californian thistle	<i>Cirsium arvense</i> *
Catsear	<i>Hypochoeris radicata</i> *
Chewings fescue	<i>Festuca rubra</i> *
Cleavers	<i>Galium aparine</i> *
Cocksfoot	<i>Dactylis glomeratus</i> *
Coral broom	<i>Carmichaelia crassicaule</i>
Crack willow	<i>Salix fragilis</i> *
Creeping buttercup	<i>Ranunculus repens</i> *
Creeping mapou	<i>Myrsine nummularia</i>
Creeping pohuehue	<i>Muehlenbeckia axillaris</i>
Crested dogstail	<i>Cynosurus cristatus</i> *
Curled dock	<i>Rumex crispus</i> *
Downy brome	<i>Bromus tectorum</i> *
Edelweiss	<i>Leucogenes grandiceps</i>
Elderberry	<i>Sambucus nigra</i> *
Everlasting daisy	<i>Helichrysum bellidioides</i>
False speargrass	<i>Celmisia lyallii</i>
Fescue tussock	<i>Festuca novae-zelandiae</i>
Giant speargrass	<i>Aciphylla scott-thomsonii</i>
Golden speargrass	<i>Aciphylla aurea</i>
Gooseberry	<i>Ribes uva-crispa</i> *
Gorse	<i>Ulex europaeus</i> *
Harebell	<i>Wahlenbergia albomarginata</i>
Haresfoot trefoil	<i>Trifolium arvense</i> *

Hawkweeds	<i>Hieracium*</i> spp.
Jointed rush	<i>Juncus articulatus*</i>
Kentucky blue grass	<i>Poa pratensis*</i>
King devil	<i>Hieracium praealtum*</i>
Koromiko	<i>Hebe salicifolia</i>
Kowhai, South Island kowhai/Kowahi Kohai	<i>Sophora microphylla</i>
Lawyer	<i>Rubus schmidelioides</i>
Little hard fern	<i>Blechnum penna-marina</i>
Lotus	<i>Lotus pedunculatus*</i>
Male fern	<i>Dryopteris filix-mas*</i>
Maori onion	<i>Bulbinella angustifolia</i>
Matagouri	<i>Discaria toumatou</i>
Mingimingi	<i>Coprosma propinqua</i>
Monkey musk	<i>Mimulus guttatus*</i>
Mountain clubmoss	<i>Lycopodium fastigiatum</i>
Mountain flax/Wharariki	<i>Phormium cookianum</i>
Mountain toatoa/Toatoa	<i>Phyllocladus alpinus</i>
Mountain totara	<i>Podocarpus hallii</i>
Mountain wineberry	<i>Aristotelia fruticosa</i>
Mouse-ear hawkweed	<i>Hieracium pilosella*</i>
Mousetail	<i>Myosurus minimus</i> var. <i>novae-zelandiae</i>
Narrow-leaved snow tussock	<i>Chionochloa rigida</i>
Native broom	<i>Carmichaelia australis</i>
Native jasmine	<i>Parsonsia capsularis</i>
Native violet	<i>Viola cunninghamii</i>
Necklace fern	<i>Asplenium flabellifolium</i>
Nodding thistle	<i>Carduus nutans*</i>
Patotara	<i>Leucopogon fraseri</i> agg.
Plume grass	<i>Dichelachne crinita</i>
Poplars	<i>Populus*</i> spp.
Porcupine shrub	<i>Melicytus alpinus</i>
Prickly shield fern	<i>Polystichum vestitum</i>
Prostrate kowhai	<i>Sophora prostrata</i>
Pukio	<i>Carex secta</i>
Purging flax	<i>Linum catharticum*</i>
Raupo	<i>Typha orientalis</i>
Red clover	<i>Trifolium pratense*</i>
Red woodrush	<i>Luzula rufa</i>
Ripgut brome	<i>Bromus diandrus*</i>
Rock fern	<i>Cheilanthes sieberi</i>
Russell lupin	<i>Lupinus polyphyllus*</i>
Ryegrass	<i>Lolium perenne*</i>
Sandwort	<i>Arenaria serpyllifolia*</i>
Scabweed	<i>Raoulia australis</i>
Scrub pohuehue	<i>Muehlenbeckia complexa</i>
Sheep's burr	<i>Acaena agnipila*</i>
Sheep's sorrel	<i>Rumex acetosella*</i>
Shepherd's purse	<i>Capsella bursa-pastoris*</i>
Silver tussock/Wi	<i>Poa cita</i>
Slim snow tussock	<i>Chionochloa macra</i>
Snowberry	<i>Gaultheria depressa</i>
Snow totara	<i>Podocarpus nivalis</i>
Soft brome	<i>Bromus hordeaceus*</i>
Soft rush	<i>Juncus effusus*</i>

