Before the Queenstown Lakes District Council

Under	the Resource Management Act 1991
In the matter of	the Queenstown Lakes Proposed District Plan – Topic 13 (Group 2 Rural)

Legal Submissions for New Zealand Tungsten Mining (#519)

29 August 2017

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MAY IT PLEASE THE PANEL

Introduction

1 These legal submissions are presented on behalf of New Zealand Tungsten Mining Limited (**NZTM**) in respect of Topic 13 (Group 2 Rural) of the Queenstown Lakes Proposed District Plan (**PDP**).

2 NZTM supports the recommendations from Council's landscape and planning experts (section 42a Report) in respect of NZTM's relief sought to amend the Outstanding Natural Feature (**ONF**) line at Mt Alfred, Glenorchy to exclude the Dart River flats on the western side of Mt Alfred.

3 In these submissions, NZTM however submits that the mapping of the Mt Alfred ONF and its description within the PDP is incomplete, and would benefit from further particularisation and explanation within the PDP so as to enable better informed future planning decisions.

Executive Summary

4 These legal submissions consider the following issues:

(a) Amendment of the ONF landscape boundary over Mt Alfred and the Dart River Flats;

(b) Incompleteness of the ONF as identified over Mt Alfred.

Amendment of the ONF landscape line

5 NZTM's submission sought to amend the ONF boundary at the bottom of Mt Alfred to better reflect the biophysical, sensory, and associative attributes of Mt Alfred. The Queenstown Lakes District Council (**Council**) landscape expert Dr Read, and the Council Planner are both in agreement that moving the boundary to the toe of Mt Alfred would be appropriate and accept NZTM's relief sought:

> *On the basis of Dr Read's comments that the requested realignment of the ONF is logical and that the resultant changes to the rules affecting the status of mining and farming activities can be absorbed by the river flat environment, I recommend that the request to change the ONF boundary to that shown in Dr Read's evidence is accepted.*[1]

6 Accordingly, Counsel respectfully submits that the Commissioners should approve this amendment to the PDP.

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[1] Topic 13, Group 2 section 42a Report, Robert Buxton, at [7.7]

Incompleteness of ONFs and ONLs under the PDP

7 Counsel further submits that the PDP currently suffers from 'incompleteness' in relation to ONFs and Outstanding Natural Landscapes (**ONLs**). This issue might also lead to consideration of further amendments which may be necessary to Chapter 6 Landscapes in particular.

8 The majority Supreme Court's reasoning in *King Salmon*[2] considered the meaning of *'inappropriateness'* as it appears within section 6(b) of the Act:

> *Both pt 2 of the RMA and provisions in the NZCPS refer to protecting areas such as outstanding natural landscapes from "inappropriate" development – they do not refer to protecting them from any development. This suggests that the framers contemplated that there might be "appropriate" developments in such areas, and raises the question of the standard against which "inappropriateness" is to be assessed.*[3]
>
> *…*
>
> *We consider that where the term "inappropriate" is used in the context of protecting areas from inappropriate subdivision, use or development, the natural meaning is that "inappropriateness" should be assessed by reference to what it is that is sought to be protected.*[4]
>
> *…*
>
> *We consider that "inappropriate" should be interpreted in s 6(a), (b) and (f) against the backdrop of what is sought to be protected or preserved.*[5]

9 Subsequent case law has, in the context of ONF and ONL decision making, determined what is an 'inappropriate' development with reference to the particular attributes of that ONF or ONL sought to be protected. To inform this planning decision, sufficient information and particularisation is needed within the Plan.

10 In the course of Hearing Stream 01B of the PDP, the process for identifying and providing for ONFs and ONLs within section 6 was discussed at length.

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[2] *Defence Society Inc v The New Zealand King Salmon Co Ltd* [2014] NZSC 38, [2014] 1 NZLR 593.

[3] Ibid, at [98].

[4] Ibid, at [101].

[5] Ibid, at [105].

11 The High Court in the *Man o War* litigation followed on from the *King Salmon* decision and reasoned that characteristics of a landscape should first be identified and then provisions should be set to recognise and provide for those characteristics.

> *"It is clear from the fact that "the protection of outstanding natural features and landscapes" is made, by s 6(b), a "matter of national importance" that those outstanding natural landscapes and outstanding natural features* ***must first be identified.*** *The lower level documents in the hierarchy (regional and district policy statements) must then be formulated to protect them. Thus, the* ***identification of ONLs drives the policies.*** *It is not the case that policies drive the identification of ONLs, as MWS submits". "As identified by the Council, the RMA clearly delineates the task of identifying ONLs and the task of protecting them. These tasks are conducted at different stages and by different bodies. As a result it cannot be said that the RMA expects the identification of ONLs to depend on the protections those areas will receive. Rather, Councils are expected to identify ONLs with respect to objective criteria of outstandingness and these landscapes will receive the protection directed by the Minister in the applicable policy statement".*[6]

12 If the Supreme Court's reasoning in *King Salmon* is considered within the context of what is sought to be protected, then clearly those characteristics, features, and values must be more explicitly identified in the PDP to be of meaningful assistance to decision makers.

13 These considerations are particularly important where in this District over 96% of the land has been classified as protected in accordance with section 6 of the RMA.

14 The identified features of the Mt Alfred ONF are considered at para 5.3.1 of Dr Read's Hearing Stream 02 evidence and includes the existence of scheelite mining and relics of the mine:

> *Mount Alfred is a large roche moutonee located at the mouth of the Dart River Valley. It is approximately 9.7km in length and rises to 1386m. It is partially clad with beech forest, and partially with regenerating forest and areas of tussock grassland. The largest area of beech forest is on land managed by the Department of Conservation. The majority of the mountain forms a part of Earnslaw Station and is grazed by cattle which are moved up and down the mountain on a seasonal basis. The mountain has high aesthetic appeal from all directions and is highly*

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[6] *Man O War Station Ltd v Auckland Regional Council* [2015] NZHC 767, at [59]- [60]

memorable. It is highly legible as a glacial landscape feature. It is high enough to be capped with snow in the winter giving it seasonal interest. Scheelite was mined on it at its northern tip and relics of the mine are a protected feature in the District Plan.

15 While that is a helpful starting point for a description of the Mt Alfred outstanding attributes, it does not recognise the importance of modern day mining still occurring at Mt Alfred (see **Appendix 1** and section on Mt Alfred Attributes below for further detail)[7], as well as other associative attributes such as its recreational features.

16 Furthermore, this description of its attributes is not pulled forward in the Landscape or Rural Chapters of the PDP. It therefore will not be helpful to future decision makers in determining appropriateness of activities.[8] The Landscape Chapter instead only provides a one page high level summary of the entire District's landscapes generally (see **Appendix 2** extract).

17 I submit such an omission in the PDP necessitates a rethink of Chapter 6.

18 Conversely, Counsel is aware of other more recent second generation district planning instruments which by comparison have particularised attributes of section 6(b) landscapes in much more detail than this PDP.[9]

19 Counsel finally submits that this deficiency will not only be unhelpful for future decision makers, but it may raise an incompleteness argument, which could be disputed as one of the three King Salmon Caveats[10], thereby justifying resort to Part 2.

Mt Alfred Attributes

20 NZTM considers the following attributes should be better particularised within the PDP:

Vegetation

21 Parts of Mt Alfred are classified as a Significant Natural Area (**SNA**).

22 Referring to the LINZ Conservation Resources Report (**Appendix 3**) the vegetation present on Mt Alfred reflects the history of disturbance - forestry,

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[7] Refer Evidence of Gary Gray, Topic 01B, NZ Tungsten Mining

[8] Key landscape policies include Pol 6.3.3

[9] Auckland Unitary Plan, Schedules 6 and 7; Kaipara District Plan Appendix 18A; Western Bay of Plenty District Council Appendix 2.

[10] *King Salmon* at [88] being; invalidity, uncertainty of meaning, and incomplete coverage.

mining, fire and grazing – and also illustrates its ability to regenerate following disturbance.

23 Areas below the natural treeline where forest has been removed now exhibit various successional states, the most extensive and conspicuous being bracken fern, cabbage tree, emergent broad-leaved species, and manuka shrubland. Again showing its ability to regenerate following disturbance

Mining

24 Associative attributes are relevant considerations from the modified Pigeon Bay Criteria and more recently have been codified in the Otago Proposed Regional Policy Statement, Schedule 3. Those include whether values are shared and recognised, cultural and spiritual associations, and historical and heritage associations.

25 Mining of scheelite was active on Mt Alfred from 1917 to 1950 and this is now virtually invisible and has been absorbed. NZTM has been undertaking exploration within here since 2008.

26 A mine has been active (MP51824 – **Appendix 4**) on the eastern slopes of Mt Alfred since 2010. Mining has occurred in the past with no lasting effects except that it has provided a protected feature in the District Plan.

27 Mining is still being undertaken by NZTM via exploration (which is a part of mining) with no effects. NZTM intend to mine again in the near future. Future exploration and mining will have only minor or less than minor effects on the values that Dr Read has identified as warranting an ONF classification

Dated this 29th day of August 2017

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Rosie Hill / Maree Baker-Galloway
Counsel for NZTM

Appendix 1 – Evidence of Gary Gray for NZTM, Topic 01B (further detail on mining history at Mt Alfred)

BEFORE THE QUEENSTOWN LAKES DISTRICT COUNCIL

IN THE MATTER of the Resource Management Act 1991 (the "Act")

AND

IN THE MATTER of the Queenstown Lakes District Proposed District Plan

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EVIDENCE OF GARY GRAY
21 APRIL 2016

New Zealand Tungsten Mining (#519/#1287)

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1. Introduction

1.1 Qualifications and Experience

1.2 My name is Gary Roger Gray and I am a Director of New Zealand Tungsten Mining Ltd (NZTM). NZTM holds exploration and prospecting permits for tungsten, gold and other minerals within the Queenstown Lakes District (QLD).

1.3 I hold the degrees of Bachelor of Mineral Technology (Mining) (with Honours) and a Master of Mineral Technology, both from the Otago School of Mines at the University of Otago, Dunedin.

1.4 I am a professional member of the Canadian Institute of Mining Metallurgy and Petroleum, the Australasian Institute of Mining and Metallurgy, and the Society for Mining, Metallurgy and Exploration (USA).

1.5 I have gained over 30 years of experience as a Mining Engineer, and since 1990 have worked as a mining consultant providing professional services to clients in the mining industry.

1.6 I have worked on mines with a variety of minerals such as coal, graphite, hard rock gold, copper, bentonite, greywacke and volcanic quarry rock.

1.7 In my role as a mining consultant much of my work involves the planning of exploration and mines, and these plans are then used as the basis of assessing environmental effects and for resource consenting purposes.

1.8 I also undertake planning to sequence the mine's development in such a way to avoid and minimise environmental effects, such as those on visual amenity, sound effects, avoiding protected historical sites and significant natural areas. Water management is also addressed within this planning process.

1.9 Part of the work I undertake when scheduling a mine over its life will often involve rehabilitation planning, with a view to establishing final landforms and restoring revegetation as soon as practically possible.

1.10 During the 1990’s I consulted to, and provided mine planning for a number of alluvial gold mines that have subsequently closed. Each of these mines was restored after mining to have quality pasture land for productive farming,

1.11 Within the QLD one example of a fully rehabilitated mine is at Nokomai Station in the Nokomai valley south of Queenstown. It still operates as a high country station with the addition of tourist activities.

2. Scope of Evidence

2.1 This evidence addresses Chapter 21 Rural of the Proposed District Plan ("**PDP**") on behalf of New Zealand Tungsten Mining Limited (NZTM)

2.2 In preparing this evidence I have reviewed the following relevant material;

(i) PDP Rural Chapter 21, and section 42A report Rural Appendix 1 revised chapter

(ii) PDP Rural Chapter 21 section 42A Report

3. Executive Summary

3.1 Since the 1800's mining has contributed significantly to the growth and development of the Queenstown Lakes District. Old mining sites now provide the district with a wealth of heritage.

3.2 Tungsten is a critical element that is in short supply in the western world, and the Glenorchy scheelite deposits have the potential to contain significant amounts of tungsten.

3.3 New Zealand Tungsten Mining Ltd is actively exploring for tungsten with the aim of re-opening the old scheelite mines in the Glenorchy area.

3.4 NZTM consider that the most likely mining method will be to mine and recover tungsten will be small scale underground mining - in a manner similar to that which was done historically.

3.5 The use of modern mining methods, equipment and technology that is safer, cleaner and more efficient than in the past, and when combined with good planning of mining operations it can remove, avoid and minimise environmental effects of mining.

3.6 With modern mine management and rehabilitation methods, restoration of the ecosystem after mining to a state that is as good or better than prior to mining is not only achievable, it is the standard required these days, and is the threshold that needs to be met to obtain approvals.

3.7 Mining provides the building blocks for our modern civilisation, and the proposed mining of tungsten by NZTM will provide not only a valued and needed raw material, but also financial benefits to the local and national economy, additional tourism and visitor experiences within the district, and additional mining heritage sites.

3.8 Mining is a site specific activity that can only occur where the minerals are found and similarly it can only happen when the cycles of economics and demand for the mineral being mined are acceptable.

3.9 To enable future generations to benefit from the mineral resource assets contained within the district, the district plan needs to recognise the importance of mining to the district and accommodate the long term cycles involved for mining projects.

3.10 The district plan needs also to ensure that mining and mining related activities such as exploration are treated in the same manner as other activities, and assessed and treated according to the facts and their actual effects, not according to a lack of understanding or incorrect beliefs.

4. Description of NZTM operations and sites

4.1 Scheelite mining within the QLD at Glenorchy has occurred periodically since the late 1800's. Mining has mainly occurred during the World Wars and the Korean War to provide tungsten that is contained within scheelite. Underground mining ceased in the early 1970's, and the most recent surface mining was in the early 1980's. Exploration and drilling continued in the area until 1988.

4.2 NZTM was formed in 2001 by me and another mining engineer who had worked at the Glenorchy scheelite mines in the 1970's. NZTM's aim was, and still is, to undertake exploration for scheelite and gold, re-open the mines, and operate them in an environmentally and socially responsible manner.

4.3 In New Zealand all gold and most minerals are owned by the Crown. Before anyone can legally undertake sampling or mining of minerals they must obtain a permit to do so from New Zealand Petroleum and Minerals, part of the Ministry of Business Innovation and Employment.

4.4 There are 3 levels of permits;

(a) Prospecting permits – these allow for mapping and sampling for minerals to be undertaken by hand or using hand held equipment.

(b) Exploration permits – these allow such methods as drilling, dredging and excavations to be used to collect samples.

(c) Mining Permits – these allow the permit holder to extract minerals from the ground and sell them at which time a royalty is payable.

4.5 NZTM holds one prospecting permit on the Richardson range to the east of Glenorchy, and two exploration permits granted by New Zealand Petroleum and Minerals in the Glenorchy area.

4.6 Geological mapping and sampling by hand has been undertaken by NZTM on all three permits.

4.7 One exploration permit, the Glenorchy permit, contains the majority of the old Glenorchy scheelite mines, including the State Mine. The other exploration permit is at northern end of Mt Alfred.

4.8 An assessment of environmental effects has been undertaken for both exploration permit sites to assess the effects of drilling. These assessments included an ecological survey and heritage survey. Discovery of an historical reporting at Mt Alfred of a rare lizard resulted in a specialised lizard survey also being completed.

4.9 The effects of drilling and associated activities at both permit sites were assessed to be minor or less than minor, and the only affected parties are the landowners and occupiers.

4.10 As a result resource consent has been obtained for drilling at Mt Alfred and a resource consent application is currently being processed by QLDC for drilling within part of the Glenorchy permit. Assuming this consent is granted it will also provide for servicing of drill sites by helicopter, and the utilisation of campsites for the drilling crews.

4.11 Since granting of the resource consent for drilling at the Mt Alfred exploration permit, the first round of drilling was undertaken with no tangible effects on the environment.

4.12 Future drilling planned at Mt Alfred will require the development of access tracks through the bush. As with farm tracks in the area, these tracks will be aligned through the bush to minimise effects, and guided

by an ecologist to minimise disturbance to any significant vegetation that may be present.