St John's wort	<i>Hypericum perforatum</i> *
Suckling clover	<i>Trifolium dubium</i> *
Sweet brier	<i>Rosa rubiginosa</i> *
Sweet vernal	<i>Anthoxanthum odoratum</i> *
Tall oatgrass	<i>Arrhenatherum elatius</i> *
Tarweed	<i>Parentucellia viscosa</i> *
Tauhinu	<i>Ozothamnus leptophyllus</i>
Thousand-leaved fern	<i>Hypolepis millefolium</i>
Toetoe	<i>Cortaderia richardii</i>
Turpentine shrub	<i>Dracophyllum uniflorum</i>
Tussock hawkweed	<i>Hieracium lepidulum</i> *
Vipers bugloss	<i>Echium vulgare</i> *
White clover	<i>Trifolium repens</i> *
White fuzzweed	<i>Vittadinia australis</i> agg.
Willows	<i>Salix</i> spp.
Willow weed	<i>Polygonum</i> sp.*
Wire moss	<i>Polytrichum juniperinum</i>
Woolly mullein	<i>Verbascum thapsus</i> *
Yarrow	<i>Achillea millefolium</i> *
Yorkshire fog	<i>Holcus lanatus</i> *

Animal Species referred to in text

Species names follow King (1990) for mammals, the June 2003 version of the New Zealand Recognized Bird Names list (compiled by C.J.R. Robertson and D.G. Medway for the Ornithological Society of New Zealand Inc.) for birds and Whitaker (1998) for lizards. Maori names are included for taonga species listed in Schedule 97 of the Ngai Tahu Claims Settlement Act 1998.

Below is a list of fauna cited in the text and their scientific names

Native bird species

Australasian harrier/Kahu	<i>Circus approximans</i>
black shag/Koau	<i>Phalacrocorax carbo novaehollandiae</i>
grey warbler/Riroriro	<i>Gerygone igata</i>
New Zealand falcon/Karearea	<i>Falco novaeseelandiae</i> "eastern"
New Zealand pipit/Pihoihoi	<i>Anthus n. novaeseelandiae</i>
paradise shelduck/Putakitaki	<i>Tadorna variegata</i>
silveryeye	<i>Zosterops l. lateralis</i>
South Island fantail/Piwakawaka	<i>Rhipidura f. fuliginosa</i>
South Island pied oystercatcher	<i>Haematopus ostralegus finschi</i>
southern black-backed gull/Karoro	<i>Larus d. dominicanus</i>
spur-winged plover	<i>Vanellus miles novaehollandiae</i>

Introduced bird species

Australian magpie	<i>Gymnorhina tibicen</i>
blackbird	<i>Turdus merula</i>
California quail	<i>Callipepla californica</i>
chukor	<i>Alectoris chukar</i>
dunnock	<i>Prunella modularis</i>
goldfinch	<i>Carduelis carduelis</i>

greenfinch	<i>Carduelis chloris</i>
house sparrow	<i>Passer domesticus</i>
little owl	<i>Athene noctua</i>
mallard	<i>Anas platyrhynchos platyrhynchos</i>
peafowl	<i>Pavo cristatus</i>
pheasants	<i>Phasianus colchicus</i>
red-legged partridge	<i>Alectoris rufa</i>
redpoll	<i>Carduelis flammea</i>
rock pigeons	<i>Columba livia</i>
skylark	<i>Alauda arvensis</i>
turkey	<i>Meleagris gallopavo</i>
yellowhammer	<i>Emberiza citrinella</i>

Lizards

common skink	<i>Oligosoma nigriplantare polychroma</i>
jewelled gecko	<i>Naultinus gemmeus</i>
long-toed skink	<i>Oligosoma longipes</i>
McCann's skink	<i>Oligosoma maccanni</i>
scree skink	<i>Oligosoma waimatense</i>
spotted skink	<i>Oligosoma lineocellatum</i>
Southern Alps gecko	<i>Hoplodactylus "Southern Alps"</i>

Introduced mammals

Bennett's wallaby	<i>Macropus r. rufogriseus</i>
brown hare	<i>Lepus europaeus occidentalis</i>
brush-tail possum	<i>Trichosurus vulpecula</i>
European hedgehog	<i>Erinaceus europaeus occidentalis</i>
European rabbit	<i>Oryctolagus c. cuniculus</i>
fallow deer	<i>Dama d. dama</i>
ferret	<i>Mustela furo</i>
red deer	<i>Cervus elaphus scoticus</i>
stoat	<i>Mustela erminea</i>
weasel	<i>Mustela nivalis vulgaris</i>

Invertebrates

copper butterfly	<i>Lycaena salustius</i> Fb.
Southern blue butterfly	<i>Zizina otis oxleyi</i> Felder

Aquatic Fauna

longfin eel/tuna	<i>Anguilla dieffenbachii</i>
Lowland longjaw galaxias	<i>Galaxias cobitinis</i>
common bully	<i>Gobiomorphus cotidianus</i>
Bignose galaxias	<i>Galaxias macronasus</i>
Sockeye salmon	<i>Oncorhynchus nerka</i>
Rainbow trout	<i>Oncorhynchus mykiss</i>
Chinook salmon	<i>Oncorhynchus tshawytscha</i>

4.1.2 References Cited

Arand, J., Basher, L., McIntosh, P. and Heads, M. 1991: Inventory of New Zealand soil sites of international, national and regional importance. Part 1 - South Island and southern offshore islands. The New Zealand Society of Soil Science, Lincoln University, Canterbury.