4.13 Future drilling at the Glenorchy permit site will rely on helicopter transportation of the drill rig and equipment, thereby avoiding the need to develop tracks for drill rig access, minimising the footprint and effects.

4.14 Future mining by NZTM is expected to use underground mining methods similar to that undertaken historically but with modern technology that is cleaner, quieter and safer than any used in the past at Glenorchy and the QLD. This small scale underground mining will be limited in size by the size of the scheelite bearing reefs, and will create virtually no effects above ground.

4.15 The physical effects of mining on the environment will therefore be minimal, limited and temporary, with any above ground facilities built and visually screened so that they are visually not intrusive when in use and after mining they will be removed as required.

4.16 During mining, the main activity above ground will occur on roads where mined rock is carried away from the mine. When being used, these roads will be visually screened as much as possible using such methods as earth bunds and planting to make them visually not intrusive. After mining, roads will be rehabilitated, and if necessary, to the point that that no evidence remains.

4.17 Mine entrances will be only small (with a maximum size of 5m X 5m) and they will be sealed at the end of mine life. NZTM would however like to provide at least some limited access to both new and old mine portals so that visitors can experience the old and modern mining heritage. There are many options available for the visual appearance of portals after mining, such as the creation of “Hobbit” style openings into the hill side.

4.18 It is the aim of NZTM to undertake mining operations to a standard that produces no, or at most minimal, negative short term effects and after mining to leave only a positive contribution to the environment and the communities of Glenorchy and the QLD.

4.19 As with any mining company, NZTM expects to make contributions amongst other things to pest control and native plantings in the areas of the mines during mining, with the aim of not only mitigating effects, but to result in an enhanced ecological environment for both flora and fauna.

5. Positive effects of Mining

5.1 The potential benefits to the district that are expected to result from NZTM's plan to mine tungsten range from local to far reaching.

5.2 Tungsten is a strategic element that is in short supply in the western world, used in the aerospace industry, medical equipment and many other industrial types of machinery. It is an element that enables many other things to be made and done.

5.3 The tungsten deposits at Glenorchy in the QLD are potentially some of the best in the world, and as the tungsten is owned by the Crown, mining will provide benefit for whole of New Zealand by way of royalty payments, taxes and export earnings.

5.4 Other countries on the planet such as Austria remember the Second World War and the vulnerability experienced by not having security of supply of such strategic elements, and they now maintain their own mines to ensure their supplies are safe. By operating mines "in their own back yards" they can also ensure and be responsible for the mines being operated to a very high environmental standard.

5.5 By NZTM mining "in our own back yard", New Zealand will have their own security of supply and also the responsibility to ensure that mines are operated to a high standard.

5.6 Mining is a very valuable industry and a high value use for land. Given the temporary nature of mining, and the fact that in the QLD mining will likely be limited to small scale underground mining limited by the geology, it does provides the opportunity for significant financial returns to the local community and the district while mining occurs, after which the land will still be available for other uses. Nothing is lost.

5.7 With environmentally sound mining operations and because of the relatively small footprint of mines compared to the large area of rural land in the QLD, there should be no loss caused by mining. In fact a large amount of the district's heritage sites, and a reasonable amount of tourist attractions, are historic mining sites. New mining will create new heritage sites and new tourist attractions.

5.8 In broad terms, projections for development of NZTM exploration permits into operating mines could provide employment for between 10 and 100 people depending on the number of mines and their production rates

and would inject between 1 and 10 million dollars per year in wages and contractor payments directly into the local economy each year.

5.9 Beyond financial contributions and the mitigation of any effects of mining, mining companies know that they depend on their local communities, and therefore expect to contribute both to their local communities and to the improvement of their environment. This can occur in a number of ways from such things as supporting programmes to improving in-stream habitat values, the planting of native trees and plants and the undertaking or underwriting of pest control programs to help increase biodiversity.

6. Mitigation of adverse effects of Mining

6.1 Modern mining methods and technologies allow focussed and highly planned mining operation. This helps avoid problems and reduces mistakes that can cause adverse effects from mining.

6.2 Machinery is safer and cleaner and more efficient, and good planning of mining operations removes and avoids environmental effects.

6.3 On the ground surface, modern mines rehabilitate and restore the ecosystem after mining to a state that is as good or better than prior to mining. That is the standard required these days, and is the threshold that needs to be met to obtain approvals.

6.4 Visible signs of mining associated with underground mining can be remedied so that no signs of mining remain, if that is required – although mining usually provides a popular tourist destination and visitor attraction. NZTM would like to leave an example of a safe and accessible underground mine for visitor appreciation as this could provide an additional long term benefit (however if required to completely close all operations on closure that can be done as well).

6.5 The effects of surface mining operations on landscape amenity values are able to be mitigated through the design and generation of appropriate land forms and planting to ensure that they merge with the surrounding landscape in a natural manner.

6.6 Effects of mining will be greatest while mining is occurring, but as the resource being mined is finite, so the duration of mining is limited.

6.7 When compared to housing and commercial property developments, these are designed to last as long as possible and to be visibly seen. Mine operators on the other hand usually want their mines to be discrete and hidden away as much as possible. The scale of mining in the district is likely to be smaller than many of the property developments in the area or large scale tourist operations such as gondolas and ski fields.

6.8 There has been a lot of mining in the QLD historically, and now there are very few signs remaining of the historic disposal of waste into rivers, and the bulldozing and sluicing of hillsides that was once undertaken. This does demonstrate that the effects of mining, even when no attention was paid to caring for the environment, are only temporary and can be removed.

7. Our Civilisation Exists Because of Mining

7.1 To understand the importance of mining we need to realise that our civilisation exists because of mining. All materials that are used by human beings are derived from mining and without mining we would not have the civilisation we live in.

7.2 Some people know that their cars, glass windows, cutlery, washing machines, light bulbs, computers, mobile phones and electronics equipment are produced from mined materials.

7.3 Most people do not realise that the wood used to build houses is only available because it is cut down and prepared by machinery made from mined materials or that concrete is produced from limestone and other rock that is mined and processed.

7.4 The clothing we wear is produced on machines that are made with mined materials, just as is the machinery used to plant and harvest food.

7.5 All machinery, cars, trucks, houses and electronic devices are powered by energy. In New Zealand this energy is produced by coal, natural gas, or from renewable sources such as the hydro power stations, solar panels or wind turbines.

7.6 In all cases, including energy from renewable resources, the energy is produced using machinery and technology that is constructed from mined materials.

7.7 Mining literally provides the foundations upon which our civilisation is built, and also the building blocks.

7.8 Future mining is needed to provide materials for new technologies needed to provide environmentally friendly options for living and energy.

8. Mining Cycles

8.1 Farming operates in cycles that revolve around plants and animals growing and maturing before harvesting them. As with tourism, farming has annual cycles affected by seasons, and longer cycles that are dependent on fluctuating economics.

8.2 Similarly mining occurs in cycles in response to the changing demands for raw materials. These cycles are measured in years - sometimes 5 years, sometimes 50 years. This is important to realise so that the ability to undertake mining in the future is not blocked by shorter term views and plans.

8.3 Since the Queenstown Lakes District birth in the 1800's, mining has cycled around a number of times and contributed significantly to the growth and development of the district.

8.4 These cycles of mining have appeared as the periodic resurgence of gold mining, and at other times with the recurring mining of scheelite to provide the strategic element tungsten during times of war.

8.5 The number of activities undertaken as part of the mining cycle are considerable, and most of these occur outside times that mining is actually being undertaken, and all require significant investment of money.

8.6 Prospecting initially identifies the location of a potential mineral deposit, and then exploration is undertaken using drilling and sampling to identify and evaluate the geology.

8.7 Next an assessment of all technical, social, economic and environmental aspects of the project is undertaken to determine the feasibility of mining and any effects on the environment. This includes planning for the end use of land after mining. Only after these assessments are completed can resource consents be obtained to allow actual mining to begin.

8.8 It is not unusual for 20 years or more to elapse while these mining related activities are undertaken as part of the mining cycle prior to opening a mine to begin physical mining.

8.9 As evidence of the long life cycle of mining there are currently a number of closed old tungsten mines re-opening world-wide due to the increasing demand for tungsten. An example is the Hemerdon tungsten mine that has just reopened to become Britain's first metal mine in over 40 years providing, employment for about 200 people.

8.10 Just like the Glenorchy Scheelite mines, the Hemerdon mine was discovered in the later part of the 1800's and mining of tungsten occurred periodically during the World Wars and the Korean War. After this the mine went into hibernation and from 1960 to 2006 exploration drilling was undertaken. Between 2007 and 2011 feasibility studies were undertaken and the mine re-opened in 2014 with tungsten production in 2015 – 58 years after the mine went into hibernation.

8.11 Planning permissions for the mine were granted in 1987 for 34 years, accommodating the time required to undertake exploration and feasibility studies, and the cycle of demand to reach levels sufficient for mining.

8.12 Because of the length of the mining cycle, investors need confidence that their investment will be able to be realised many years in the future and that the sovereign risk is acceptable.

8.13 For this reason, and to ensure that future generations are able to benefit from mining, the district plan does need to recognise both the importance of mining to the district, and also accommodate the long term cycles involved for mining projects to come into being.

8.14 Mining is in ways like plants that flower every 20 years, or trees planted for timber – if we want to see it flower or have the tree available for harvest we must plan ahead and make sure both that there is somewhere for the plant to grow, and also that it is not pulled out before it flowers or reaches maturity. For future generations to benefit from mining we must make sure that it is accommodated in our future plans.

9. Conclusion

9.1 Since the 1800's mining has contributed significantly to the growth and development of the Queenstown Lakes District. Old mining sites now provide the district with a wealth of heritage and the Glenorchy scheelite deposits have the potential to contain significant amounts of tungsten.

9.2 Modern mining methods, equipment and technology are safer, cleaner and more efficient than in the past and when combined with good planning of mining operations can remove, avoid and minimise environmental effects of mining.

9.3 Modern mine management and rehabilitation methods allow restoration of the ecosystem to a state that is as good or better than prior to mining. This is the standard required these days, and is the threshold that needs to be met to obtain approvals.

9.4 Mining provides the building blocks for our modern civilisation, and the proposed mining of tungsten will provide not only a valued and needed raw material, but also financial benefits to the local and national economy, additional tourism and visitor experiences within the district, and additional mining heritage sites.

9.5 To enable future generations to benefit from the mineral resource assets contained within the district, the district plan needs to recognise the importance of mining to the district and accommodate the long term cycles involved for mining projects.

9.6 The district plan also needs to ensure that mining and mining related activities are treated in the same manner as other activities, and that they are assessed and treated according to the facts and their actual effects, not according to a lack of understanding or incorrect beliefs.

21 April 2016

Gary Gray

Appendix 2 – Chapter 6 Landscapes Extract

The District's landscapes are of significant value to the people who live in, work in or visit the District. The District relies in a large part for its social and economic wellbeing on the quality of the landscape, open spaces and environmental image.

The landscapes consist of a variety of landforms created by uplift and glaciations, which include mountains, ice-sculpted rock, scree slopes, moraine, fans, a variety of confined and braided river systems, valley floors and lake basins. These distinct landforms remain easily legible and strong features of the present landscape.

Indigenous vegetation also contributes to the quality of the District's landscapes. Whilst much of the original vegetation has been modified, the colour and texture of indigenous vegetation within these landforms contribute to the distinctive identity of the District's landscapes.

The open character of productive farmland is a key element of the landscape character which can be vulnerable to degradation from subdivision, development and non-farming activities. The prevalence of large farms and landholdings contributes to the open space and rural working character of the landscape. The predominance of open space over housing and related domestic elements is a strong determinant of the character of the District's rural landscapes.

Some rural areas, particularly those closer to Queenstown and Wanaka town centres and within parts of the Wakatipu Basin, have an established pattern of housing on smaller landholdings. The landscape character of these areas has been modified by vehicle accesses, earthworks and vegetation planting for amenity, screening and shelter, which have reduced the open character exhibited by larger scale farming activities.

While acknowledging these rural areas have established housing rural living and development, and there is limited capacity for sensitive and sympathetic housing and development in appropriate locations. A substantial amount of subdivision and development has been approved in these areas and the landscape values of these areas are vulnerable to degradation from further subdivision and development. It is realised that rural lifestyle living development has a finite capacity if the District's distinctive rural landscape values are to be sustained.

The lakes and rivers both on their own and, when viewed as part of the distinctive landscape, are a significant element of the national and international identity of the District and provide for a wide range of amenity and recreational opportunities. They are nationally and internationally recognised as part of the reason for the District's importance as a visitor destination, as well as one of the reasons for residents to belong to the area. Managing the landscape and recreational values on the surface of lakes and rivers is an important District Plan function.

Landscapes have been categorised into three classifications within the Rural Zone. These are Outstanding Natural Landscapes (ONL) and Outstanding Natural Features (ONF), where their use, development and protection are a matter of national importance under Section 6 of the RMA. The Rural Landscapes C classification (RLC) makes up the remaining Rural Zoned land and has varying types of landscape character and amenity values. Specific policy and assessment matters are provided to manage the potential effects of subdivision and development in these locations

Appendix 3 - LINZ Conservation Resources Report

Toitu te Land whenua Information New Zealand

Crown Pastoral Land Tenure Review

Lease name : *EARNSLAW*

Lease number : PO 047

Conservation Resources Report

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.

May *12*

DOC CONSERVATION RESOURCES REPORT ON TENURE REVIEW OF

EARNSLAW PASTORAL LEASE

PART 1: INTRODUCTION

1.1

The lessees of Earnslaw pastoral lease (PL) have reapplied to the Commissioner of Crown Lands (CCL) for a review of the property's pastoral lease tenure. The property originally entered the tenure review programme in 2002 but was withdrawn by LINZ in 2004.

The PL was originally inspected by DOC specialists for tenure review purposes between 11-15th February 2002. In December 2010, two days were spent on the property to assist with the updating of the conservation resources report. Information attained during the recent inspection has been incorporated into this revised report. Significance of the values has been assessed against revised DOC guidelines.

Earnslaw Station is leased by Geoffrey Lewis Thomson. The 5253 hectare property is located at the head of Lake Wakatipu, approximately 18 kilometres from Glenorchy. The property lies immediately south of Mt Earnslaw/Pikirakatahi (2830 m.a.s.l). It is bound by the Rees River to the east, and the Dart River to the west.

When the Thomson family first leased Earnslaw Station in 1952, it comprised 14900 ha, and included Mt Earnslaw/Pikirakatahi and some of the Forbes Mountains. A Special Condition was included in the lease whereby the lessee agreed that "... the lessor shall resume any portion or portions of the land included in the lease for the purpose of the creation of a National Park, the Lessee shall not be entitled to any compensation or reduction in rental for any loss of grazing or other inconvenience arising from such resumption, but not including any loss of substantial improvements".

In 1971, 364 ha of beech forest in the Dart valley were resumed and added to Mt Aspiring National Park, followed in 1973 by 9250 ha, which saw Mt. Earnslaw and the southern Forbes Mountains become part of the National Park.

The significance of Ngai Tahu's traditional association to Mt Earnslaw/ Pikirakatahi is specifically acknowledged in the Ngai Tahu Claims Settlement 1998.

Today, the PL is divided into two geographically separated blocks. The first is the Mt Alfred area, which includes approximately 1300 ha, extending from valley floor (380 m) to the summit of Mt Alfred (1375m). It adjoins the Diamond Creek flats and the Dart River. The second area near Mt Earnslaw/Pikirakatahi covers approximately 3900ha. It includes the western side of Rees River, from near Lennox Falls downstream to Lovers Leap and Cockburns Bush, and the Earnslaw Burn catchment (excluding the forested Lower Dart Conservation Area). This area extends from valley floor (380m) to mountaintops, and includes Turret Head (2315m), Black Peak (2240m) and Lennox Pass (1697m). The northern boundary of this part of the PL skirts along the base of the Earnslaw Glacier.

The homestead is situated off the Glenorchy-Paradise Road between the two parcels which make up the PL, on adjoining freehold land.

The PL lies mainly within the Aspiring Ecological Region and Dart Ecological District. The eastern side of the property is in the Lakes Ecological Region and Richardson Ecological District. No Protected Natural Areas Survey Programme (PNAP) of these districts has been carried out.

No parts of the lease are currently subject to formal protection; however, the property is surrounded by land protected for conservation purposes: -

- Mt Aspiring National Park to the north
- Lower Dart Conservation Area (ex State Forest Earnslaw Burn)
- Mt Alfred Conservation Area (ex State Forest at northern and southern end of Mt Alfred)
- Diamond Lake Wildlife Management Reserve
- Diamond Lake Recreation Reserve, eastern side of Mt Alfred above Diamond Lake
- Recreation Reserve (southern end of Mt Alfred, between State Forest and Glenorchy-Routeburn Road)

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

2.1 LANDSCAPE

Methodology

Earnslaw Station is broken into four landscape units (refer Map 4.2.2). These include:

- Mt Alfred (LU1)
- Valley Floor (LU2)
- Earnslaw Burn (LU3)
- Rees Valley (LU4)

For each unit a landscape character description is provided along with a description of the key visual and scenic attributes present. An evaluation summary has been undertaken for each unit using a range of criteria to determine inherent values present. The criteria include:

1. **Intactness**: - refers to the condition of the natural vegetation, patterns and processes and the degree of modification present.

2. **Legibility**: - refers to its expressiveness - how obviously the landscape demonstrates the formative processes leading to it.

3. **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.

4. **Historic Factors**: - refers to historically valued attributes in the context of a high country landscape.

5. **Visibility:** - refers to the visibility from public places such as highways, waterways or local vantage points.

6. **Significance:** - is the significance of the characteristics and features, or combination of characteristics and features within individual units and whether they are locally, regionally or nationally significant.

7. **Vulnerability:** - is a measure of each landscape unit's susceptibility to further ecological deterioration, which would impact on landscape values.

Landscape Unit 1 (LU1) – Mt Alfred

Character Description

Mt Alfred is a steep to very steep ice-scoured isolated mountain block rising abruptly within the fluvio-glacial valley floor of the Rees and Dart Rivers. Its glacial origins are highly legible. The rivers of ice although not over topping Mt Alfred but have resulted in extensive scraping and scouring of the sides as the ice parted and moved around its flank.

This ice-sculptured landform has steep rocky slopes and ice-shorn features. Vegetation is a diverse mix of beech forest (much of it conservation land), snow tussock, subalpine scrub, modified fescue /snow tussock grassland, shrubland, bracken and matagouri.

The east side is a patchwork of beech forest, bracken and regenerating shrubland and tussock. Tussock includes both fescue and tall tussock with a significant indigenous inter-tussock component. Exotic grasses and legumes are also part of the mix. Tussock is dominant above the bushline, and appears robust and in good condition.

Farm access tracks cut across the bracken covered open slopes above Diamond Lake and Lake Reid are assuming less dominance as bracken and regenerating shrubland slowly mask their visual impact. A large natural slump occurs above Diamond Lake. A small fan with scattered matagouri, exotic grasses and thistle has formed at the southern end of Diamond Lake.

The Dart side (west) of Mt Alfred retains similar characteristics to the east side. Watercourses cut vertically into ice worn bedrock. A large mid section of the mountain slope is clothed in bracken with regenerating shrubland and grassy areas grading into tussock further up. Similar bracken fern country occurs on the northwest flank but also includes a large chunk of beech forest adjacent to land owned by Paradise Trust Ltd.

Key Visual & Scenic Values

Mt Alfred is a dominant and important landscape feature between the two rivers at the ‘Head of the Lake’. It is separate from the main ranges and visible over a wide area. Most views at the Head of the Lake include Mt Alfred, including views from the Glenorchy Routeburn Road and the Glenorchy Paradise Road. The steep, ice shorn, rocky and distinctive landform and the patchwork of beech, tussock, shrubland, bracken and emerging shrubland is a Glenorchy icon and highly memorable in the context of the Head of the Lake.

Mt Alfred’s eastern face forms the visual backdrop to Diamond Lake, Diamond Creek, and Lake Reid. This is an area widely recognised as having high scenic values.

For some people the access tracks and the periodic burning of bracken and scrub detract from visual values. This aside, Mt Alfred has a high level of landscape

coherence. Natural patterns, though modified are intact. Modified areas can be returned to a more natural state with different management.

Evaluation Summary

Criteria	Value	Comment
Intactness	Medium to High	Varies. Beech and tussock intact. Bracken and shrubland more modified
Legibility	High	Glacial processes highly legible
Aesthetic Factors	High	Highly distinctive and visually impressive glacial landform. Cloak of indigenous vegetation very distinctive. High level of landscape coherence
Historic Factors	-	Culturally important to Maori and European
Visibility	High	Very visible from most areas at the Head of the Lake. Important local landmark.
Significance	High	
Vulnerability	Medium	Landscape values vulnerable to scarring by access tracks and bracken and shrubland burning

Landscape Unit 2 (LU2) – Valley Floor

Character Description

This unit includes the small areas of fluvio-glacial outwash plains and fans within the PL (but excluding Rees Valley flats). The unit includes the narrow strip adjacent to the Dart and Mt Alfred, the small areas adjacent to Diamond Creek and toe slopes below Lovers Leap.

A narrow strip of valley floor, which is part of the Darts meander floodplain, is present from the base of Mt Alfred to the edge of the river bed. Vegetation is primarily pasture grasses in the strip from Humes Road to a prominent point where Mt Alfred intersects with the river (approximately three kilometres).

The Diamond Creek flats include the small parcels of land adjacent to the Diamond Creek wetland system at the base of the east side of Mt Alfred. It is a remnant of a much larger wetland that extended over the valley floor. Diamond Creek meanders along the floodplain below Mt Alfred within a fenced corridor. Vegetation is a mix of exotic grasses and native sedge and rush. Matagouri woodland is also a distinctive feature.

The third area of valley floor is below Lovers Leap. The narrow fan below Lovers Leap consists of pasture grasses and scattered matagouri, but also includes a significant stand of red beech. Stock graze into the bush edge. A small pond occupies low-lying topography within open farmland. Waterfowl are abundant.

Key Visual & Scenic Values

All three areas described form a small segment of the fluvio-outwash plain. The outwash plain inturn is part of a larger montane landscape widely recognised as having outstanding visual and scenic values.

The Dart River strip, while entirely modified in terms of vegetation is part of an important braided river system with high scenic values.

The Diamond Creek flats contain high visual values derived from the natural character of the meander floodplain and wetlands, the quality of the water, and its superb setting at the base of Mt Alfred.

The toe of Lovers Leap is notable for the stand of red beech at the base of the steep and precipitous scarp behind it which forms part of the view of this landscape feature.

Evaluation Summary

Criteria	Value	Comment
Intactness	Medium	Vegetation modified for all three locations
Legibility	High	Natural processes very legible
Aesthetic Factors	High	All locations visually very coherent
Historic Factors	-	Not significant
Visibility	High	Reasonably visible from public places
Significance	High	Diamond Creek is a very important local waterway with high water quality Dart River strip is part of a nationally significant braided river Red Beech are a significant local stand at the Head of the Lake
Vulnerability	Medium to High	Diamond Creek wetland vulnerable to landuse changes

Landscape Unit 3 (LU3) – Earnslaw Burn

Character description

This unit includes all of the lease area within the Earnslaw Burn. The Earnslaw Burn is an impressive alpine valley and integral part of the Mt Earnslaw/Pikirakatahi massif. It is a classic U-shaped valley, heavily glaciated and upper regions steep to precipitous. Eroded bedrock, cirque basins, permanent ice and snow, scree and talus slopes, ice-shorn rock, and moraine are all features of the upper basin. The Gilkison Falls are within the PL. Alpine vegetation, snow tussock and subalpine scrub, herbfield and pockets of beech forest are the main vegetation types. A subalpine basin extends from the bushline at about 900 metres to the head of the valley. The Earnslaw Burn meanders across the narrow valley floor with extensive boulder fields, snow tussock, and subalpine scrub. Grazing has introduced an exotic component

particularly on sites favoured by stock. Natural characteristics are dominant and intact.

The open tussock-covered mountain slopes on the true left of the Earnslaw Burn (between Lovers Leap and the Earnslaw Burn bushline) are the most modified area of the unit. The lower parts are predominantly browntop and scrub, grading into scattered snow tussock. A slip area is located between the Lovers Leap scarp and the beech forest.

Key Visual & Scenic Values

This mountainous unit has inherently high visual and scenic values that are synonymous with Mt Earnslaw/Pikirakatahi and the ranges west of the main divide. These values are derived from the following features:

Visually impressive, heavily glaciated alpine landscape including ice scraped rock, talus and scree slopes, cirque basins, waterfalls

A subalpine glaciated basin with intact snow tussock and shrubland

The Earnslaw Burn forms an integral and important part of the landscape of one of Otago's tallest and well known mountains

The unit is part of a mountainous area that represents sheer alpine splendour and grandeur.

Evaluation Summary

Criteria	Value	Comment
Intactness	High	Natural characteristics intact apart from localised areas. In a landscape sense retains appearance of a natural landscape
Legibility	High	Underlying landform processes very legible
Aesthetic Factors	High	Very distinctive and memorable. High degree of landscape coherence
Historic Factors	-	
Visibility	Low	Most of basin out of public view
Significance	High	Significant in the context of Mt Earnslaw/Pikirakatahi and Mt Aspiring National Park
Vulnerability	High	Fragile alpine area

Landscape Unit 4 (LU4) - Rees Valley

Character description

This unit is typical of high rainfall, western mountain/glaciated valleys east of the main divide, with predominantly beech covered valley sides, grassy valley floor and braided river.

The upper mountain area of the unit has similar characteristics to LU3 (Earnslaw Burn) with the same very rugged ice plucked landform and steep to precipitous slopes. However the lower slopes and valley floor have different characteristics and justifies a separate unit. The unit includes the whole of the east faces of the Rees Valley (within Earnslaw Station) from the Lovers Leap ridge to the northern end of the lease and including the valley floor.

The east facing mountain slopes are very steep, heavily glaciated with much bare rock, gnarled landforms, high basins and predominantly snow tussock and sub alpine scrub. Deeply incised slot gorges cut into bedrock and waterfalls are significant features. Beech forest is extensive and dominant on lower colluvial side slopes below approximately 1200 metres but extends higher within dark gorges and watercourses. Some pockets of red beech occur away from the bush edge.

Generally the faces at the southern end of the Rees Valley are more modified by grazing and burning than further up the valley. Lower slopes in between large areas of bush have been converted to bracken and grass for grazing. These areas also include matagouri with shrubland associated with bluffs and more rugged areas.

North of Cockburns Bush is also modified. A stock track through the bush provides access to open tussock, bracken and introduced grasses above the bushline. These pockets of modified areas are relatively small and natural character remains dominant.

The Lovers Leap scarp is sheer and bush clad apart from a small cleared toe slope of bracken fern and grass.

The Rees Valley flats (Top Flats, Middle Flats, and Bottom Flats) are similar to each other in character. The wide braided and active Rees River meanders across the valley floor. The scale of the main valley is large. Terraces, fans, dry watercourses and backswamps are typical characteristics of the flats. The grass covered valley floor consists of introduced grasses and a substantial native component of short tussock and other low native species.

In 2002 the lessees were granted consent by the CCL to cultivate an area of flats at the northern extremity of the PL in the Rees Valley. This area in part adjoins Mt Aspiring National Park. This work has been undertaken. While the flats still retain their open landscape characteristics, their degree of naturalness has been degraded. In addition to the area consented for within the PL, an area comprising Crown land river bed and marginal strip have also been cultivated.

Taken together, the rugged upper slopes, bush covered valley sides, and valley floor reads as a highly natural landscape.

Key Visual and Scenic Values

This unit (as with much of the PL) has inherently high visual values derived from the:

- Steep, rugged heavily glaciated mountain slopes from one end of the unit to the other.
- Pattern of vegetation i.e. grass covered valley floor contrasting with beech forest, shrubland, tussock and sub-alpine scrub.
- Impressive water forms i.e. waterfalls, gorges and the braided Rees River and associated watercourses and wetlands.

- Scale and grandeur of the valley as a whole and impressive views up and down valley.

Evaluation Summary

Criteria	Value	Comment
Intactness	Moderate-High	Mostly high. Localised areas on lower mountain slopes and valley floor modified (in particular the recently cultivated upper Rees Flats). Natural patterns and processes largely intact.
Legibility	High	Formative processes highly legible
Aesthetic Factors	Moderate - High	Visually coherent. Few disruptive features. Visually impressive
Historic Factors		Not significant
Visibility	Low to medium	Viewed from Rees and Dart Walking track
Significance	High	Important backcountry valley on the edge of Mt Aspiring National Park
Vulnerability	High	Vulnerable to farm development e.g. cultivation, fencing, structures drainage on valley floor. Burning on valley sides

2.1.2 Significance of Landscape Values

Earnslaw Station has inherently high landscape values (see Map 4.2.2). The PL is on the edge of Mt Aspiring National Park within an area recognized as having outstanding landscape values. Much of it is mountainous with spectacular glacial features and largely intact and highly natural vegetation patterns.

Mt Alfred is a major local landmark and, an outstanding example of an ice scoured isolated mountain block within a fluvio-glacial valley floor. It retains highly natural and distinctive vegetation patterns of beech, tussock, and shrublands. It also is an important landscape feature forming the backdrop for many dramatic views at the Head of the Lake, including the Diamond Lake/Paradise area and the lower Dart River.

The Earnslaw Burn is a spectacular alpine valley and part of the Mt Earnslaw/Pikirakatahi massif. The upper Earnslaw Burn represents an area of alpine splendour and very high landscape values. The lower slopes from the bush line to the east ridge are more modified but still appear as a tussock grassland and integral to Mt Earnslaw/Pikirakatahi as an entity.

The small parcels of land adjacent to Diamond Creek provide a protective buffer and context for this important waterway.

The red beech below Lovers Leap is a significant stand in a landscape sense, and contributes to the special natural quality and integrity of this high country landscape. Its long-term viability is being threatened by grazing.

The Dart River strip is significant as part of the Dart River floodplain.

The Rees Valley Unit as a whole contains very high landscape values derived from the steep, rugged and glaciated mountain slopes and fluvial/glacial floor, the contrast and diversity of vegetation patterns, (beech, shrubland, tussock and sub alpine scrub and valley floor plant associations). It appears as a predominantly natural and indigenous landscape with similar and complementary values to the adjoining Mount Aspiring National Park.

2.2 LANDFORMS, GEOLOGY & SOILS

Landforms and Geology

The underlying geology of the PL is predominantly schist and schist/greywacke intergrades. The geomorphology of the lower slopes is heavily influenced by past glacial activity, characterized by glacial till and schist gravels of fluvio-glacial origin. The river flats comprise greywacke/schist gravels and loess.

The lower Dart and Rees Valleys as they emerge from the mountains were filled by vast quantities of glacial moraine created by the coalescing of several valley glaciers. Reworking of glacial moraine gravels by the rivers has formed an extensive area of flat land from below Sandy Bluff on the Dart and below the Twenty-Five Mile Creek on the Rees. Small areas of river flats along the lower Rees River, base of Lover's Leap, and base of Mt Alfred are included in the PL.

Landforms on the up valley side of glacial flow tend to be smooth and rounded from abrasion whilst cliff features on the downside of the ice flow such as Lovers Leap, were formed by a plucking action. Mt Alfred located between the Rees and Dart Rivers is an example of a dome-shaped roche moutonnee.

The alpine parts of the property exhibit more recent signs of glaciation. The lower part of Earnslaw Glacier is located within the property in the upper valley of the Earnslaw Burn, while surrounding vertical to overhanging faces are swept by ice and snow avalanches.