Boffa Miskell Partners Ltd. 1992: Landscape Change in the Mackenzie/Waitaki Basins

Bowie, S. 2007: Streamlands and Curraghmore pastoral leases: A report on the Aquatic Fauna Surveys. Unpublished report, Dept of Conservation.

Chadderton, W.L., Brown, D.J. & Stephens, R.T. 2004: Identifying Freshwater Ecosystems of National Importance for Biodiversity. Discussion document. Department of Conservation, Wellington. 112p.

de Lange, P.J.; Norton, D.A.; Heenan, P.B.; Courtney, S.P.; Molloy, B.P.J.; Ogle, C.C.; Rance, B.D.; Johnson, P.N.; Hitchmough, R. 2004: Threatened and uncommon plants of New Zealand. *NZ Journal of Botany* 42: 45-76.

Department of Conservation, 2000: Canterbury Conservation Management Strategy, *Canterbury Conservation Management Planning Series No. 10*. Department of Conservation, Christchurch. 320p.

Elkington, S. 1995: Field Notes for the Tenure Review Survey of Kirkliston Pastoral Lease. Unpublished field information.

Emberson, R. and Syrett, P. 2006: Curraghmore and Streamlands Pastoral Leases Tenure Review. Assessment of Invertebrate Values and Recommendations for their protection. Unpublished internal Department of Conservation report. Department of Conservation, Christchurch.

Espie, P.R.; Hunt, J.E.; Butts, C.A.; Cooper, P.J.; Harrington, W.M.A. 1984: *Mackenzie Ecological Region, New Zealand Protected Natural Areas Programme*. Department of Lands and Survey, Wellington.

Forsyth, P.J. (compiler) 2001: Geology of the Waitaki Area. Scale 1:250 000. Institute of Geological & Nuclear Sciences 1:250 000 geological map 19.

Grove, P. 2001: The conservation status of *Carmichaelia curta* in the Waitaki River catchment. Dept of Conservation unpublished report.

Hitchmough, R., Bull, L. & Cromarty, P (compilers): 2007: New Zealand threat classification system lists 2005. Threatened Species Occasional Publication. Department of Conservation, Wellington, New Zealand.

Johns, P. M. 2003: New species of *Holcaspis* and others of conservation interest, and a species guide (Coleoptera: Carabidae). *Records of the Canterbury Museum* 17: 7-16.

Johnson P. and Gerbeaux P. 2004: Wetland types in New Zealand. Department of Conservation, Wellington.

Leathwick, J.; Wilson, G.; Rutledge, D.; Wardle, P.; Morgan, F.; Johnston, K.; McLeod, M.; Kirkpatrick, R. 2003: *Land Environments of New Zealand*. David Bateman, Auckland. 184p.

Lettink, M. 2007: Assessment of the bird and lizard values of Curraghmore and Streamlands Pastoral Leases, South Canterbury. Unpublished Tenure Review Report, Department of Conservation Canterbury Conservancy, Christchurch, New Zealand. 16 pp + maps.

McEwen, W.M. (editor) 1987: Ecological regions and districts of New Zealand, third revised edition (Sheet 4). *New Zealand Biological Resources Centre Publication No.5*. Department of Conservation, Wellington, 1987.

McGlone, M.S. 2001: The origin of the indigenous grasslands of south eastern South Island in relation to pre-human woody ecosystems. *NZ Journal of Ecology* 25: 1-15.

Norbury, G. 2001: Conserving dryland lizards by reducing predator-mediated apparent competition and direct competition with introduced rabbits. *Journal of Applied Ecology* 38: 1350-1361.

Pinney, R. 1971. *Early South Canterbury Runs*. A.H. & A.W. Reed Ltd. 330p.

Rogers, G., Walker, S., Tubbs, M., Henderson, J. 2002: Ecology and conservation status of three “spring annual” herbs in dryland ecosystems of New Zealand. *New Zealand Journal of Botany*, 40: 649-669

Rogers, G., Overton, J McC., Price, R. in prep.: Land use impacts on “spring annual” herbs in rare non-forest ecosystems of New Zealand.

Walker, S., Price, R., and Rutledge, D. 2005: New Zealand’s remaining indigenous vegetation cover: recent changes and biodiversity protection needs. Landcare Research Contract Report: LC0405/038 prepared for the Department of Conservation (unpubl.). URL:http://www.landcareresearch.co.nz/databases/lenz/downloads/New%20Zealand_indigenous_cover.pdf

Wardle, K. 2000: The conservation status of *Carmichaelia kirkii* in the Mackenzie Basin. Unpublished report for the Dept of Conservation.

Whelan, C.D. 1989: An inventory of Historic and Archaeological Sites in the Mackenzie Ecological Region. Prepared for the Department of Conservation. Canterbury Region Technical Report Series No. 1.

Worthy, T.H. 1997: Quaternary fossil fauna of South Canterbury, South Island, New Zealand. *Journal of the Royal Society of New Zealand* 27:67-162.