Soils

The river flats are characterised by Matukituki sand loams, silt loams and stony loams, of medium natural nutrient status. The montane hillslopes are characterised by Moonlight Steepland sand loams while subalpine hillslopes have McKerrow Steepland sandy loams, both of which are of very low natural nutrient status. Cass soils also occupy hillslopes of low to very low natural fertility. The alpine zone which mostly features bare ground, comprises Alpine Steepland soils.

2.2.1 Significance of Landform, Geology and Soils

The lower Earnslaw glacier lies within the PL, together with a range of other landforms resulting from glaciation. These include alpine cirque basin, U shaped valley, roche moutonnee (Mt Alfred), and braided riverbeds. These landforms are rarely found together within pastoral leases, and are all highly significant.

2.3 LAND ENVIRONMENTS NEW ZEALAND

There are two databases that have been used to assess biodiversity protection (Walker *et al.* 2003).

1. Environmental distinctiveness has been assessed through the Land Environments of New Zealand (LENZ). This is a classification of New Zealand landscapes using a comprehensive set of climate, landform and soil variables chosen for their roles in driving geographic variation in biological patterns (Leathwick *et al.* 2002 & 2003). It is presented at four levels of detail containing 20, 100, 200 or 500 environments nationally. The most detailed is called LENZ Level IV.

2. The area of unprotected indigenous cover in threatened land environments has been identified in the national land cover database (LCDB).

From the above databases, spatial data depicting indigenous cover and legal protection were overlaid on LENZ Level IV environments to identify biodiversity that is most vulnerable (most likely to be lost). This provides a measure for:

a. percentages legally protected and;
b. percentages of remaining indigenous cover

Based on these two criteria, five categories of threatened environments have been used to identify environments containing indigenous biodiversity at most risk of loss. They are classified as follows:

1. **Acutely threatened:** <10% indigenous cover remaining
2. **Chronically threatened:** 10-20% indigenous cover remaining
3. **At risk:** 20-30% indigenous cover remaining
4. **Critically underprotected:** >30% indigenous cover remaining and <10% protected
5 **Underprotected:** >30% indigenous cover remaining and 10-20% protected
6. **No Threat:** >30% indigenous cover remaining and >20% protected

Table 1: Land Environments of New Zealand (LENZ) Units on Earnslaw PL

Threat Category	Level 4 LENZ Unit	% Indigenous vegetation cover remaining	%Protected nationally for conservation purposes	Indigenous Vegetation Cover Change 1997-2002	Approximate Area on Lease (ha)
At Risk	M2.2b	22	13	No change	185
	Q4.3a	23	8	Decrease	12
Critically Underprotected	Q2.1a	38	9	Decrease	9
Underprotected	Q3.3c	90	17	No Change	.2
	Q4.1c	52	20	Decrease	125
	Q1.1c	91	18	No change	640
No Threat Category	M2.3a	62	70	No change	124
	O1.4a	67	54	Decrease	5
	O2.3b	100	98	No change	210
	P5.1d	97	92	Decrease	309
	P5.1e	86	34	No change	43
	P5.2a	73	54	Decrease	4
	Q1.1a	98	25	No change	3
	Q1.1d	85	35	No change	37
	Q1.2a	99	37	No change	1482
	Q4.2a	34	25	Decrease	3
	R1.1a	99	76	No change	52
	R1.1b	100	60	No change	1183
	R1.1e	100	99	Decrease	335
	R1.2b	100	99	Decrease	475
	T1.1a	100	97	No change	17
Total					**5253**

2.3.1 Significance of Land Environments of New Zealand

Attributing significance to LENZ units, while a useful exercise must be treated with caution. Work is currently underway to improve the accuracy of underlying spatial data. For example, soils data is being upgraded, as median patch size for polygons sourced from the Land Resource Inventory is currently between 10,000 and 100,000 hectares, while at Level IV resolution, LENZ units cover areas as small as 10 hectares. Also underway, albeit as lesser priority, is ongoing work relating to continuous improvements of the underlying classification process which generates LENZ units.

Earnslaw PL has a tiny area comprising less than one percent of the PL area made up of land environments that are significant because the indigenous vegetation cover has

largely been removed and/or little of the environment is represented in lands protected for conservation purposes. These areas as follows:

- ~4% of the PL has Level IV LENZ Units that have 20-30% of their land area under indigenous cover. These comprise the two 'At Risk' units Q4.3a and M2.2b which comprise river flats in the Dart and Rees Valleys and flat land adjacent to Diamond Creek.
- ~ 2% of the PL comprises the 'Critically Under Protected' Level IV LENZ Unit Q2.1 which retains 30% or more of the land area in indigenous cover but of which and less than 10% is protected. This unit makes up small toe slope areas under Mt Alfred and Lovers Leap.
- ~ 15% of the PL comprises the 'Under Protected" Level IV Units Q3.3c, Q4.1c, Q1.1c and Q3.3c of which less than 20% of the land area is protected but more than 30% indigenous vegetation cover remains. These units are largely clothed in red beech forest and are located on the lower flanks of mountain slopes on Mt Alfred and the lower Rees Valley.

Where these units retain their indigenous vegetation cover, this adds to the area's significance.

A map depicting LENZ Units for the PL is attached as Map 4.2.3.

2.4 CLIMATE

Climate is typical of the West Otago/Lakes region with warm but variable summers and cold winters. Frosts can occur throughout the year. Winters bring intermittent snow to lower parts of the property, whilst within the alpine zone it is present for much of the year. Rainfall at the homestead is about 1420 mm, and increases to 2000 mm^{+} in the alpine zone. The PL experiences frequent high winds, especially at higher altitudes.

2.5 VEGETATION

Three land units are identified for the purpose of describing the vegetation. These are:

- Mt Alfred
- Earnslaw Burn
- True right Rees Valley

Mt Alfred

Eastern faces

This glacial sheared mountain is a mosaic of beech forest and non-forest communities with the larger beech forest remnants already protected as conservation area. It spans from 340 m at its southern tip on the river flats between the Dart and Rees valleys, to 1375 m on the Mt Alfred summit. Eastern faces above Diamond Lake and Lake Reid

to about 800 m have a mostly dense cover of bracken (*Pteridium esculentum*) with abundant and conspicuous cabbage trees (*Cordyline australis*). Other occasional native tree and shrub species include broadleaf (*Griselinia littoralis*), marbleleaf (*Carpodetus serratus*), mountain wineberry (*Aristotelia fruticosa*), mingimingi (*Coprosma propinqua*), *C. rugosa*, tutu (*Coriaria sarmentosa*), koromiko (*Hebe salicifolia*), fuchsia (*Fuchsia excorticata*) and kohuhu (*Pittosporum tenuifolium*). Manuka (*Leptospermum scoparium*) forms a dense shrubland in the southern half of the face. A small number of weeds are present including blackberry (*Rubus fruticosus*) and Chilean flame creeper (*Tropaeolum speciosum*). These slopes would previously have supported beech forest, of which tongues and other remnants still exist.

Small rock outcrops have a distinctive community dominated by *Olearia avicenniifolia, Gaultheria antipoda, G. crassa, Coprosma tayloriae* and tutu with an understorey including blue tussock (*Poa colensoi*), prickly shield fern (*Polystichum vestitum*), *Asplenium appendiculatum* subsp. *appendiculatum* and *Parahebe catarractae*.

Between about 800 - 900 m in the north is a predominantly native community dominated by blue tussock, patotara (*Leucopogon fraseri*), *Helichrysum filicaule*, and alpine hard fern (*Blechnum penna-marina*) and, less commonly, *Celmisia gracilenta, Leptinella squalida, Raoulia subsericea, Pimelea oreophila*, manuka and harebell (*Wahlenbergia albomarginata*). In the south, similar species also occur but significant swards of browntop (*Agrostis capillaris*) are also present along with wet seepages that support *Hebe pauciramosa* and bog-rush (*Schoenus pauciflorus).*

Narrow-leaved snow tussock (*Chionochloa rigida*) becomes dominant above about 900 m with shrubs of *Ozothamnus vauvilliersi*, manuka, and snowberry (*Gaultheria depressa*). A line of bluffs at about 900 m at the northern end (beech forest fire margin) support *Olearia arborescens, Gingidia montana, Epilobium pubens, Aciphylla* "lomond" and blue tussock.

Mountain beech (*Nothofagus solandri* var. *cliffortioides*) forest at this altitude has a very sparse understorey with evidence of stock and deer browsing. Occasional understorey species include Hall's totara (*Podocarpus cunninghamii*), celery pine (*Phyllocladus alpinus*) and *Coprosma pseudocuneata*. The upper extent of the natural tree-line is about 1150 m.

Snow tussock grasslands above the natural tree-line are mostly tall and dense with isolated patches of browntop. Hawkweeds (*Hieracium* spp) are conspicuously absent. Ridge crests and other areas without tussock have a dense cover of herbs and sub-shrubs including *Celmisia sessiliflora, C. densiflora, Phyllachne colensoi, Anisotome aromatica*, snowberry, *Euphrasia zelandica, Leucogenes grandiceps, Brachyglottis bellidioides, Kelleria dieffenbachii* and *Dracophyllum muscoides*. Many of these species are also present in the inter-tussock flora.

Reid Lake Wetlands

A narrow strip of land between Diamond Creek and the toeslopes of the Mt Alfred massif, lying immediately northwest of Lake Reid, is comprised of swamp vegetation. Common indigenous species include *Carex secta, C. sinclairii*, and *Juncus* spp.

Small wet hollows have sharp spike-sedge (*Eleocharis acuta*) and red pondweed (*Potamogeton cheesemanii*).

Watercourses have abundant *Myriophyllum triphyllum*. At least 50 plants of the 'At Risk' grass *Deschampsia cespitosa* are present near Lake Reid. Introduced plants are also common and include a few small willows (*Salix* sp.), briar (*Rosa rubiginosa*), bittersweet (*Solanum dulcamara*), musk (*Mimulus moschatus*), water forget-me-not (*Myosotis laxa* subsp. *caespitosa)* and timothy (*Phleum pratense*).

The western side of the swamp grades into *Coprosma propinqua* shrubland then into the mountain beech forest margin which also includes kowhai (*Sophora microphylla*) and *Corokia cotoneaster*.

Western faces

The vegetation of the western faces is very similar to that described for the east. They are dominated by bracken with an even greater component of cabbage trees. Pockets of mountain beech are present as well as larger forest areas contiguous with existing public conservation lands. Where the hill slopes rise abruptly from the Dart River terraces, the forest margin contains several species uncommon or not observed on the eastern side. These are lowland totara (*Podocapus totara*), kowhai, *Raukaua anomalus* and pepperwood (*Pseudowintera colorata*).

Dart River Terraces

A narrow strip of flat land between the hillslopes of Mt Alfred and the gravel bed of the Dart River is mostly pasture which grades into silver tussock (*Poa cita*) and *Carex buchananii* near the braided river bed. Unconsolidated gravels in the riverbed have the typical colonisers of this ecosystem including species in the genera *Raoulia* and *Epilobium*.

Earnslaw Burn

This mountainous valley head rises to 2350 m at Turret Head within the pastoral lease, and 2830 m at the summit of Mt Earnslaw/Pikirakatahi outside the lease. It supports mostly alpine plant communities on very steep terrain above the natural tree-line.

On the highest and most exposed rocky ridges are fellfields comprised of prostrate herbs and sub-shrubs dominated by *Chionohebe thomsonii* and *Haastia sinclairii*. Other common species include *Hectorella caespitosa, Colobanthus buchananii, Pachycladon novae-zelandiae, Leptinella pectinata* subsp. *wilcoxii, Myosotis elderi, Anisotome capillifolia,* and *Agrostis muelleriana.*

Loose debris slopes with small rock ledges below the ridge are very sparsely vegetated with *Ranunculus buchananii, Anisotome pilifera, Poa novae-zelandiae, Luzula rufa,* and *Epilobium pycnostachyum*. Slightly less exposed areas with greater soil accumulation have additional species including mid-ribbed snow tussock (*Chionochloa pallens*), false Spaniard (*Celmisia lyallii*), *C. hectorii, C. angustifolia, Raoulia grandiflora, Marsippospermum gracile, Dracophyllum muscoides, Hebe petriei,* snowberry and *Gentiana* sp.

By 1500 m the slopes are well covered in midribbed snow tussock along with abundant *Celmisia hectorii* and *Marsippospermum gracile*. Other common species include *Celmisia sessiliflora, C. angustifolium, Aciphylla crenulata,* false Spaniard, *Ourisia caespitosa* and *Myosotis pulvinaris*. Large bluff systems 1100 – 1300 m have dense sub-alpine shrubland dominated by turpentine shrub *(Dracophyllum rosmarinifolium*) and *Olearia moschata*. Further south along the range on the true left of the valley, mid-ribbed snow tussock merges into slim snow tussock (*Chionochloa macra*) and then into narrow-leaved snow tussock, along a declining rainfall gradient. Active shingle slides along this portion of the range are sparsely vegetated with *Craspedia uniflora, Stellaria gracilenta, Anaphalioides bellidioides, Gingidia dicipiens, Wahlenbergia albomarginata, Parahebe decora, Acaena saccaticupula, Anisotome pilifera, Raoulia* spp and blue tussock.

The lower slopes and valley bottom are comprised of coalesced colluvial fans with many exposed boulders. The eastern side of the valley has good mixed shrublands dominated by *Hebe subalpina*. Other shrub species include *Olearia moschata, Brachyglottis cassinioides, Podocarpus nivalis* and *Coprosma dumosa*. Prickly shield fern and *Aciphylla* "lomond" are common associates. On the western side of the valley dense shrublands are dominated by turpentine shrub with *Hebe subalpina* restricted to near watercourses. Grasslands on these slopes are a mix comprising mid-ribbed snow tussock, blue tussock and hard tussock (*Festuca novae-zelandiae*) with considerable sweet vernal (*Anthoxanthum odoratum*) and Scotch thistle (*Cirsium vulgare*). Short tussocklands with a significant component of exotic grasses appear to be largely confined to where beech forest has been burnt in early pastoral times. These areas are being gradually re colonised by native shrub species, with a slow ingress of mountain beech along forest margins and around solitary mature trees.

Lower in the valley, alongside the main watercourse, are shrublands with a different mix to those above. Common species include *Olearia bullata, O. nummulariifolia, Ozothamnus vauvilliersii,* mountain wineberry, *Coprosma serrulata, C. fowerakeri,* and inaka (*Dracophyllum longifolium*). Occasional species include celery pine and mountain ribbonwood (*Hoheria lyallii*). These contrast with shrublands of spherical *Hebe cockayneana* and *Hebe anomala,* and tall armoured heads of *Aciphylla* that grow amongst short tussock on some well drained river terraces.

On other valley terraces with impeded drainage, small *Sphagnum* moss dominated bogs are present. Other common species include sundews (*Drosera* spp.), comb sedge (*Oreobolus pectinatus*), *Hebe pauciramosa,* bog-rush, eyebrights (*Euphrasia* spp.), *Forstera tenella* and *Celmisia glandulosa*.

A line of mostly dry, bare schist bluffs near the tree line (true left) have *Myosotis macrantha* and *Anaphalioides bellidioides*. Wet cracks support the distinctive creeping herb *Celmisia bellidioides*. The base of cliffs has thousand-leaved fern (*Hypolepis millefolium*), *Myosotis forsteri*, Californian thistle (*Cirsium arvense*) and various rank introduced grasses.

The tree-line (boundary of pastoral lease) on the true left shows signs of retreat with evidence of fire in the form of standing dead/burnt beech trees. Previous beech areas have been invaded by sub-alpine shrublands, particularly *Brachyglottis cassinioides* near the valley floor and turpentine shrub higher up the valley slopes.

An area of cleared beech forest west of Lovers Leap is now dominated by exotic pasture.

True Right Rees Valley

This unit comprises the eastern faces of the long ridge that runs south from the East Peak of Mt Earnslaw/Pikirakatahi, from the ridge crest to the margins of the Rees River.

Alpine and subalpine vegetation communities are similar to those described for the Earnslaw Burn. The upper tree line is depressed in places presumably as a result of both human induced fires and natural disturbance. The resulting non-forest vegetation reflects the downward migration of snow tussock communities and shrubland communities. An area of disturbance on steep hillslope at low altitude has a diverse shrubland amongst bracken of *Coprosma rugosa*, koromiko, *Olearia arborescens*, manuka, mingimingi and mountain wineberry with emerging tree species of mountain beech, broadleaf and kohuhu. Also at low altitude, an alluvial fan opposite Muddy Creek supports matagouri (*Discaria toumatou*) shrubland.

Forest extends in a more-or-less continuous belt down valley from the most northern limits of the lease. Mountain beech forms the upper half of the forest zone, a narrow fringe near the valley bottom, and on the sides of gullies. Warmer and more fertile lower slopes support mostly red beech (*Nothofagus fusca*) with some silver beech (*N. menziesii*). A sparse understorey includes juveniles of the canopy species, *Coprosma linariifolia, C. rhamnoides, C. pseudocuneata,* with mountain ribbonwood and fuchsia along creeks. Ground cover species include green bird orchid (*Simpliglottis cornuta*), *Lagenifera petiolata*, hook grass (*Uncinia uncinata*), *Viola cunninghamii, Nertera villosa, Polystichum neozelandicum* subsp. *zerophyllum, Blechnum novae-zelandiae, B. fluviatile* and thousand-leaved fern.

River terraces above Lennox Creek

Two distinct terraces exist; one large and close to the river and a second 20 m higher near the hillslope. The lower terrace is dominated by blue tussock with a range of other native grasses including hard tussock (*Festuca novae-zelandiae*), silver tussock, *Elymus* spp, *Deyeuxia* spp, and *Rytidosperma* spp. A surprising indigenous herb and sub-shrub component also remains. Common species include *Pimelea prostrata, Carmichaelia petriei*, patotara, *Muehlenbeckia axillaris, Anisotome aromatica*, and *Wahlenbergia albomarginata*. A narrow deep channel running along the western edge has high herbaceous diversity including *Plantago triandra, Hydrocotyle novae-zelandiae, Potentilla anserinoides* and *Myosotis* sp.

The southern end of the higher terrace has a blocky colluvium overlay with areas of impeded drainage. These ephemeral tarns (almost dry at time of both inspections) have a silty bottom with red pondweed, and a fringe of *Carex secta* and the rare grass *Deschampsia cespitosa*. Further north along the terrace, amongst swards of introduced grasses, are small sphagnum moss dominated bogs, some with *Carex secta*, and *Celmisia glandulosa* with introduced *Juncus effusus* and *J. articulatus*.

River terraces and lower slopes below Lennox Creek
These areas are dominated by exotic grassland, especially chewings fescue (*Festuca rubra* subsp. *commutata*) interspersed with numerous bogs and wet channels. Some channels are man-made. As with the terraces above, high indigenous species diversity remains amongst the grassland. Common species include *Acaena saccaticupula, A. caesiiglauca, Helichrysum filicaule, Coprosma perpusilla, Pimelea prostrata*, leek orchid (*Prasophyllum colensoi*), small onion orchid (*Microtis oligantha*), *Geranium brevicaule*, native dock (*Rumex flexuosus*), *Lycopodium fastigiatum, Ranunculus multiscapus* and *Gonocarpus micranthus*.

Typical bogs are dominated by *Sphagnum* spp., sundews, *Viola cunninghamii, Carpha alpina, Gentianella grisebachii*, comb sedge, *Coprosma perpusilla, Celmisia glandulosa, Argyrotegium mackayi*, and *Carex flaviformis*. Some bogs have *Carex coriacea* and occasional red tussock (*Chionochloa rubra*). Lotus (*Lotus pedunculatus*) and musk dominate artificial drains which cut through this community.

A small tarn about 2 km south of Lennox Falls has a fringe of *Carex secta* and the rare *Deschampsia cespitosa* (150 – 200 plants), with red pond weed and sharp spike-sedge in the standing water. Surrounding damp grassland has *Epilobium pallidiflorum*, alpine hard fern and *Juncus* spp. Another larger ephemeral tarn opposite Arthurs Creek also has *Deschampsia cespitosa* (about 25 plants), sharp spike-sedge, *Carex sinclairii*, red pond weed, *Myriophyllum* sp and *Juncus* sp.

Recent terraces, alongside the braided channels of the Rees River, have dry stony pavements dominated by *Raoulia tenuicaulis, R. subsericea, R. hookeri, Muehlenbeckia axillaris*, patotara, *Pimelea prostrata, Gaultheria parvula, Coprosma atropurpurea, Stellaria gracilenta* and *Lobelia angulata*. Silver tussock replaces exotic grasses in the most disturbed areas.

2.5.1 Significance of Vegetation

Map 4.2.3 outlines the significant inherent ecological values on Earnslaw Pastoral Lease.

Mt Alfred

The Mt Alfred massif is a distinctive landform with a mosaic of vegetation communities reflecting its large altitudinal range and history of disturbance (especially fire and grazing). It was clearly once entirely covered in beech forest, up to the natural treeline at approximately 1100 m. Areas below the natural treeline where forest has been removed now exhibit various successional states back towards forest. Most extensive are the conspicuous bracken fern/cabbage tree land with emergent broad-leaved species, and manuka shrubland. These areas have important linkages to existing protected areas (mostly forested) which surround them. These linkages will strengthen as succession to forest advances. In particular the protection of the low alpine zone communities would complement existing protected areas by allowing the down slope component of ecosystem processes to operate in an unconstrained manner.

Wetlands at the eastern base of the massif are remnants of a previous large wetland complex between Diamond Lake and the Rees River. They are the last unprotected areas of a wetland of ecological and representative importance included in the 'Wetlands of Ecological and Representative Importance' (WERI) inventory. They are in excellent ungrazed condition and support a population of the rare grass *Deschampsia cespitosa*, which has a ranking of 'At Risk – Declining' (de Lange *et al*. 2009).

Earnslaw Burn

The Earnslaw Burn has good examples of subalpine and low alpine vegetation communities and associated patterning which reflect the range in altitude, aspect and landform present in this mountainous valley head. In this respect it is representative of the Dart Ecological District.

It is a large unprotected enclave surrounded at its head by the high alpine zone of Mt Aspiring National Park and, in the lower valley by the beech forest communities of the Lower Dart Conservation Area. In an ecosystem strongly driven by down slope processes it plays a major role in the natural functioning and ecological integrity of the entire valley. While the quality of the valley floor vegetation above the tree-line has been compromised by pastoralism, restoration to its former shrubby potential will occur if the area is not burnt or grazed by domestic stock or wild animals.

Peat bog wetlands on the streamside terraces are a rare ecosystem which has undergone significant decline. These bogs support highly specialised plants dependent on that habitat.

The tops and valley headwaters have not been grazed for many years which is reflected in the largely pristine condition of vegetation.

True Right Rees Valley

The work of Walker *et al.* (2002) on post-pastoral succession in valleys of the eastern South Island points to the desirability of protecting and managing a full range of valley environments and of increasing the areal extent of the protected environment across all types. They recommend that conservation strategies be formulated for whole catchments, recognising the need to protect the downslope component of the key driving ecosystem processes. Catchments with the greatest potential for the recovery of a variety of native vegetation types should have precedence, with restoration directed towards recreating the original patterns of inverted tree line and shrubland communities that were determined by cold air drainage, edaphic factors, and flooding regimes.

That part of the Rees valley within Earnslaw Station is a prime candidate for such protection given its location in a mountain environment with highly natural vegetation communities and sequences, and where the catchment slopes are already protected or proposed for protection. Such a context reduces the risk of unpredictable outcomes of protection. Despite the ingress of exotic grasses into the natural short tussock

grasslands of the valley floor, considerable indigenous plant diversity remains including species now uncommon in these ecosystems in Otago.

The narrow strip of grasslands in the valley floor has integral functional links with both the adjoining braided riverbed, for which it acts as a buffer in times of high flow, and with the adjoining beech forest with which it forms an abrupt transition zone. These valley grasslands are the lowest altitude component of a vegetation sequence which extends over 2300 m to the summit of Mt Earnslaw/Pikirakatahi.

Valley floor wetlands, especially ephemeral tarns and peat bogs within the grassland matrix, are a rare ecosystem supporting highly specialised plants dependant on that habitat. The presence of a wetland grass *Deschampsia cespitosa*, a rare species with the status of ''At Risk – Declining' (de Lange *et al.* 2009) is highly significant. The population discovered in the Rees Valley is the largest recorded for Otago.

2.5.2 PROBLEM PLANTS

Few plants with serious potential to disrupt species or ecosystems are present. The PL is particularly notable for the absence of hawkweeds (*Hieracium* spp). By far the most widespread alien species are pasture grasses which have infiltrated most non-forest communities below about 1100 m. On Mt Alfred the occurrence of Chilean flame creeper is of concern. DOC has an active programme for the control of this weed on the northern end of Mount Alfred. This is a serious weed of shrub and forest communities that is difficult to contain once well established. It is a very uncommon weed in the Wakatipu Basin and its control is a priority. A few small willows and other exotic deciduous trees are present in and adjacent to wetlands at the eastern base of Mt Alfred and these should be controlled at this early stage of establishment. Broom is also present along the margins of lower Diamond Creek and should be controlled as a matter of priority.

2.6 FAUNA

2.6.1 Invertebrates

A range of trapping techniques were used including sweep netting and ground searching throughout, the setting of malaise traps and light trapping in the Earnslaw Burn and light trapping in the Upper Rees Valley. A wide range of species were collected.

Mt Alfred and Diamond Creek

Seven species of moths and butterflies were recorded here. The undescribed tussock ringlet butterfly *Argyophenga* sp., the common grass moths *Orocrambus vittellus* and *O. vulgaris*, the geometrid *Asaphodes clarata*, the Southern Blue Butterflies Z*izina oxleyi* and *Z. labradus* were present throughout the grasslands on Mt Alfred at various altitudes. The range of Lepidoptera collected is indicative of good quality habitat.

Five species of beetles were present in the forest edges and upper grasslands on Mt Alfred. These included the predatory tiger beetle *Cicindela parryi*, the predatory ground beetles *Mecodema sculturatum, M. costipenne* and *Agonum otagoensis.* Also present was the herbivorous tenebrionid *Philoneis* sp., which has a restricted distribution.

Also present was the Syrphid hover fly *Melangyna novaezealandiae*. These flies are usually found around flowers. Their larvae vary in habitat, with some living in decaying vegetation, some scavengers and others predatory.

Both the red damselfly (*Xanthocnemes zealandica*) and the blue damselfly (*Austrolestes colensoi*) were recorded from the wetlands adjacent to the true left of Diamond Creek. Larvae of the order Odonata are key predators in wetland systems.

Three species of crickets were recorded form the Mt Alfred, Diamond Creek Area. These are the cicadas *Kikihia angusta, K. rosea* and the shorthorned grasshopper *Phaulacridium marginale*. These species are widespread species in lowland and montane grasslands of good quality in Otago. The native bee *Leioproctus fulvescens* was also present in grasslands.

Earnslaw Burn

The highest part of the PL inspected was around 1700 metres in the vicinity of Lennox Pass. The alpine cockroach *Celatoblatta quinquemaculata* was widely distributed under rocks in this area as well as lower down in the Earnslaw Burn. Also present under rocks in this locality were the peripatus *Peripatoides novaezealandiae.*

Four species of Lepidoptera were recorded in the alpine herbfields around Lennox Pass. These included a local undescribed species of *Percnodaimon* sp., a localised scree species *Scoparia sideraspis,* and the high alpine geometrid *Asaphodes omichlas,* which is localised in western areas. Also present was the short horned grasshopper (*Sigaus obelisci)* which is restricted in its distribution.

In the middle slopes and lower parts of the Earnslaw Burn (900-1300 m) a wide range of insects was collected from a variety of habitats.

The predatory ground beetles *Mecodema costipenne, M. sculpturatum,* and *Megadromus fultoni,* and herbivorous beetles *Odontria striata* and *Philoneis* sp. were present. A number of flies from different families were also recorded including the horse fly *Odontomyia chloris* and parasitic wasp *Ophion perigrinus*.

Nineteen species of moth and butterfly from seven families were collected in this Valley. A number of findings are of note:

- the uncommon plume moth *Stenoptilia lithoxesta* whose larvae are found on hebe buds
- the noctuid *Dasyuris catadees* and geometrid *Notoreas blax* which is a day flying moth, both species found only locally in the Western Mountains

- the grass moth *Orocrambus crenaeus* which has very limited dispersal as the females are flightless.

Also present were a number of more common grassland moth species such as *Argrophenga sp.,Graphania mollis, Persectania aversa,* and *Tmetlolphota propria* which are indicative of intact indigenous grassland. There was also a suite of species such as *Eudonia octophora, Asaphodes clarata, Graphania agorastis, Scoparia crypsinoa* and *Tmetolophota atristriga* which are indicative of intact wetter areas of either sedge or moss areas.

Six species of cricket were recorded from the mid to lower Earnslaw Burn. Grasshoppers were common in the grassland communities sampled. The species are inhabitants of mid altitude grasslands. Some such as *Sigaus australis* and the cicada *Kikihia subalpinai* are widespread in Otago grasslands. Others have more specific habitat requirements. For example *Maoricicada campbelli* inhabits shingle banks on open riverbeds while *Alpinacris tumidicauda* is an alpine species which is found only locally.

Rees Valley

The grasslands of the middle Rees Valley were surveyed. Two species of predatory carabid beetles, *Agonum otagoensis* and *Mecodema sculpturatum* were recorded from along the forest edge.

Stiletto flies (*Anabarhynchus* sp.), hover flies (*Melangyna novaezealandiae*) and the native bee (*Leioproctus fulvescens*) were present throughout the Valley. Hover fly larvae vary in habitat, with some living in decaying vegetation, some scavengers and others predatory.

Six species of moths were present. Some species such as *Eudonia octophora* are indicative of wetter areas. Others such as *Argyrophenga* sp., *Lycaena salustrius* (the common copper butterfly), *Orocrambus vittellus Graphnia rubescens* are widespread species indicative of intact indigenous grasslands.

The presence of wetland areas and edges in the Rees Valley was indicated by the number of damselflies both red (*Xanthocnemes zealandica*) and blue (*Austrolestes colensonis*) and dragon flies *(Procordulia grayi*) that were seen in amongst sedges and carex's.

The widespread shorthorned grasshoppers *Sigaus australis, Phaulacridium marginale* were present throughout the Valley.

2.6.2 Significance of Invertebrates

The short horned grasshopper (*Sigaus obelisci)* is a rare species ranked as "At Risk - Range Restricted" Hitchmough, R. (2007)**.** Previous records for this species are located in the Old Man Range and Mid Dome area of Northern Southland.

The alpine cockroach, *Celatoblatta quinquemaculata* have specialized habitat requirements by virtue of living in the alpine zone.

The weta *Hemiandrus focalis* found on the PL, has very disjunct populations within Otago.

The species collected and seen during this inspection covered a large number of functional groups. Herbivores were represented by grasshoppers, cicadas, beetles, wetas and moths. Predators were well represented by carabid beetles and dragonfly larvae. Carabids are the top predators in the invertebrate food chain. Their presence is a good indicator of an intact ecosystem that can provide sufficient prey and shelter for beetles. As a system degrades, the top predators are often the first to disappear. Pollinators were represented by moths and flies. Parasoitids were represented by wasps. Detritivores were represented by Syrphid flies and Tenebrioid beetles.

2.6.3 Herpetofauna

Previous Surveys

There are no known previous systematic lizard surveys of the PL. Whitaker (1986) reports on a survey for grand and Otago skinks (*Oligosoma grande* and *O. otagense*) in the Wakatipu region. The survey area extended as far west and north as the Ben Lomond Station. Lizards reported found in this survey are McCann's skink *Oligosoma maccanni, O. nigriplantare polychroma,* and geckos *Hoplodactylus maculatus* 'maxi' and 'mini' (probably *H.* 'Otago' and *H.* 'southern mini' (Hitchmough 1997)). Whitaker (1986) also reports past records of large dark skinks at the Nokomai River, green skink (*O. chloronoton*) at Gorge Burn, Eyre Mountains, and possibly on Ben Lomond, and a green gecko (possibly *Naultinus gemmeus*- Jewelled Gecko) at Bobs Cove.

The Amphibian Reptile Distribution Survey (ARDS) database contains records for green gecko near Diamond Lake, Glenorchy (1970), cryptic skink (*Oligosoma inconspicuum*) at Tree Island, Lake Wakatipu (1997) and at Diamond Lake near Glenorchy (2001). Three members of the *Hoplodactylus maculatus* complex are known from the Wakatipu area – Cromwell gecko, Otago gecko and southern mini (Whitaker *et al.* 2002).

There have been no assessments of shrubland or forest lizard faunas anywhere in the Wakatipu area (Whitaker *et al*. 2002). *Hoplodactylus granulatus* complex occur in subalpine habitat in the Wanaka Area, Fiordland and Southland (Whitaker *et al*. 2002) and a gecko most likely to be a member of this group was found on Mt Creighton P.L. in March 2002, only 35 km away from Earnslaw Station.

2002 Survey
A lizard survey was conducted on Earnslaw Station between 11th-15th February 2002. Samples of habitat were surveyed on Mt Alfred, Earnslaw Burn and Rees valley.

Mt Alfred

Eastern Faces
The lower part (altitude 360 – 700m asl) of the northeast-facing slope of Mt Alfred was searched from the access road upwards. Vegetation has been formerly burnt over and is now comprised of bracken with some woody weeds and *Coprosma* spp. Two cryptic skinks (*O. inconspicuum*) were found amongst loose rock near to a track. Five geckos (*Hoplodactylus* sp. 'Otago') were found on bluffs. Further sign (droppings) of this species was found in rock crevices nearby.

At the base of Mt Alfred where dense mixed shrubland occupies the base of the hills, and borders rough pasture and wetland, a single cryptic skink was found under a rock at the track edge.

Western Faces - North of Paradise
Geckos were spotlighted for at the bush edge north of Paradise. No lizards were seen, and few invertebrates observed. A possible reason for not finding lizards is that the invertebrate community upon which they are dependent, has been depleted following mouse and rat plagues induced by the beech mast. In addition the forest lacks understorey due to deer and cattle browsing over a long period.

Earnslaw Burn

The valley floor of the Earnslaw Burn was surveyed between 820 -910m. Rock outcrops were searched but no lizards or sign were found.

A steep east-facing hillslope (820 -1320m asl) with extensive screes was also searched. Vegetation comprised of unmodified tussockland. Lizards and sign found are detailed in the Table 2 below.

Rees Valley

The beech forest bordering exotic pasture river flats was spotlighted after dark for geckos. None were seen.

Additional species of lizards (rare or common) could have been overlooked during the survey as a relatively small area was covered in often marginal or poor weather. The known lizard fauna of Earnslaw Station is not typical of the Central Otago / Otago Lakes area. Absence of commonly seen and often abundant *O. nigriplantare polychroma* and *O. maccanni* may be due to higher rainfall in the area.

2.6.4 Significance of Herpetofauna

A number of notable endemic lizards were observed on the PL whilst others have been recorded from nearby locations.

- Cryptic skink (*Oligosoma inconspicuum*)

The cryptic skinks found in the Earnslaw Burn are considerably larger, more robust and more drably-coloured than those commonly seen (A. Jewell pers. comm.). Cryptic skink are likely to be at, or near the north-western limit of their range on the PL. Habitat destruction and modification through agricultural practices (especially burning of vegetation and grazing) and predation by introduced mammals (cats, mustelids, rodents) are likely to be the major causes of decline of these species. Areas of highly significant habitat for cryptic skinks include all parts of the east/north eastern side of Mt Alfred, between 900 m and 1500 m asl in Earnslaw Burn valley; and between 900m and 1500m asl in the Rees valley.

- Jewelled gecko (*Naultinus gemmeus*)

While not found during the survey of the PL , Jewelled gecko has been found nearby at Paradise (E40 2142700 5599200) during 1970s (ARDS database).

This species is ranked as "At Risk –Declining"Hitchmough, R. (2009). This implies that a species is chronically threatened and facing extinction, but buffered slightly by either a total large population or slow decline. Jewelled gecko are likely to be at, or near the western limit of their range on the PL. Habitat destruction and modification through agricultural practices (especially burning of vegetation and grazing) and predation by introduced mammals (cats, mustelids, rodents) are likely to be the major causes of decline of these species.

Areas of significant habitat for Jewelled geckos include the eastern face of Mt Alfred to 700m asl, and beech forested areas where aspect and vegetation would provide good habitat for this species.

- *Hoplodactylus* geckos (H. "Otago")

The *Hoplodactylus* geckos found on Mt Alfred during this survey are likely to be *H.* 'Otago' and are near the north-western limit of the species known range in Otago (Whitaker *et al.* 2002). There is also the potential for an undescribed gecko species to be present in beech forest near Paradise (M. Tocher, pers. comm.). Specimens at the Museum of New Zealand collected from Paradise or Diamond Lake are reported to be of bold and bright coloration, which is in stark contrast to the very dark and drab individuals seen in this survey on Mt Alfred (A. Jewell pers. comm.) This suggests that in the vicinity of the lowland part of the PL the species is highly variable, or more than one species is present.

- *Hoplodactylus granulatus* complex or H. *nebulosus* geckos

Although poor weather prevented the survey for H*oplodactylus granulatus* complex or H. *nebulosus* geckos at high altitude sites (above 1000m) in the Earnslaw Burn and Rees, these areas are considered highly significant habitat for these species.

Members of the *Hoplodactylus granulatus* complex (e.g. *H.* 'Roys Peak' or a close relative) or *H. nebulosus* Takitimu form are likely to be present on parts of the PL (A.

Jewell pers. comm.) as they occur in subalpine habitat in the Wanaka Area, Fiordland and Southland (Whitaker *et al*. 2002). Earnslaw PL is situated approximately halfway between Roy's Peak (near Wanaka) to the east, and the Esperance Valley (near Milford Sound) to the West, and a similar distance to the north is Cascade Plateau. Each of these localities support a distinct species of gecko belonging to the *H. granulatus* species complex. The Takitimu Mountains are twice this distance to the south-west and *H. nebulosus* Takitimu form occurs here. A gecko found on Mt Creighton PL in March 2002, only 35 km away is likely to be a member of this group (M. Tocher pers. comm.). This does not have a threat classification because it is a data deficient recent discovery.

All of these geckos are known from only one individual up to about a dozen specimens, and all have been found at relatively high altitude sites (montane shrublands to alpine scree). 'Roys Peak Gecko' (*Hoplodactylus* aff. *granulatus* 'Roys Peak') has a threat status of 'Threatened - Nationally Vulnerable' which implies a very small population or a very high predicted decline Hitchmough, R. (2009).

2.6.5 Avifauna

2.6.5.1 Birds

Previous Survey
Survey results for the area can be found in the Atlas of Bird Distribution in New Zealand (Bull *et al.* 1985). The survey indicated that a wide range of species were present on this property. For forest birds the range of species present was almost as complete as for the more contiguous forest areas in the Lower Dart Forests. Of particular note was the presence of kea (At Risk – Naturally Uncommon), rock wren (Threatened - Nationally Vulnerable) Eastern falcon, (Threatened - Nationally Vulnerable), long tailed cuckoo (At Risk – Naturally Uncommon). The criteria are defined in Miskelly *et al.* 2008.

Current Survey
The survey confirmed that key species present during the Atlas project (Bull *et al*. 1985) are still present.

Mt Alfred

Eastern falcon utilize the matrix of forest shrublands and rough pasture for foraging. They can also be expected to have nests in the bluff systems on Mt Alfred. The forest areas on the crest of Mt Alfred all had tomtit, rifleman, brown creeper and bellbird present. In the tussock grassland areas on the crest the New Zealand pipit and harrier were present.

Black-fronted tern and black-billed gull were recorded on the flats adjacent to the Dart River. Black-fronted terns were also observed over the flats adjacent to Diamond Lake. New Zealand scaup were recorded on the Diamond Lake and Creek area and could be expected to use the dense swamp vegetation found on the true left of Diamond Creek for breeding. Black-fronted terns, banded dotterel and black- billed gull all breed on the adjacent river flats and would use areas of the property for foraging.

Earnslaw Burn and Hillslopes in Rees valley (true right)

A wide variety of habitats exist here, ranging from pen alpine through to river flats with multiple terraces. The Earnslaw Burn is headed by a cirque basin with large areas of debris mantled bedrock, interspersed with tussockland, pen alpine shrubland and forest.

Some notable bird species were recorded throughout this part of the PL. Rock wren are present in the blockfields near Lennox Pass and in the main Earnslaw Burn valley, where shelter from the winter climate is also present. At least two groups of kea were observed in the Earnslaw Burn, with young birds present. Eastern falcon were observed in the middle Earnslaw Burn Valley. There was at least one chick among the birds seen.

Rees Valley Flats

The Rees Valley flats and adjacent forest areas support relatively high numbers of South Island robin. Eastern falcon, including young, were also present in the forest edges and adjacent grasslands. They appear to be utilize the forest edge for food. Yellow-crowned parakeet were also observed. The forest areas had good numbers of bellbird, brown creeper tomtit and fantail. Pipit and paradise shelduck were present on the grasslands.

2.6.5.2 Significance of Birds

A number of threatened endemic birds were observed at Earnslaw PL. Threat rankings are derived from Miskelly et al. 2008.

- Black Fronted Tern

This species has a ranking of "Threatened-Nationally Endangered".

- Eastern Falcon and Rock Wren.

These species are ranked as "Threatened Nationally Vulnerable". The presence of breeding groups of falcon in the Earnslaw Burn and the Rees Valley is significant. A sizable population of Rock Wren is present in the Earnslaw Burn. This species is truly restricted to the alpine zone throughout the year.

- The New Zealand Pipit which is present within the proposal is ranked as "At Risk – Declining" due to extensive and continuing loss of habitat.

- Long tailed Cuckoo and Kea.

These species are ranked as "At Risk – Naturally Uncommon". Long tailed cuckoo can be expected to be breeding in the forest areas along the Rees Valley flats.
The presence of at least two groups of kea in the Earnslaw Burn here is significant.

2.6.5.3 Bats

Mt Alfred

Based on road transects long-tailed bats are present throughout Mt Alfred, Diamond Creek and in the vicinity of the Earnslaw Homestead. They have communal roost areas in red beech forest opposite Diamond Lake, Jordan Creek area and the NE corner of Mt Alfred at Paradise. They are present on the PL in moderate numbers in the Lower Diamond Creek area. They are also occasionally present along the forest edge on the western side of Mt Alfred. They can be expected to also be present on forest edges on the eastern side and crest of Mt Alfred.

Earnslaw Block

Long-tailed bats are known to have communal roosts in the forest on the PL opposite the Invincible confluence. Bats can be expected to roost on the PL along the rest of forest edges of Cockburns Bush and the Rees Valley at least as far as the Hunter confluence, and certainly forage these edges.

2.6.5.4 Significance of Bats

Long tailed bats are an endemic species (King 1990). They have been ascribed the highest threat ranking – "Threatened – Nationally Critical" (O'Donnell *et al.* 2009). The population in the Upper Lake Wakatipu is at the eastern edge of the distribution of the species in Otago (O'Donnell 2001).

A particular cause of concern is the loss of large old beech trees which bats use as roost sites. It appears from existing research that the loss of such trees which bats use for a specialized purpose is having a disproportionate effect on this species (O'Donnell 2001).

2.6.5.5 Aquatic Fauna

The National Institute of Water and Atmospheric Research Ltd Freshwater Fish Database has no freshwater fish records for the Rees River, Lennox Creek, Earnslaw Burn or Hunter River.

On 12-13 November 2001, short sections (up to 70m) of stream on the PL were sampled by staff of the Otago Fish and Game Council using a backpack electric fishing machine. Access was by helicopter or 4WD vehicle. Fishing was conducted at the Earnslaw Burn and Lennox Creek.

Water quality at all sites was of high quality, with pool-run-riffle habitats dominating. Bottom fauna was abundant in mayflies which also indicate good water quality.

Earnslaw Burn

No fish were detected in the headwaters of the Earnslaw Burn or its tributary.

Lennox Creek

The top site fished at Lennox Creek has galaxiids and brown trout co-existing. One galaxiid, (Koaro (*Galaxias brevipinnis)*) was caught. This species can be found long distances inland in submontane lakes and alpine streams at high elevation. It favours clear, swiftly flowing, boulder-cobble streams of small to moderate size, and often occurs in tussock streams draining alpine areas. The species is widespread and does show some ability to co-exist with trout, although usually at reduced densities.

No fishing was done above a 20+m waterfall present in Lennox Creek. While it is unlikely that fish occur there, it cannot be ruled out as Koaro are known for their amazing climbing abilities. Brown trout occur occasionally at lower sites on Lennox Creek and are abundant further downstream.

2.6.5.6 Significance of Aquatic Fauna

Galaxias brevipinnis are listed as having a threat status of "At Risk – Declining" (Alibone *et al.* (2010). This galaxiid was previously considered 'not threatened', however long term monitoring has shown the population to be in decline, largely due to widespread predation by introduced trout. Furthermore the New Zealand population has been found to be genetically divergent from that of Australia and is now considered to be an endemic species.

The upper Earnslaw Burn is also of significant value in that it is an area that currently contains no fish and may never have had any. Such areas can be valuable because they can contain aquatic invertebrate communities that have evolved in the absence of fish predation. Unfortunately, detailed sampling of the aquatic invertebrates was not done during the inspection.

2.6.5.7 Problem Animals

The following pest animals are present on the PL. Rabbits are a problem on sandy soils at low altitudes, while hare are present on river flats and in sub-alpine areas. Deer, possums, mice, stoats, ferrets, cat and rats are widespread.

Mt Alfred

Mt Alfred supports moderate to high numbers of red deer. Moderate to high numbers of white tail deer have built up in the ex State Forest areas on Mt Alfred, following the White Tail Deer Hunting Moratorium.

Earnslaw Burn

Chamois, white tail deer and hare are present above bushline, while red deer and goats are common in the forest. In the Lovers Leap area, white tail deer and a few fallow deer are a problem.

2.7 HISTORIC

2.7.1 Maori cultural values

Ngai Tahu have important cultural, spiritual, historic and traditional values relating to Pikirakatahi (Mount Earnslaw) as set out in Schedule 87 of the Ngai Tahu Claims Settlement, 1998, No. 97 (see section 3.6).

Ngai Tahu have visited the property and reported on significant cultural values directly to the Commissioner of Crown Lands.

Under section 206**,** Ngai Tahu Claims Settlement 1998, the Crown acknowledges Te Runanga o Ngai Tahu's statement of Ngai tahu's cultural, spiritual, historic, and traditional association to Pikirakatahi as set out below (more detail is presented under section 3.6)

Ngai Tahu Association with Pikirakatahi
The creation of Pikirakatahi (Mt Earnslaw) relates in time to Te Waka o Airaki and the efforts of Tu Te Rakiwhanoa. It is said that during its formation a wedge of pounamu was inserted into this mountain, which is the highest and most prominent peak in this block of mountains. The mountain is also linked to travels of Rakaihautu, who dug out the great lakes of the interior with his ko (~spade), known as Tu Whakaroria and later renamed Tuhiraki at the conclusion of the expedition.

For Ngai Tahu, traditions such as this represent the links between the cosmological world of gods and present generations, these histories reinforce tribal identity and solidarity, and continuity between generations and document the events which shaped the environment of Te Wai Pounamu and Ngai Tahu as an iwi.

Pikirakatahi stands as guardian over the pounamu resource and marks the end of a trail, with the tohu (marker) to the pounamu resource sitting opposite on Koroka (Cosmos Peak). The tupuna (ancestors) had considerable knowledge of whakapapa, traditional trails, places for gathering kai (food) and other taonga, ways in which to use the resources of the land, the relationship of people with the land and their dependence on it, and tikanga for the proper and sustainable utilisation of resources. All these remain important to Ngai Tahu today.

The origins of the name "pikirakatahi' have been lost, but it is known that many places and physical features have more than one name, reflecting the traditions of the successive iwi who peopled the land. It is however, likely that the name relates to

Rakaihautu or subsequent people, as most of the prominent lakes, rivers, mountains of the interior take their name from the journey of Rakaihautu.

The retrieval of large amounts of pounamu from this source, so far inland and over a range of physical barriers, attests to the importance of this resource to the economy and customs of the iwi over many generations. The people would also gather native birds for kai and firewood with which to cook and provide warmth, from the forests covering the lower flanks of Pikirakatahi. Strategic marriages between hapu strengthened the kupenga (net) of whakapapa and the rights to use the resources of the mountain. It is because of these patterns of activity that Pikirakatahi continues to be important to runanga located in Otago, Murihiku and beyond. These runanga carry responsibilities of kaitiaki in relation to the area, and are represented by the tribal structure, Te Runanga o Ngai Tahu.

The mauri of Pikirakatahi represents the essence that binds the physical and spiritual elements of all things together, generating and upholding all life. All elements of the natural environment possess a life force, and all forms of life are related. Mauri is a critical element of the spiritual relationship of Ngai Tahu Whanui with Pikirakatahi.

Significant cultural values have been identified on Earnslaw PL and are summarized below:

- Mahika kai, Awa, Roto, Repo Rapuo, Wai Maori
- Wahi Pounamu
- Ara Tawhito, Huarahi
- Ikoa Wahi. Wahi Rakau

Mahika Kai

Areas important for Mahika kai, or “customary gathering of food and natural materials and places where those resources are gathered”, are predominantly within freshwater wetland habitats. These include Diamond Lake, Lake Reid, Dart River and Rees River and their associated tributaries.

Wahi Pounamu

Under the Ngai Tahu Pounamu Vesting Act 1997, all pounamu (i.e. bowenite, nephrite, semi-nephrite or serpentine) occurring in its natural condition in the takiwa of Ngai Tahu Whanui is owned by Ngai Tahu. Although the property is not a known source of pounamu, its presence cannot be discounted. Isolated boulders of pounamu have been found in the Wakatipu region with an uncertain origin (Beck, 1970). Also, it is very likely that pounamu from the primary gathering sites have been transported down the Dart River through flooding or past glacial activity.

Ara Tawhito, Huarahi

Ara tawhito, or pounamu trails followed mahika kai resources from settlements on the east coast leading to sources of pounamu on the north-western head of Lake Wakatipu. On Earnslaw PL, the Dart River and Rees River pounamu trails are of significance. The main trail west went from Lake Wakatipu to Lake McKerrow over Harris Saddle. Important mahika kai seasonal settlements in the vicinity of the trail include Paradise, Dart Bridge and Camp Hill. Access to sections of the ancient trails from the head of Lake Wakatipu to the west is fragmented by the Earnslaw PL.

Ikoa Wahi, Wahi Rakau
This is the application of both traditional and modern interpretative Maori place names to landscape features.

2.7.2 Heritage values

No known historic sites post dating early European settlement are known to occur on the PL. This can be attributed to the PL predominantly comprising the less habitable parts of Earnslaw Station. Local Branch Committees of the New Zealand Historic Places Trust have identified the old climbing and mustering huts on this property to be of local interest; however these huts lie outside of the PL.

2.7.3 Significance of Historic Values.

The significance of Ngai tahu's cultural, spiritual, historic, and traditional association to Mt Earnslaw/ Pikirakatahi is specifically acknowledged in the Ngai Tahu Claims Settlement 1998.

No known significant values relating to post European settlement activity are present on the PL.

2.8 PUBLIC RECREATION

2.8.1 Physical Characteristics

In 1992 DOC compiled a Recreation Opportunity Spectrum (Harper, 1992) for the entire Conservancy whereby all areas regardless of land tenure were classified and mapped according to setting, activity and recreational experience characteristics.

Recreation opportunities on Mt Alfred are zoned "Rural Natural Remnant", where there are remnants of natural habitat, including beech forest and subalpine grasslands present. There are also patches of modified vegetation, such as regenerating bracken fernland, shrubland and grazed pasture.

The head of the Earnslaw Burn basin, with its high alpine basins, screes, bluffs and ice faces is zoned "Remote Experience". This recreation opportunity is characterized by a sense of complete isolation from human interaction and activity. The naturalness of the setting is an important part of the experience. Outdoor survival skills and experience are essential.

The Rees Valley faces, and ridges at the southern end of the Earnslaw Burn, comprised of tussock grasslands, beech forest, and screes are zoned "Backcountry Walk-in" which "although relatively close to visitor facility developments, access to these areas is only possible on foot and is often associated with tramping tracks or routes".

The Rees Valley river flats are zoned "Backcountry 4x4 drive-in which is "characterised by a feeling of relative remoteness from populated areas". The highly natural setting is a valued part of the experience and may be associated with motivations of "escape from town", education and nature appreciation.

In 1989, Federated Mountain Clubs compiled an outdoor recreation plan for Otago's Alps (Mason, 1989). The document notes that areas of beech forest and subalpine grassland on Mt Alfred are zoned "Natural (Experience) Environment", while the more modified slopes are zoned "Open Space".

All but the open grazed grasslands in the south of the Earnslaw Block are zoned "Natural (Experience) Environment. Within this zone "natural landscapes should be free of obvious developments or sophisticated facilities. … no vehicle track construction permitted, although air access for recreational purposes should be permitted".

2.8.2 Legal Access

Map 4.2.1 shows where marginal strips and legal roads exist on the PL.

The majority of adjoining land to Earnslaw PL is managed as national park, conservation land or reserves. These public lands allow legal public foot access to much of the PL's boundary.

Mt Alfred/Diamond Lake

Legal access to the western side of Mt Alfred Block is provided by a combination of legal road, Dart River marginal strip and riverbed. Humes Road, which comes off the Glenorchy- Routeburn Road, is formed as far as the Dart Valley Station but continues northwards through the PL as an unformed legal road on the true left of Dart River.

Marginal strips, unformed legal road and wildlife management reserve provide legal access to Diamond Creek, Diamond Lake, and the eastern side of Mt Alfred. An unformed legal road almost links Priory Road to a track at the southern end of Diamond Lake. Public access to Diamond Lake is available on an informal basis along a rough vehicle track located on the southern margin of the lower reaches of the Earnslaw Burn.

Public foot access up Mt Alfred is legal only within the Mt Alfred Reserve and Conservation Area i.e. from the Glenorchy-Routeburn Road to bushline. There is no legal access to the summit of Mt Alfred.

Earnslaw Burn

Legal access to the start of the Earnslaw Burn track, which is in the Lower Dart Conservation Area is available via the Earnslaw Burn river bed and marginal strip.

Alternative legal access to the start of the track, is possible via two unformed legal roads. Camphill Road, crosses the cultivated paddocks from the existing Glenorchy-

Paradise Road to the southern boundary of the Earnslaw Block, near Lovers Leap. There, it links with another unformed legal road which starts at the property boundary with the Lower Dart Conservation Area near the track starting point, and follows the PL's southern boundary, before going up the Rees Valley. Part of this road has recently been formed.

Rees Valley

Public access up the true right of the Rees valley is provided by a combination of legal road, marginal strip and river bed. Several additional creeks (e.g. Lennox Creek) which flow into the Rees River, also qualify for marginal strips.

2.8.3 Activities

Significant recreational routes are shown on Map 4.2.4.

Mt Alfred

Mt Alfred, being an isolated massif away from the surrounding mountains, provides an excellent viewpoint of the area, including the Dart and Routeburn Valleys, Mt Earnslaw/Pikirakatahi, and south the Lake Wakatipu. A walking track is provided through the Mt Alfred Conservation Area forest to bushline. With landholder permission, a marked route can then be followed to the top of Mt Alfred. Mt Alfred is also periodically ascended via various routes on its eastern flanks.

Diamond Lake

Diamond Lake Wildlife Management Reserve, which is adjacent to the PL, is popular with anglers and picnickers. A private hut on the fan above Diamond Lake (on the PL) is a popular spot for lake users and picnickers.

Earnslaw Burn and Adjacent Mountain Slopes

A marked route through the Lower Dart Conservation Area (Earnslaw Burn Catchment) to a rock biv at bushline is a popular route for trampers. In addition it provides access through the PL lease for climbing the south face of Mt Earnslaw/Pikirakatahi. Other tramping routes include going from the Rees River (Kea Basin) to Lennox Pass and down the Earnslaw Burn, or alternatively to Paradise via Turret Head or River of Jordan. It is also possible to do a round trip up the Earnslaw Burn to Lennox Pass, then back down the main ridge on the true left of Earnslaw Burn.

Rees Valley

The Rees Valley is popular with trampers doing the Rees-Dart track, accessing the Upper Rees valley and it's tributaries. Trampers and climbers wanting to go to Kea Basin or climb Mt Earnslaw/Pikirakatahi itself have to cross the Rees River, and walk along the Rees Flats on the PL.

The Rees Valley also attracts considerable vehicle use, which occurs with or without permission from Earnslaw Station.

Commercial Recreation

The PL is also a popular location for a range of commercial activities.
As of 2011 the following recreation permits were in place:

High Country Horses – horse trekking
Heliworks – scenic flights
Guided Walks NZ Ltd – Guided walks, 4WD and camping
Sportbase Ltd – Guided walks and mountain biking

2.8.3 Significance of Recreation

Routes on the PL provide strategic access to a variety of locations including adjoining public lands. Sections of several relatively popular tramping routes lie on the property including classical routes such as Earnslaw Burn to the Rees Valley via Lennox Pass and onto Mt Alfred. Multiple access routes provide access to lands of significant inherent natural values.

The Rees Valley flats provide practical access to the western margins of the Rees River and must be crossed to access strategic routes including access to Mt Earnslaw, Kea Basin Bivvy and Lennox Pass.

Much of the PL provides a spectacular scenic backdrop to activities occurring within and outside of the PL.

PART 3: OTHER RELEVANT MATTERS & PLANS

3.1 CONSULTATION

The property was discussed at an NGO early warning meeting held in Alexandra on October 8th 2001. NGO representatives have inspected the property.
The main points raised during the meeting were:

- Public access to Mt Alfred is important (all NGOs agree).
- Conservation covenant may be adequate for Mt Alfred (not all NGOs agree).
- Removal of cattle grazing on top Rees Valley flats must take place (most NGOs agree).
- Diamond Creek has fish spawning values.
- Diamond Lake faces deserve conservation status.
- Include several small parcels of freehold land e.g. in Rees Valley, as part of tenure review (some NGOs agree).

The Upper Clutha Branch of Royal Forest and Bird Protection Society of NZ provided the following submission on Earnslaw tenure review:

(a) There are considerable landscape values to be protected here, especially Mt Alfred and on the spur south of Lovers leap. These would preclude aerial top dressing from any development programme.
(b) Freehold land in the Rees Valley opposite Arthurs Creek should be included in the review.
(c) Perhaps cattle should be excluded from the Rees Valley and sheep grazed instead to prevent damage to river and stream banks. First terrace in Rees highly modified.
(d) Maori interests in Topuni- Mt Earnslaw/Pikirakatahi.
(e) Secure continual walking access up Mt Alfred.
(f) The north end of Mt Alfred boundary to be straightened up, there is some ex Forest Service land jutting into the leasehold land.
(g) Marginal strip west side Diamond Lake.
(h) The wetlands around Diamond Lake, and the stream out of the lake should be protected.

Further consultation was undertaken at an NGO meeting held at Clyde on April 19th 2011 following the PL's readmission to the tenure review programme.

Focus of discussion was on the recently developed area in the Upper Rees Valley and Mount Alfred.

- Consensus was that if freeholded, the entire Rees Flats should be subject to a landscape covenant which precludes further fencing, further intensification of farming or erection of buildings.

- Grazing of flats should be confined to sheep only (John Turnbull suggested perhaps to cattle only as this would not require upgrading of current two wire fences). Cattle OK if confined behind subdivision fences on recently cultivated land in the Upper Valley in the vicinity of Lennox Falls.
- Public foot access should be secured across the flats to provide access up the valley and to likely points of interest on the western side of the flats including Lennox Falls, Earnslaw Hut and Hunter Creek. Consensus was that if wander at will access is not secured, multiple easement corridors would be required.
- Option of creating a linkage from the Earnlsaw Burn Car Parking area to the lower Rees Valley supported (on further checking this is currently available via an unformed legal road and marginal strip).
- There is a need to rationalize land status on Mount Alfred which currently comprises pastoral lease, conservation land, recreation reserve and some freehold (RANZ).
- Current landscape of Mount Alfred is fragmented – a tenure review outcome should facilitate vegetation recovery on cleared areas.
- Suggestion that pastoral lease land on Mount Alfred should be designated conservation land – perhaps with a phase out grazing license for the period while it takes for forest and shrublands to exclude lower altitude grassy areas.
- Acceptance that the same could be achieved through use of a covenant which excludes burning and spraying although it was acknowledged that such a covenant may be of little value to the owner.
- Access needs to be formalized for track on west side of Mount Alfred – also need create a through route to the eastern side of the massif.
- Adamant that all forested, steepland and high altitude areas in the Earnslaw Burn and Rees Valley Faces should be designated as conservation land.
- If any land is freeholded at the base of the Earnslaw Burn above Lovers Leap year round foot access must be secure to the Earnslaw Burn-Rees Valley ridge crest.

Subsequent to the April 2011 meeting written reports have been received from Forest and Bird (Central Otago-Lakes Branch), Forest and Bird Dunedin Branch, Federated Mountain Clubs and the Otago Conservation Board. A full copy of these reports are attached as Appendices 6-9.

A summary of recommendations contained in these reports is presented in Table 3 below.

Table 3

	Recommendations			
NGO / **Area**	**Forest & Bird Dunedin**	**Otago Conservation Board**	**Forest & Bird Central Otago Lakes**	**FMC**
Mount Alfred Forest	PCL*	?	PCL	PCL
Mount Alfred Tops	PCL – limited grazing	?	PCL	Freehold
Diamond Creek wetlands	PCL	Protect – covenant	PCL	?
Earnslaw Burn	PCL – monitored grazing?	PCL – add to MANP	PCL	PCL
Clear Hills slopes adjacent to Lovers Leap	PCL – monitored grazing?	Freehold	PCL	Freehold
Rees Valley hill slopes including beech forest	PCL	?	PCL	PCL
Lower Rees Valley Flats	PCL – finite grazing phase out	Protect important biodiversity areas	PCL – 10 year grazing phase out	Freehold – strategic access easements
Upper Rees Valley Flats	PCL – finite grazing phase out	Protect important biodiversity areas	PCL – no phase out above 25 Mile Ck	Freehold – strategic access easements

* PCL – Public conservation land.

3.2 REGIONAL POLICY STATEMENTS & PLANS

(a) Regional Policy Statement. The Regional Policy Statement for Otago provides a policy framework for all of Otago's significant regional resource management issues. It does not contain rules. District Plans shall not be inconsistent with the Regional Policy Statement.

In respect of natural values the Regional Policy Statement includes the following policy and method:

Policy: "To maintain and where practicable enhance the diversity of Otago's significant vegetation and significant habitats of Indigenous fauna, trout and salmon…"

Method: “Identify and protect Otago’s significant indigenous vegetation and significant indigenous habitat of indigenous fauna, trout and salmon, in consultation with relevant agencies and with Otago’s communities.”

In respect of landscapes and natural features it includes the following policy and method:

Policy: “To recognize and provide for the protection of Otago’s outstanding natural features and landscapes.”

Method: “Prepare in conjunction with relevant agencies and in consultation with the community and affected landowners, and inventory of outstanding features and landscapes that are regionally significant.”

3.3 DISTRICT PLANS

The property is located within the General Rural zone of the operative Queenstown Lakes District Plan (the Plan).
The Plan (amended to incorporate Council decisions) requires that a resource consent be gained for the clearance of areas of indigenous vegetation greater that 0.5 hectares or where threatened plants (as listed in an appendix) are present or in areas over 1070m asl.
Resource consent is also required for earthworks over and above specified thresholds, subdivision and subsequent development, buildings, forestry and also ski area activities. Forestry is prohibited in areas above 1070 m asl.
A small part of the southeast of the Mt Alfred block and larger areas of the eastern side of the Mt Earmslaw block are within the scheduled "Area of Significant Vegetation" 114A, described in the Plan as "SSWI: A healthy area of bush with red beech, totara, mountain beech, *Grisilinea*, fuchsia, wineberry, *Coprosma* sp., hard fern. Good numbers of bush bird present, including yellow breasted tit, rifleman, bellbird, grey warbler and silvereye". In this area resource consent is required for earthworks of greater thatn 1000m3 and/or 50m3 in any one hectare in any continous period of 5 yrs and the clearance of indigenous vegetation of more than 100m2 on any one hectare in any continuous period of 5 years.
There are no registered historic sites or protected features as set out in the appendices of the Plan.
Pursuant to the relevant Otago Regional Plan: Water rule a resource consent is required for any suction dredging within any waterway on the lease.
Protection is limited to the controls set our above.

3.4 CONSERVATION MANAGEMENT STRATEGIES & PLANS

The Otago Conservancy of DOC has prepared a Conservation management Strategy (CMS) which was approved by the Minister of Conservation in August 1998.

The CMS identifies 41 special places of conservation interest in Otago Conservancy. Earnslaw lies within the Dart-Rees Special Place.

The CMS objective for the Dart-Rees Special Place relevant to Earnslaw is:

"To protect the high landscape and indigenous biological values of the area and to improve access to values recreational opportunities through integrated management of the braided riverbeds, the beech forests and the high mountains, and the adjoining park."

The key implementation methods relevant to Earnslaw are:

(a) Opportunities arising out of pastoral lease tenure reviews of other processes involving leasehold land will be taken to achieve negotiated protection of areas for their landscape or biological significance, or to achieve more efficient or integrated conservation management, or to secure access to recreational opportunities.

(b) Protection of braided river bird habitats will be sought. The preferred mechanism is allocation of the habitat to the department as conservation area. Requests by regional and local authorities to locate flood protection works on areas so allocated will be considered on their merits.

(c) Grazing of areas of low conservation value may be allowed under strict conditions and subject to monitoring to ensure that conservation values and public enjoyment are sustained and not adversely affected.

(d) The Earnslaw Burn route will be retained as a route to preserve the remote quality of the area

(e) When informed of the nature and location of waahi taoka and waahi tapu on land administered by the Department, consult with Kai Tahu about the appropriate management of that site.

Priorities for the Dart-Rees Special Place are:

"The provision or negotiation of protection for the braided river beds and privately owned red beech forests will be priorities in this Special Place".

3.5 FRESHWATER FISHERIES PLANS

None.

3.6 NGAI TAHU CLAIMS SETTLEMENT 1998, NO. 97

The following extracts are relevant:

221. Pikirakatahi (Mount Earnslaw) – (1) If any part of the area included on pastoral lease CL 338/105 (Otago Land District) on 21 November 1997 is ever surrendered to the Crown, then such part of that area as-

(a) Is held under the Conservation Act 1987 or under a statute listed in the First Schedule of the Conservation Act 1987; and
(b) Is identified using similar processes to those used before the date of the deed of settlement by the Te Runanga o Ngai Tahu and the Crown for the identification of statutory areas which are mountains; and
(c) Is agreed by Te Runanga o Ngai Tahu and the Crown- becomes part of the statutory area known as Pikirakatahi (Mount Earnslaw) for the purposes of sections 205 to 220, on the date on which the agreement of Te Runanga o Ngai Tahu and the Crown, pursuant to this subsection, is notified in the Gazette pursuant to subsection (2).

(2) As soon as reasonably practicable after Te Runanga o Nga Tahu and the Crown agree pursuant to subsection (1) (c), the Minister of Conservation must notify that agreement, and the inclusion of the agreed area as part of the statutory area known as Pikirakatahi (Mount Earnslaw) pursuant to subsection (1) in the Gazette.

235. Pikirakatahi (Mount Earnslaw)-(1) If any part of the area presently included in pastoral lease CL 338/105 (Otago Land District) on 21 November is ever surrendered to the Crown and becomes a conservation area and managed by the Department of Conservation, then such part of that area as-

(a) Is held under the Conservation Act 1987 or under a statute listed in the First Schedule of the Conservation Act 1987; and
(b) Is identified using similar processes to those used before the date of the deed of settlement by Te Runanga o Ngai Tahu and the Crown for the identification of sites which are mountains; and
(c) Is agreed by Te Runanga o Ngai Tahu and the Crown-becomes part of the site known as Pikirakatahi (Mount Earnslaw) for the purposes of sections 230 to 233, on the date3 on which the agreement of Te Runanga o Ngai Tahu and the Crown, pursuant to this subsection, is notified in the Gazette pursuant to subsection (2).

(2) As soon as reasonably practicable after Te Runanga o Ngai Tahu and the Crown agree pursuant to subsection (1) (c), the Minister of Conservation must notify that agreement, and the inclusion of the agreed area as part of the statutory area known as Pikirakatahi (Mount Earnslaw) pursuant to subsection (1) in the Gazette.

Schedule 51: Statutory Acknowledgement for Pikirakatahi (Mount Earnslaw)
Statutory Area
The statutory area to which this statutory acknowledgement applies is the area known as Pikirakatahi (Mount Earnslaw), as shown on Allocation Plan MS 4 (S.). 24666).

Preamble
Under section 206, the Crown acknowledges Te Runanga o Ngai Tahu's statement of Ngai tahu's cultural, spiritual, historic, and traditional association to Pikirakatahi as set out below.

Ngai Tahu Association with Pikirakatahi
The creation of Pikirakatahi (Mt Earnslaw) relates in time to Te Waka o Airaki and the efforts of Tu Te Rakiwhanoa. It is said that during its formation a wedge of pounamu was inserted into this mountain, which is the highest and most prominent peak in this block of mountains. The mountain is also linked to travels of Rakaihautu, who dug out the great lakes of the interior with his ko (~spade), known as Tu Whakaroria and later renamed Tuhiraki at the conclusion of the expedition.

For Ngai Tahu, traditions such as this represent the links between the cosmological world of gods and present generations, these histories reinforce tribal identity and solidarity, and continuity between generations and document the events which shaped the environment of Te Wai Pounamu and Ngai Tahu as an iwi.

Pikirakatahi stands as guardian over the pounamu resource and marks the end of a trail, with the tohu (marker) to the pounamu resource sitting opposite on Koroka (Cosmos Peak). The tupuna (ancestors) had considerable knowledge of whakapapa, traditional trails, places for gathering kai (food) and other taonga, ways in which to use the resources of the land, the relationship of people with the land and their dependence on it, and tikanga for the proper and sustainable utilisation of resources. All these remain important to Ngai Tahu today.

The origins of the name "pikirakatahi' have been lost, but it is known that many places and physical features have more than one name, ref;lecting the traditions of the successive iwi who peopled the land. It is however, likely that the name relates to Rakaihautu or subsequent people, as most of the prominent lakes, rivers, mountains of the interior take their name from the journey of Rakaihautu.

The retrieval of large amounts of pounamu from this source, so far inland and over a range of physical barriers, attests to the importance of this resource to the economy and customs of the iwi over many generations. The people would also gather native birds for kai and firewood with which to cook and provide warmth, from the forests covering the lower flanks of Pikirakatahi. Strategic marriages between hapu strengthened the kupenga (net) of whakapapa and this rights to use the resources of the mountain. It is because of these patterns of activity that Pikirakatahi continues to be important to runanga located in Otago, Murihiku and beyond. These runanga carry responsibilities of kaitiaki in relation to the area, and are represented by the tribal structure, Te Runanga o Ngai Tahu.

The mauri of Pikirakatahi represents the essence that binds the physical and spiritual elements of all things together, generating and upholding all life. All elements of the

natural environment possess a life force, and all forms of life are related. Mauri is a critical element of the spiritual relationship of Ngai Tahu Whanui with Pikirakatahi.

3.7 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.

The strategy outlines action plans to achieve this goal covering terrestrial and freshwater habitat and ecosystem protection, sympathetic management, pest management, terrestrial and freshwater habitat restoration, threatened terrestrial and freshwater species management, etc.

3.8 PROTECTING OUR PLACES

In April 2007 the Ministry for the Environment produced a new policy document titled 'Protecting Our Places' which was jointly launched by the Minister of Conservation and the Minister for the Environment. This publication introduces four national priorities for protecting rare and threatened native biodiversity on private land. The national priorities identify the types of ecosystems and habitats most in need of protection.

The policy statement supports the government's pledge to maintain and preserve New Zealand's natural heritage. This began in 1992 when New Zealand signed the United Nations Convention on Biodiversity; followed in 2000 with the release of the New Zealand Biodiversity Strategy.

The four national priorities for biodiversity protection are listed below. They are based on the most up to date scientific research available.

National Priority 1:
To protect indigenous vegetation associated with land environments, (defined by Land Environments of New Zealand at Level IV), that have 20 percent or less remaining in indigenous cover.

National Priority 2:
To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.

National Priority 3:
To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.

National Priority 4:
To protect habitats of acutely and chronically threatened indigenous species.

These national priorities have relevance beyond conservation initiatives on private land. For example they are used to help assess applications for grants under the government funded Community Conservation Fund which funds conservation projects on public land by community groups.

The national priorities also provide a useful measure for assessing tenure review recommendations and outcomes.

3.9 ECOLOGICAL SUSTAINABILITY AND CARBON STORAGE

Sustainability

The PL contributes to a number of "ecosystem services." Constanza *et al.* (1997) define ecosystem services as flows of materials, energy, and information from natural capital stocks which combine with manufactured and human capital services to produce human welfare." They identify 17 "services". This PL clearly makes a significant contribution to nine of these services excluding those of a recreation and cultural nature which are described elsewhere.

1. Gas Regulation:

Table 4 below summarizes estimated carbon storage for various vegetation types present on the PL. Sourced from Carswell *et al.* 2008.

Table 4

Vegetation Class	Carbon Storage (t ha^{-1})	Soil Carbon (t ha^{-1})
Improved Pasture	3	148
Unimproved Pasture	2	151
Snow Tussock Grassland	27	134
Grassland & mixed indigenous scrub	42	164
Tussock grassland & subalpine scrub	22	138
Mixed Indigenous scrub	99	166
Sub alpine scrub	80	144
Beech Forest	339	145
Beech- broad leaved forest	289	138

Note that one hectare of mixed indigenous scrub stores about 265 tonnes of carbon (above and below ground) versus approximately 151 for unimproved grassland.

2. Climate Regulation:

Carbon storage in expanding shrublands, forest and tall tussock grasslands and wetlands contributes to ameliorating the current anthropogenic induced rise in atmospheric carbon dioxide levels.

3. Disturbance Regulation:

Wetlands and upland bogs have an important role in flood runoff. These same wetland areas also store water which helps to maintain summer flows, as does storage of water in the shallow unconfined ground water on the colluvium mantled slopes. These values contribute to "disturbance regulation" by damping out environmental fluctuation such as floods and droughts.

4. Erosion Control and Sediment Retention:

Snow tussock catchments monitored for sediment yield elsewhere in Otago have been shown to have very low sediment yields by New Zealand standards.(Waugh 2005).

5. Nutrient cycling Storage, Internal Cycling, Processing and Acquisition of Nutrients (nitrogen fixation, N, P and other elemental or nutrient cycles):

Monitoring elsewhere in Otago has shown that of tussock covered catchments yield very good water quality.

PART 4: MAPS ETC.

4.1 ADDITIONAL INFORMATION

4.1.1 References

Allibone, R, David; B; Hitchmough, R; Jellyman, D; Ling, N; Ravenscroft, P; and Waters, J. 2010. Conservation status of New Zealand freshwater fish, 2009. New Zealand Journal of Marine and Freshwater Research, 44:4 271-287

Bull, P. C; P. D. Gaze, *et al*. (1985). The atlas of bird distribution in New Zealand. Wellington, The Ornithological Society of New Zealand.

Costanza, R., d'Arge, R; de Groot, S; Farber, M; Grasso, B; Hannon, K; Limburg, S; Naeem, R,V; O'Neill, J; Paruelo, R,G; Raskin, P; Sutton, M; & Van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature*, 387(6230):255.

Carswell, F.E; Mason, NWH, Davis, M.R, Briggs, C.M, Clinton, P.W, green, W, Standish,R.B, Allen,L.E & Burrows, L.E. 2008. Synthesis of Carbons stock Information Regarding Conservation Land. Landcare Research Contract Report LCO708/701. Prepared for Department of Conservation Policy Group Wellington, New Zealand.

Department of Conservation, New Zealand. Amphibian and Reptile Distribution Survey, Bioweb Database.

De Lange, P.J; Norton, D.A; Courtney, S.P; Heenan, P.B; Barkla, J.W; Cameron, E.K; Hitchmough, R; Townsend, A.J. 2009: Threatened and uncommon plants of New Zealand (2008 revision). New Zealand Journal of Botany 47: 61-96.

Harper, R.K. 1992. Otago Recreational Opportunity Spectrum,. Otago Conservancy, Department of Conservation. Miscellaneous Series No. 10. ISBN: 0-478-01435-X

Heather, B & Robertson, H. 1996. The Field Guide to the birds of New Zealand. Auckland, Viking.

Hitchmough, R,A. 1997. A systematic revision of the New Zealand Gekkonidae. Ph. D. thesis, Victoria University of Wellington, New Zealand.

Hitchmough, R.A. 2007. New Zealand Classification System lists 2007. *Threatened Species Occasional Publication*. Department of Conservation, Wellington, New Zealand.

Hitchmough, R.A.; Hoare, J.M; Jamieson, H; Newman, D; Tocher, M.D; Anderson, P.J; Lettink, M. & Whitaker, A,H; 2010. Conservation Status of New Zealand Reptiles, 2009. New Zealand Journal of Zoology, 37: 3, 203-224.

King, C; Ed. 1990. The Handbook of New Zealand Mammals. Auckland, Oxford University Press.

McGuinness, C.A. 2001. The conservation requirements of New Zealand's nationally threatened invertebrates. Department of Conservation, Wellington. Threatened Species Occasional Publication. No. 20. 657pp.

Mason, B. 1989. Outdoor Recreation in Otago- A recreation Plan. Volume Two: Silverpeaks & Otago's Alps.

Miskelly, C.M; Dowding, J.E; Elliott, G.P; Hitchmough, R.A; Sagar, P.M; Scofield, P.R and Taylor, A.G 2008: Conservation Status of New Zealand Birds. *Notornis, 2008, Vol. 55: 117-135* 0029-4470 © The Ornithological Society of New Zealand, Inc.

Molloy, J. and Davis, A. 1994: Setting priorities for the conservation of New Zealand's threatened plants and animals. Dept of Conservation.

Molloy, J. Bell, B.; Clout, M.; de Lange, P.; Gibbs, G.; Given, D.; Norton, D.; Smith, N. and Stephens, T. 2001. Classifying species according to threat of extinction. A system for New Zealand. Department of Conservation, Wellington, New Zealand. ISBN 0-478-22077-4.

O'Donnell, C.; 2001. Advances in New Zealand mammalogy 1990-2000: Long-tailed bat. Journal of the Royal society of New Zealand 31(1):
43-57.

O'Donnell, C.F.J; Christie, J.E ; Hitchmough, RA , Lloyd, B and Parsons, S. 2010. 'The conservation status of New Zealand bats, 2009, New Zealand Journal of Zoology, 37:4, 297 - 311

Waugh, J.R 2005. Water Resources of Tussock Grasslands in the Upper Taieri Catchment. Report prepared for Department of Conservation by OPUS International Consultants Ltd.

Whitaker, A. 1986. A survey of the lizards of the Queenstown area, Otago. 3-12th March 1986.Unpublished report New Zealand Wildlife Service, Wellington.

Whitaker, A., Tocher, M and Blair, T. 2002. Conservation of Lizards in Otago Conservancy 2002 - 2007. Department of Conservation, Wellington, New Zealand.

Appendix 4 – Location of MP51824